

# Analysis of Potential Impact of Climate Change Policies on Energy Markets

*A Study Performed for the Natural Gas Council by AGA, INGAA, IPAA and NGSA*



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Director, Energy Markets and Forecasting  
Science Applications International Corporation



Winter Workshop  
February 5, 2008 – MGM Grand Conference Center– Las Vegas, Nevada





# Our Company

**Science Applications International Corporation (SAIC) is a leading provider of scientific engineering, systems integration and technical services and solutions.**

## Our Successes

37 years of continuous growth

- \$8.3 billion in annual revenues for FY 2007
- Rated Moody's A3, S&P A-
- Fortune 500® company – #298

Diversified staff of qualified professionals

- More than 44,000 personnel worldwide
- 10,000 employees with advanced degrees

Key positions on initiatives of national importance

- Energy
- Environment
- Infrastructure
- National Security
- Healthcare

## #19 Top Energy Contactors

*Government Executive – Sept 2007*

## #2 Top Professional Services Contractors

*Federal Times – April 2007*

## #2 Top Systems Integrators

*Federal Computer Week – Sept 2006*





# Our Climate Change Energy Modeling Practice

## ▶ Comprehensive Climate Change & Modeling Services

- Climate science
- Energy / Climate Bill Analysis
- Strategic planning
  - ✓ *Allowance market forecasting*
- Information management
- Inventory preparation
- Offsets evaluation and trading
- Project design and development
- Low-carbon technologies
- Energy efficiency
- Sustainability planning

## ▶ Clients Include

- Tennessee Valley Authority
- Sacramento Municipal Utility District
- Nebraska Public Power District
- Siemens AG
- Bank of America
- Natural Gas Council
- Chevron Texaco
- DOE 1605(b) Program
- EPA Climate Leaders
- California Climate Action Registry
- The Climate Registry
- American Council for Capital Formation
- American Gas Association



# Presentation Overview

- 1. Natural Gas Council Project Objective**
2. Recap of GHG Legislation
3. NEMS Model
4. Analysis using Alternative Assumptions
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## Project Objective

- ▶ Use the National Energy Modeling System (NEMS) to analyze proposed greenhouse gas (GHG) legislation
  - Provides a common analytical tool for gaining valuable insights into the likely implications of alternative GHG reduction policy options.
  - Provides the natural gas industry the analytical tool used by government.
  - Narrows the debate to the merits of different policy choices and assumptions, and not models or methodologies used.
  - Provides an “apples to apples” comparison of GHG initiatives.
- ▶ NEMS analysis run for McCain-Lieberman Bill.
- ▶ NEMS is an economic model and does not predict technical, societal and political decisions.
- ▶ Assumptions on technical, societal and political decisions, as developed by natural gas industry and other energy experts, were used in NEMS runs.



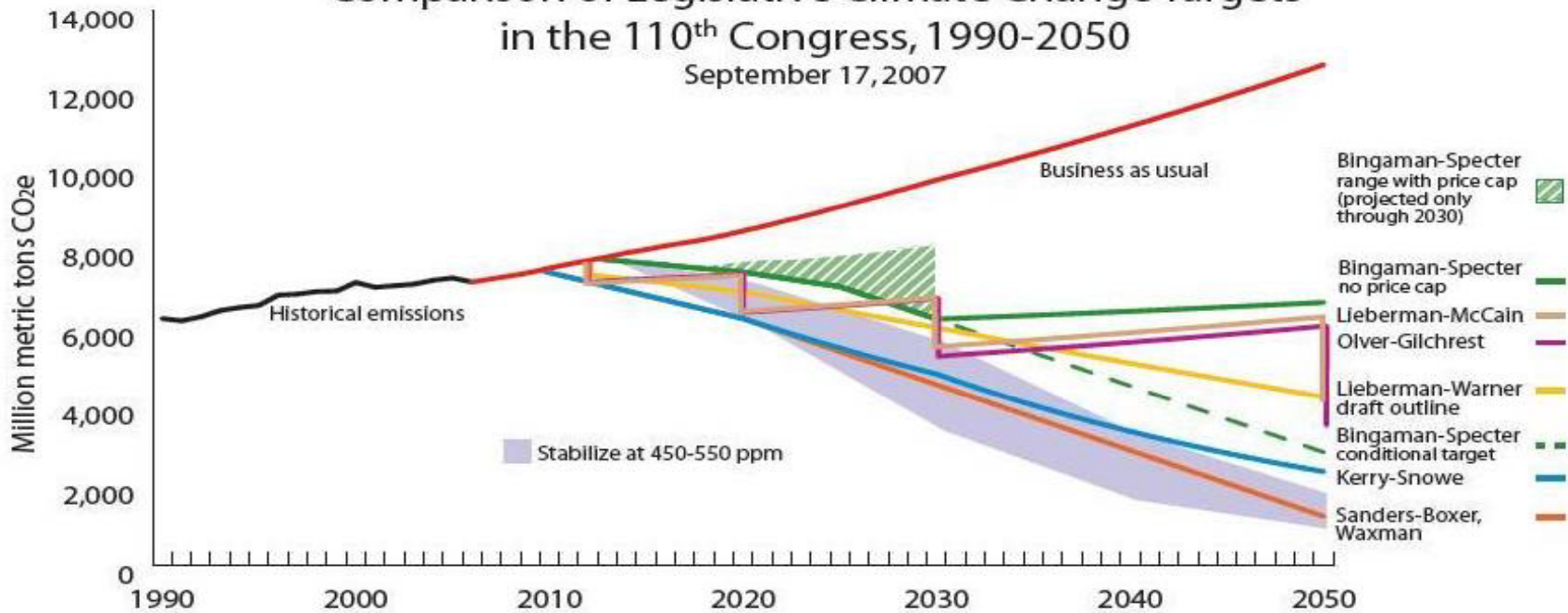
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# Comparison of Proposed GHG Legislation

Comparison of Legislative Climate Change Targets  
in the 110<sup>th</sup> Congress, 1990-2050  
September 17, 2007



WORLD RESOURCES INSTITUTE

For a full discussion of underlying methodology, assumptions and references, please see <http://www.wri.org/usclimatetargets>. WRI does not endorse any of these bills. This analysis is for comparative purposes only. Data post-2030 may be derived from extrapolation of EIA projections.





## Pending Federal Legislation

### Climate Change Proposals Before 110<sup>th</sup> Congress

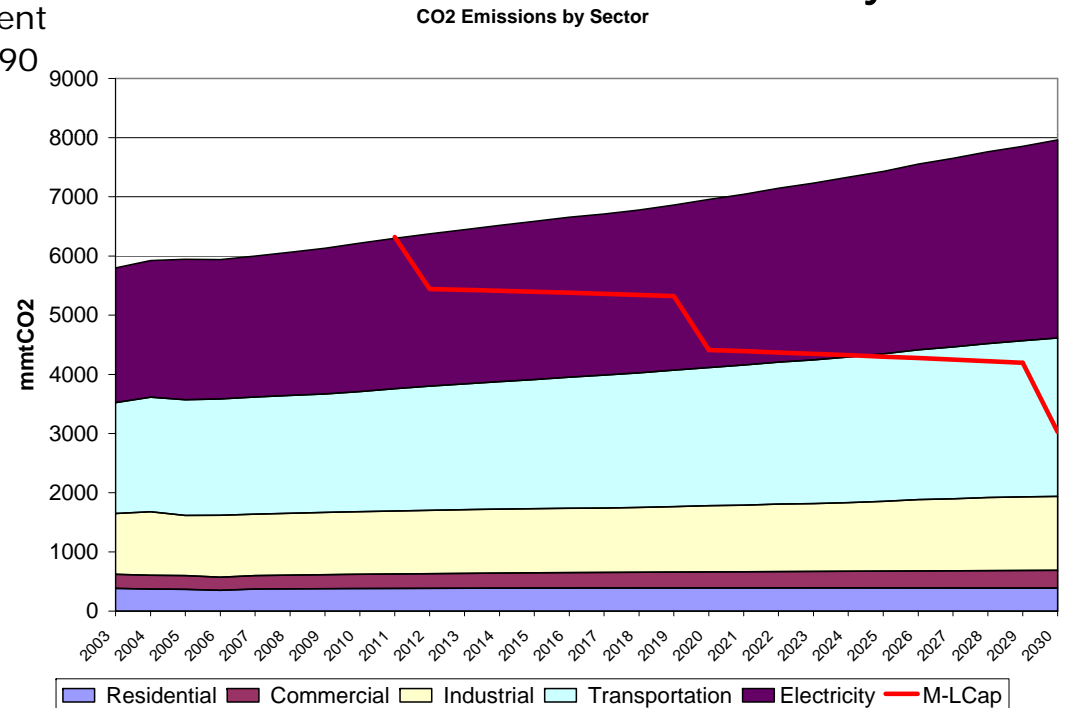
- ▶ Least restrictive is Udall-Petri and Bingaman (with price caps)
  - Requires nominal reductions of CO<sub>2</sub> emissions from Business As Usual (BAU) by 2050
- ▶ Most restrictive, Sanders-Boxer
  - Requires 80 percent reduction from BAU by 2050
- ▶ Lieberman-Warner requires 55 percent reduction from 1990 levels by 2050
- ▶ McCain-Lieberman requires 60 percent reduction from 1990 levels by 2050



# Pending Federal Legislation McCain-Lieberman

- Begins in 2012
- Incrementally declining emissions cap
  - 2012=2004; 2020=1990; 2030=20 percent below 1990; 2050=60 percent below 1990
- Economy Wide
  - Transportation
  - Electricity
  - Industrial
  - Commercial
- Entities covered –
  - over 10,000 MT CO<sub>2</sub>e/year
- Up to 30 percent of cap can be met through qualified allowances
- Entities may sell, exchange, purchase, retire, use or sell allowances between each other
- Entities may bank (borrow) allowances for (from) future use

## CO<sub>2</sub> emissions forecast with McCain – Lieberman Reduction Overlay





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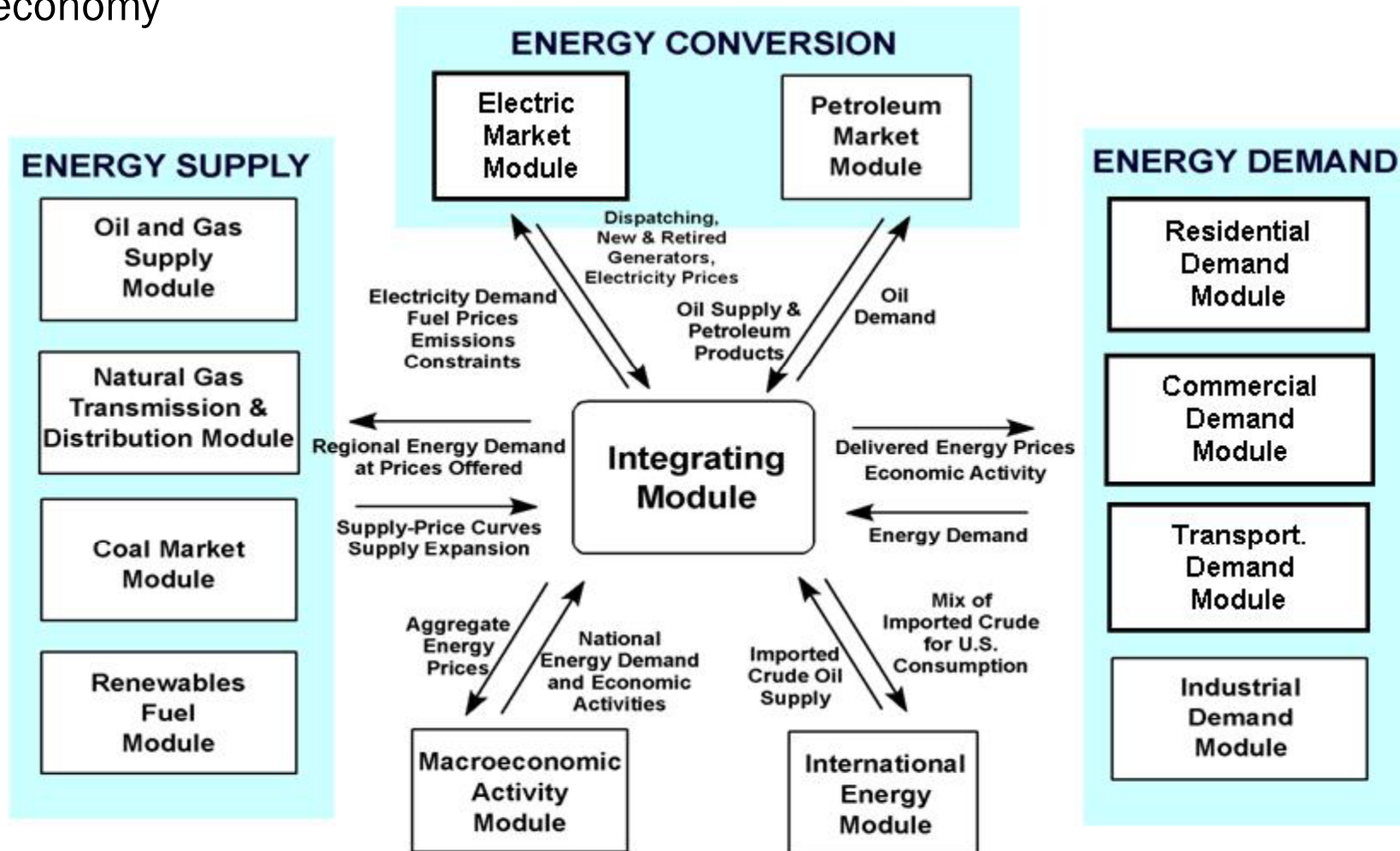
## NEMS Overview

### Main Uses of NEMS

- ▶ NEMS Original intended uses (mainly Energy Information Administration - EIA)
  - Energy forecasting (EIA's Annual Energy Outlook - AEO)
    - ✓ *NEMS generates annual forecasts out to 2030*
    - ✓ *Forecasts can be generated for alternative futures*
  - Policy/program analysis
    - ✓ *Broad policy options (e.g., CO<sub>2</sub> mitigation strategies)*
    - ✓ *Narrow programs/regulations (e.g., MTBE ban)*
- ▶ Newer uses of NEMS
  - Assessment of proposed carbon policies on
    - ✓ *Refiners*
    - ✓ *Power generators*
    - ✓ *Natural gas pipelines*
    - ✓ *Natural gas end-use sectors*
  - Technology R&D benefit assessments (Department of Energy, Fossil Energy, National Energy Technology Lab, National Renewable Energy Lab, private sector)
    - ✓ *Analyses of individual technologies/R&D programs*
    - ✓ *Analyses of broad energy R&D portfolios*
    - ✓ *Advanced Oxy-Combustion and Oxy-Gasification technologies for Siemens Power Generation*
  - NEMS adaptation to Canada (Natural Resources Canada, Canadian Provinces)

# National Energy Modeling System Integrated Energy/Economic Modeling Tool

NEMS integrates North American energy market across industry segments and the economy





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## McCain-Lieberman Impact Examined Under Three Scenarios and Alternative Assumptions

### Scenarios:

1. McCain-Lieberman (M-L) Bill "*Base Case*"  
EIA Analysis of M-L Bill – S280 Core
2. M-L Bill with Alternative Assumptions using EPA offsets up to 30% ceiling under bill
3. M-L Bill with Alternative Assumptions if only 15% offsets actually available

### Alternative Assumptions:

- ▶ Nuclear - 25 GW (25 units) maximum new capacity by 2030
- ▶ IGCC with Sequestration - 150 GW maximum for all regions by 2030
- ▶ Wind – 3 GW/year maximum growth
- ▶ Biomass - 3 GW/year maximum growth (equivalent to 40 biomass gasification combined cycle power plants)
- ▶ Natural Gas Supply
  - LNG at *AEO2007* levels plus 500 Bcf
  - Higher costs for unconventional gas production
  - Alaska Gas Pipeline operational in 2020, rather than 2018 assumed in *AEO2007*



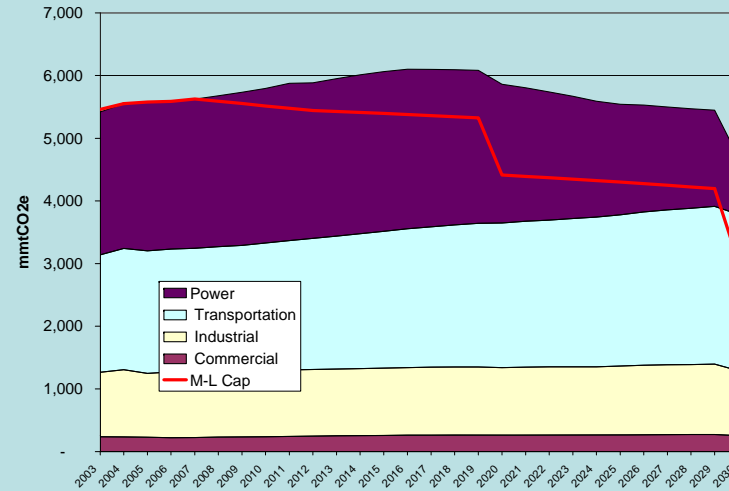
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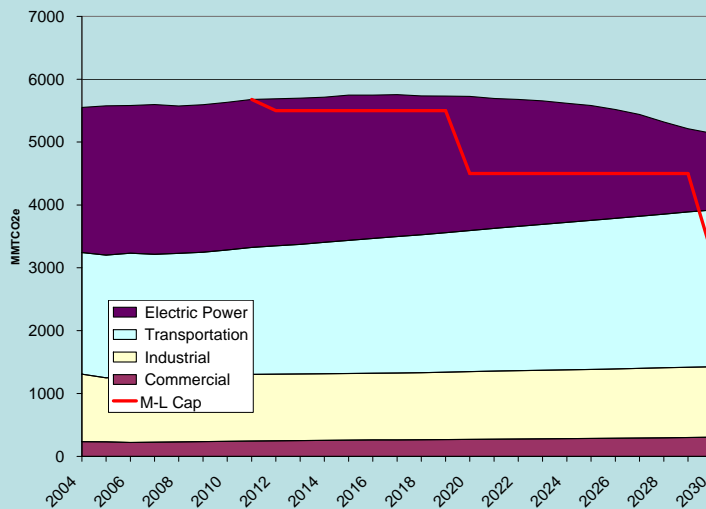
# CO<sub>2</sub> Emissions

▶ *The M-L Bill is very stringent and could de-carbonize the power sector unless a mix of offsets and technologies are employed and limits are placed on the transportation sector.*

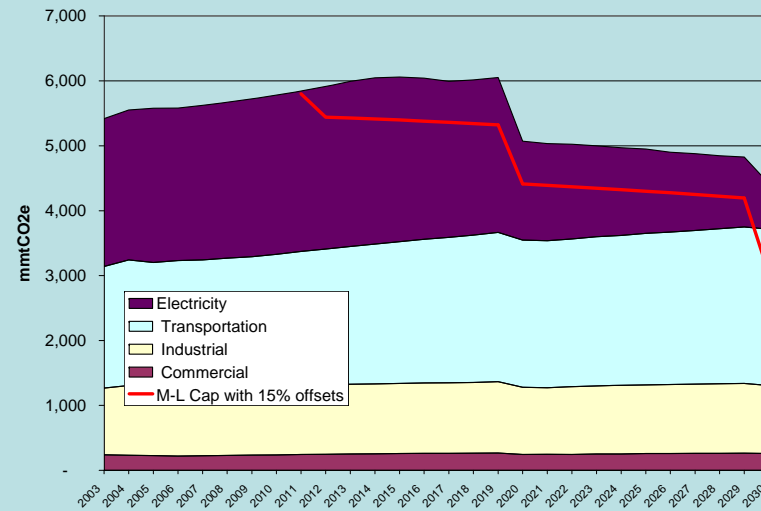
## Constrained Nuclear & Renewables with 30% offsets



## EIA S280 Core with 30% offsets



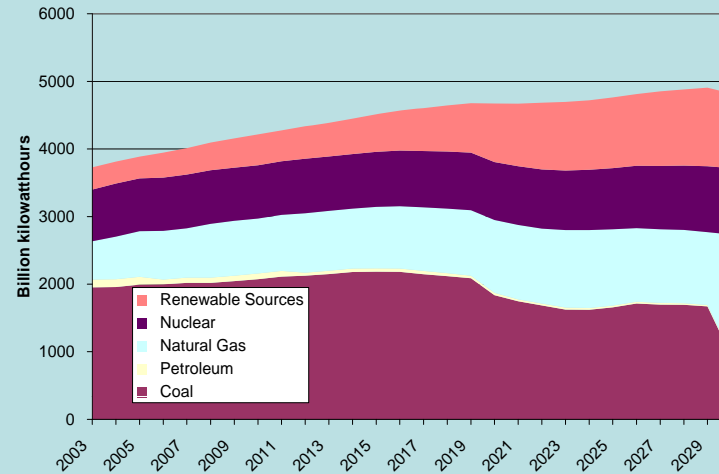
## Constrained Nuclear & Renewables with 15% offsets



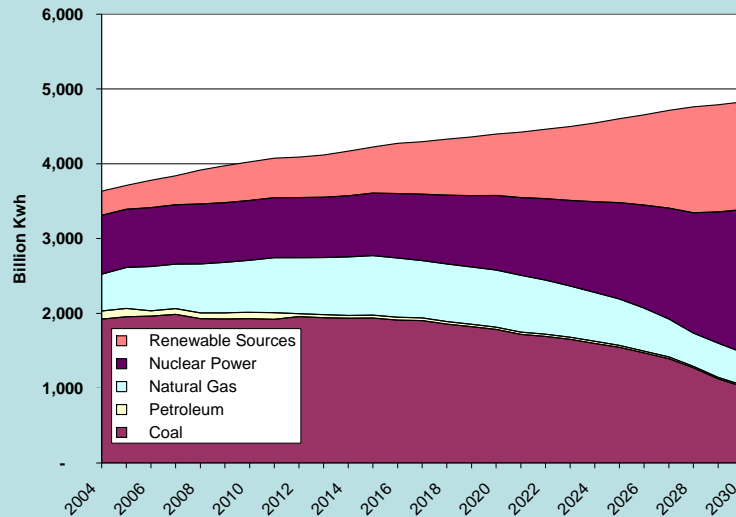
# Generation Portfolio

- ▶ Nuclear and renewables eventually dominate under EIA S280 core, while coal and gas decline
  - 145GW in new nuclear capacity
- ▶ If development of nuclear is constrained, natural gas' role grows and coal is less severely impacted. This requires the deployment of carbon capture & sequestration.
- ▶ With only 15% offset availability, natural gas becomes the dominant form of generation.

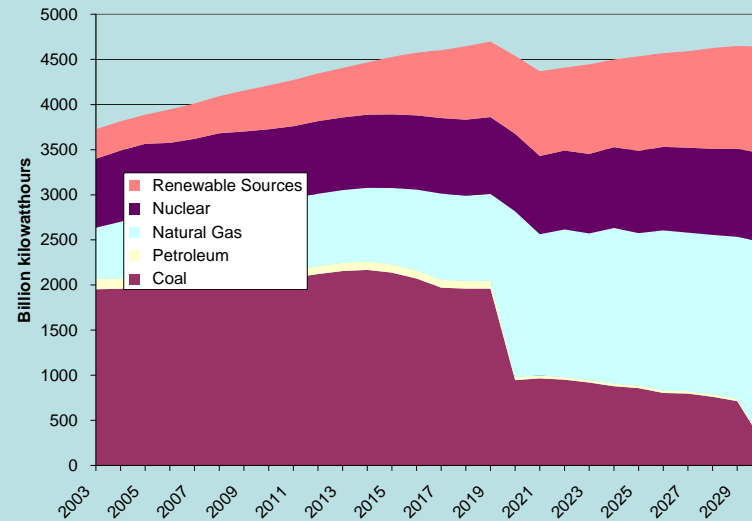
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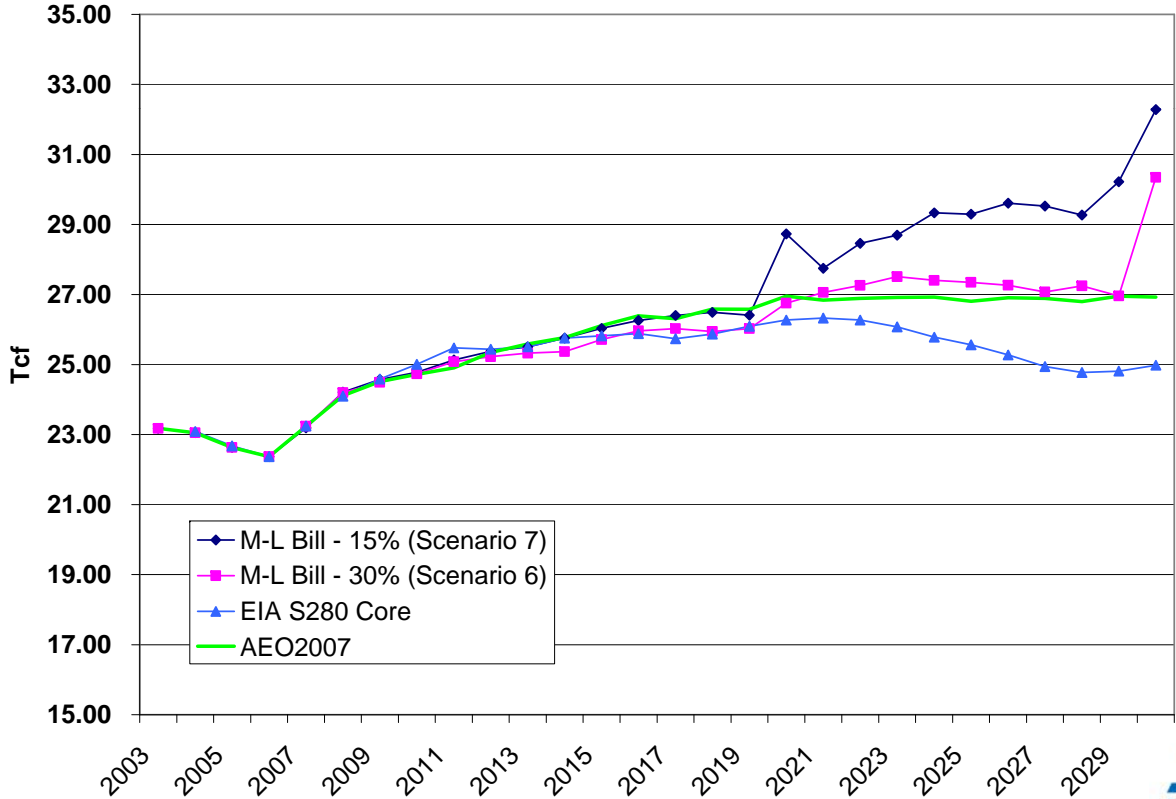
## Constrained Nuclear & Renewables with 15% offsets





# Natural Gas Consumption

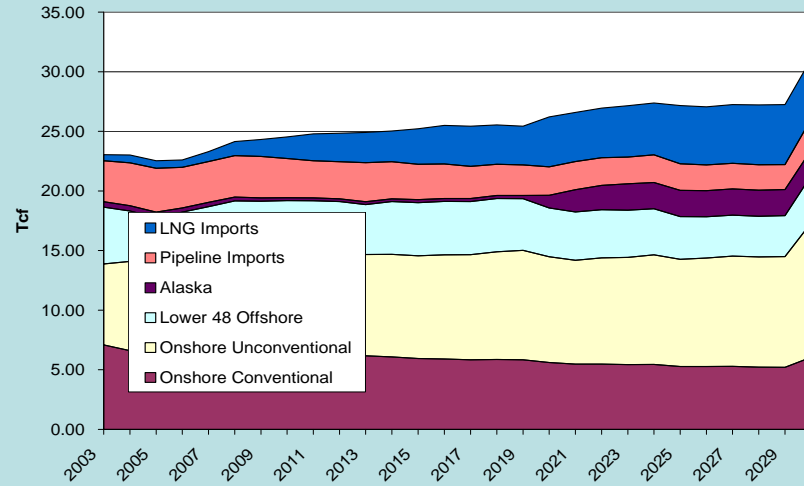
- ▶ EIA Base Case - growing gas consumption through 2020, followed by declining consumption due to growth of nuclear power.
- ▶ 30 percent offsets - steady gas consumption of approximately 25 Tcf, 20 percent over current levels.
- ▶ 15 percent offsets - high levels of gas use in the power sector. Industrial gas consumption falls due to high gas prices.



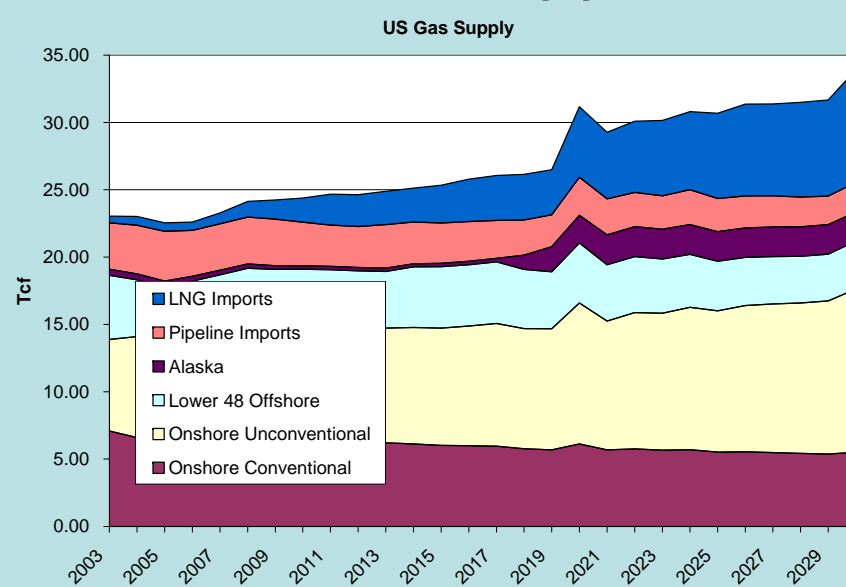
# Natural Gas Supply

- ▶ All three cases show the need for additional gas supplies either as a transition fuel or a permanent feature
  - Base-Case M-L bill – Growth followed by falling gas supply in response to low consumption
  - M-L, 30 percent - Moderately increasing gas supply in response to moderate gas consumption growth
  - M-L Bill, 15 percent - Rapidly rising natural gas supply, led by LNG imports in response to high gas consumption.

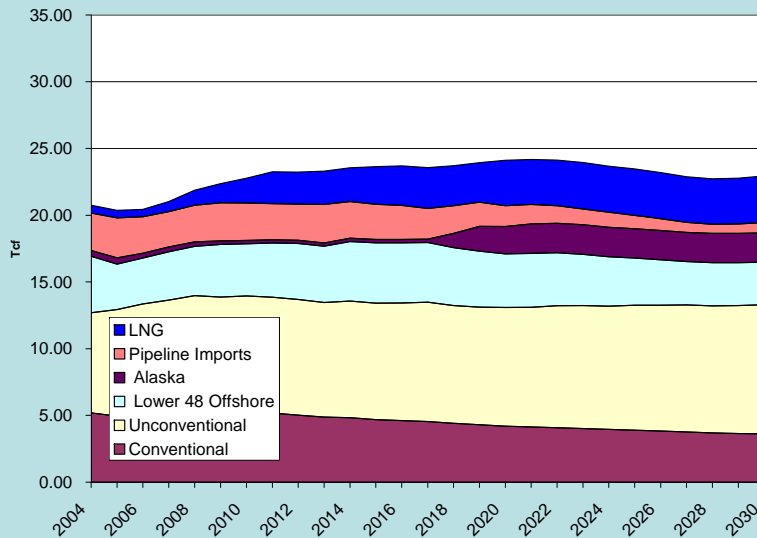
**M-L, 30% - Moderately increasing gas supply in response to moderate gas consumption growth**  
US Gas Supply



**M-L Bill, 15% - Rapidly rising natural gas supply, led by LNG imports in response to high gas consumption**  
US Gas Supply



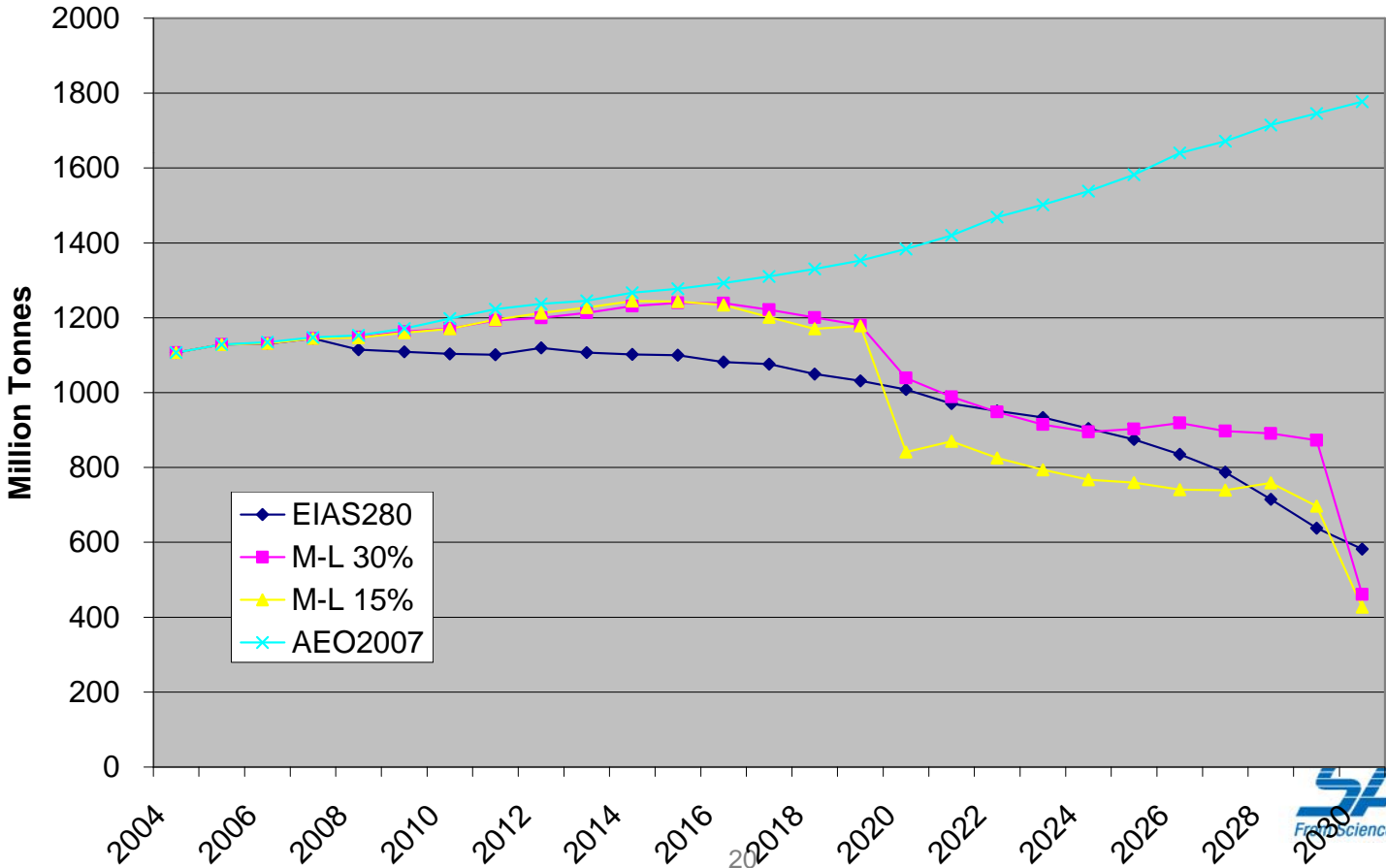
**EIA S280 Core with 30% offsets**





# Coal Consumption

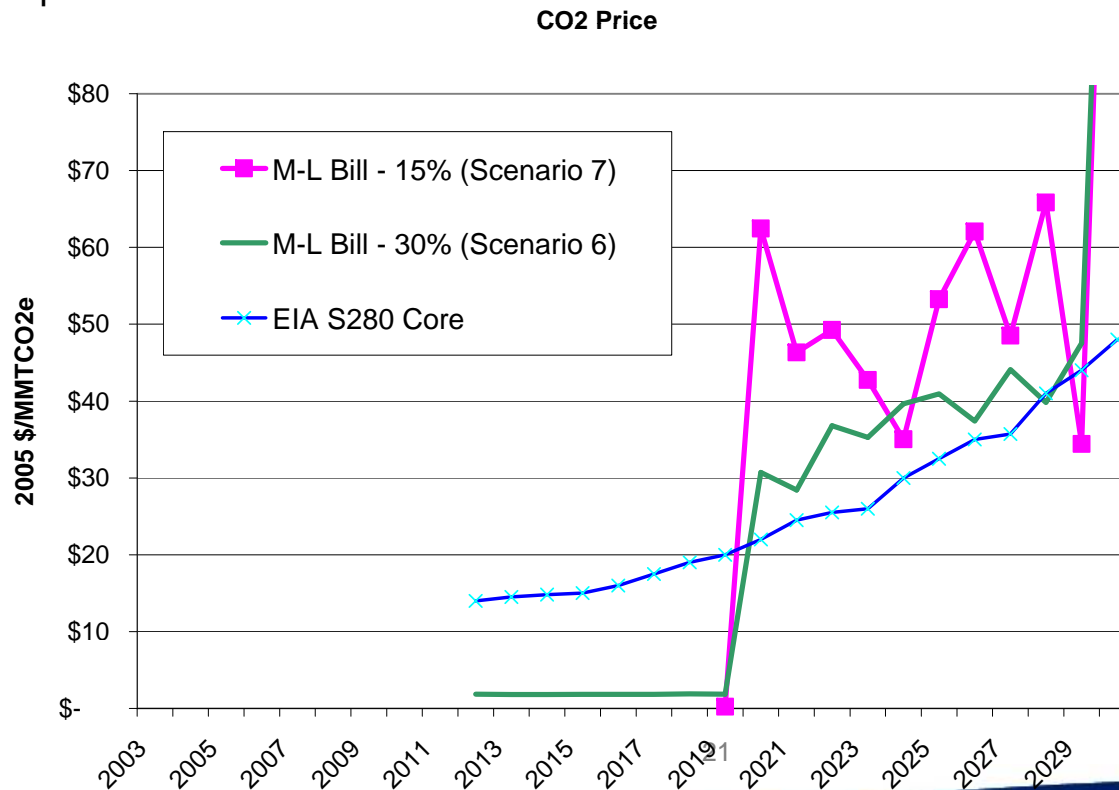
**Coal consumption falls precipitously in all three cases as power industry shifts to other fuels and technologies**



Except for EIA's S280 Core Case, the other runs were performed by SAIC

# CO<sub>2</sub> Prices

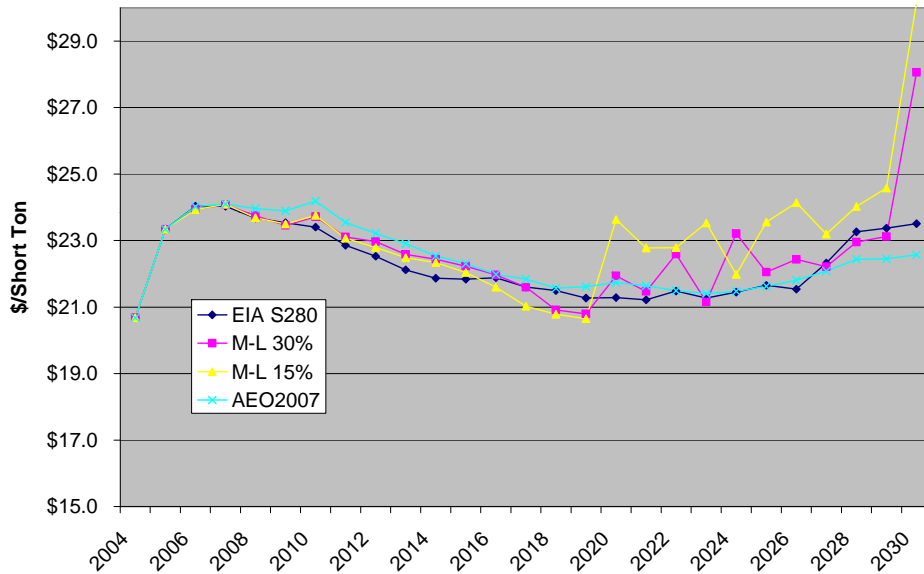
- ▶ The price of CO<sub>2</sub> allowances is affected by the number of allowances auctioned, the amount of CO<sub>2</sub> offsets available, and by the prices at which such offsets are available, and the technologies available to mitigate CO<sub>2</sub> emissions.
- ▶ Base Case M-L bill – Large nuclear and renewable builds mean less pressure is placed on allowance markets and lower prices.
- ▶ 30% & 15% Offsets – Greater reliance on fossil fuels results in greater use of allowances and higher prices.



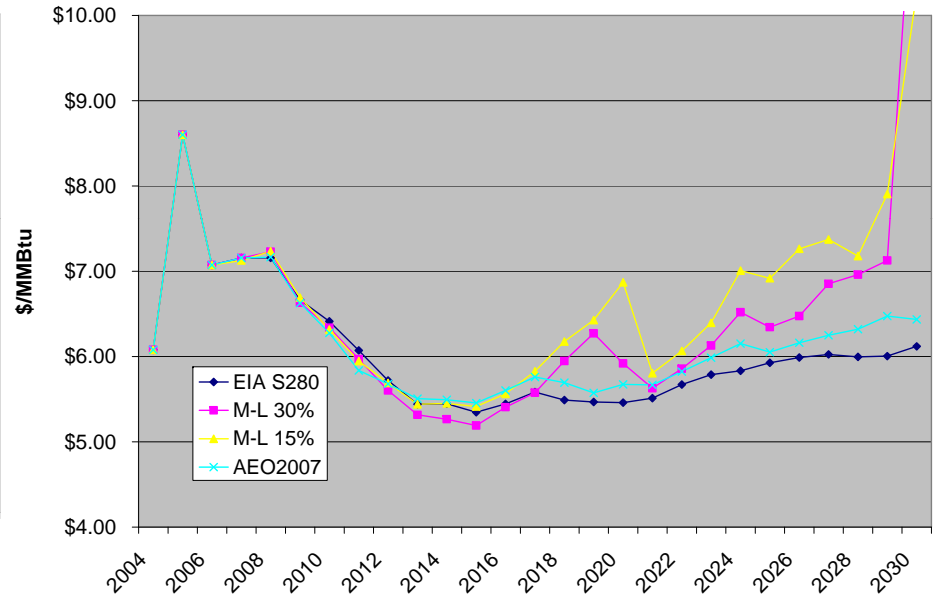


# Producer Energy Prices

Minemouth Price



Wellhead Gas Price



**M-L is equivalent to a tax on consumption, not on production.**

**Mine mouth coal prices relatively unchanged**

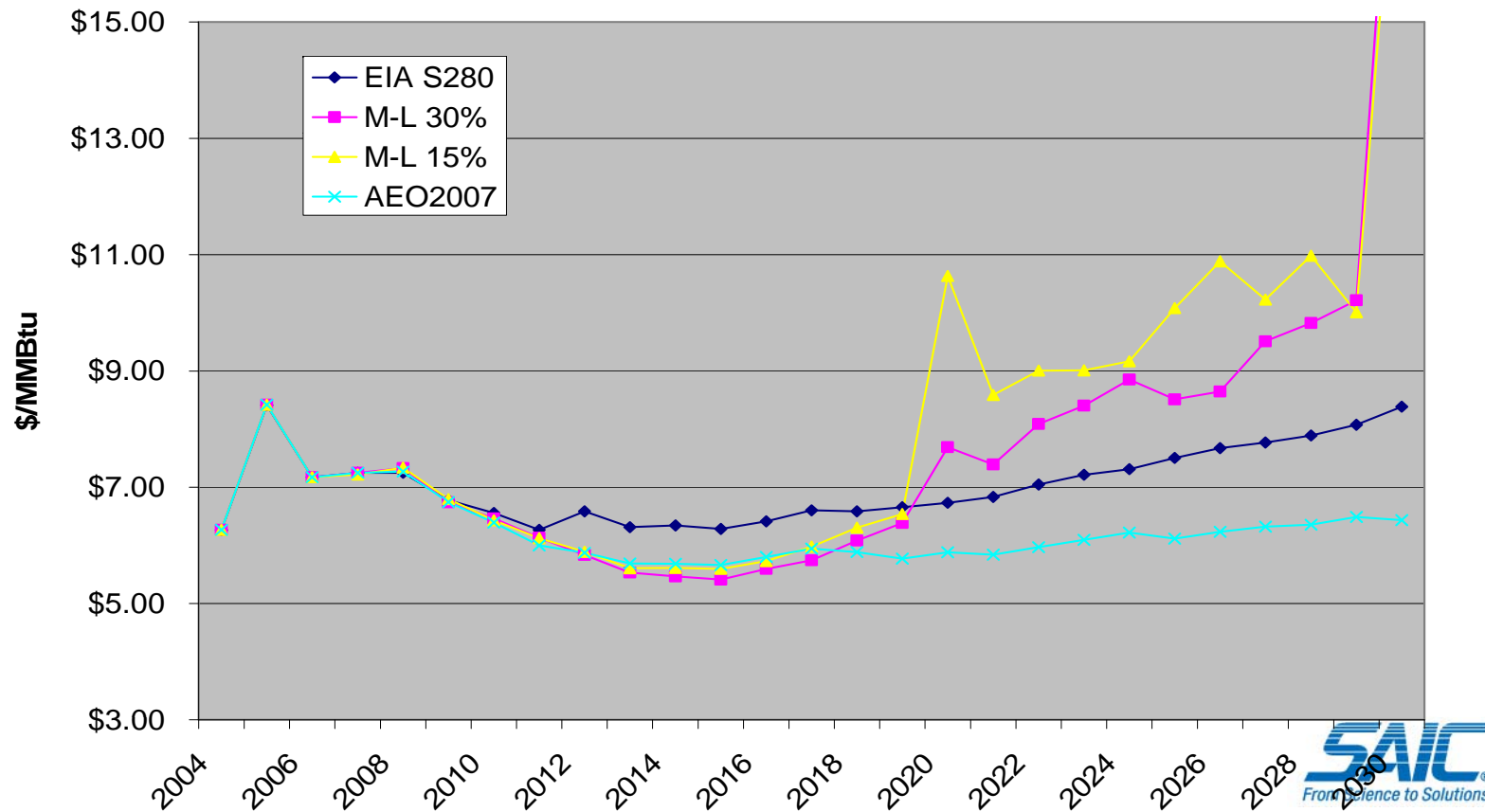
**Rise in producer gas prices are due to greater gas consumption, not price of CO<sub>2</sub>**



# Effects on Consumer Energy Prices Natural Gas

**Gas prices rise by between \$2.00 and \$5.00 /MMBtu over AEO2007.**

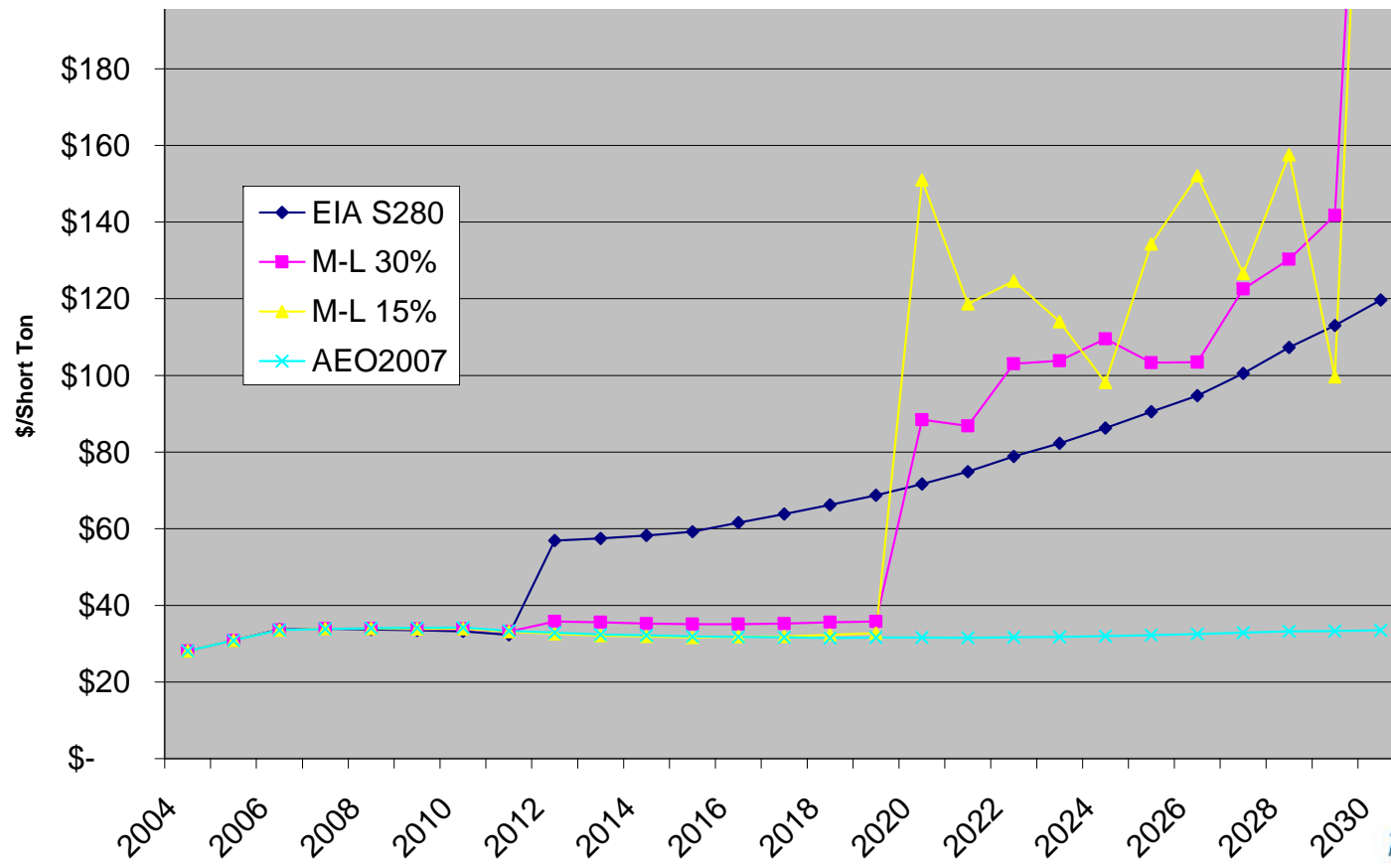
NG Prices to Electric Sector



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# Effects on Consumer Energy Prices Coal

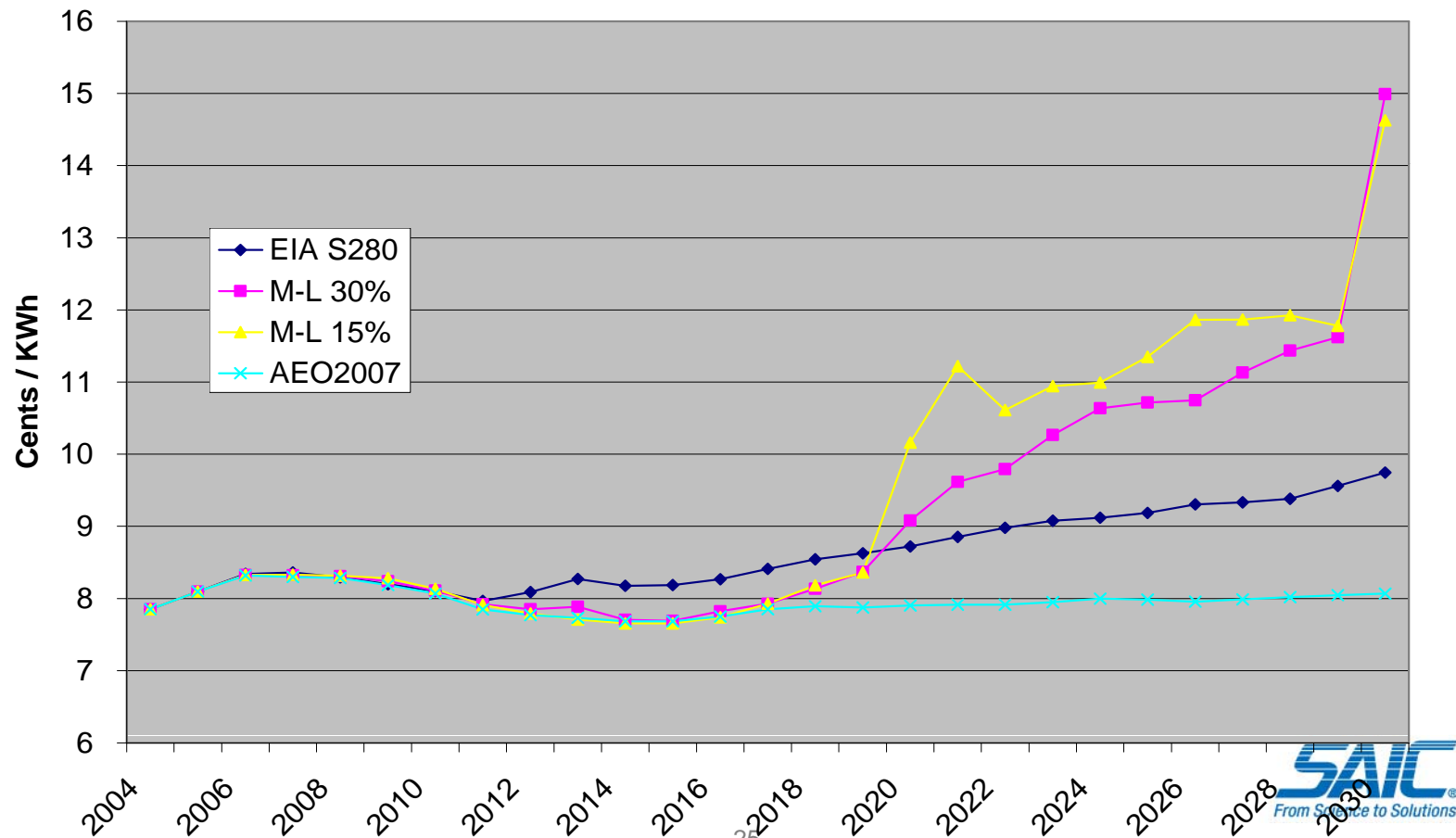
**\$40 carbon price more than doubles the price of coal over AEO 2007.**



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# Effects on Consumer Energy Prices Electricity

Electricity prices rise by between 1 and 4 cents per KWh over AEO2007

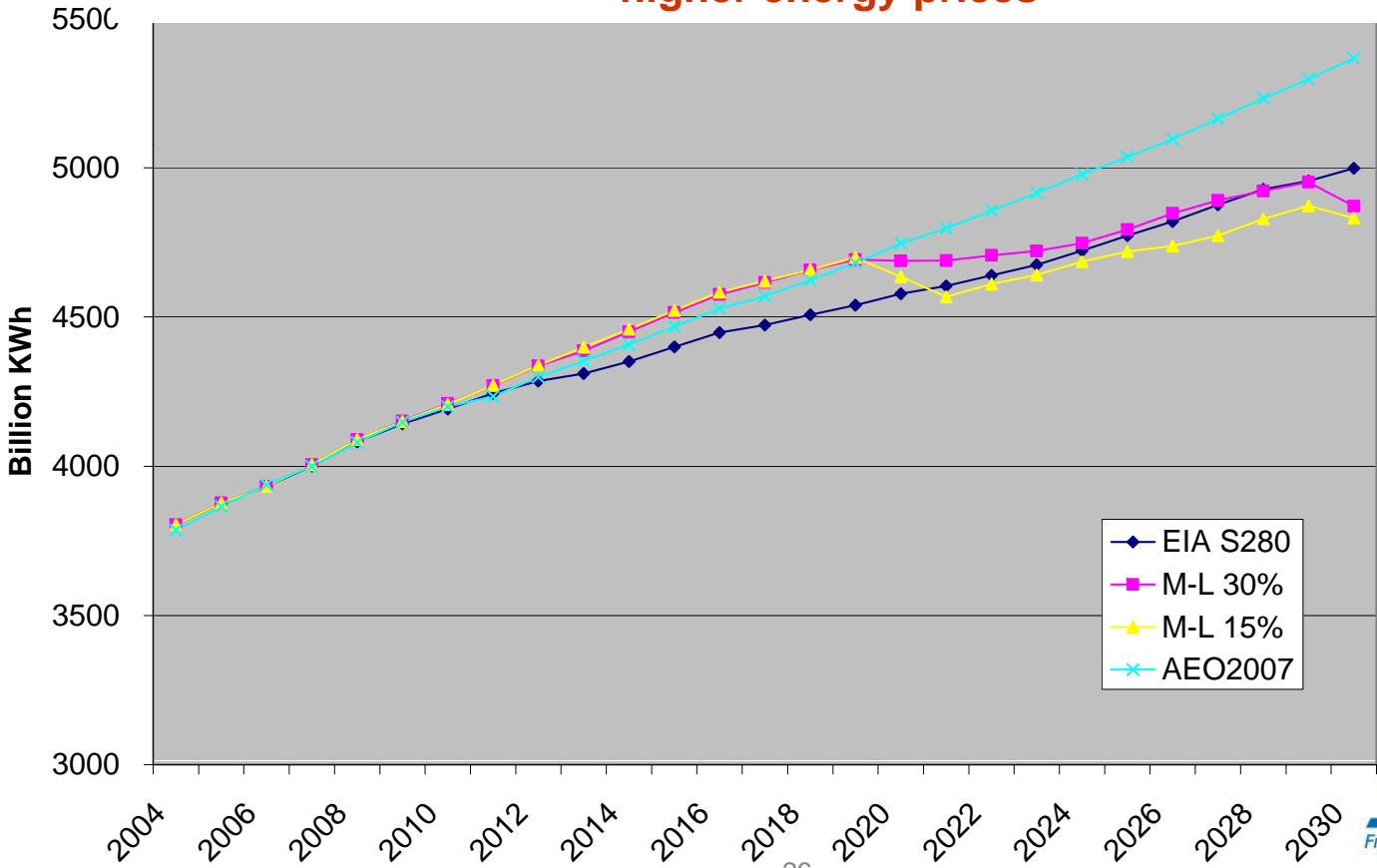


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# Electricity Demand

**M-L results in substantial savings in electricity demand due to improvements in energy efficiency and conservation induced by higher energy prices**



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### **General Conclusions from SAIC - NEMS Runs:**

- ▶ S.280 or Lieberman-Warner would severely limit the use of fossil fuels in power generation unless a mixture of carbon offsets, carbon allowances, and technologies such as carbon sequestration are employed to mitigate CO<sub>2</sub> emissions from burning fossil fuels
- ▶ Analytic results are particularly sensitive to assumptions about available offsets, choice of technologies, and the use of carbon allowances

### **Conclusion for the Natural Gas Council (NGC):**

- ▶ Under the NGC assumptions, natural gas will play a more prominent role in GHG emission reduction than projected in the EIA "S 280 Core Case" analysis.

- ▶ Full NGC report is available at
  - ▶ <http://www.ingaa.org/cms/28/5565.aspx>
  
- ▶ SAIC is now analyzing Warner Lieberman
  - Multi-client study
  - Individual Analysis
  
- ▶ On the Horizon
  - Dingell –Boucher
  - Carbon tax



# Contact Us



Please contact us to discuss how SAIC's energy and climate change teams can help you:

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