

# U.S. MARKAL Model Sensitivity to Value of Carbon

Presented At:  
**ETSAP Workshop**  
Palo Alto, CA  
June 28, 2007

Paul Friley and Thomas Alfstad  
Brookhaven National Laboratory  
PFriley@bnl.gov  
TAlfstad@bnl.gov



## BNL 10 Region US MARKAL

- Calibrated to EIA's Annual Energy Outlook for 2007
  - Scenarios are generally run in parallel with NEMS. US MARKAL tends to be more responsive than NEMS (i.e. greater difference between scenarios)
- Covers all sectors of the economy
- Designed to handle analysis of DOE technology programs
- Uses latest version of MARKAL, GAMS and Answer
  - Solves in approx. 5 minutes
  - 2 minutes for writing output tables



## 10 Region US MARKAL continued

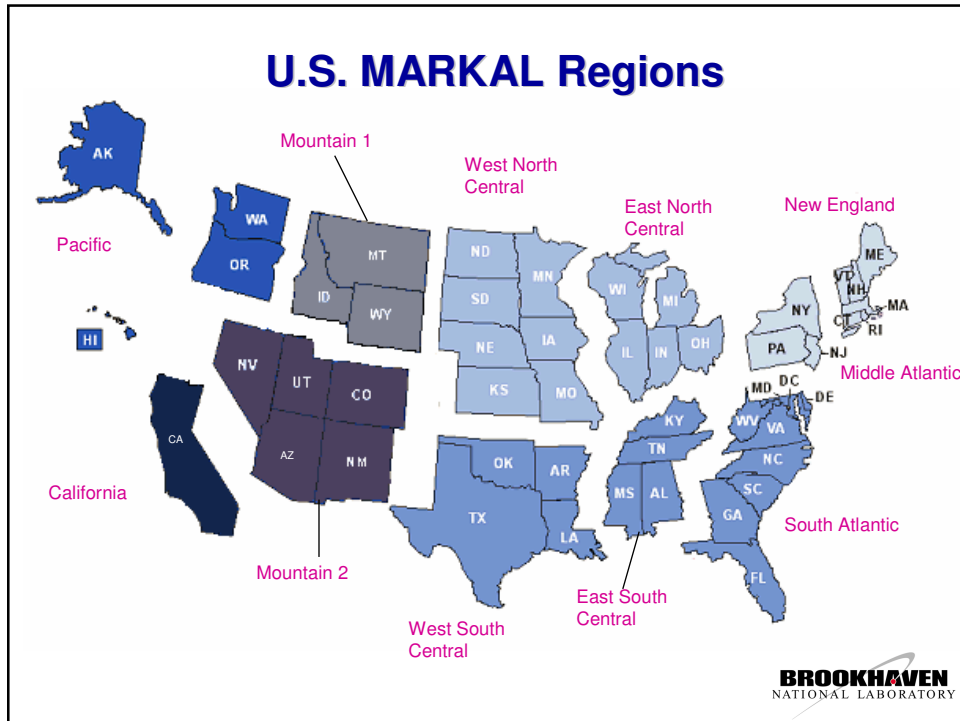
- Electricity sector
  - Relatively high level of technology detail.
  - Vintaging and option to re-power coal fired stations.
  - Size distribution of generators
  - Renewable technologies subdivided by resource class and cost category
- Transport sector
  - LDV demand by market size (Small, Medium, Large)
- Industrial sector
  - Detailed representation of steam heat demand
  - Rest of explicit industrial demand technology descriptions have been removed to fit DOE Industrial EE program



## Multiregion US MARKAL continued

- Residential/Commercial sectors
  - Description of building shells and major demand technologies
  - Lighting demand is binned based on hours of use and CRI
- Other
  - Exogenous technology learning
  - Elastic demands to be introduced this summer
  - More detailed time-slice resolution for the electricity sector to be introduced this summer/autumn

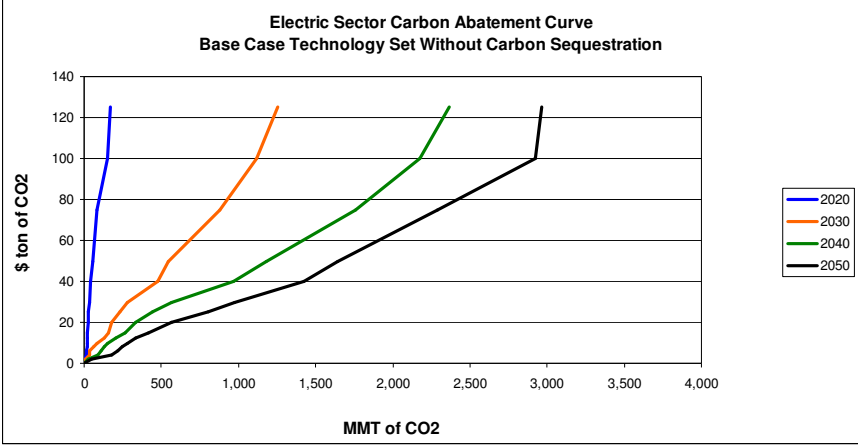




## Work in progress

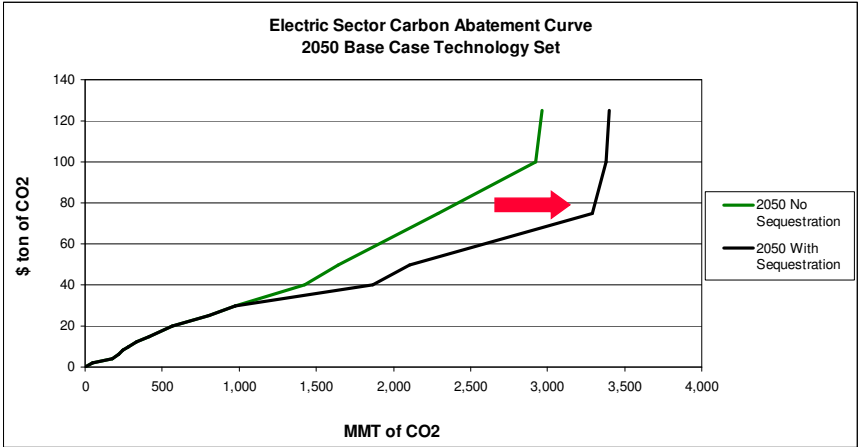
- CCS
  - Adding regional sequestration curves
  - Adding regional CO<sub>2</sub> transportation costs
- Increased time slice resolution for the electricity sector
  - Data under development by sub-contractor
- Elastic demands
  - Data under development by sub-contractor

# Carbon Abatement Curves Over Time



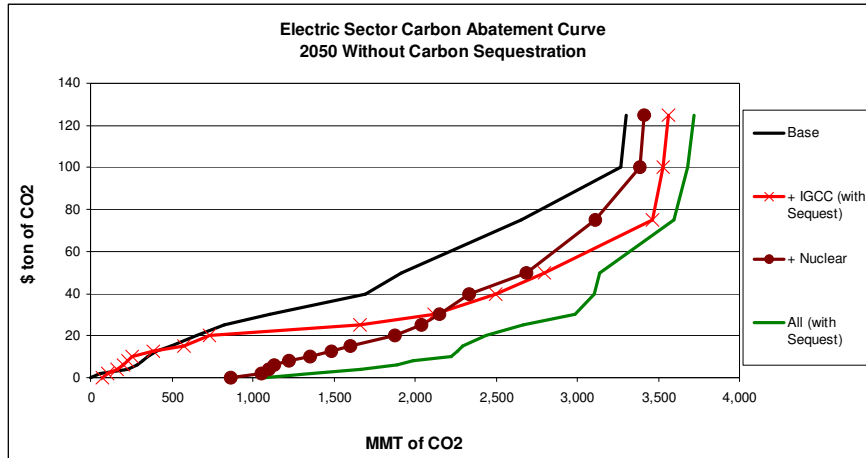
**BROOKHAVEN**  
NATIONAL LABORATORY

# Effect of Carbon Sequestration on Carbon Abatement Curves



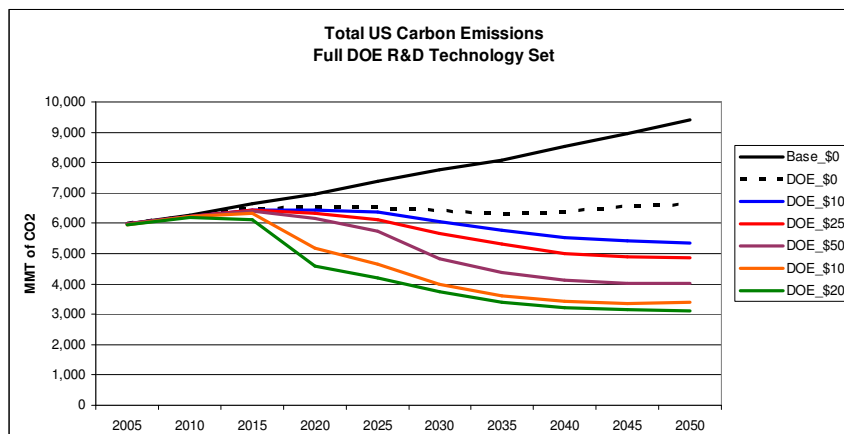
**BROOKHAVEN**  
NATIONAL LABORATORY

## Effect of R&D on Carbon Abatement Curves



**BROOKHAVEN**  
NATIONAL LABORATORY

## Total U.S. Carbon Emissions by Carbon Value



**BROOKHAVEN**  
NATIONAL LABORATORY

# **U.S. MARKAL Model Sensitivity to Value of Carbon**

Presented At:  
**ETSAP Workshop**  
Palo Alto, CA  
June 28, 2007

Paul Friley and Thomas Alfstad  
Brookhaven National Laboratory  
PFriley@bnl.gov  
TAlfstad@bnl.gov

