

# *US Multi-region MARKAL Modeling*

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## *Northeast 9-State Model*

ETSAP Semi-annual Workshop  
Annex X, 5<sup>th</sup> Workshop  
Stanford University  
June 28, 2007

Pat Delaquil, Clean Energy Commercialization  
Gary A. Goldstein, International Resources Group  
Less Goudarzi, OnLocation  
Gary Kleiman, Northeast States for Coordinated Air Use Management  
Evelyn Wright



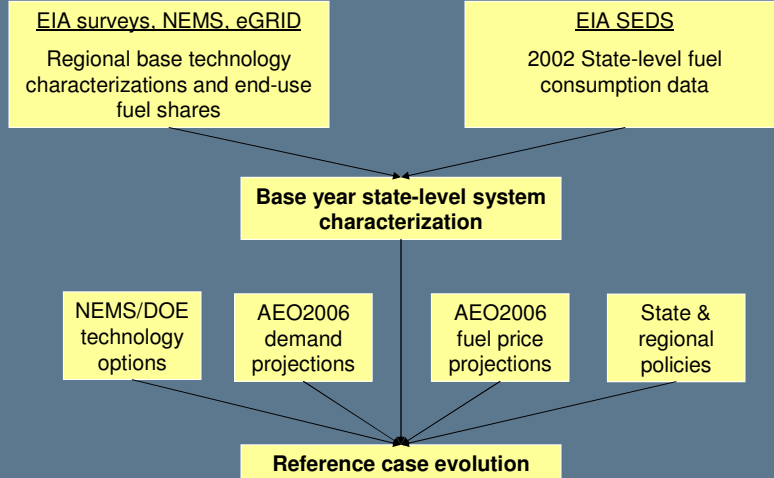
## *NE9 States Face Multiple Energy- Environment-Economy Policy Challenges*

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- CAA implementation (O<sub>3</sub>, PM, haze, CAIR, NSR)
- Mercury (CAMR, state Hg programs)
- Transportation planning (CA LEV GHG, feebates, diesel reduction initiatives)
- Climate (state action plans, RGGI, NEG/ECP goals, RPSs, low carbon fuels)
- Economic impact of changing energy markets and prices



## NE9/12 Data Development Process



## Model Representation

- Resource Supply
  - ❑ Price taker, importing fuels at AEO2006 regional sector delivered prices
  - ❑ State-level biomass supply curves (ORNL)
  - ❑ State-level renewables potential (NREL and RGGI)
- Power Sector
  - ❑ Power plants above 25MW represented individually, others by fuel/emissions control
  - ❑ Current inter-state/Canada+Other exchange options at current grid capacity, expandable
  - ❑ Six time slices currently, expanding to at least nine

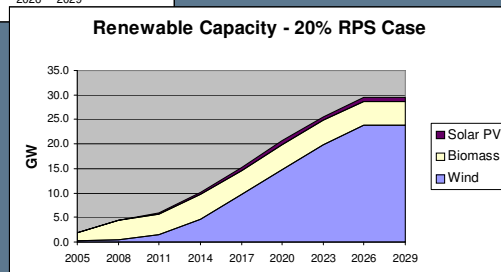
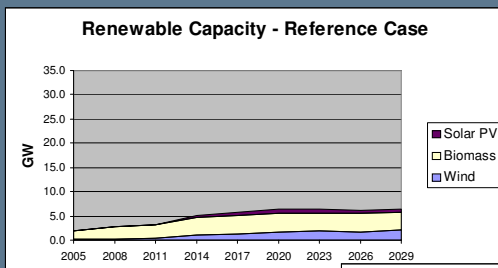


## NE-9 Demand Sectors Representation

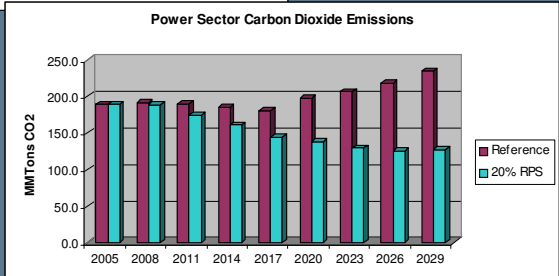
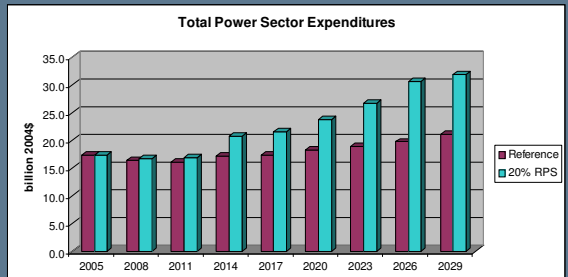
Residential	Space Heating, Cooling, Clothes Washers, Dish Washers, Water Heating, Cooking, Clothes Dryers, Refrigeration, Freezing, Lighting, Personal Computers, Television, Furnace Fans, Other Appliances, Secondary Heating
Commercial	Space Heating, Cooling, Water Heating, Cooking, Ventilation, Refrigeration, Lighting, Office Equipment, Other
Industrial	Steam, Process Heat, Machine Drive, Electro-Chemical, Other, Feedstocks, Non-Energy, and captive CHP in each of Chemicals, Durables, Glass-Cement, Metals, Paper, Other
Transportation	Robust Light Duty Vehicles, expanding Heavy Duty Vehicles, Other



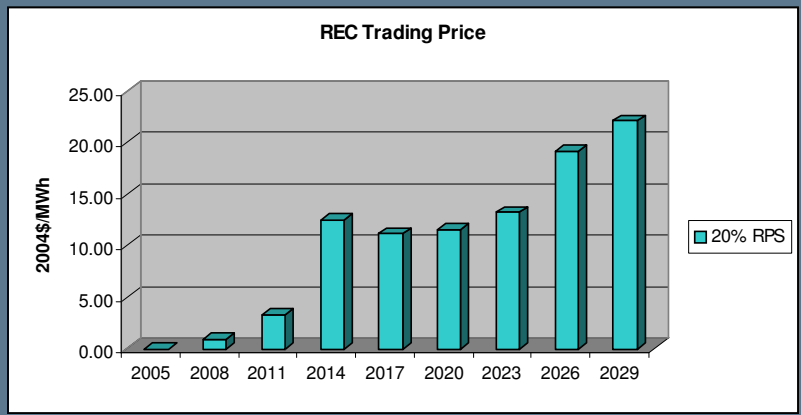
## NE9 RPS - Renewable Capacity



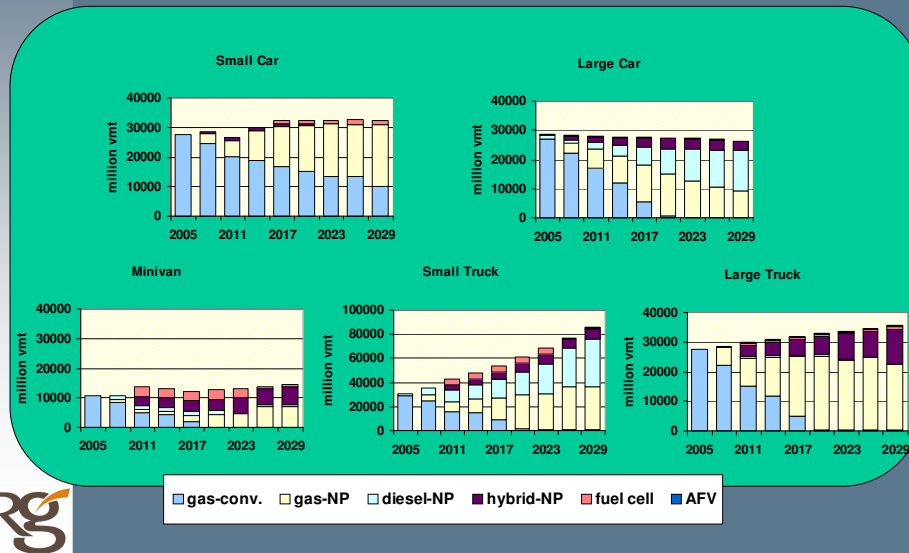
# NE9 RPS – Power Sector Costs & CO2



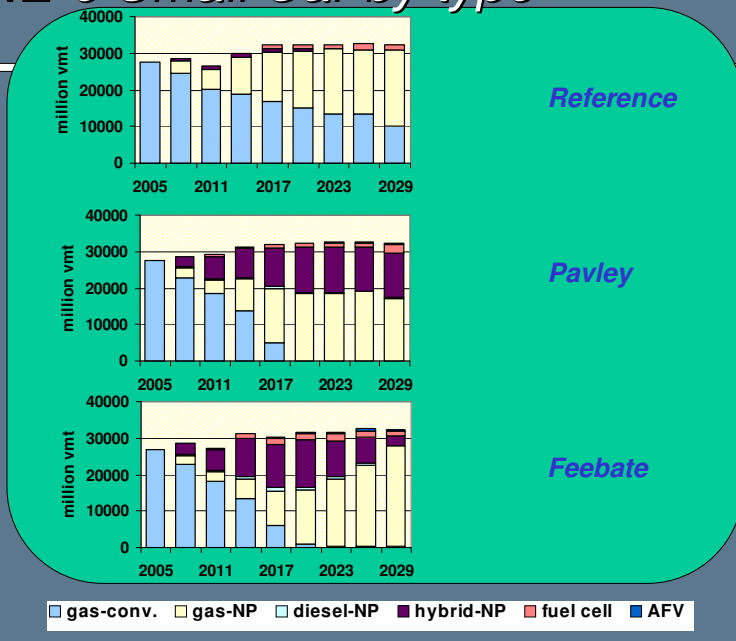
# RPS – REC Trading Price



# NE-6 Reference Transportation Technology Evolution



## NE-6 Small Car by type

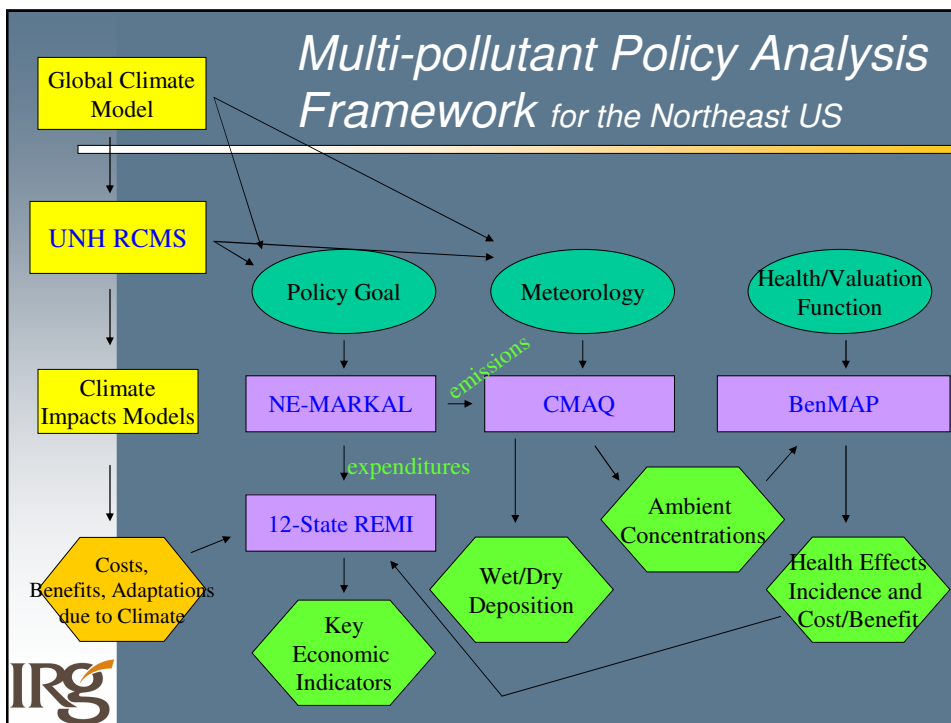


## NE9/12 Next Steps

- Three additional states, with some refinements
  - Additional regional policies (e.g., RGGI)
  - Move power sector to more time-slices
  - Integrated multi-pollutant policy analysis
  - Breaking out individual state models for local use (e.g., NJ Master Plan, MA CHP, CT Carbon Cap, NH RPS)
  - Expanding coverage to other states/regions (Ohio (and Midwest) integration)
  - Imbedding state-level census region(s) within US9r multi-region national MARKAL model
- IRG Linkage with other planning tools



## Multi-pollutant Policy Analysis Framework for the Northeast US



# REMI-Energy: Mapping MARKAL Results to REMI Policy Variables

