Sustainable Energy and Air Quality Planning for the Northeast US

Application of a Multi-Pollutant Policy Analysis Framework at the Regional-scale

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NESCAUM Attainment Planning Committee

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Contributors

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- Member States

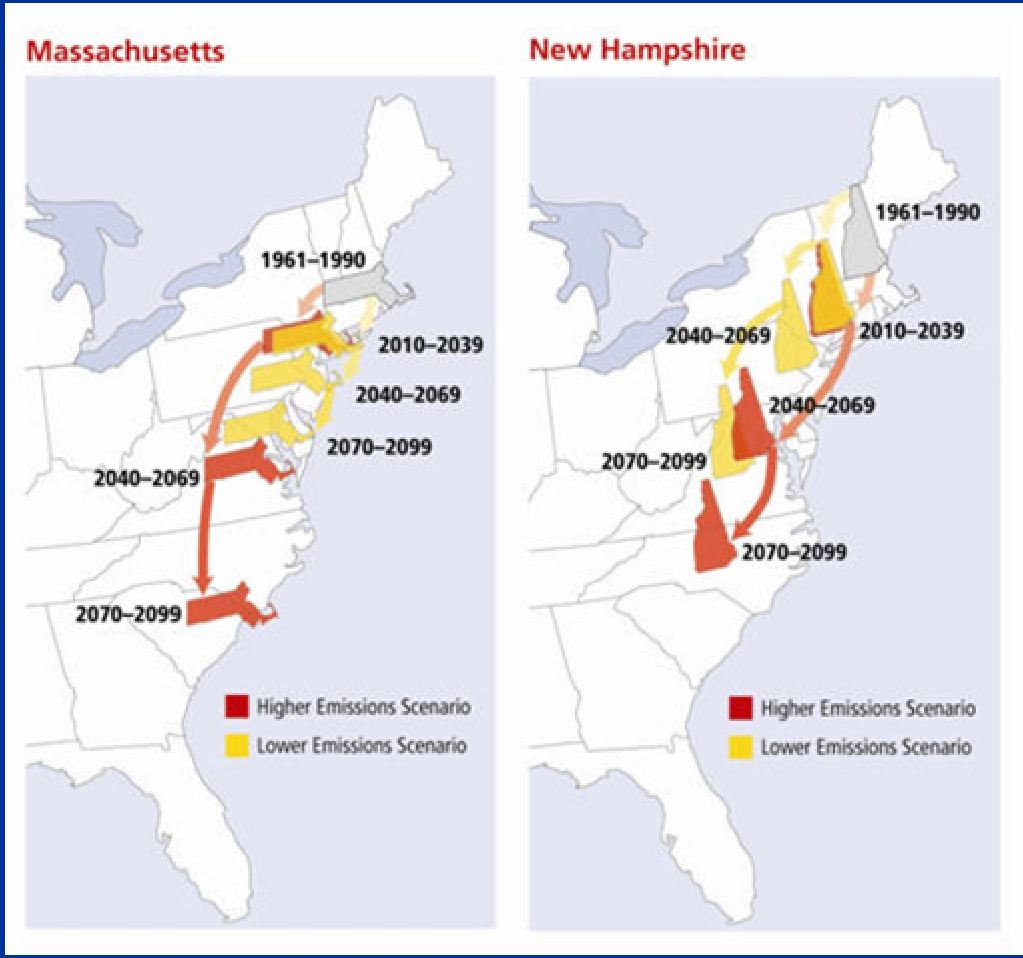
Presentation Outline

- Environmental context for multi-p planning
- Policy context for multi-p planning
- Overview of regional-scale, multi-pollutant policy analysis framework
- Examples of energy and environmental trade-offs/interactions and their economic implications
- Putting it all together: regional wedges

Rationale for thinking about alternative energy sources

(What are the challenges to, and opportunities for, sustainable air quality management?)

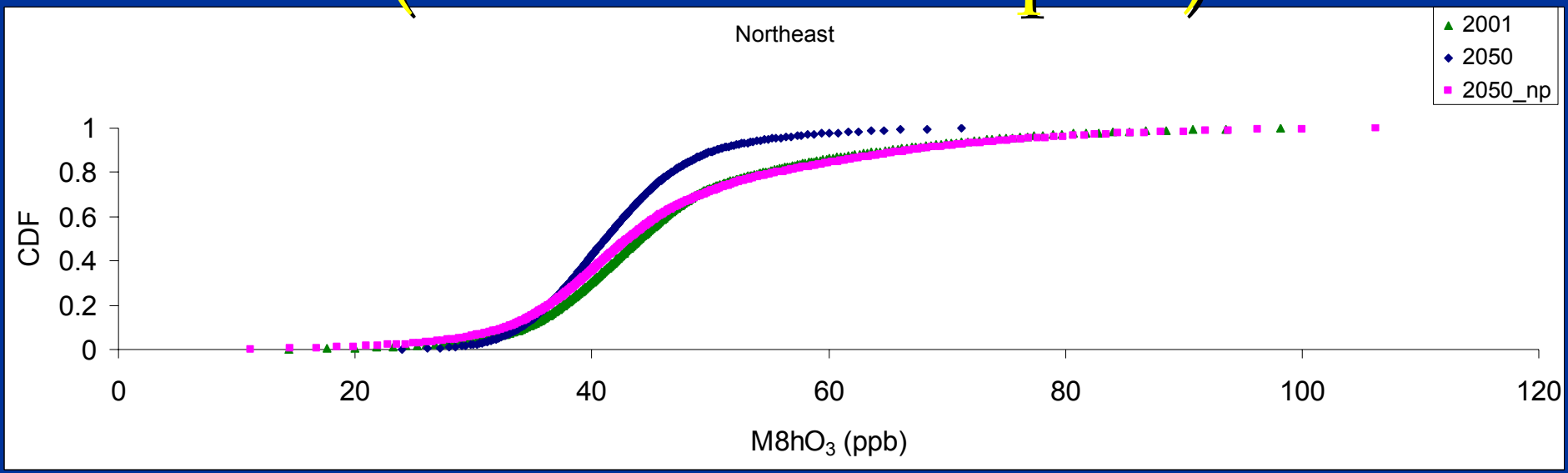
Climate Change in the Northeast

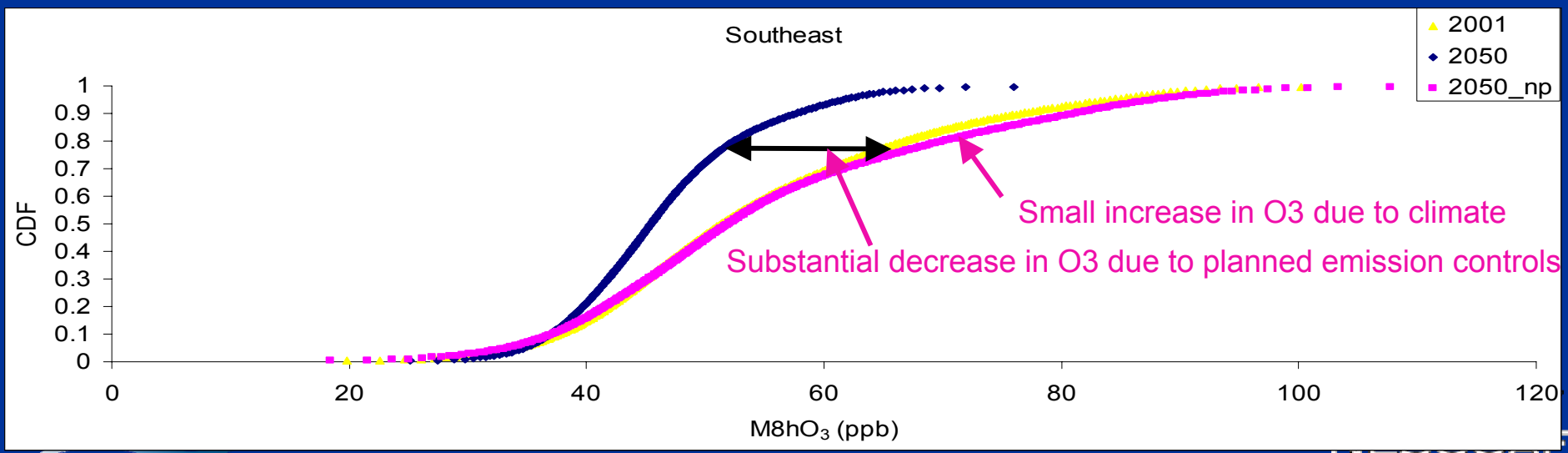


Alternative energy pathways can make a difference in our future climate change "commitment"

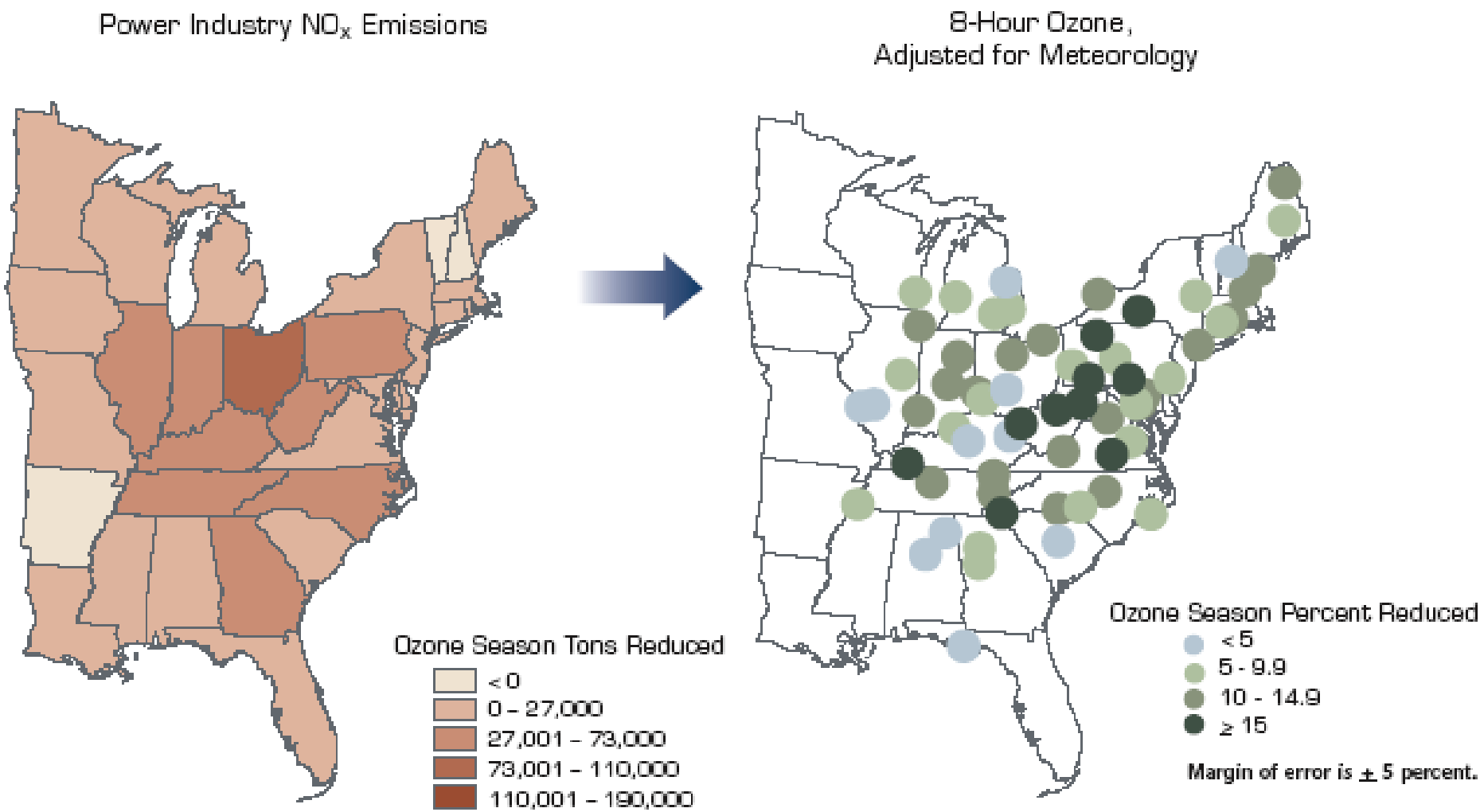
Source: UCS NECIA

Climate and Air Quality Links (Link 1 - The Impact)





Reductions in Ozone Season Power Industry NO_x Emissions and 8-Hour Ozone, 2002 versus 2004

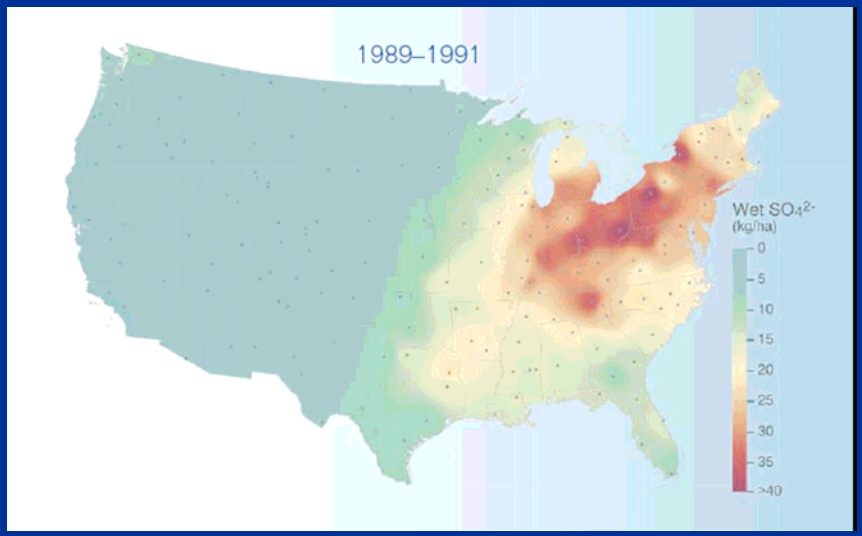


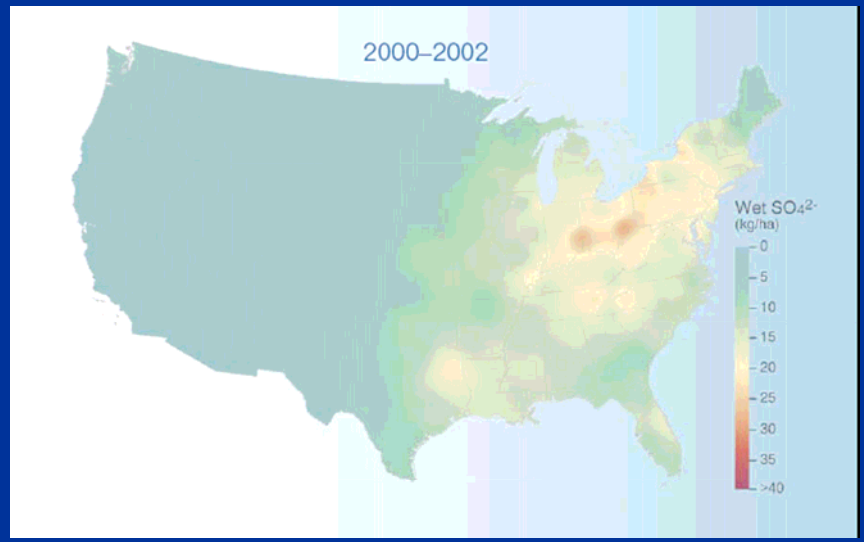
Source: EPA

Notes:

- Darker states show larger NO_x reductions.
- Arkansas (268 tons), New Hampshire (611 tons), and Vermont (16 tons) show small increases in ozone season emissions from 2002 to 2004.

Acid Deposition



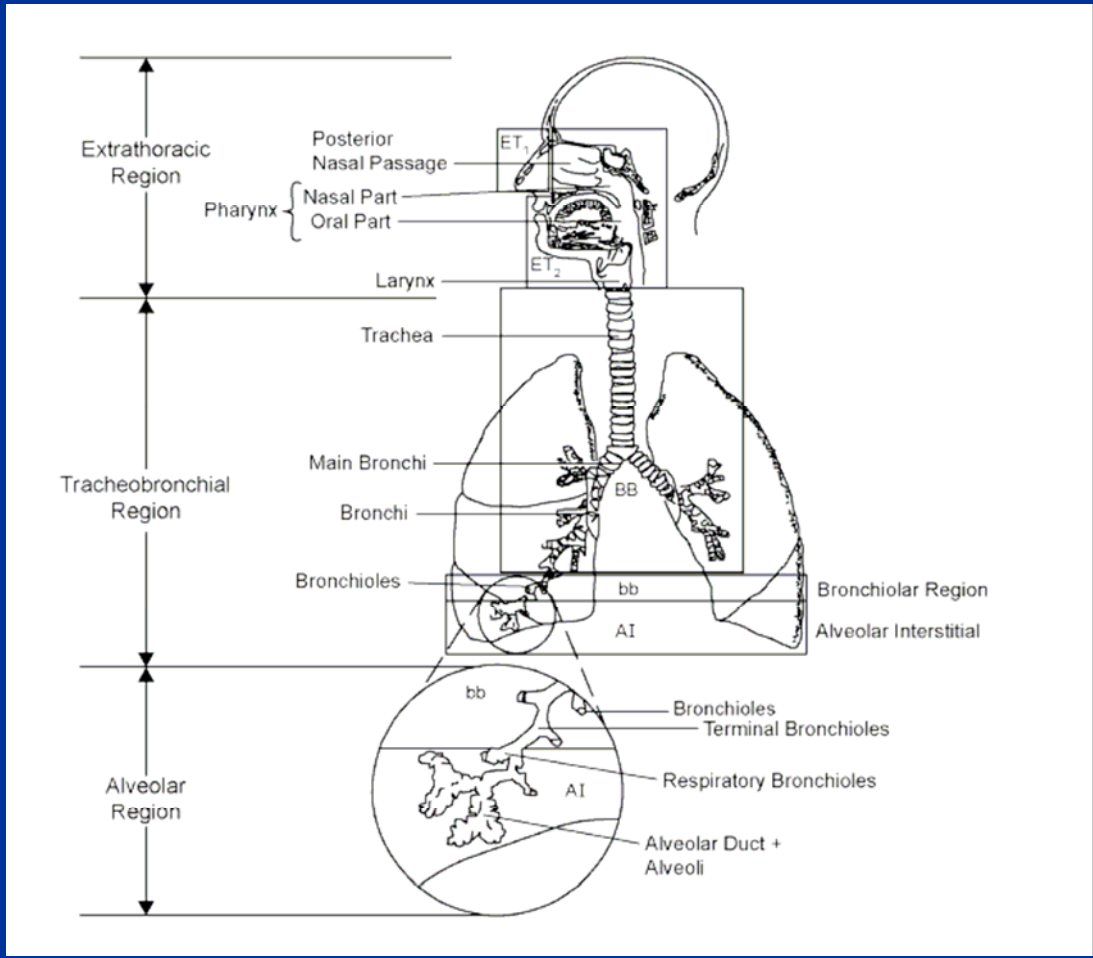


Before Title IV

After Title IV

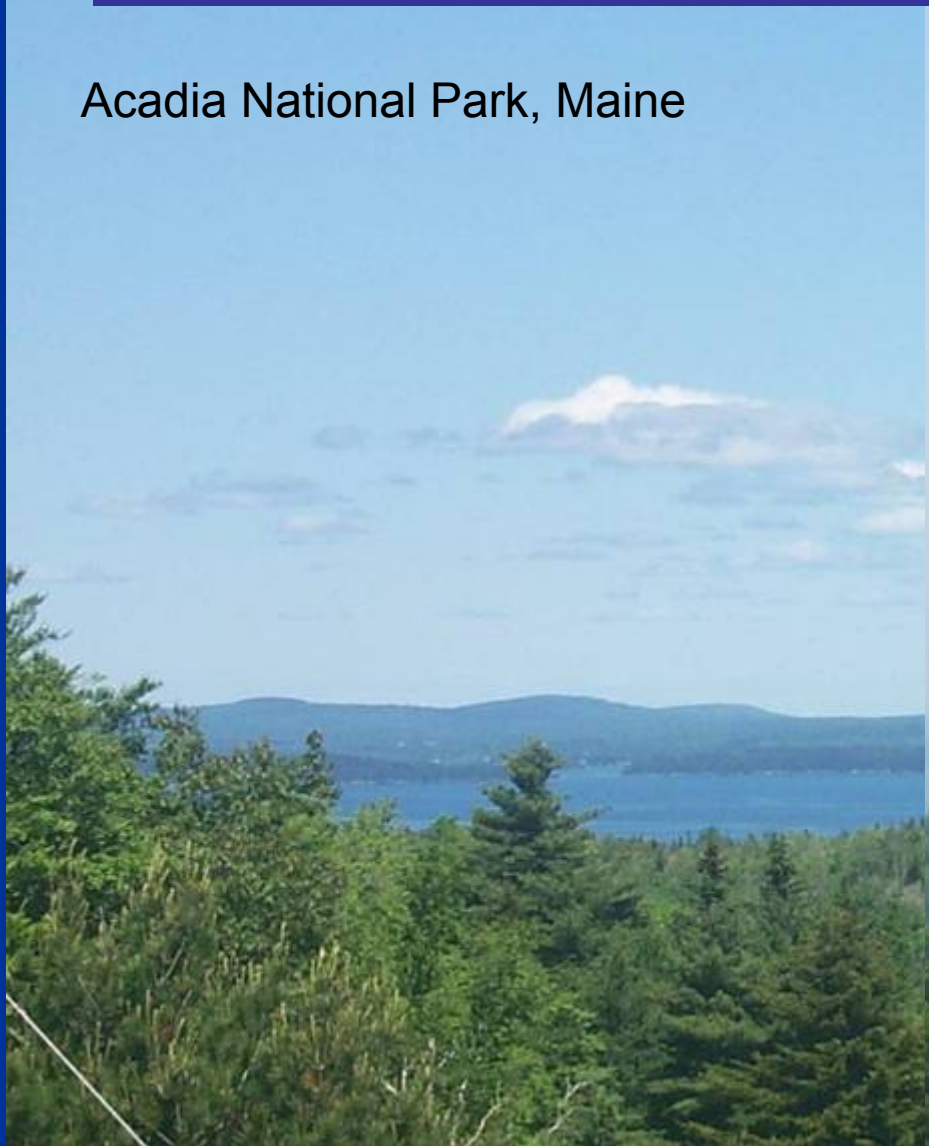
Source: NAPAP, 2005

Fine Particles and Health

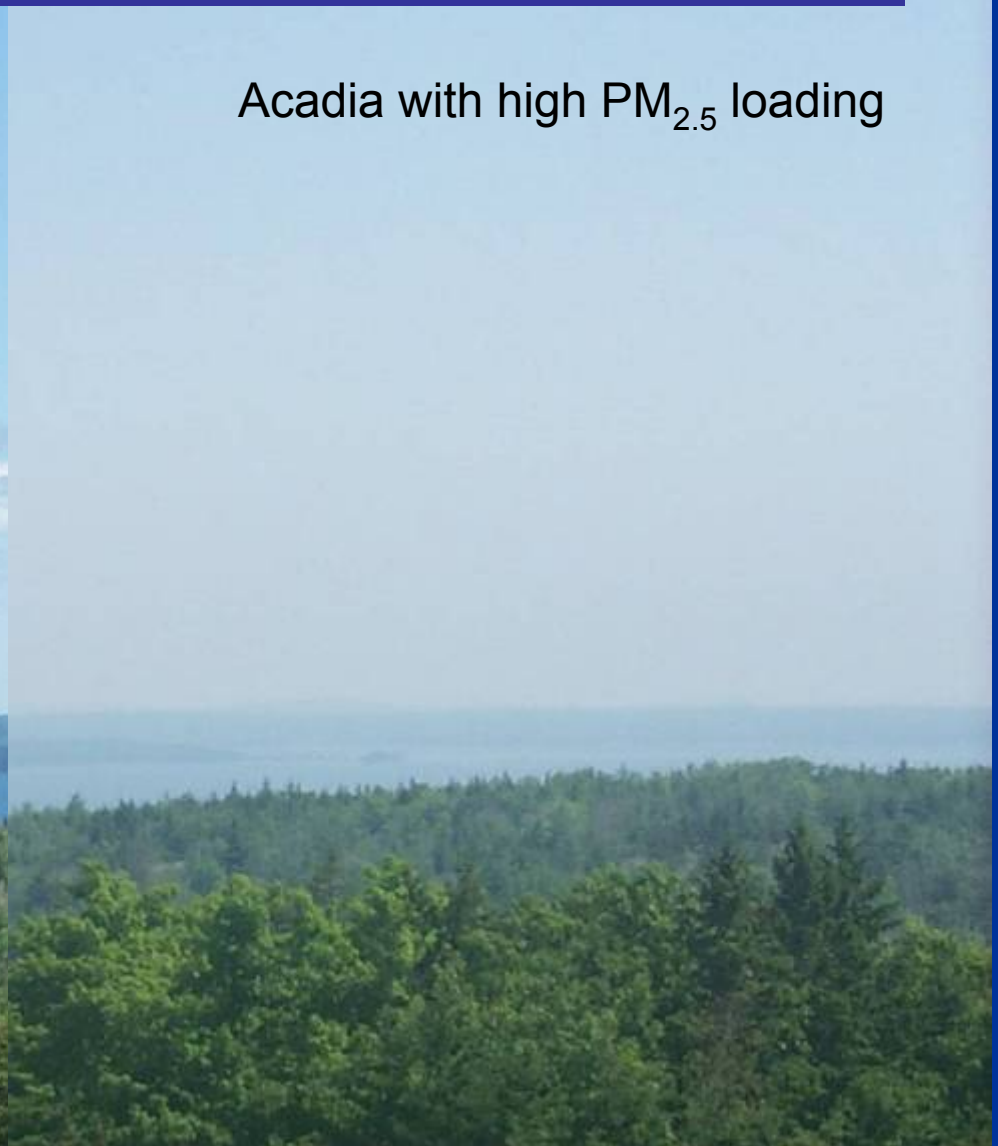


Fine Particles and Visibility

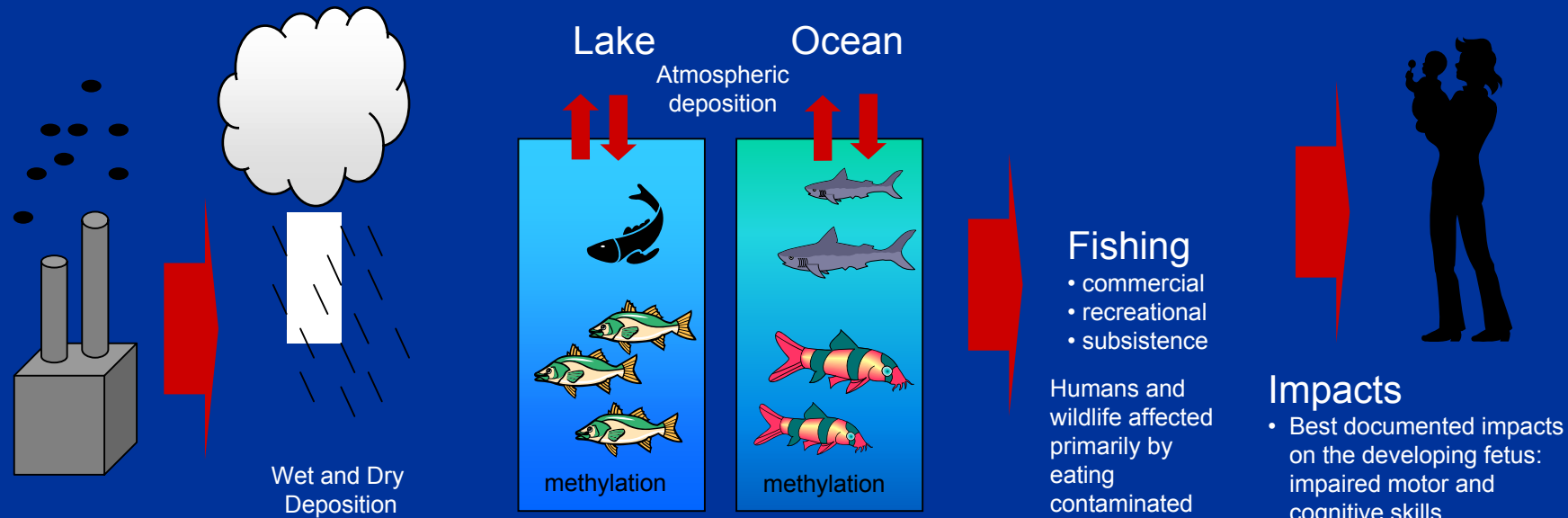
Acadia National Park, Maine



Acadia with high $PM_{2.5}$ loading



Mercury Emissions Contribute to Exposure to Mercury



Emissions and Speciation → **Atmospheric Transport and Deposition** → **Ecosystem Transport, Methylation, and Bioaccumulation** → **Consumption Patters** → **Human Exposure**

- The primary pathway of human exposure to mercury in the U.S. is through eating contaminated fish.
- Power plants emit approximately 48 tons of mercury and are the largest source of mercury emissions in the U.S. (approximately 41%).

Diesel/Black Carbon

Climate and Air Quality Links (Link 2 - The Opportunity)

A Low Carbon Future Could Mean…

- Low NOx future
- Low SO_2 future
- Low Hg and other toxic metals future
- Low Diesel/Black Carbon future

…A more sustainable Future

Multi-Pollutant Air Quality Planning

Regional Policy Context

Air Quality Management Issues

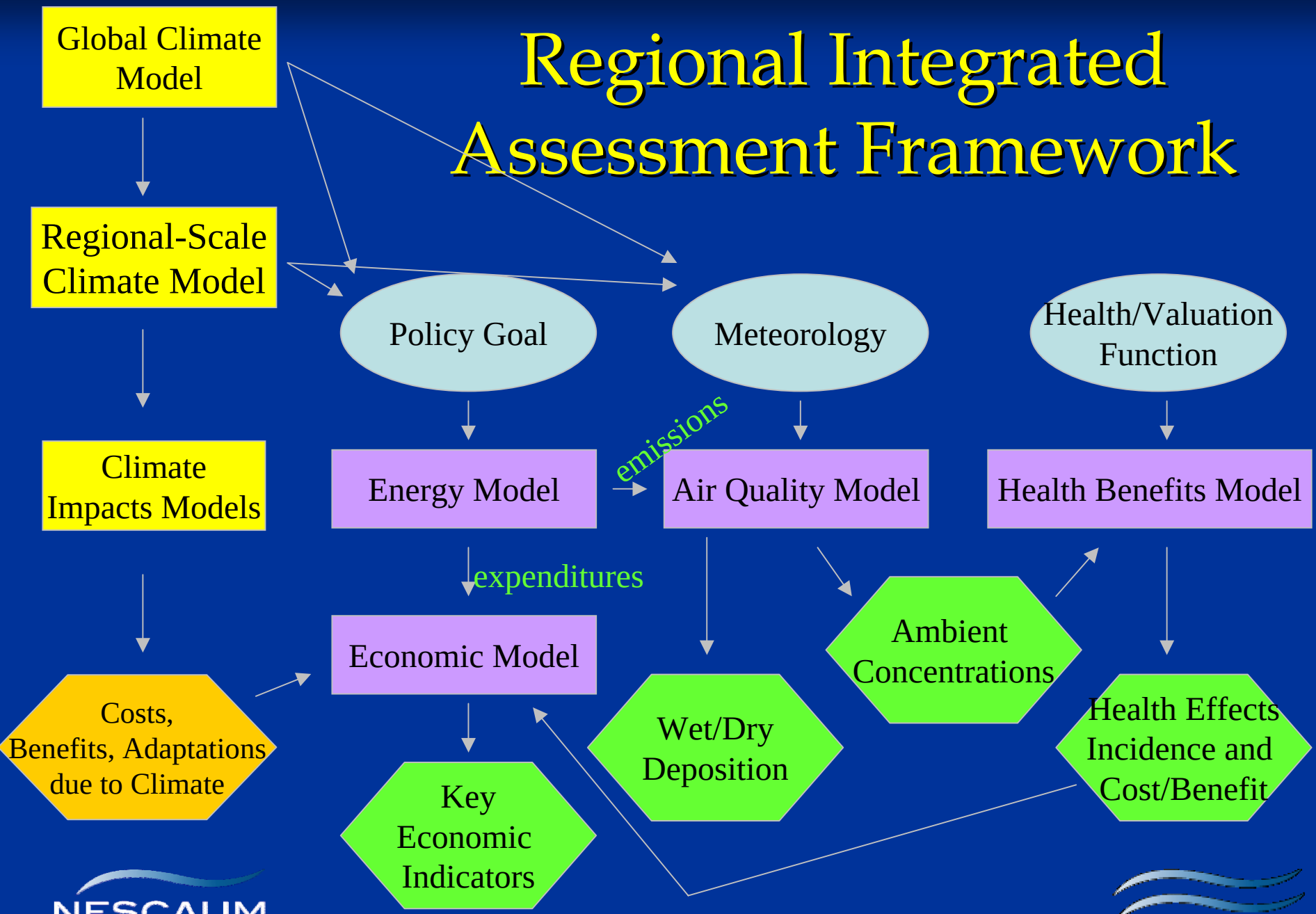
- Acid Deposition
- Mercury Deposition
- Fine Particles (Health & Visibility)
- Ozone
- Air Toxics
- Climate

Multi-Pollutant Planning

- June 2007: the federal Clean Air Act Advisory Committee recommended that governments adopt a comprehensive statewide air quality planning process and move from a single to a multiple pollutant approach in managing air quality

Multi-Pollutant Policy Analysis Framework (MPAF)

Regional Integrated Assessment Framework



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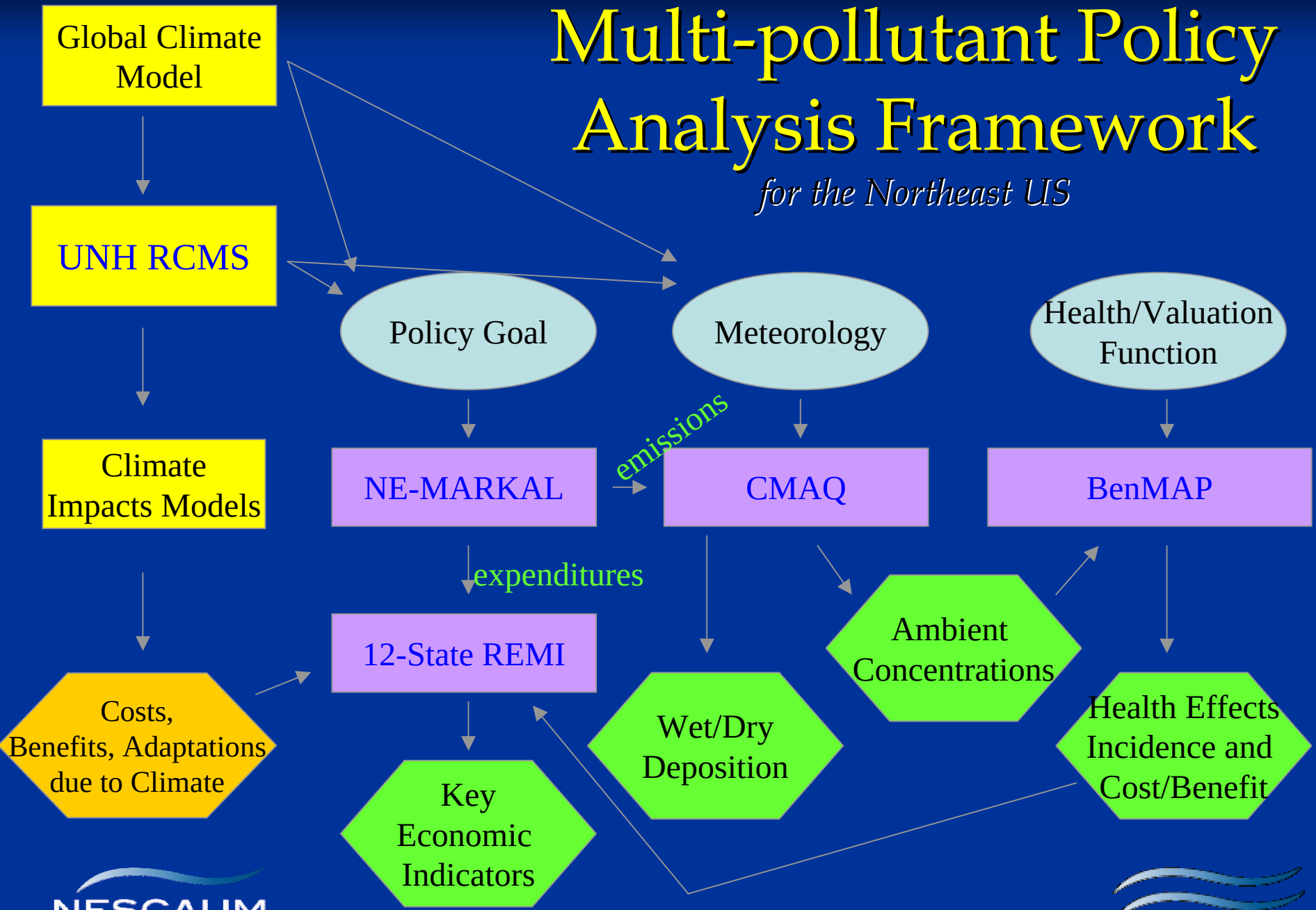
Celebrating 40 Years in Support of Clean Air for the Northeast

NESCCAF

Multi-pollutant Policy Analysis Framework

for the Northeast US



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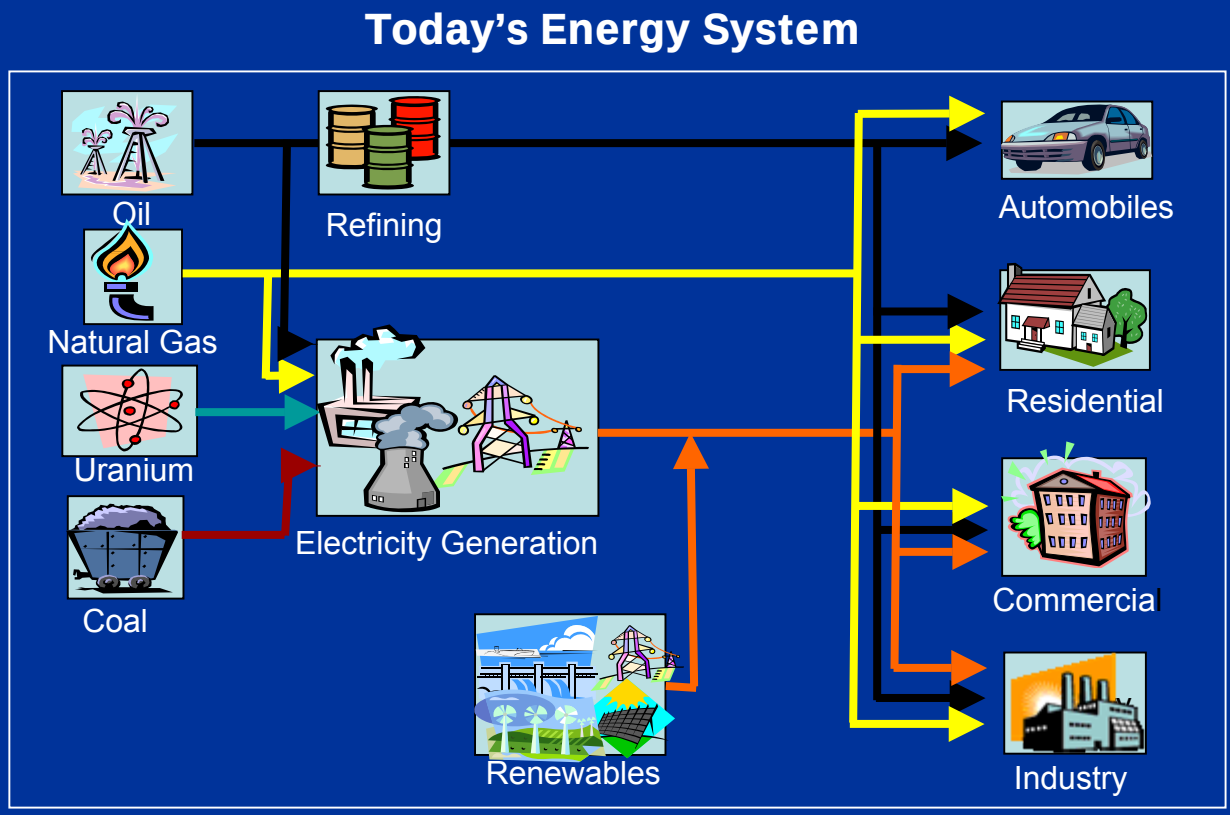
NE-MARKAL: Links Energy and Air Quality



Air Pollution

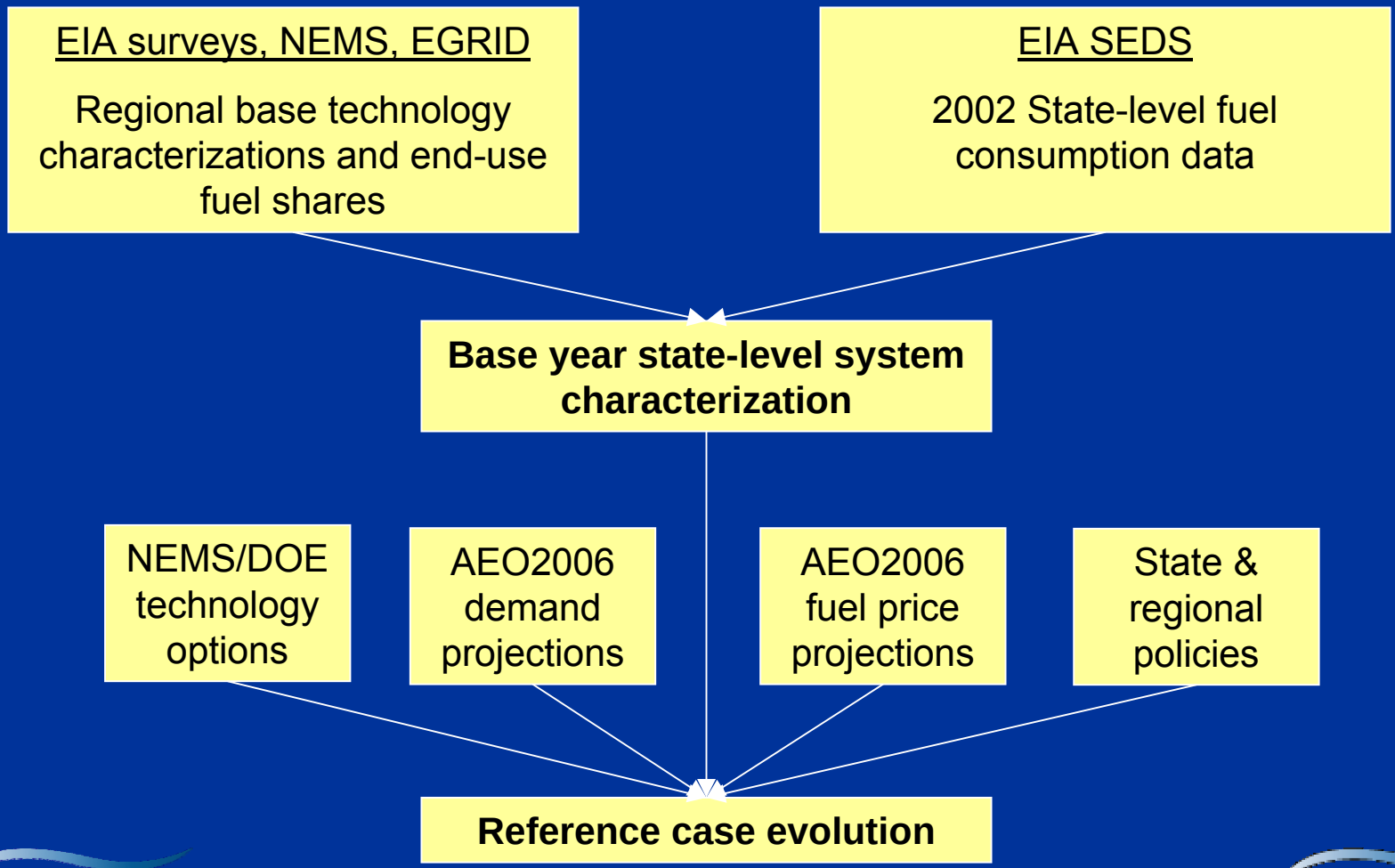
Contribution to anthropogenic emissions:

NOx ~ 95%
SOx ~ 89%
CO ~ 95%
Hg ~ 87%

Air Quality Concerns:
Ozone
PM2.5
Acid deposition
Toxics

Source: EPA ORD

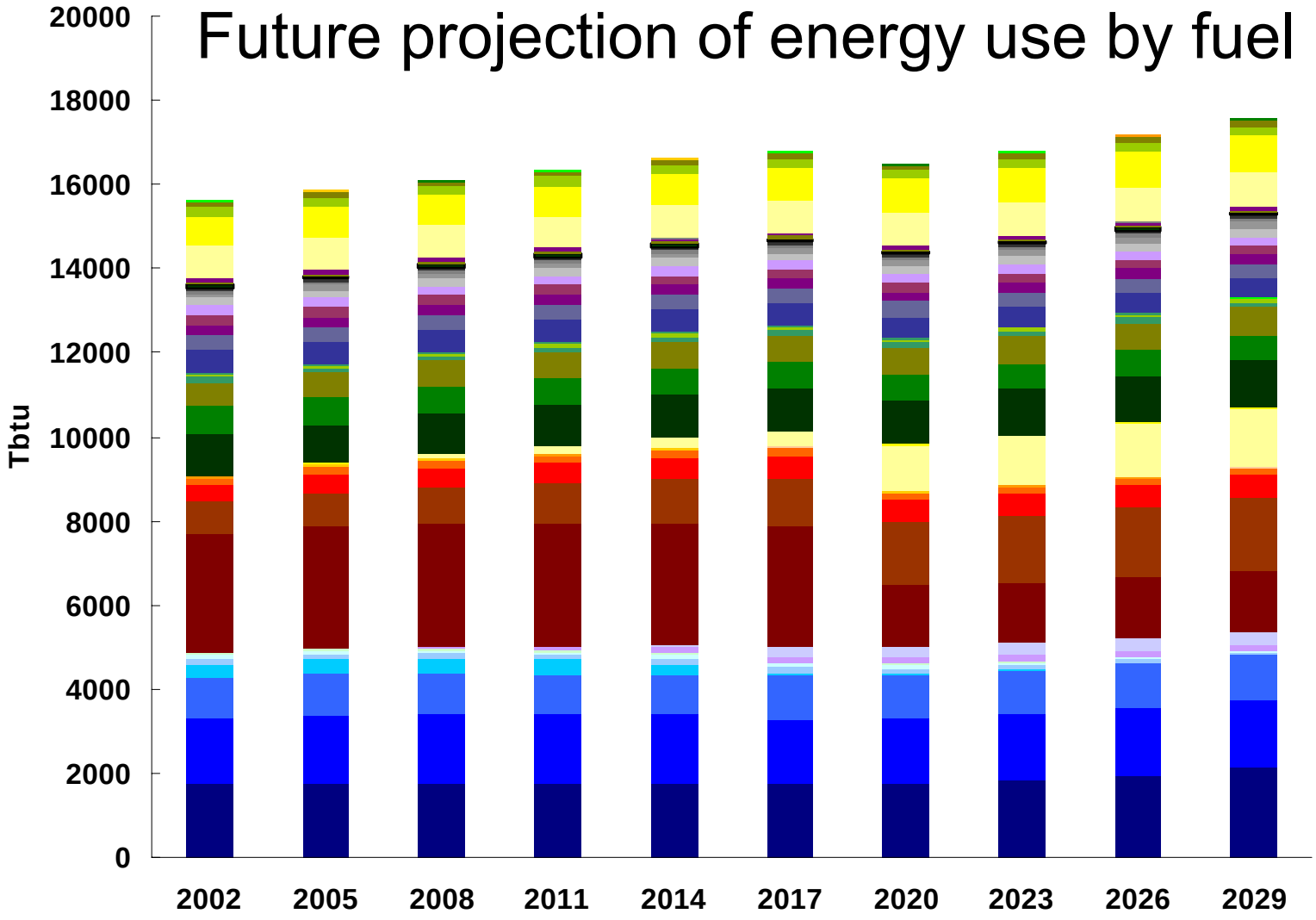
NE9/12 Data Development Process



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	Light and Heavy Duty Vehicles, Other (Aircraft, Marine, Rail available, but not yet implemented)

NE-9 Reference Scenario



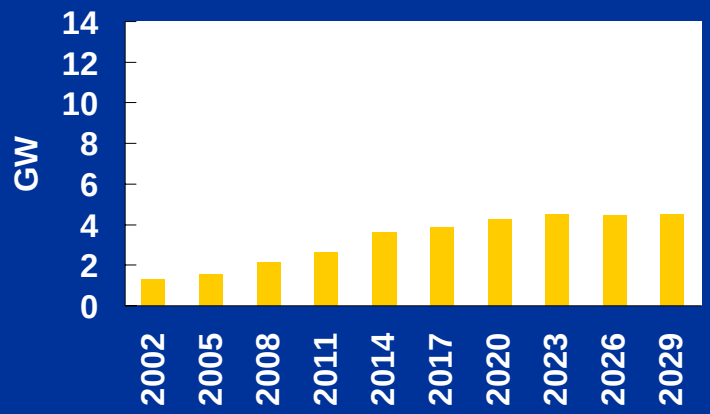
Examples of energy and air quality interaction

Rapid Deployment of Renewable Energy

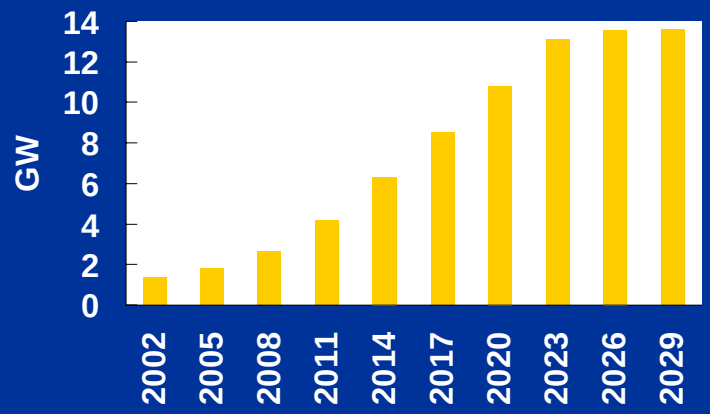
- Working with other energy modelers across U.S. (REMAP project)
- Examining the implications of requiring 20% renewable generation by 2025
- Looking at the viable opportunities and their costs
- We are one of the few *regional* models participating

Renewable Energy in the Northeast

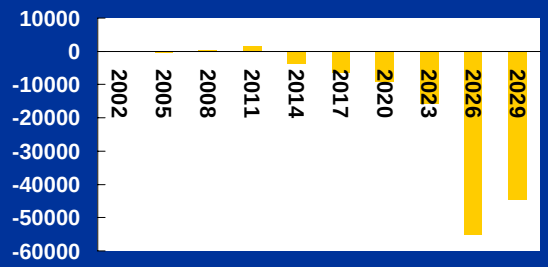
NE9 Regional Renewable Generation Reference Case



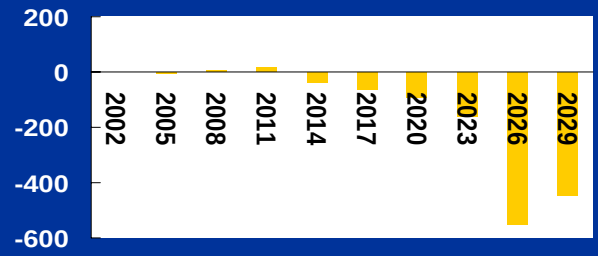
NE9 Regional Renewable Generation REMAP Case



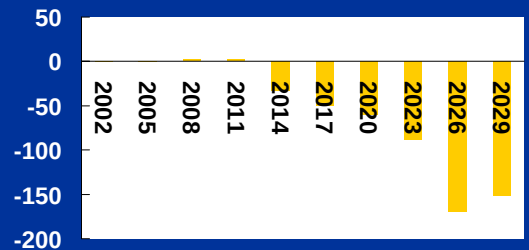
NE9 CO2 Reductions Under REMAP 20% Relative to the Reference Case



NE9 S02 Reductions Under REMAP 20% Relative to the Reference Case



NE9 NOx Reductions Under REMAP 20% Relative to the Reference Case



Thousands of Tons

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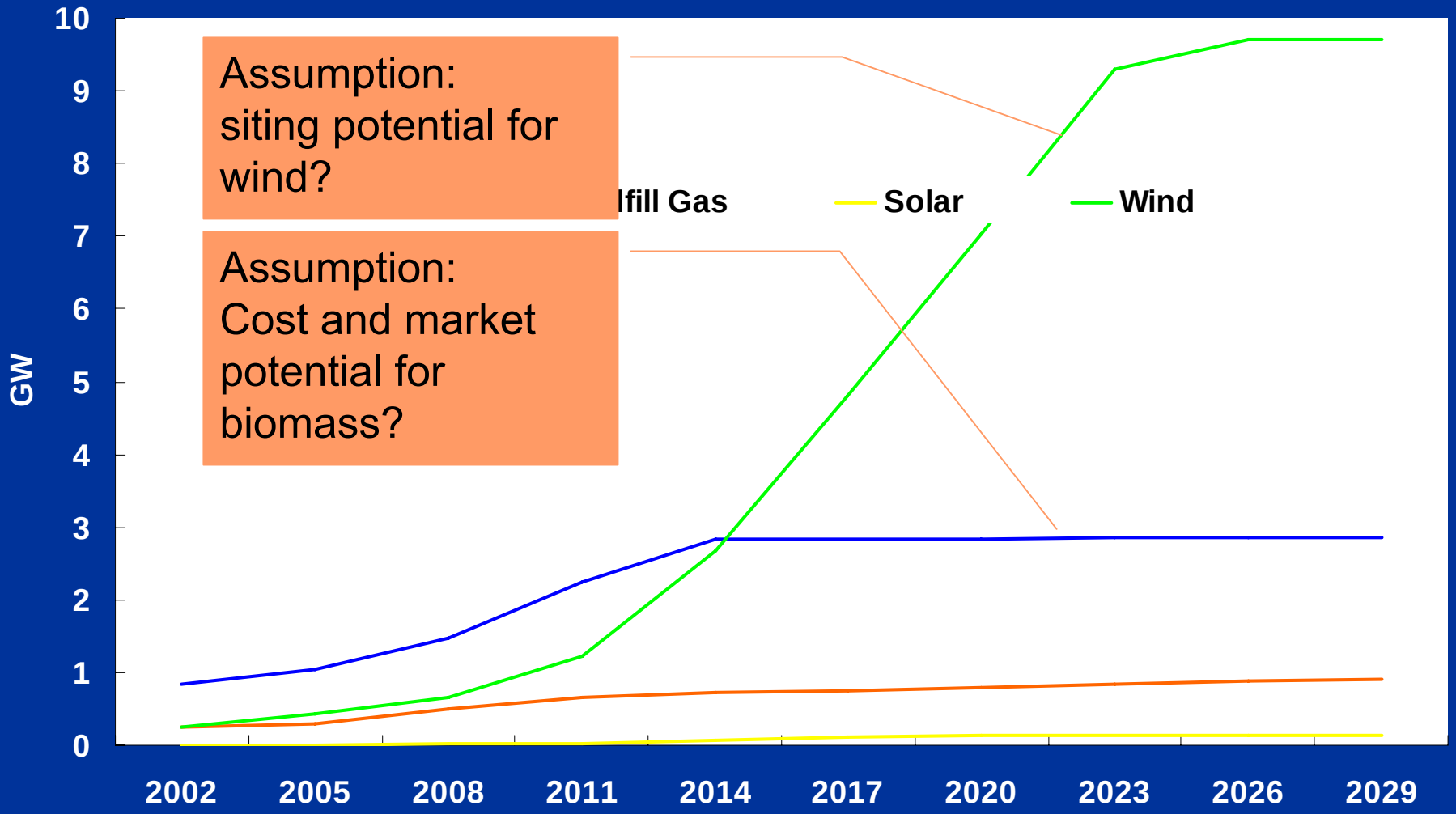
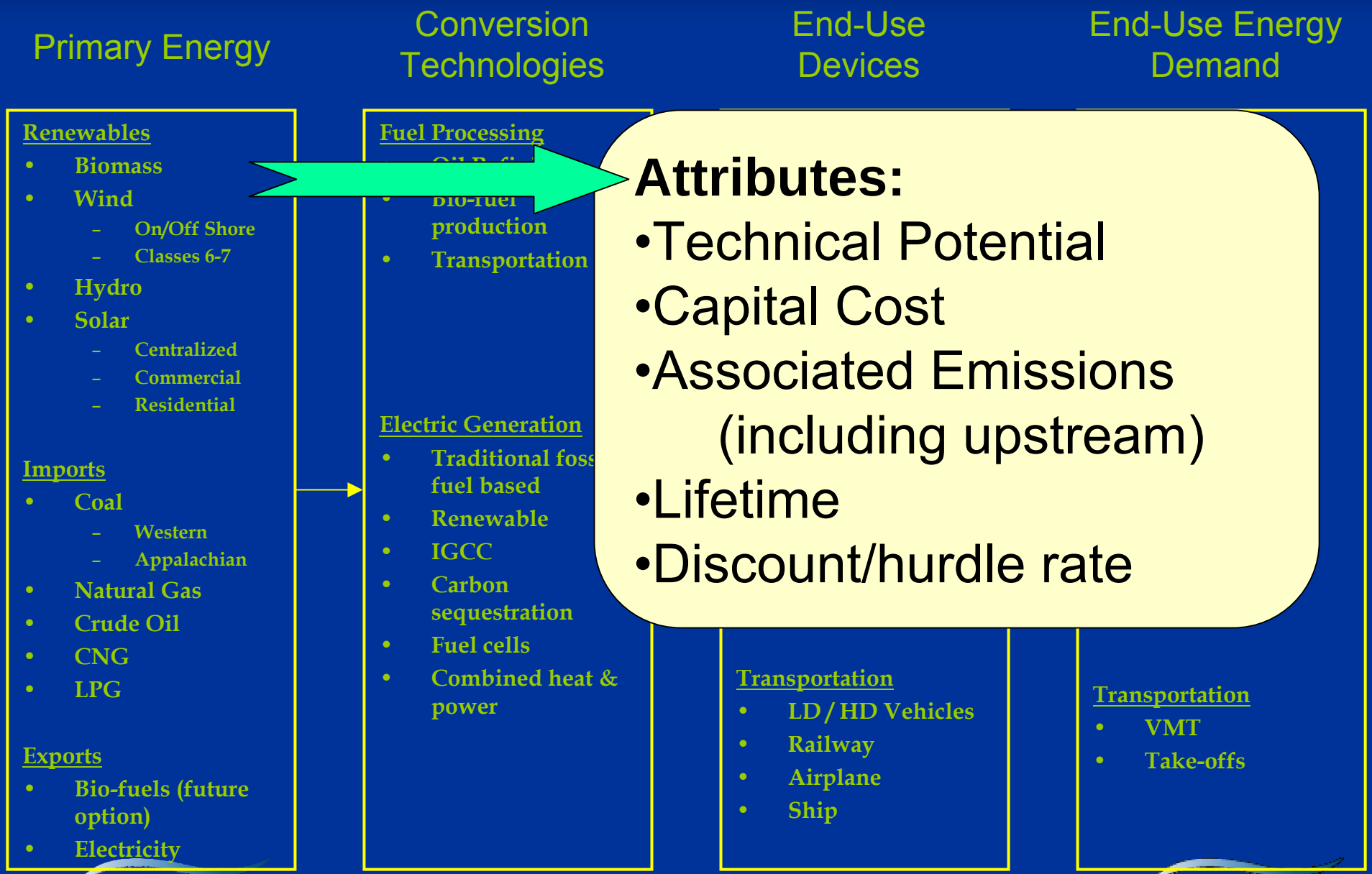
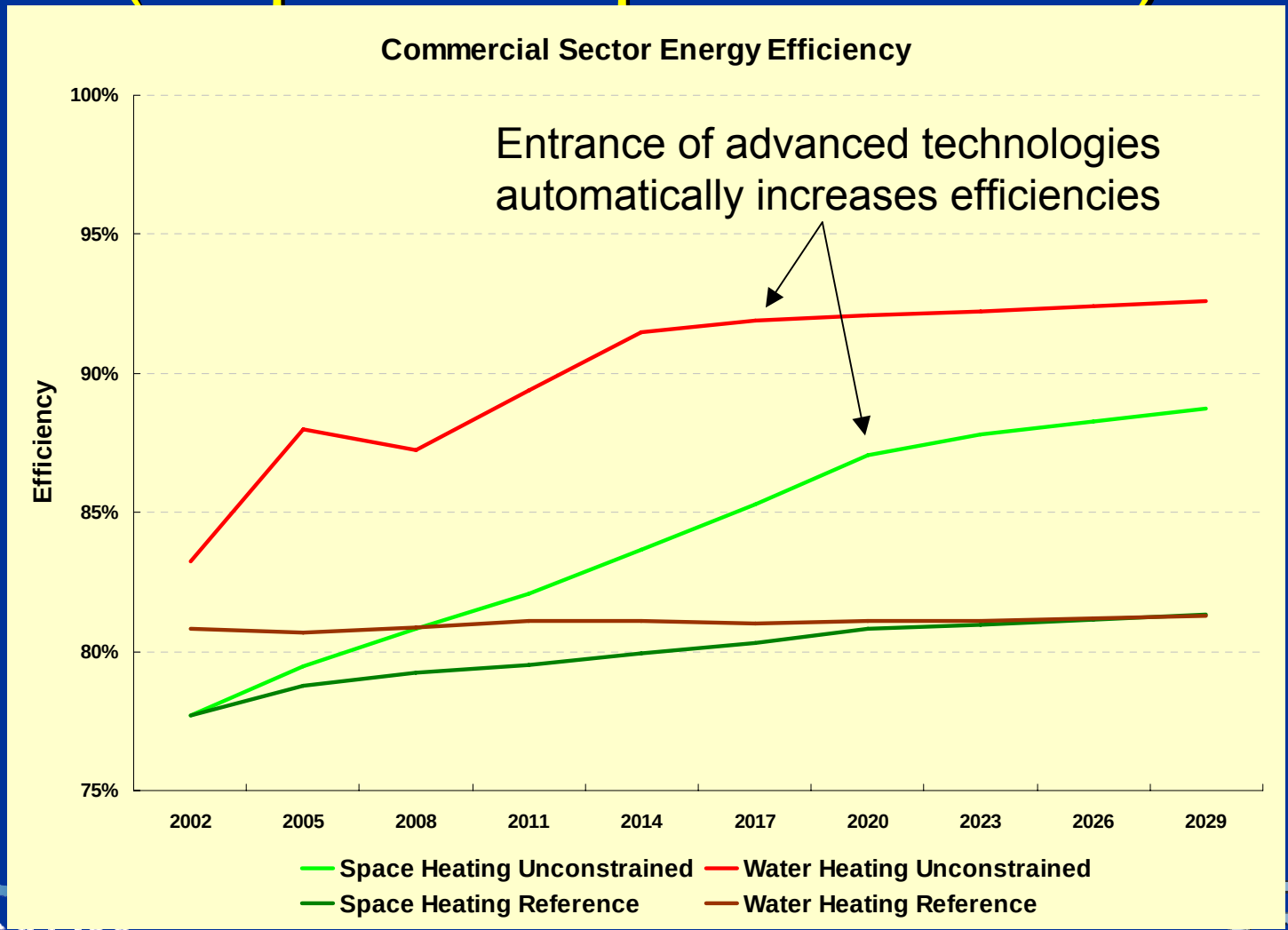
Renewable Generation with 20% RPS



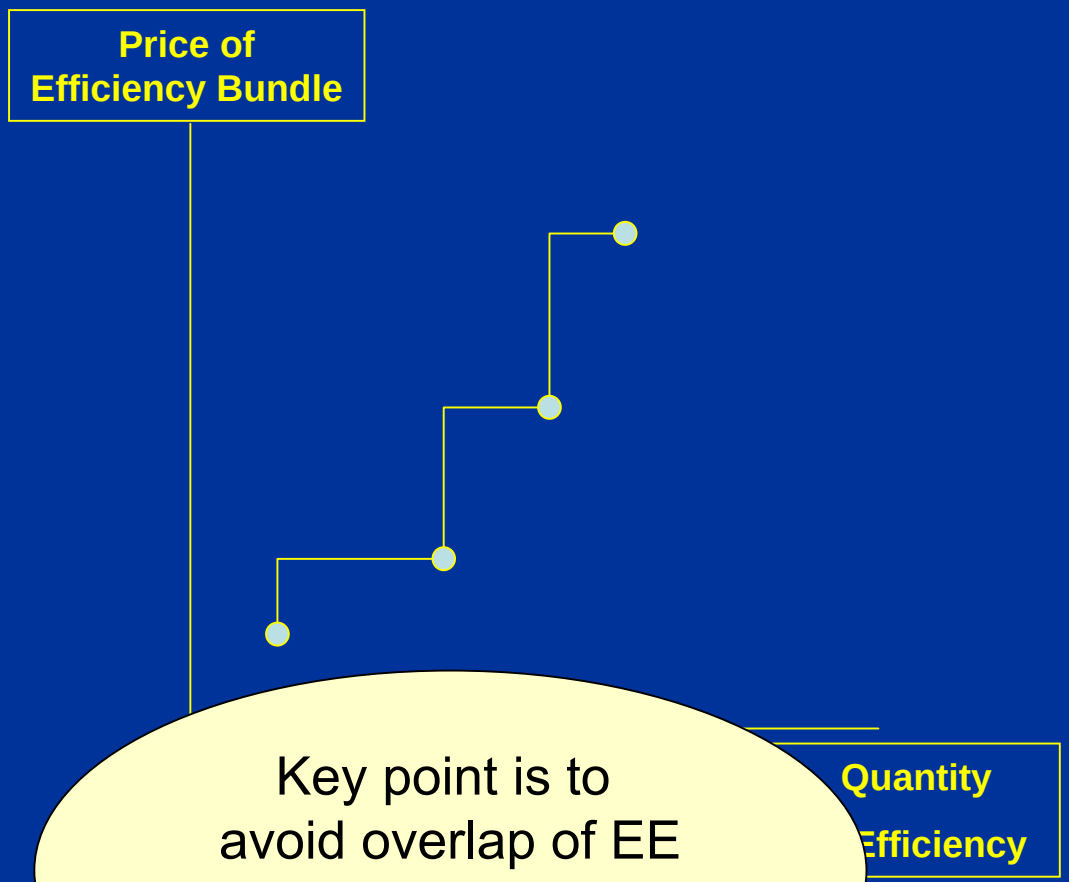
Examining Tradeoffs in the RES



Energy Efficiency in NE-MARKAL (Implicit Representation)



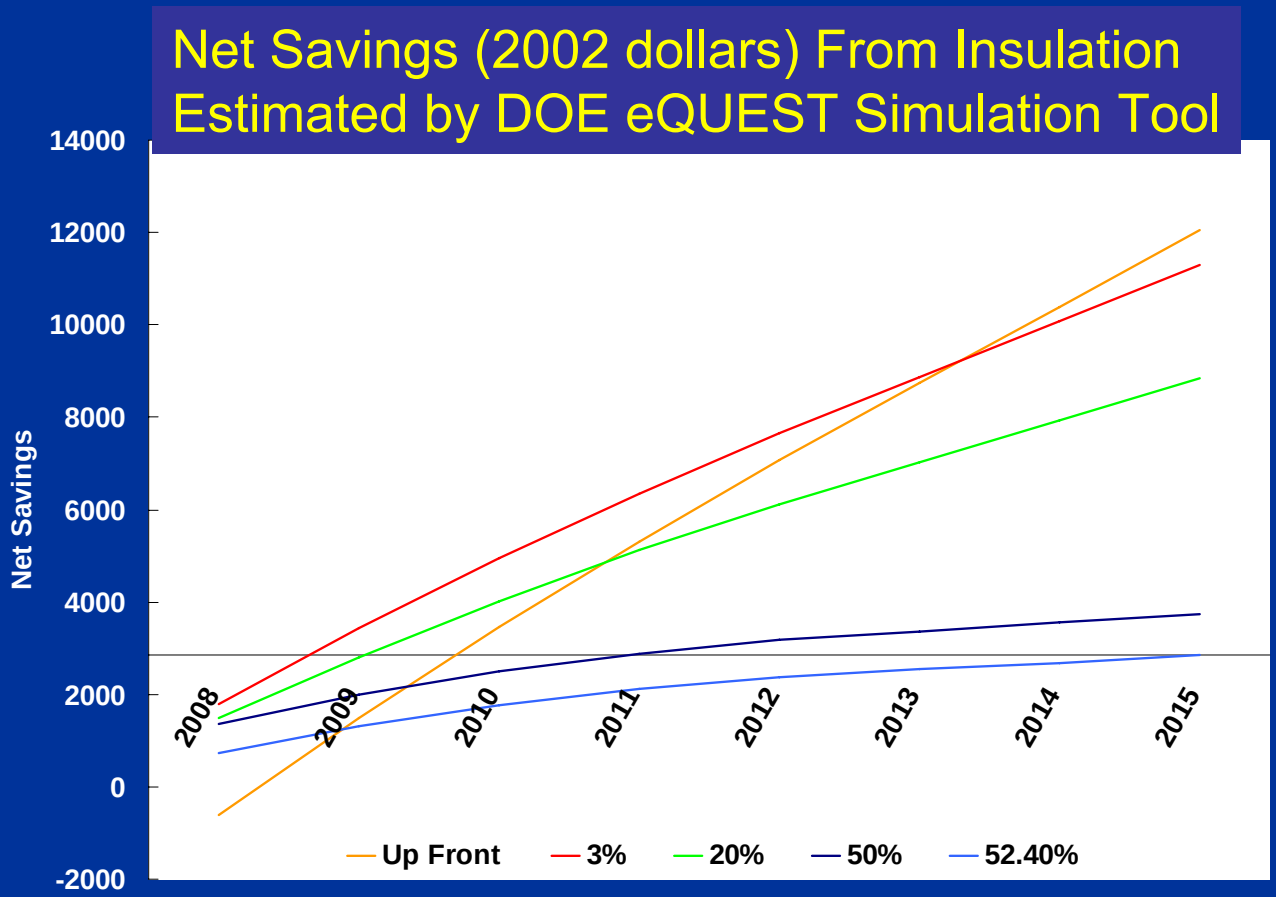
Energy Efficiency in NE-MARKAL (Explicit Representation)



- Points represent bundles of efficient technologies and practices and are modeled as distinct technologies in MARKAL.
- For Example:
  - Bundle 1
    - Smart Thermostats
    - Duct Sealing
  - Bundle 2
    - EE training programs for building managers
  - Bundle 3
    - Insulation / Shell Improvements
  - Bundle 4

Key point is to avoid overlap of EE bundles and implicit technologies

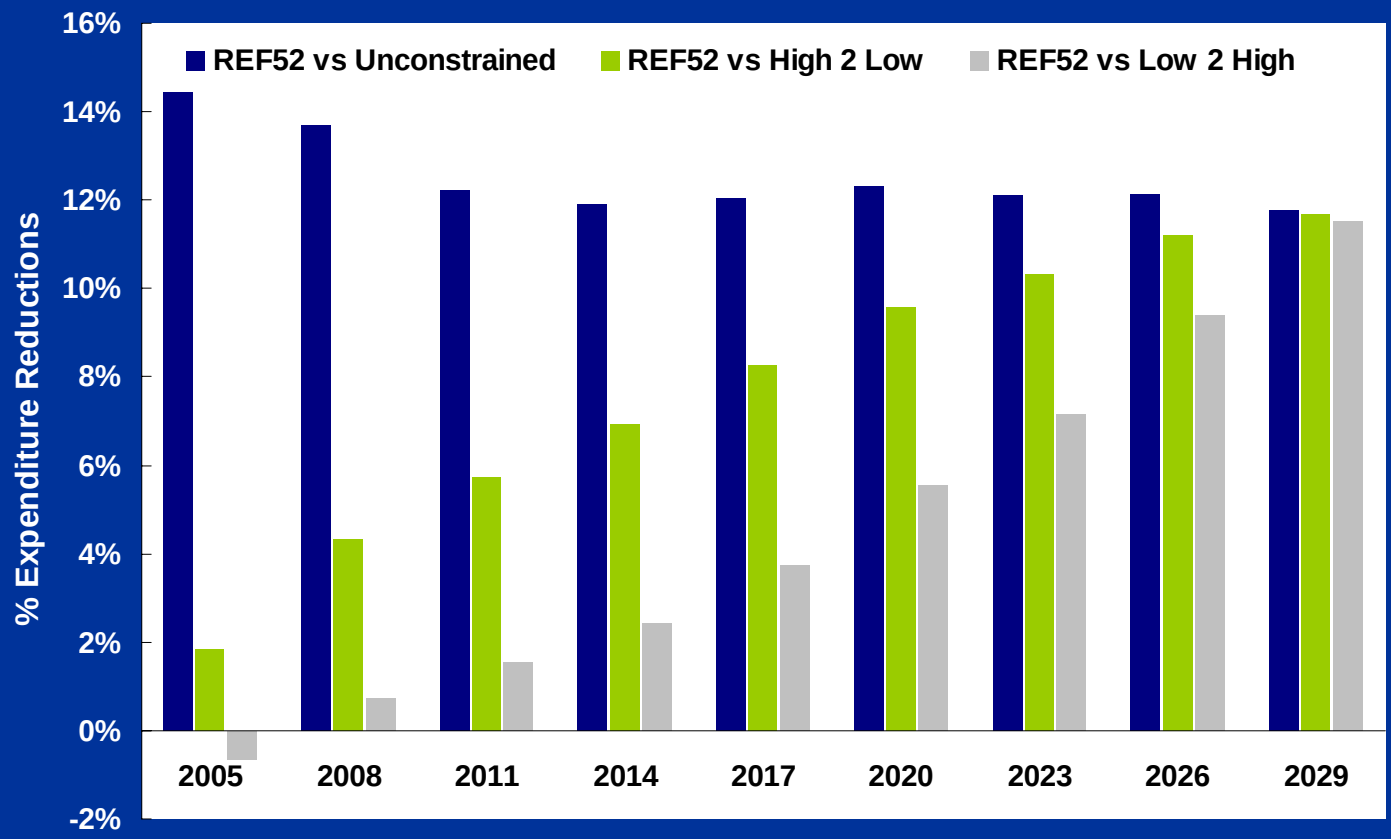
Residential Heating: Single House Insulation Economics



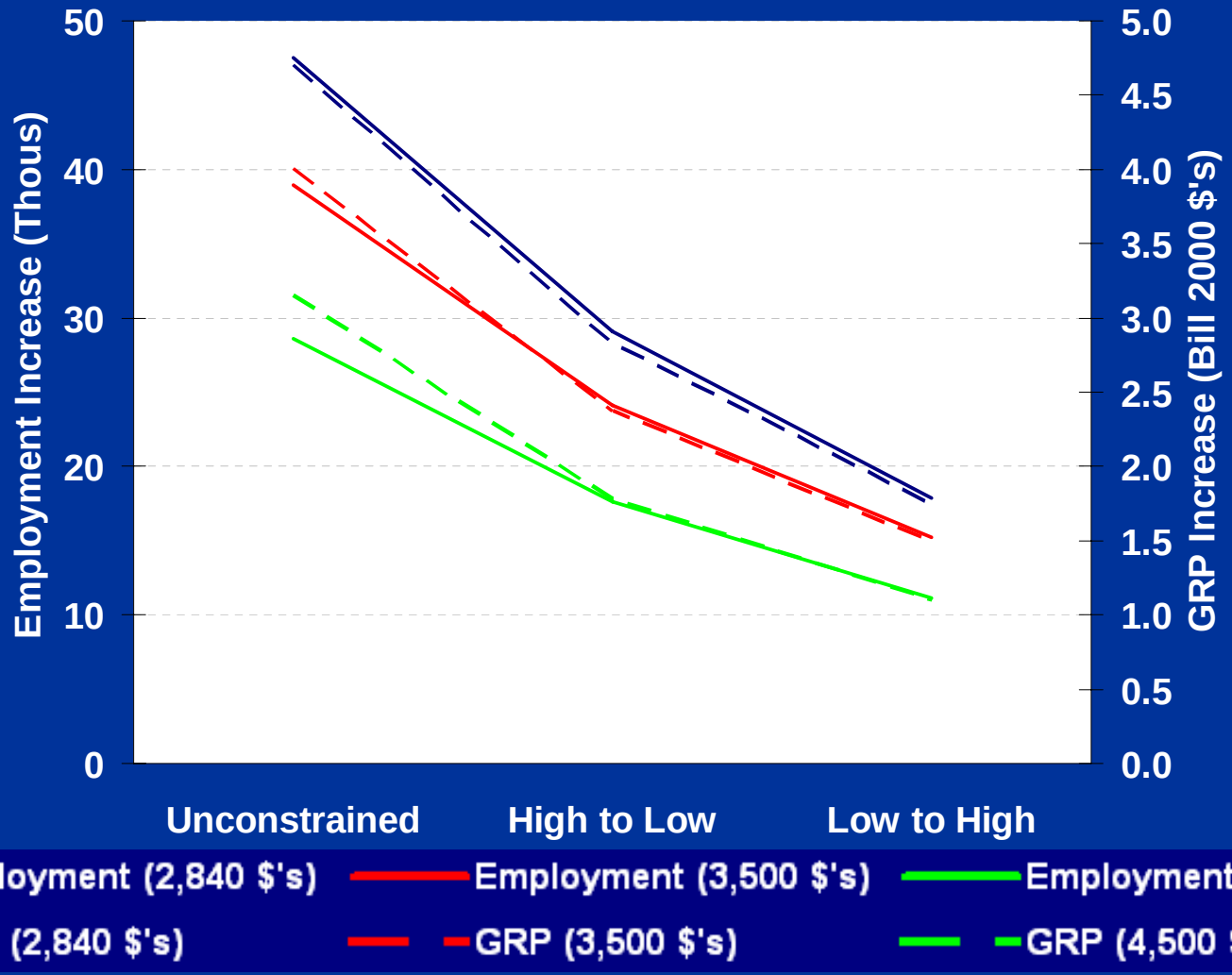
- 2500 Square feet single family house
- Using Oil Radiator
- South Central NH
- 2 Stories
  - Basement
  - Attic
- Initial base house had small amount of above ground insulation
- Insulated house upgraded to meet DOE recommended levels for NE.
- Insulation Cost $2,840
- Lines represent different interest rates assumptions for a 7 year loan program to pay for insulation.
  - 52.4% implicit discount rate

Residential Heating: Regional Insulation Economics (Direct Savings)

In the unconstrained case rapid investments in insulation up to the technical potential cause the residential heating sector to rapidly become much more efficient.



Residential Heating: Regional Insulation Economics (Indirect Benefits: Gross Regional Product, Employment)

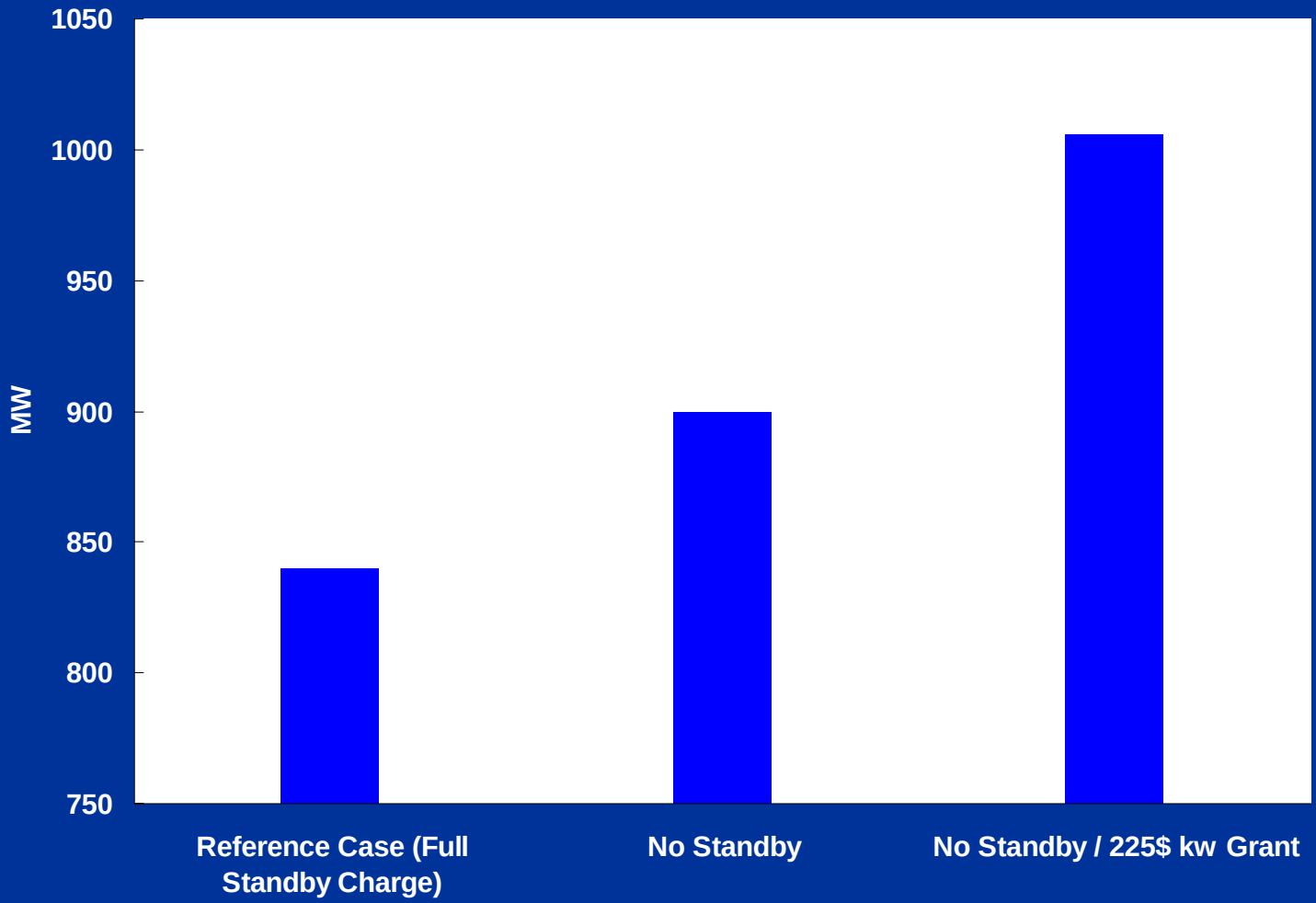


Combined Heat and Power

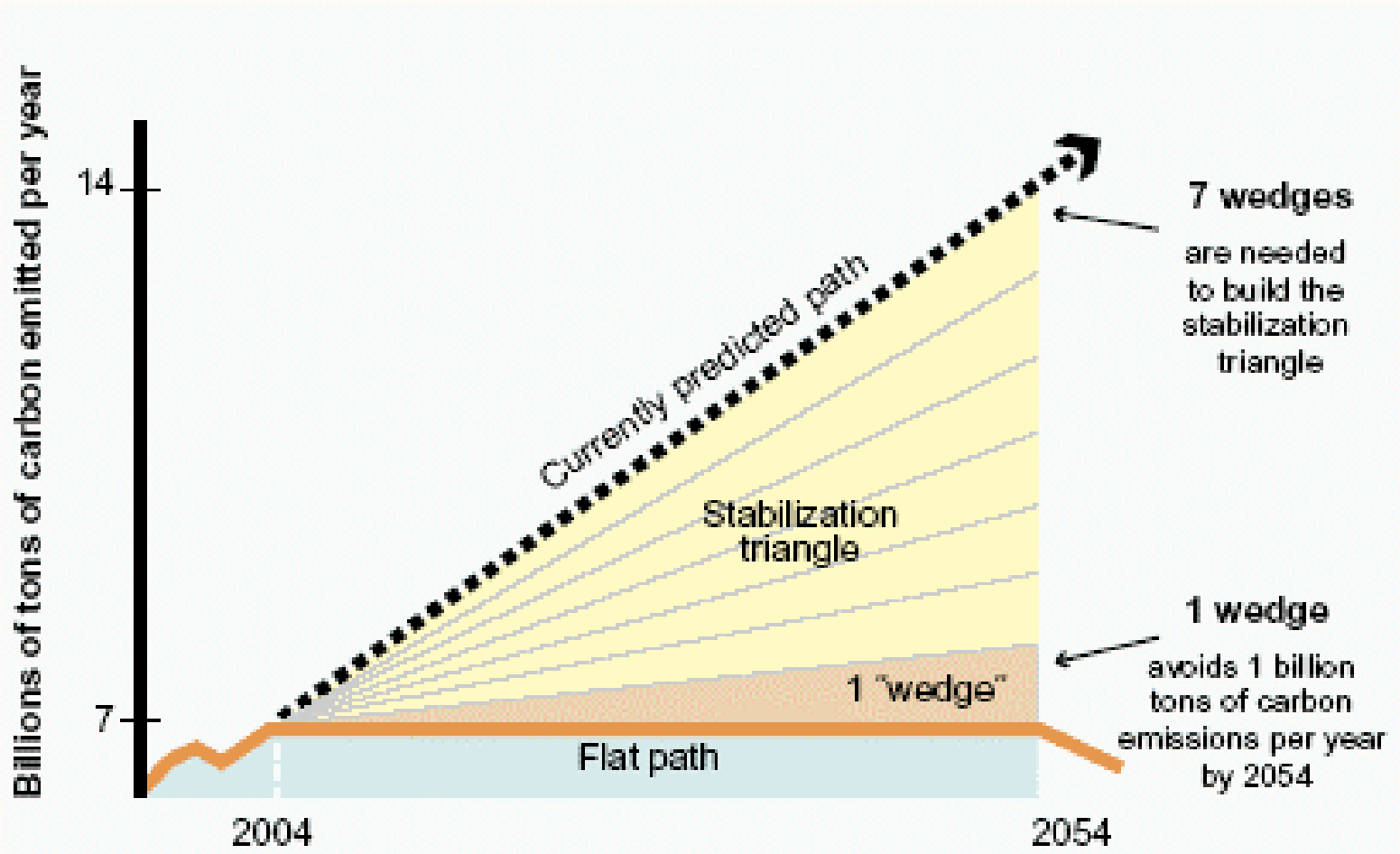
- Our study examined how CHP deployment in Massachusetts is affected by standby charges under 3 different scenarios.
  - Aggressive $C0_2$ cap on power sector
    - 30% of 2002 emissions by 2029
  - Increasing natural gas prices between 2008 and 2029
  - Power sector $C0_2$ cap & high natural gas prices

- We also highlight key changes in the energy infrastructure as CHP deployment changes.
  - Power sector fuel switching
  - CO_2 emission levels

Projected CHP Installed Capacity in MA (2005-2025)

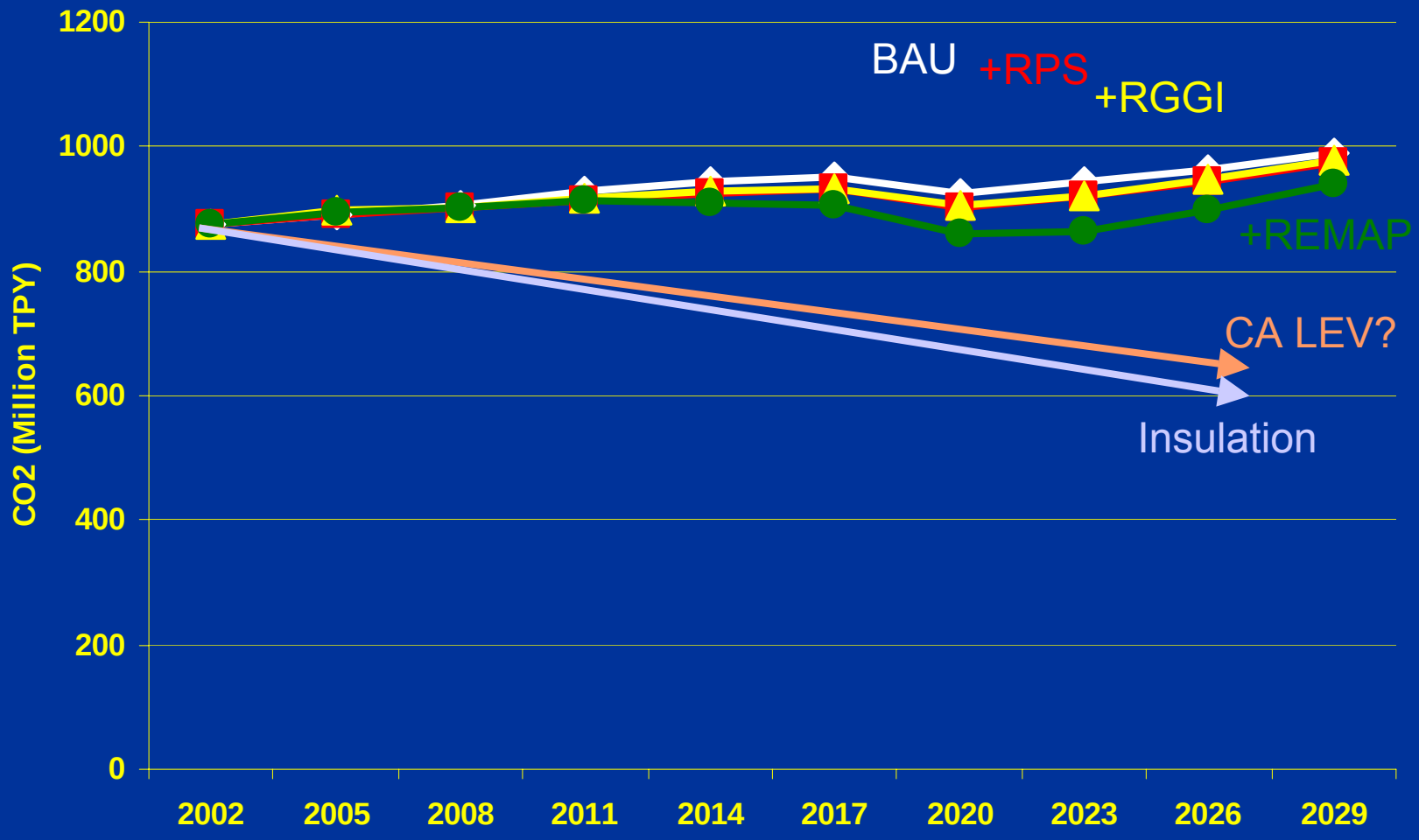


Implications for Climate Policy



Stabilization Wedges: Pacala and Socolow, Science, August 13, 2004

Regional Wedges



Typical Analysis Steps

- Review technology characterizations, emission factors, and other inputs
- Joint development of reference scenario; input assumptions and policy constraints appropriate to a particular study
- Initial focus on a couple specific measures
- This ultimately results in full description of a menu of options to meet multi-p needs

Implications

- Clear advantages to multi-pollutant planning (using climate motivation to achieve air and energy goals)
- Analytical framework to look at wide range of opportunities across sectors in regional context (i.e. interactions across pollutants/sectors)
- Need to better define state engagement for analytic support and coordination of policy approach that would allow MPAF to serve a role in future AQM plans

Data Wish list

- Actual Electricity Trade in 2002, 2005
- Capacity transfer limits MD, DE, DC
- Emission factors for HD vehicles/Buses
- Major mercury source emission factors
- Policy assumptions and criteria pollutant constraints for reference scenario
- Data for aircraft, marine, rail sources if target of analysis

Thank You!