Weighing the Costs and Benefits of State Renewables Portfolio Standards:

A Comparative Analysis of State-Level Policy Impact Projections

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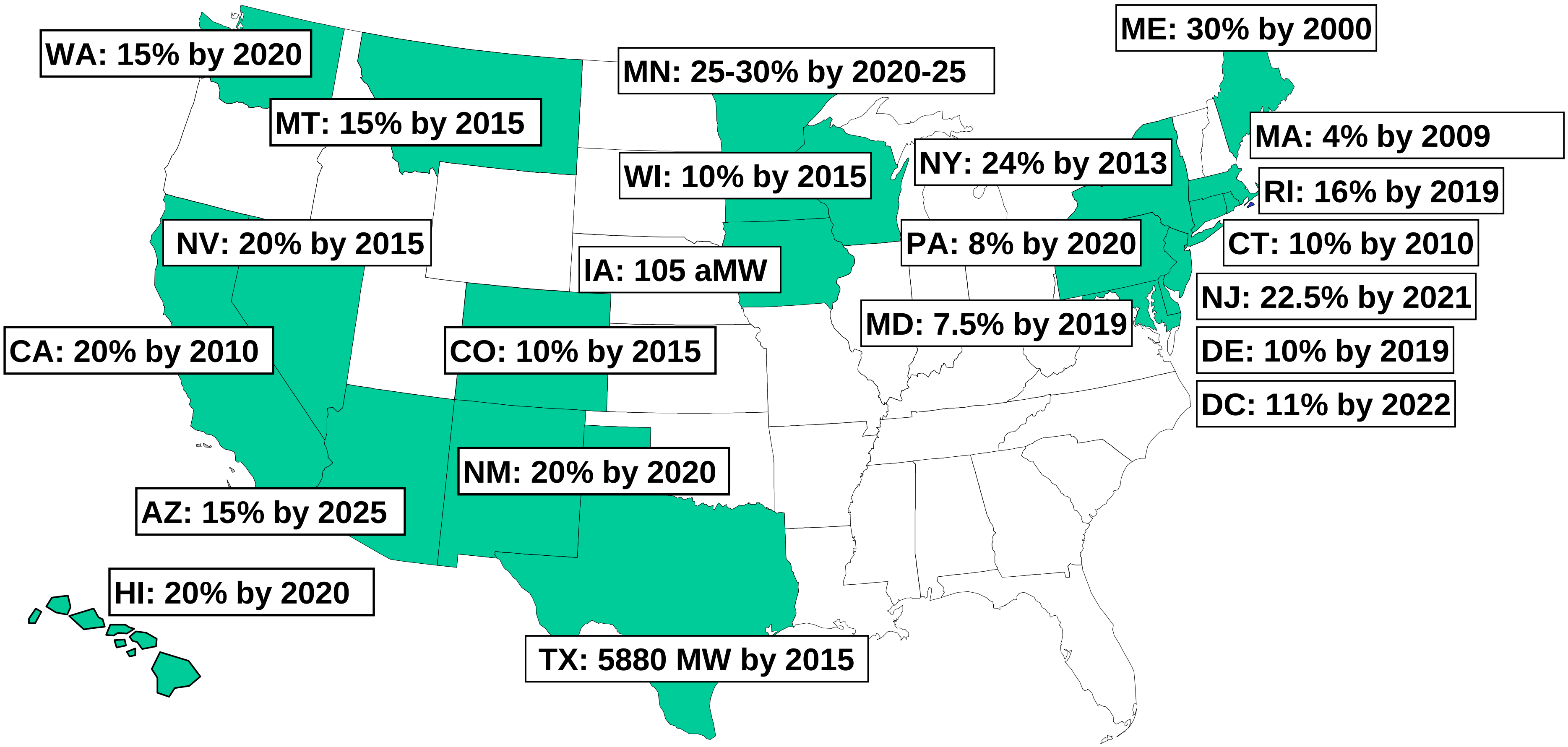
Presentation Overview

1. Project Motivation and Scope
2. Projected Renewable Resource Impacts
3. Projected Impact on Electricity Costs
4. Scenario Analysis Results
5. Projected Public Benefits
6. Cost Study Methodologies and Assumptions
7. Conclusions and Areas for Improvement

State RPS Policies and Purchase Mandates: 21 States and D.C.



Project Objectives

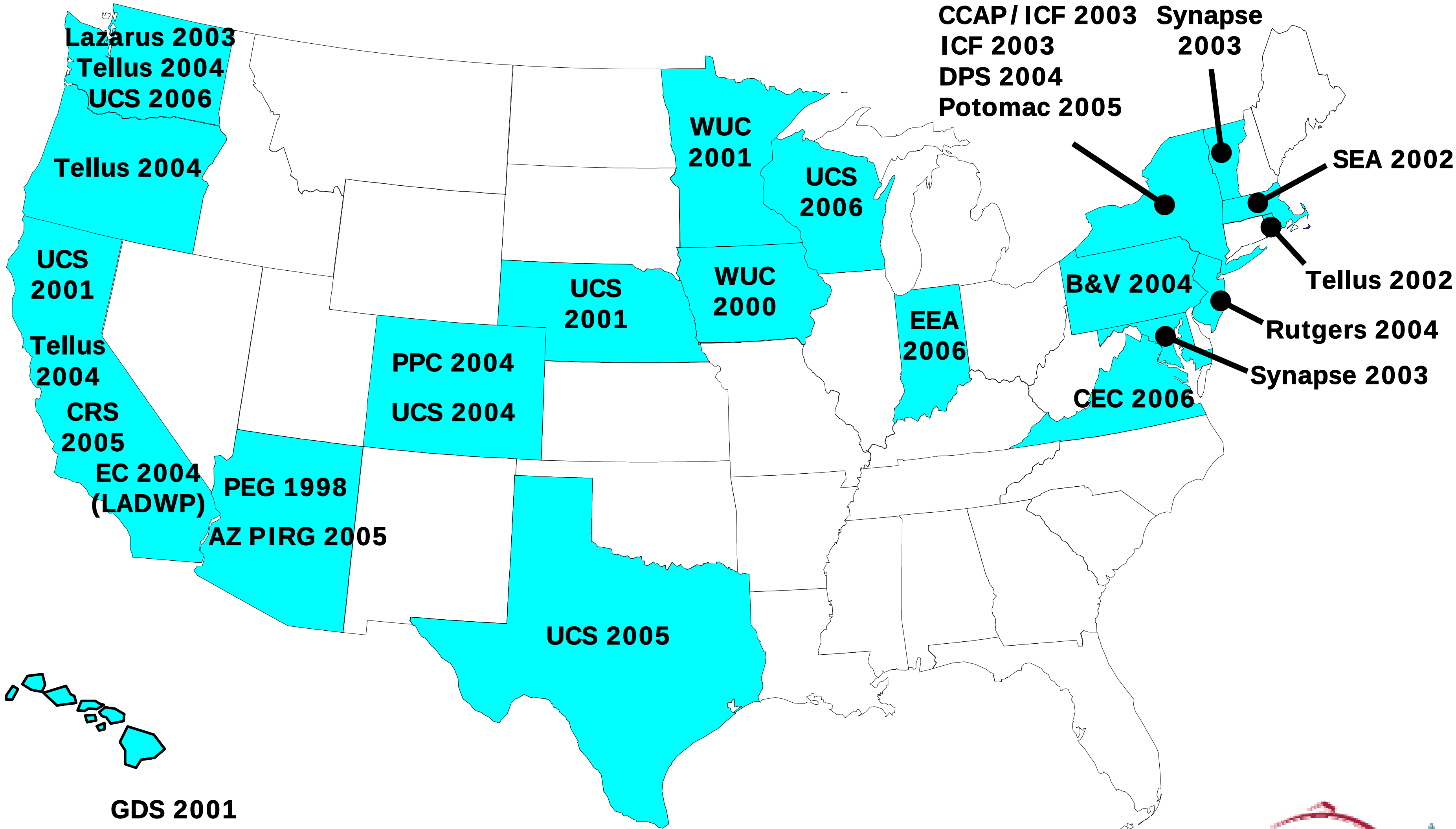
- **Background:** State RPS policies have become major drivers of renewable energy additions, but the adoption of new state RPS policies hinges on expected costs and benefits

- **Objective:** We review previous state RPS cost-benefit *projections* to compare forecasted impacts across studies, and provide methodological guidance for future state RPS cost-benefit projections

Project Overview

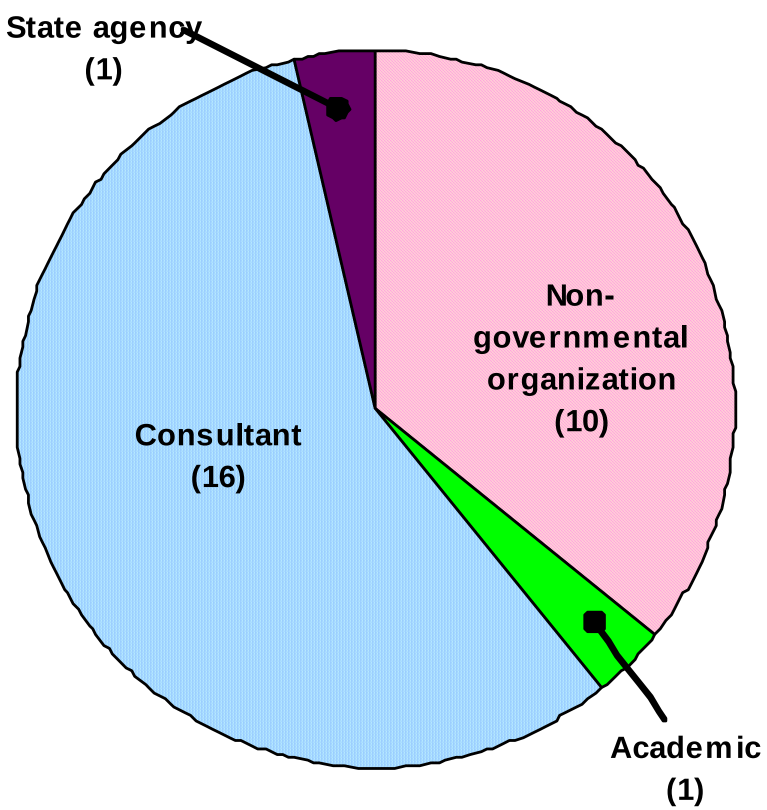
- **Project scope**
  - Survey of 28 state RPS cost impact projections in 18 states
  - Sample includes state and utility-level (not federal) analyses in the U.S.
  - Studies present <u>projected</u> (not actual) costs and benefits
- **Comparison of key results**
  - Direct or inferred projected retail rate impacts
  - Projected renewable deployment by technology
  - Scenario analysis; secondary cost impacts; and benefits
  - All results presented here are taken from the first year that each RPS hits its ultimate target level (e.g. 2013 for New York, 2010 for California)
- **Comparison of study methodologies**
  - Modeling approaches; cost characterizations; and key assumptions

State RPS Cost-Impact Study Sample: Who, When, and Where?



Author and Funding Entity Type

Author Type



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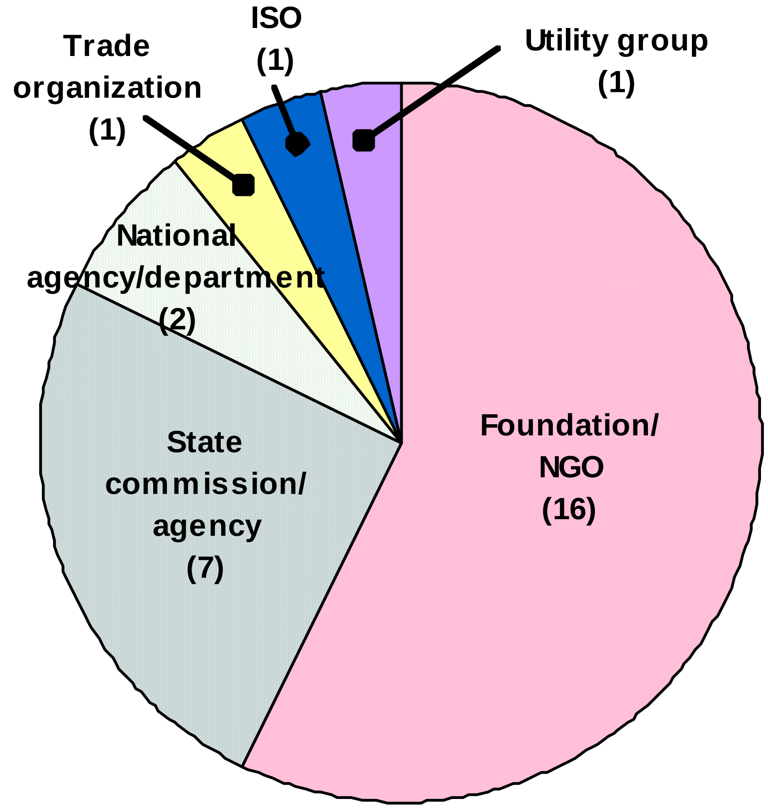
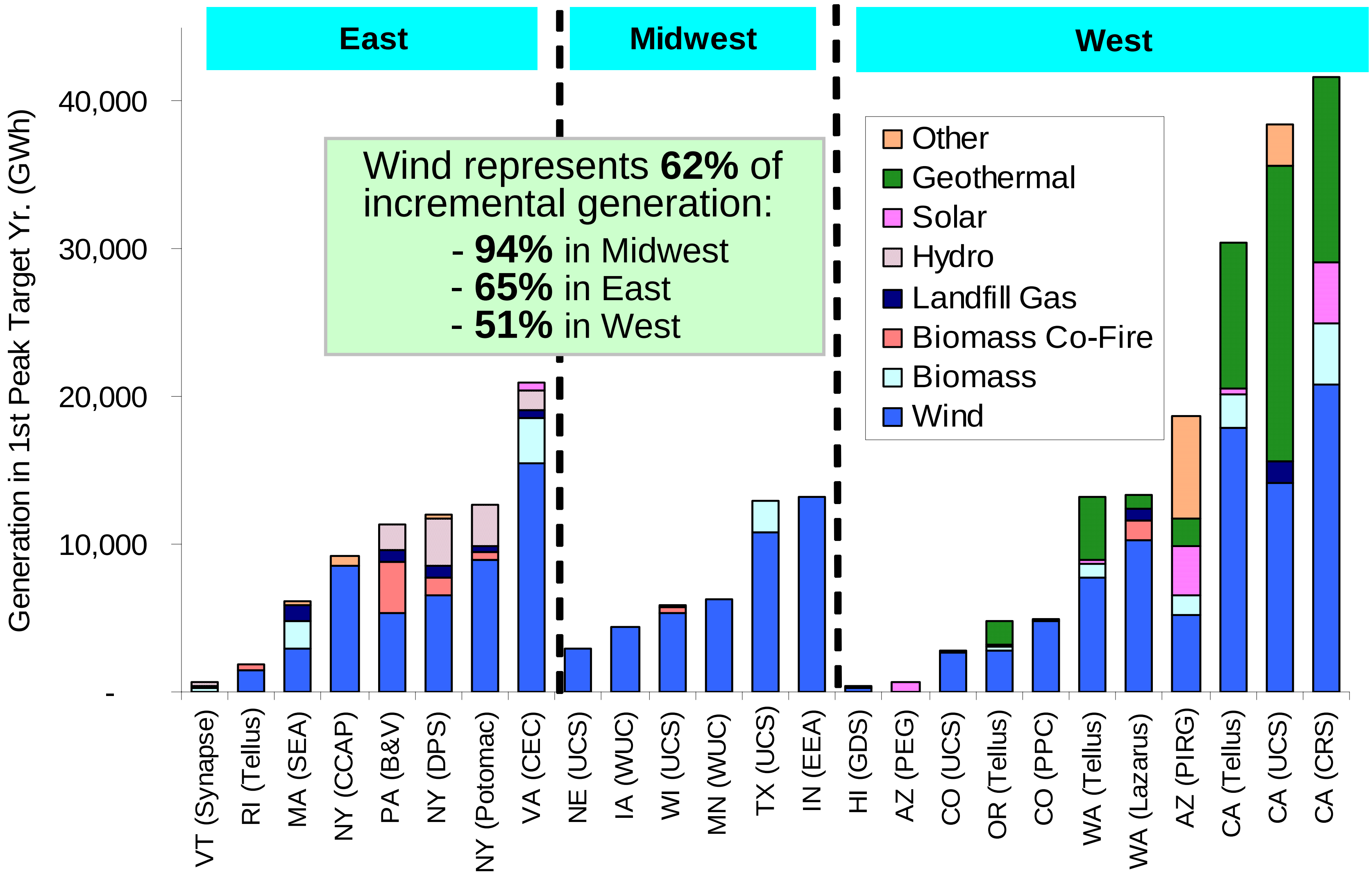
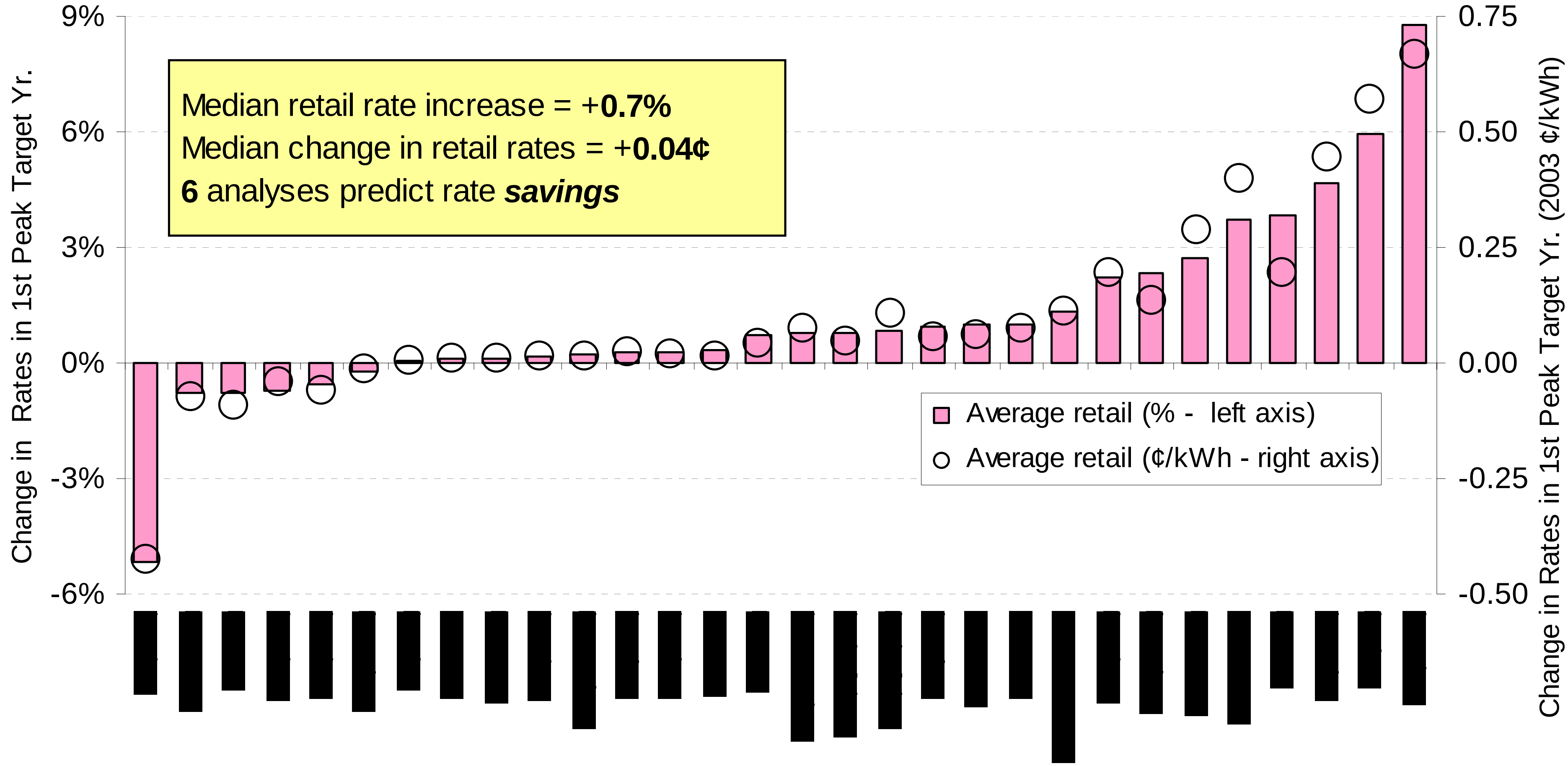


Wind Expected to Fare Well, but Not to Dominate in All Regions

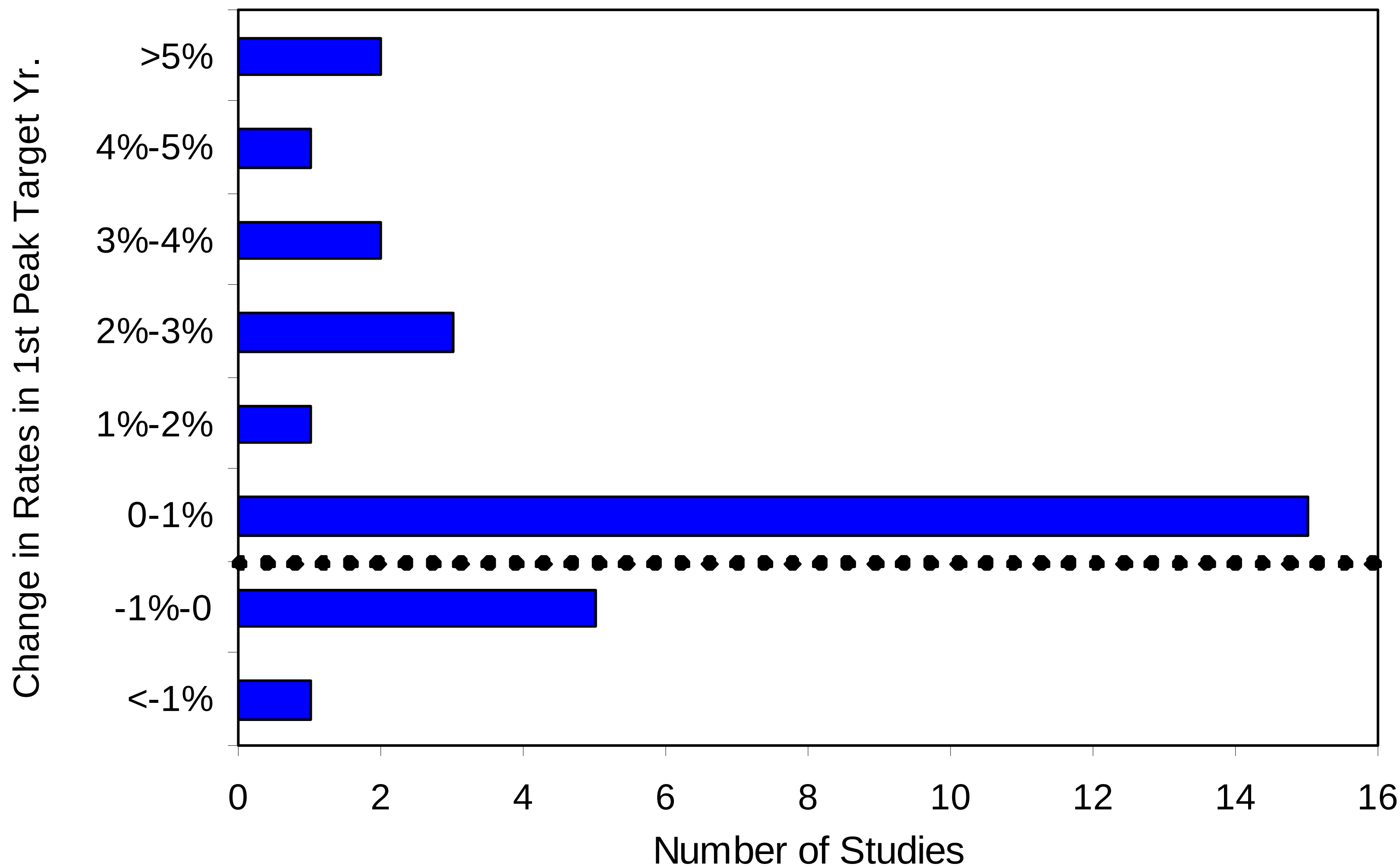


21 of 30* State RPS Analyses Predict Rate Increases of Less Than or Equal to 1%

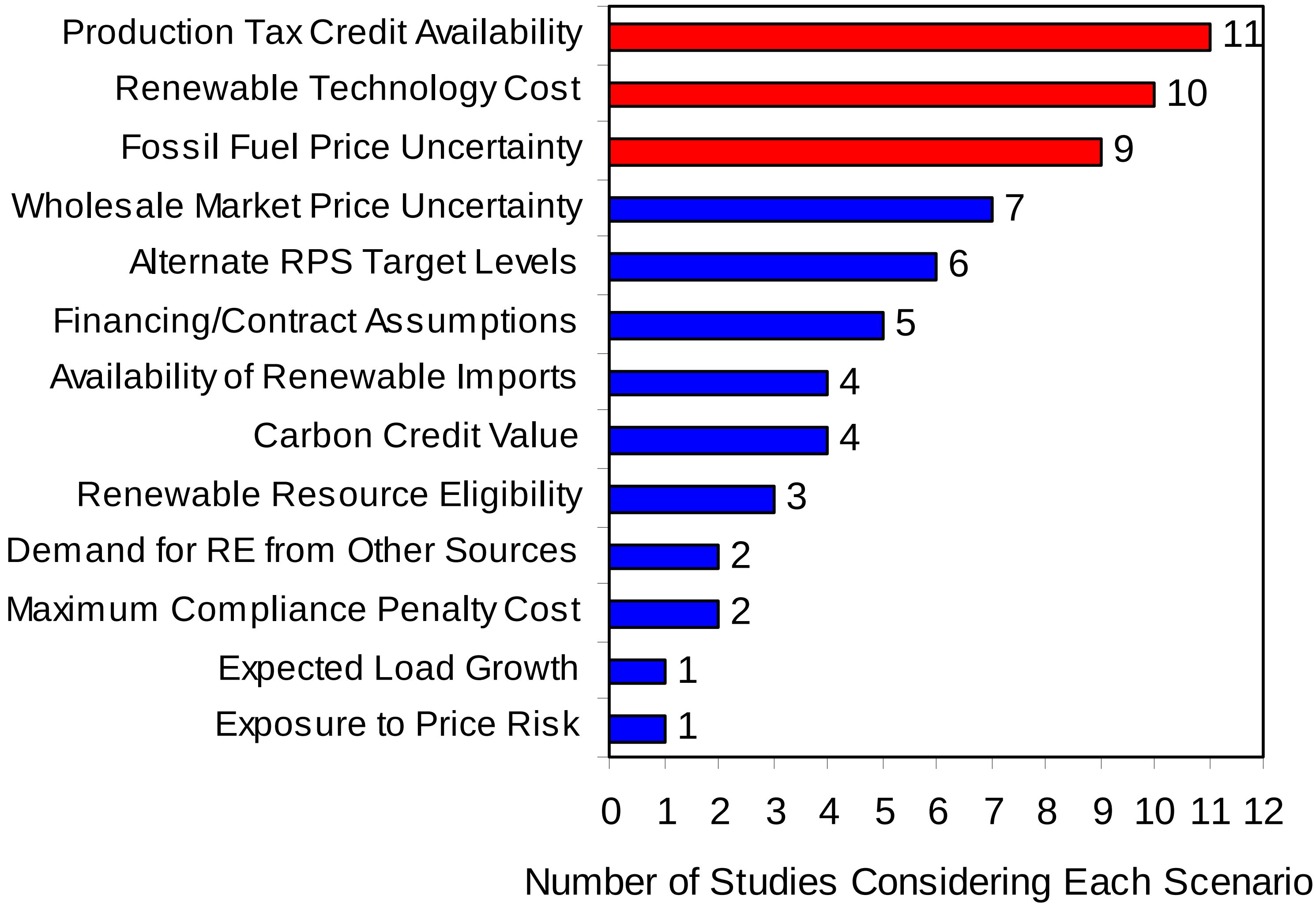


** Number of analyses is more than 28 because results for each state in CA/OR/WA (Tellus) are shown separately*

Estimated Cost of State RPS Policies is Typically Modest, But Varies Considerably by Study

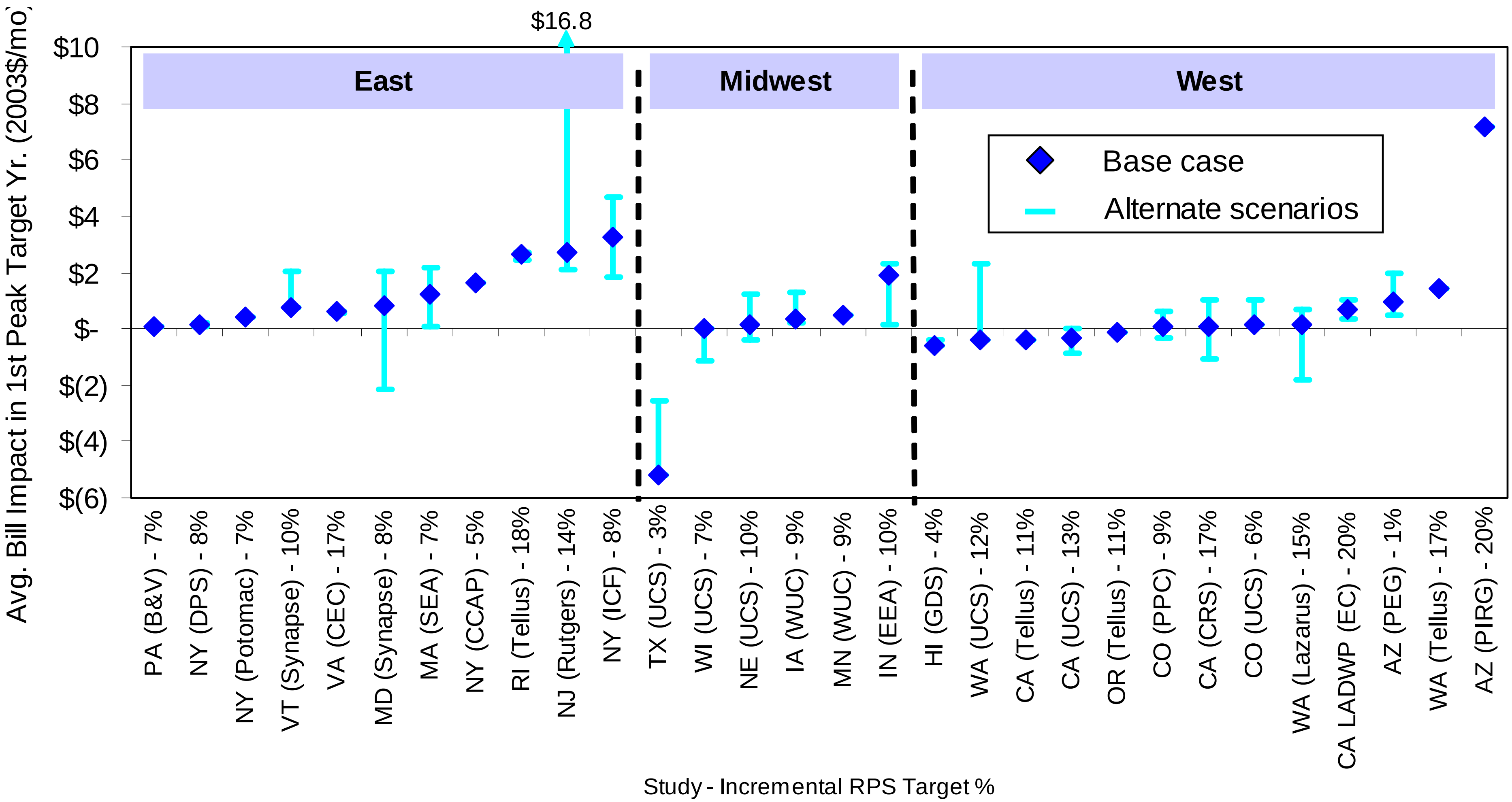


Scenario Analysis Is Often Used to Bound the Possible Impacts

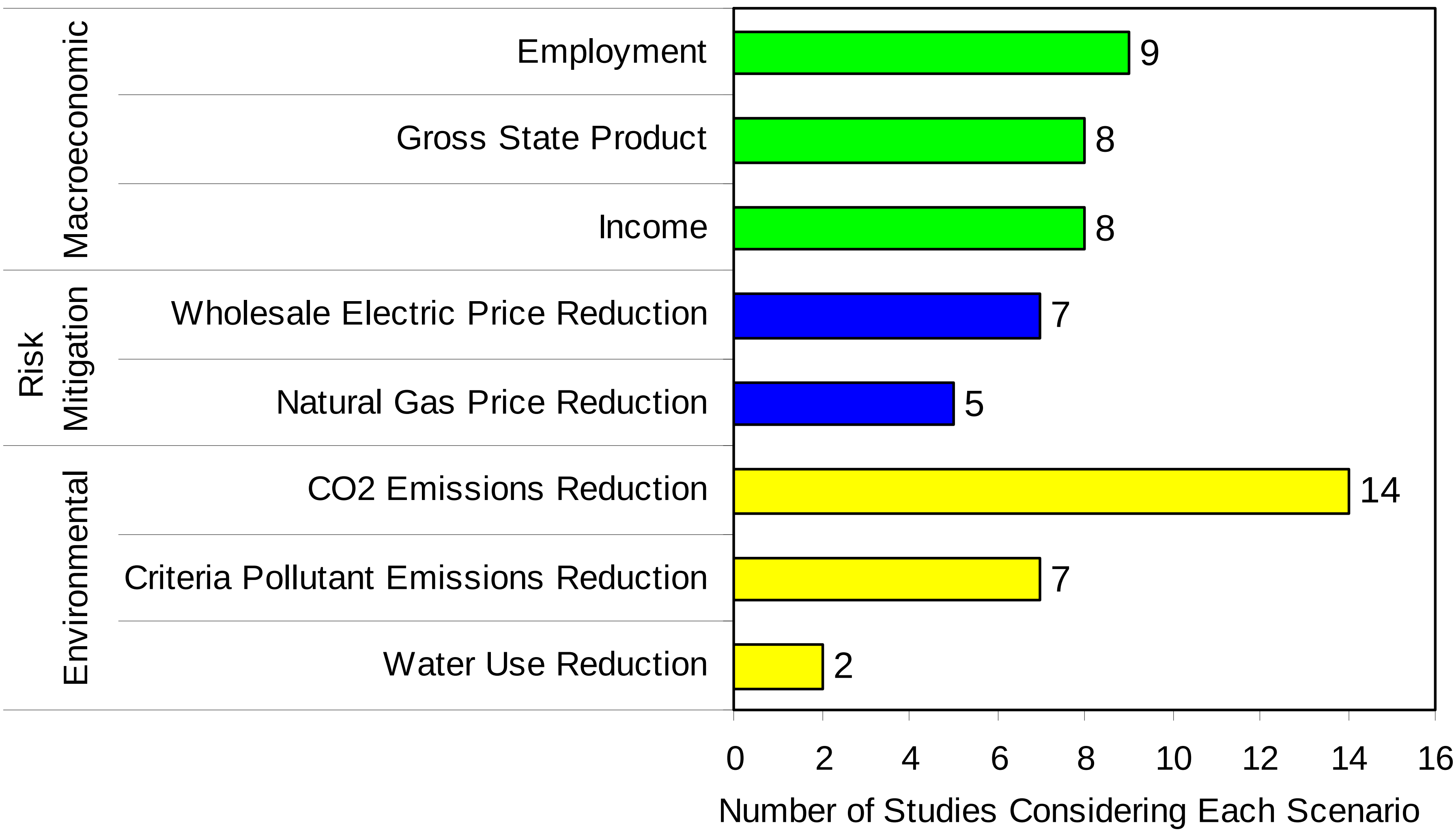


Projected Residential Electricity Bill Impacts are Lowest in Midwest and West

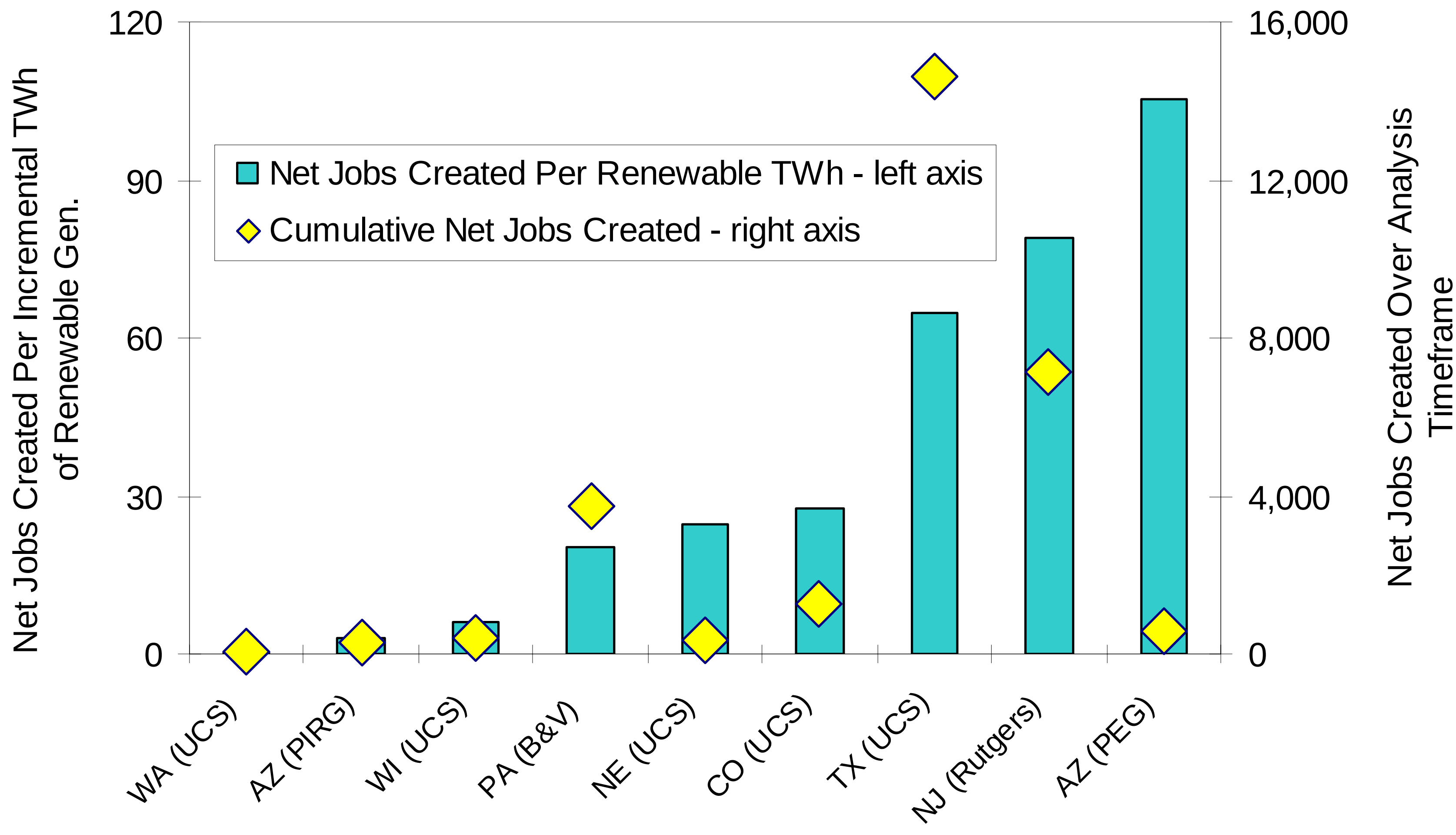
Error Bars Show Range of Results Under Scenario Analysis



Many State RPS Studies Evaluate Potential Public Benefits

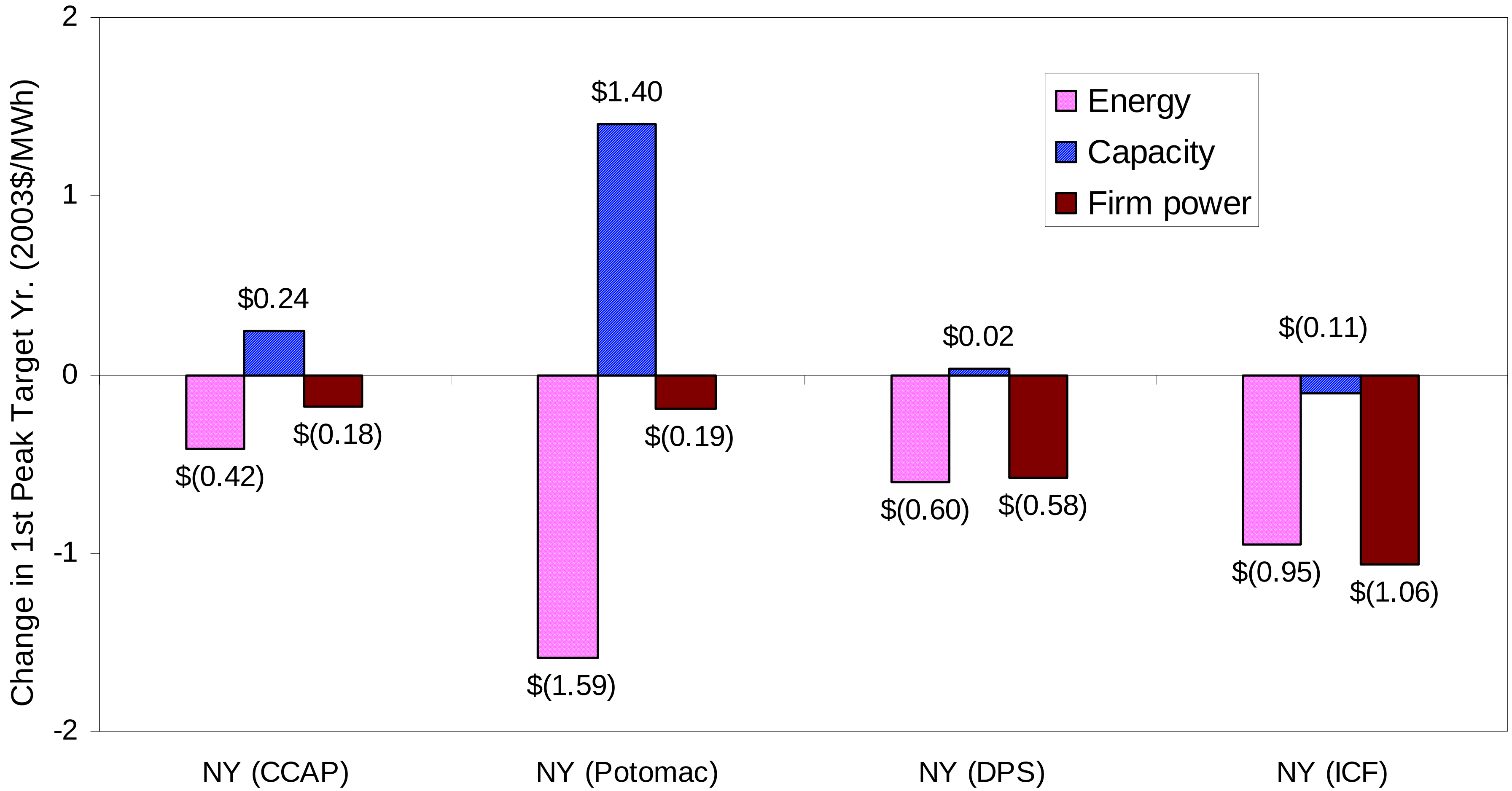


Studies Predict Varying Levels of Employment Gains, Using Widely Ranging Methods/Assumptions



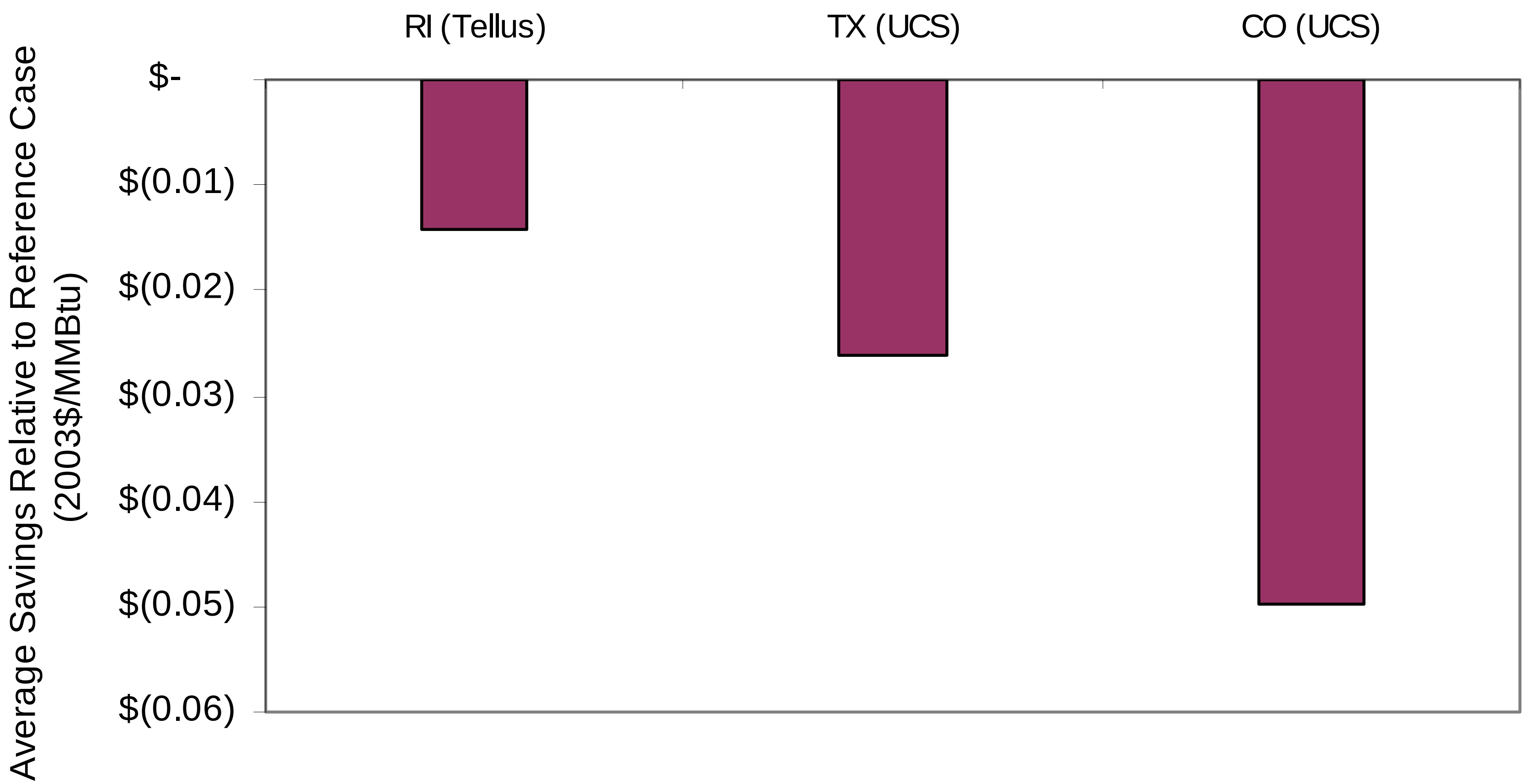
See full report for details and caveats associated with figure

State RPS May Put Downward Pressure on Market Prices, But Impacts Not Well Understood



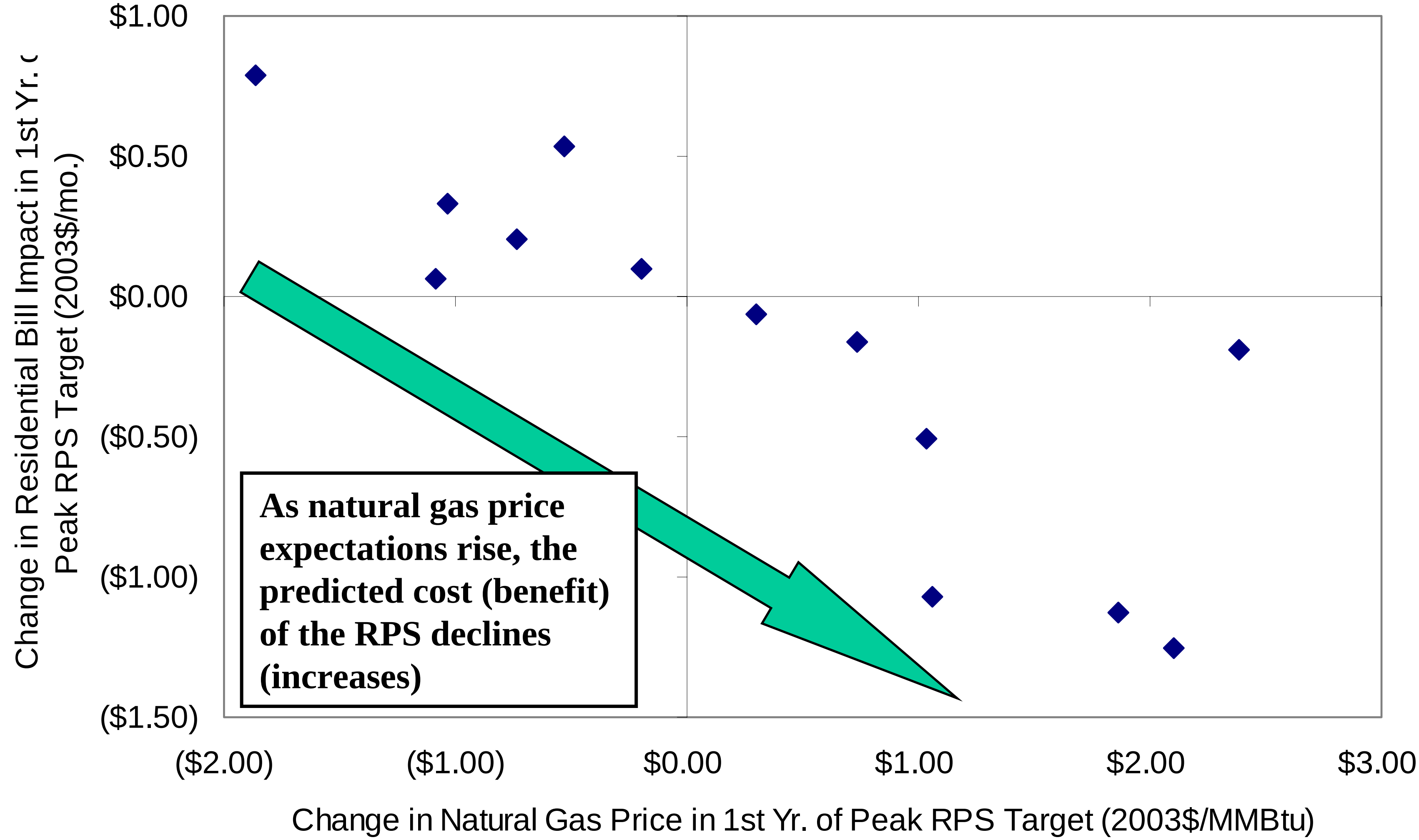
Note: CO (UCS), RI (Tellus), and TX (UCS) also model wholesale price reductions but do not provide detailed data

State RPS May Put Downward Pressure on Natural Gas Prices

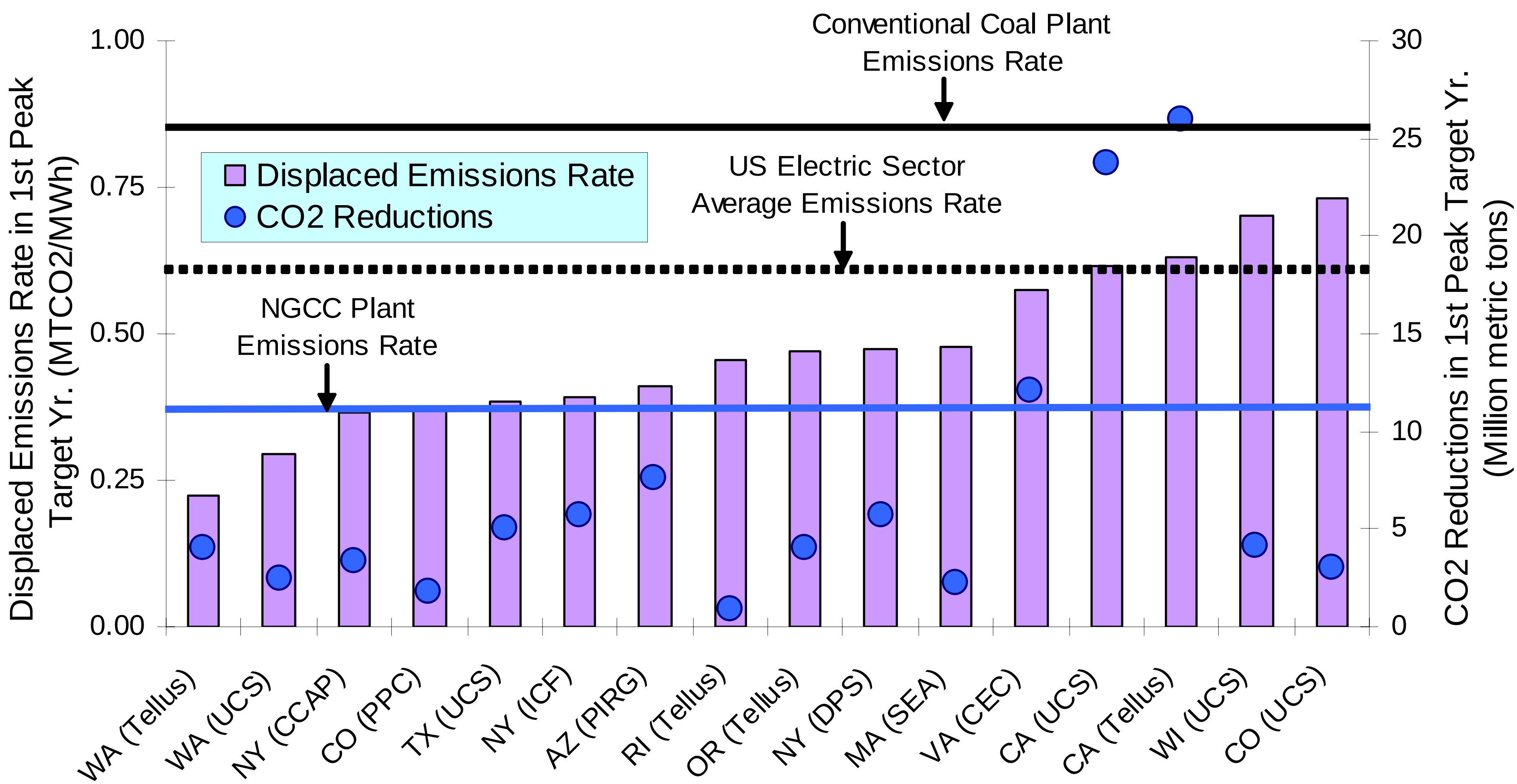


Note: NY (CCAP) and NY (ICF) also model NG price reductions but do not provide detailed data

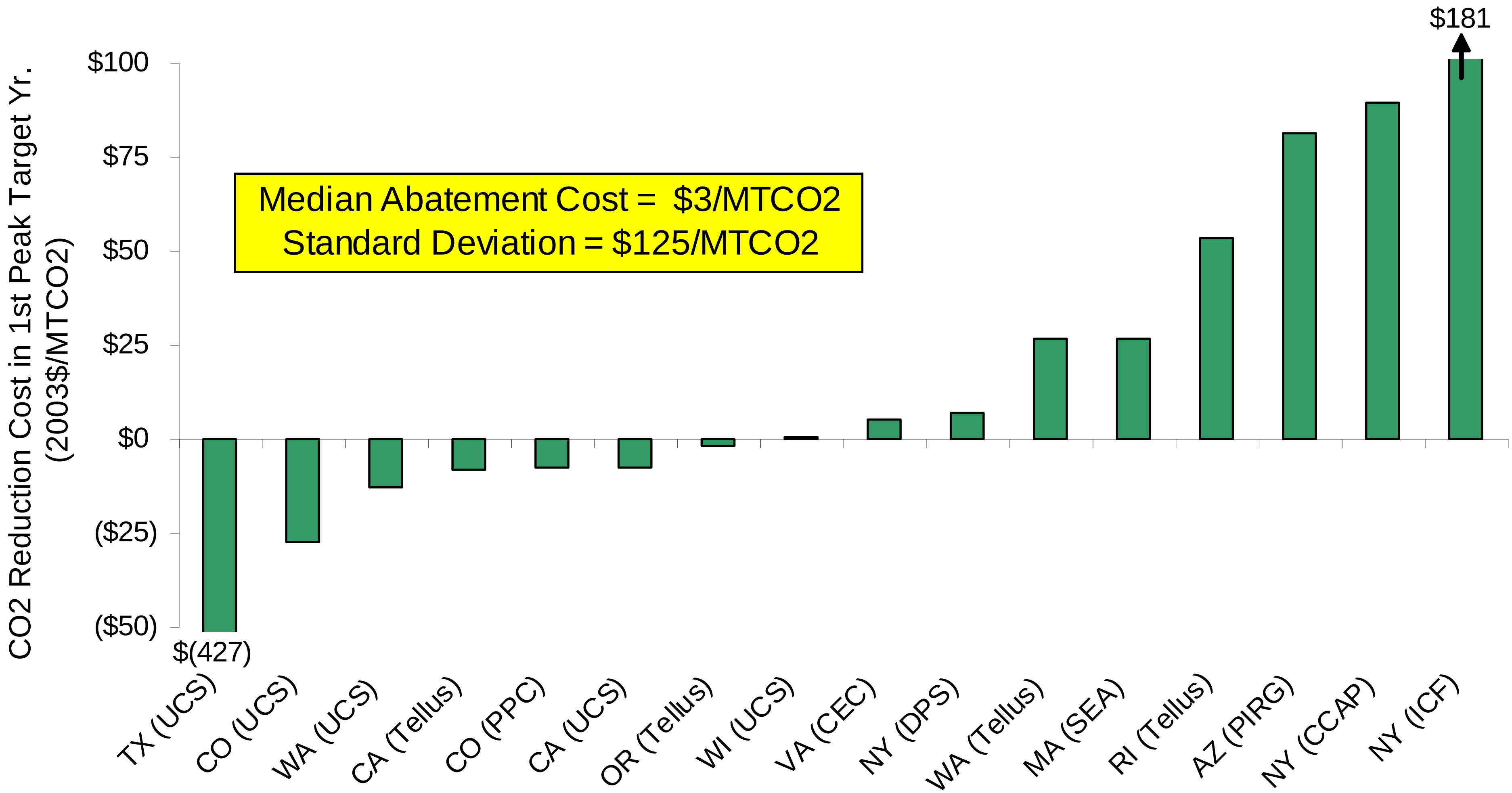
Renewable Energy As a Hedge Against Natural Gas Price Risk: Sensitivity Analysis Results



State RPS Policies Are Estimated to Displace CO2 Emissions Primarily from Natural Gas Plants



Implied CO2 Abatement Costs Vary Widely

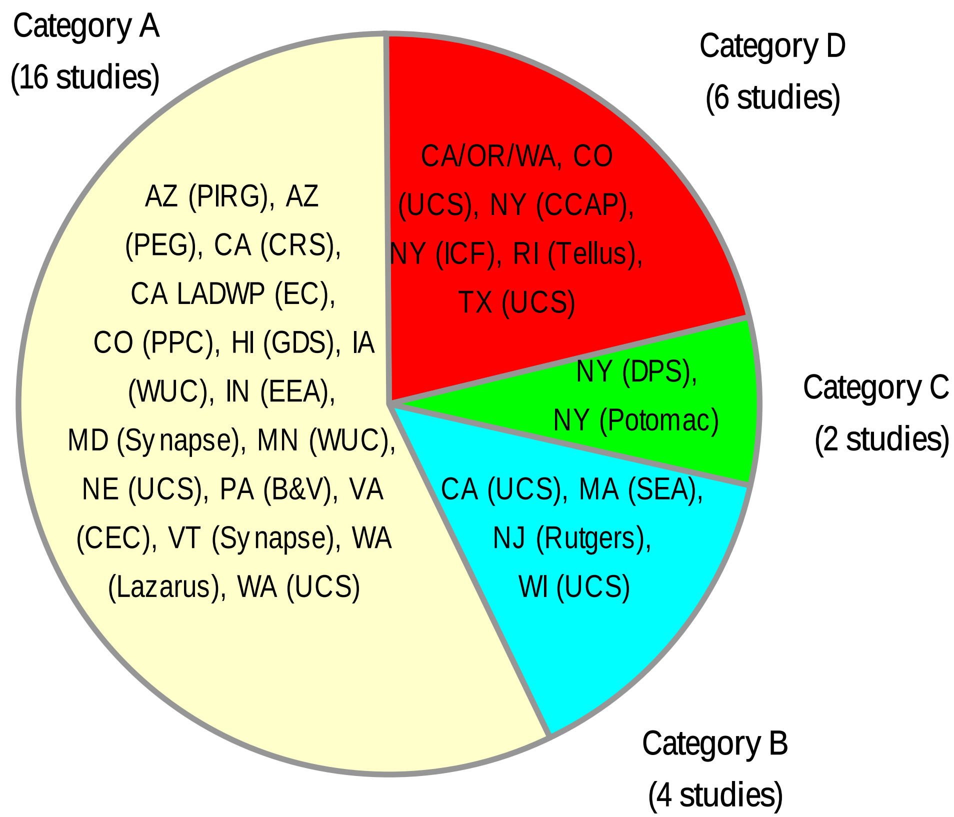


63% of the studies imply abatement costs of less than $10/metric ton

Four General Modeling Approaches Have Been Used

Four broad categories:

- **Category A:** Linear spreadsheet model of both RE + avoided utility cost
- **Category B:** Linear spreadsheet model of RE + generation dispatch model of avoided utility cost with base-case resource mix
- **Category C:** Linear spreadsheet model of RE + generation dispatch model of avoided utility cost with implied RPS mix
- **Category D:** Integrated energy model



Assumptions Matter More than the Selection of the Model

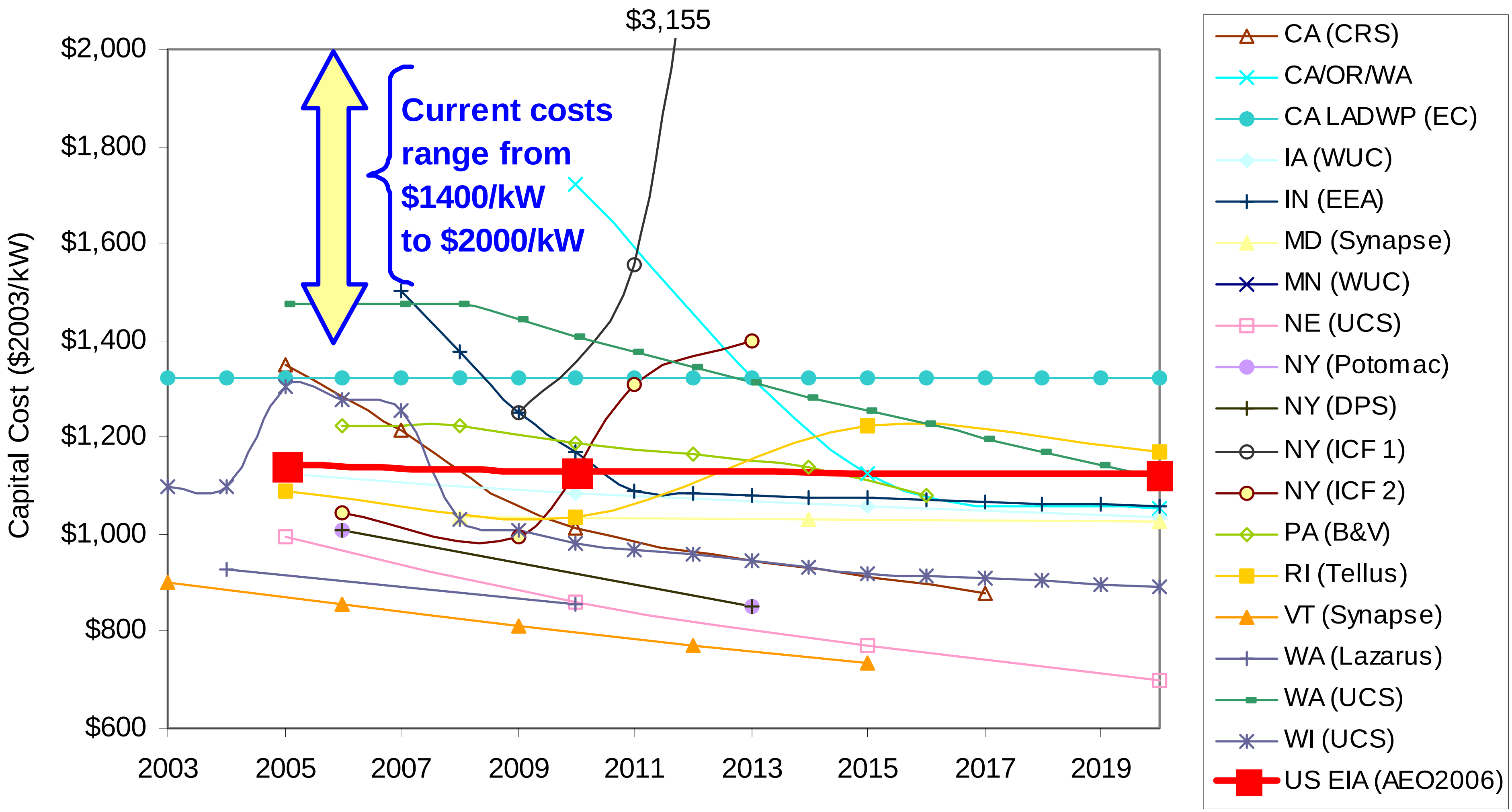
UNDER-ESTIMATION OF COSTS

- Wind capital cost assumptions appear low in many cases
- Transmission/integration costs not always considered fully
- Lack of consideration of RE demand from other sources
- Increased likelihood that RE displaces coal, not gas, not considered fully
- Expectations in some cases of long-term PTC availability

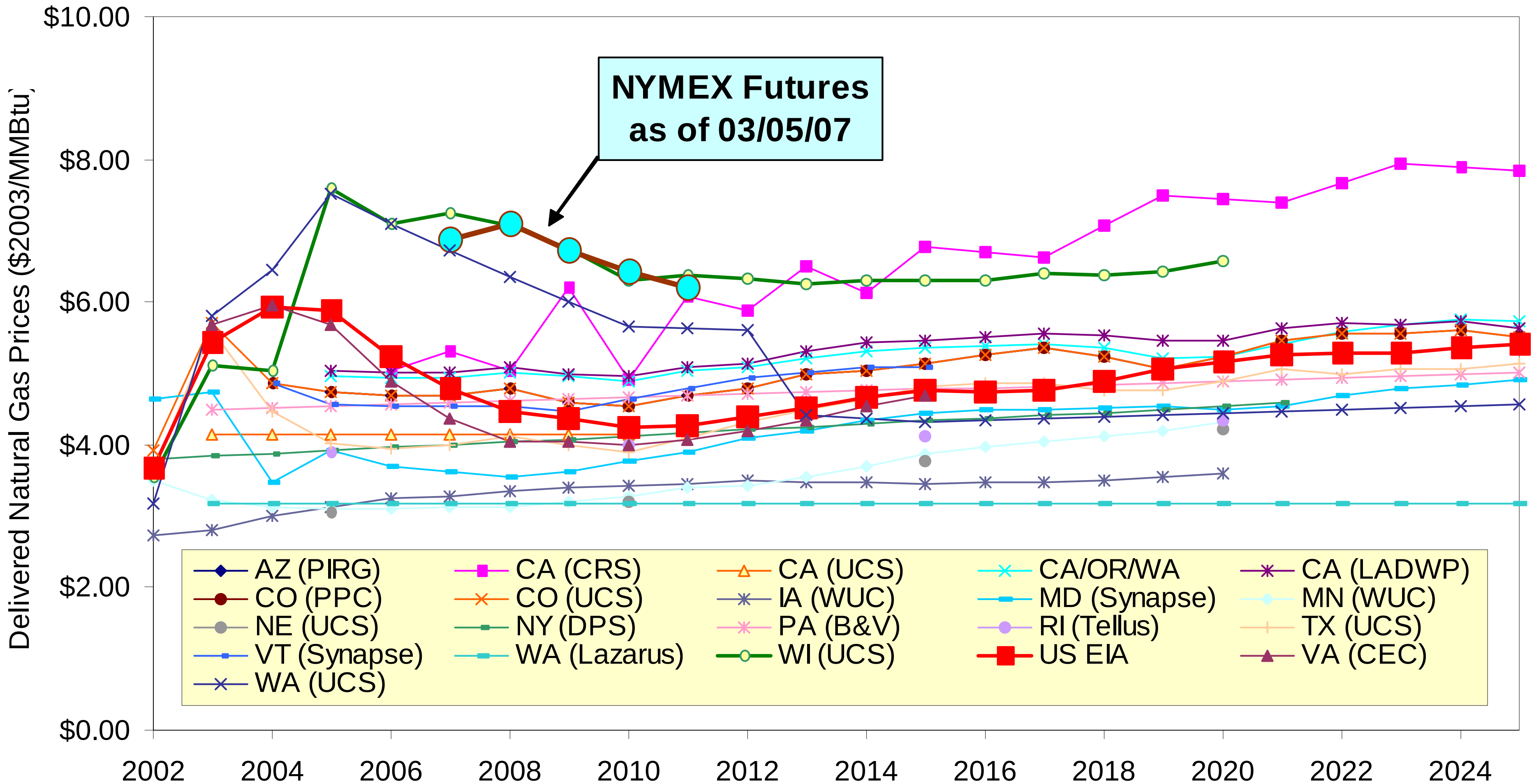
OVER-ESTIMATION OF COSTS

- Reliance on natural gas price forecasts that appear too low
- Secondary electric and gas price impacts ignored in many cases
- Potential for future carbon regulations often not considered
- Expectations in many cases that PTC will be extended for a very limited period, or not at all

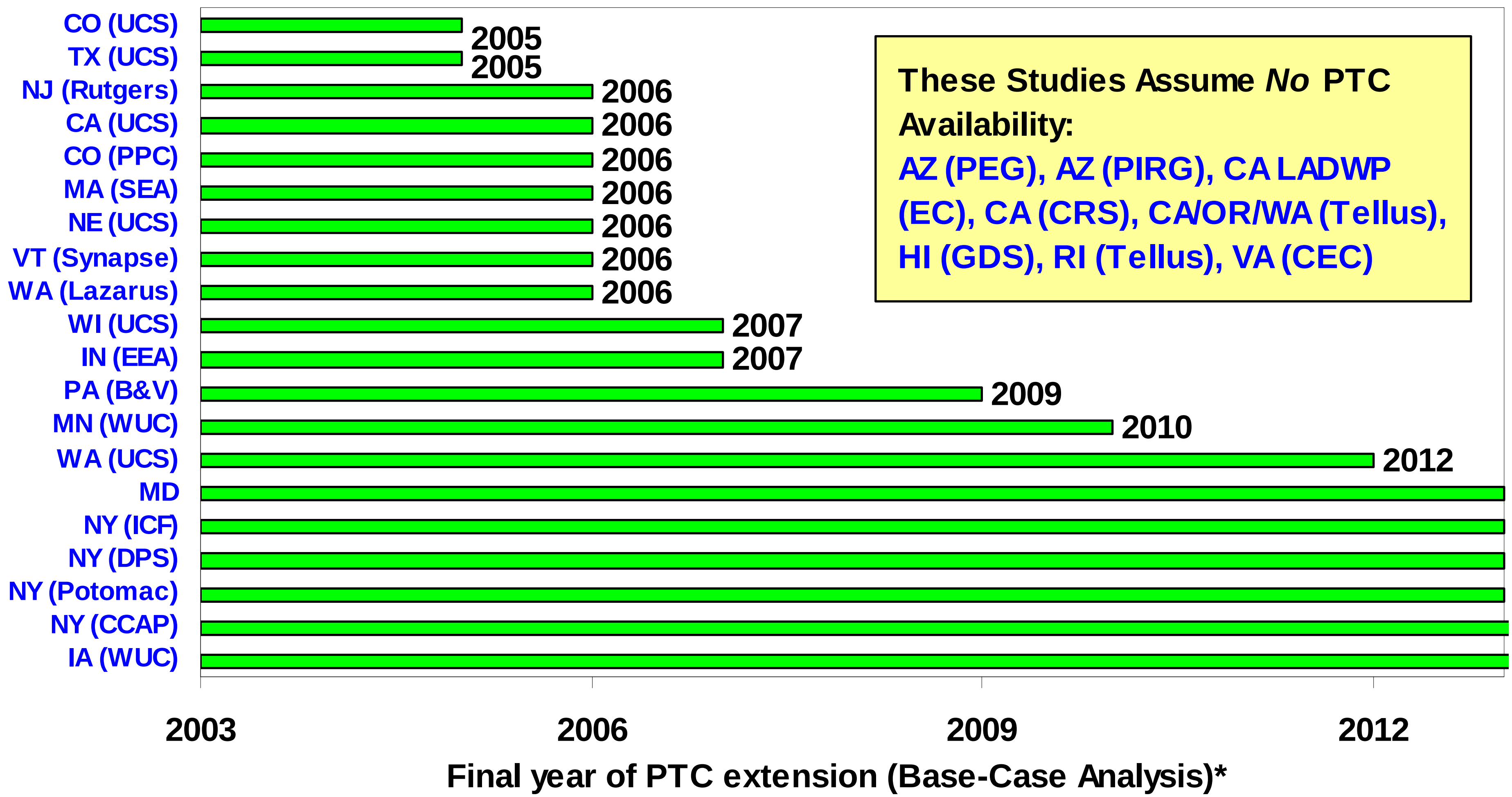
Wind Capital Cost Assumptions Range from $750/kW to $3,000/kW in 2010-2015



Most Studies' Natural Gas Price Projections Are Probably Too Low



Inconsistent PTC Assumptions Reflect Substantial Political Uncertainty



Many Studies Appropriately Consider the Secondary Costs of Renewable Generation

Cost Variable	Number of studies	Studies
Capacity value	20	AZ (PEG), CA (CRS), CA/OR/WA (Tellus), CO (PPC), CO (UCS), IA (WUC), IN (EEA), MD (Synapse), MA (SEA), MN (WUC), NE (UCS), NY (CCAP), NY (DPS), NY (ICF), NY (Potomac), PA (B&V), RI (Tellus), TX (UCS), WA (UCS), WI (UCS)
Transmission cost	15	CA (CRS), CA (UCS), CA/OR/WA (Tellus), CA LADWP (EC), CO (PPC), CO (UCS), IA (WUC), MA (SEA), MN (WUC), NE (UCS), PA (B&V), TX (UCS), VT (Synapse), WA (UCS), WI (UCS)
Integration cost	12	CA (CRS), CA/OR/WA (Tellus), CO (PPC), CO (UCS), IA (WUC), IN (EEA), MN (WUC), NJ (Rutgers), TX (UCS), WA (Lazarus), WA (UCS), WI (UCS)
Admin. & transaction cost	5	CA (UCS), MA (SEA), WA (Lazarus), WA (UCS), WI (UCS)

But as renewable penetrations reach higher levels, some of these costs need to be more carefully considered

Conclusions

- Projecting state RPS costs is inherently uncertain
- Despite uncertainties, majority of studies project modest cost impacts
- Wind power expected to serve majority of the state-RPS-driven RE demand
- Recent trend toward studies that forecast not just direct costs and environmental benefits, but also macroeconomic and hedge benefits
- Studies use a variety of methods and data sources to calculate costs and benefits: a standard study “template” has not yet emerged
- Assumptions for primary and secondary costs and benefits likely to be more important than what model is used

Some Possible Areas of Improvement…

- **Improved Treatment of Transmission/Integration Costs:** need better estimates of these costs w/high RE penetrations
- **Cost and Potential for Renewable Energy:** more rigorous and current estimates of cost and potential of RE technologies needed
- **Competing RPS Requirements:** consider how potential RPS policies in nearby states would affect RE resource supply and cost
- **Natural Gas Price Forecasts:** benchmark to NYMEX in early years; consider wide range of uncertainty
- **Coal as the Marginal Price Setter:** at high natural gas prices, need to consider possibility that RE will increasingly offset coal
- **Greater Use of Scenario/Risk Analysis:** natural gas and wholesale price uncertainty, PTC availability, wind capital costs
- **Representation of RPS Market Structure:** need to better represent actual contracting practices of obligated entities
- **More Robust Treatment of Public Benefits:** greater efforts to quantify the magnitude of hedge and macroeconomic effects
- **Consideration of Future Carbon Regulation:** consider impacts in the event that future carbon regulations are established