May 17, 2004

To: **Energy Modeling and Analysis Subgroup,**
Regional Greenhouse Gas Initiative (RGGI)

From: **Derek Murrow, Environment Northeast; Steve Clemmer, Union of Concerned Scientists, with assistance from Geoff Keith, Synapse Economics**

Stakeholders Supporting Recommendations: Dale Bryk, Natural Resources Defense Council; Rob Sargent, National Association of State PIRGs

RE: **RGGI IPM Modeling Assumptions, Results, and Model Runs**

The following pages contain detailed comments on the IPM input assumptions, the results, and a short-list of potential model runs to be used by the RGGI Energy Modeling and Analysis Subgroup.

There are a number of issues for which we will continue to develop data and recommendations. We have noted the issues within the table that we plan to comment on further. We also look forward to answering specific questions posed to stakeholders by the RGGI Modeling Subgroup.

Thank you for the opportunity to provide input on the modeling process and we look forward to discussing any questions or concerns you might have.

Regional Greenhouse Gas Initiative - Electricity Sector Modeling

Assumptions, Results, and Potential Model Runs

Authors: Derek Murrow, Environment Northeast; Steve Clemmer, UCS; with assistance from Geoff Keith, Synapse Energy Economics
Stakeholders Supporting Recommendations: Dale Bryk, Natural Resources Defense Council; Rob Sargent, National Association of State PIRGs

Assumes that the model being used is ICF's Integrated Planning Model

	Recommendations / Comments from Environmental Groups
Model Input Assumptions and Data Sources	
Model regions (spatial distribution / transmission)	The model regions should be as detailed as possible to fully capture transmission constraints and must run issues; include all areas that are contiguous to the RGGI region at a high level of detail (ECAR, SERC, and Canadian Provinces)
Model run year structure	Included in the reference case runs should be a run examining a recent historical year, such as 2001, using actual fuel prices for that year, so that the model's outputs can be compared to actual system operation; in general an attempt should be made to maximize the number of years reported
Existing Unit Characteristics	At a minimum, a select group of state agency staff should be able to view the specific model input data on a unit-by-unit basis (does the model capture and properly represent today's generation?); ideally the individual generator owners would be able to review the input data for their units; it should also be clear how many plant/unit types the model represents
Size, fuel(s), heat rate, emissions, etc	See above, maximize detail available
Existing plant O&M costs	See above, maximize detail available
Plant retirement or relicensing	Expected (announced) plant retirements should be hard-wired into the model. The plant retirement algorithm should be clearly presented and discussed, as plant retirements are an important dynamic under a carbon cap. For example, plant retirements are usually triggered by the need for a large capital investment in an old plant to keep it running. How does the model simulate these "lumpy" capital additions at old plants? Also, how does reduced plant operation (e.g., an old coal plant in a carbon cap scenario) affect the retirement decision? The carbon cap affects the retirement decision indirectly, by reducing the expected operation (and thus revenue) of the high carbon plants.
Treatment of distributed generation	A discussion and description is needed that looks at the ability or limitations of the model to represent DG
Transmission Characteristics	Transmission constraints need to be very carefully examined; the ISOs should look at all bottlenecks in comparison to the model; this should be done both for the 10 state region and for all interconnects to other states/regions (major impact on leakage) - WE WILL BE LOOKING AT THIS ISSUE AND COMMENTING FURTHER
Load projections	Load projections should be based on local ISO forecasts and it should be very clear whether they take into account efficiency and demand response programs; in the long-term EIA projections could be used (what happens after 10 years when the ISO forecasts end - percent per year?)
Reserve Margins	The model should not be overly optimistic about declining reserve margins - A floor of 15% should be considered (per changes in regulator's view of reliability)
Existing air regulations	All current air regulations/programs (state, regional, and federal) should be included in the model runs; special attention and discussion should be given to mercury and what other regulations are anticipated at the federal level over the next ~5 years (3P?) - WE WILL BE LOOKING AT THIS ISSUE AND COMMENTING FURTHER
Existing energy subsidies (PTC or others)	The federal production tax credit should be modeled as being available in the format proposed in the current energy bill

	Recommendations / Comments from Environmental Groups
Underlying market conditions (SMD, ISO load-response programs, etc)	The ISOs should look carefully at how the model is dealing with pricing; congestion charges or LMP are of particular concern
Energy Prices & Characteristics	Energy prices and forecasts should be carefully considered with the goal being to pick a forecast that most people think is reasonable and then to run multiple sensitivity runs off of it.
Coal (source, characteristics, and prices)	Coal prices have been high recently and this should be captured by the coal forecast or the IPM coal supply module; the model should also account for international supply and its characteristics (consider a coal price sensitivity run) - WE WILL BE LOOKING AT THIS ISSUE AND COMMENTING FURTHER
Oil (characteristics and prices)	Oil forecasts should receive thorough review and a high priced energy sensitivity should probably include higher oil prices and not just high gas prices
Gas (prices and elasticity)	Gas forecasts should be a priority for review; a detailed presentation of how the model handles gas supply and prices is necessary; there is concern about the model not capping gas supply for a region based on pipeline capacity constraints and also how the model handles gas contracts (interruptions); we want to see the elasticities used within IPM; also need to discuss how does the model handles LNG and pipeline expansion; sensitivities on gas prices are a must - WE WILL BE LOOKING AT THIS ISSUE AND COMMENTING FURTHER
Nuclear (prices and storage costs)	Fuel costs and storage costs should be included and a forecast made about how these costs will change with time; take into account the delay in development of long term storage and the need for more on-site storage - WE WILL BE LOOKING AT THIS ISSUE AND COMMENTING FURTHER
Financing assumptions by technology	Should be clearly documented
Transmission upgrades & additions (electric and gas)	Transmission upgrades for both gas and electric should probably be hard wired into the model, with clear documentation as to what was included; sensitivities should be considered that increase transmission capacity (let IPM build, consider technology solutions that increase capacity by some % on every line, etc)
Location, size, timing	
Interconnection costs	Costs should be clearly documented; What are the interconnection costs for each technology? Does distributed generation avoid some T&D costs (get a T&D credit)?
Plant Improvements	
Emissions controls (types and costs)	A thorough discussion and description is needed of how the model decides when and where to install emission controls.
Unit upgrades / uprates	Nuclear uprate costs should be based upon peer reviewed literature, not industry trade rags and should account for the costs of licensing and litigation; NEMS has specific assumptions about uprates (20MWs in NE, based on NRC expectations, see the NRC web site)
Re-powering or fuel switching	Clear description needed of how the model handles fuel switching - both long term fuel switched and short term switches at dual fueled units; how do duel fuel units function within the model; work with generators and gas companies to understand contracts
New Build Characteristics (capital & O&M costs, capacity factors, interconnection, learning, & resource availability)	
Coal	We are still reviewing data sources, but there should be multiple coal unit types modeled (fluidized bed, IGCC, etc); capital costs should be based on recent actual costs (not equipment/vendor estimates); in addition, new coal units with carbon sequestration should be discussed and considered (carbon capture for gas units could also be considered)- WE WILL BE LOOKING AT THIS ISSUE AND COMMENTING FURTHER

	Recommendations / Comments from Environmental Groups
Oil	
Gas	capital costs and heat rates should be based on recent actual costs and performance (not equipment/vendor estimates) - WE WILL BE LOOKING AT THIS ISSUE AND COMMENTING FURTHER
Nuclear	New nuclear facilities should not be included
Hydro	Data for New York State (done by Optimal for NYSERDA, NY Only) should be compared to the assumptions used in CT (based on U.S. Department of Energy’s Hydropower Program, operated by the Idaho National Engineering and Environmental Laboratory).
Wind	Potential: The potential wind resource available for development is limited mostly by permitting and siting issues more than technical potential; EIA's assumptions in AEO 2004 are based on updated wind resource assessments for all the states in the region developed or compiled by NREL; The NREL data is a good starting point, but additional exclusions should be applied to this potential to determine the developable resource; there is little empirical justification for the step curve EIA uses for wind that increases the capital cost of new wind projects by up to 200% as wind generation increases in a given region; it would be better to limit the availability of the resource, and apply much lower cost increases to account for additional siting, transmission, and ancillary service costs that may be incurred after the best wind sites are developed; consider using NREL WINDS model to develop more accurate approach, alternative approach adopted by UCS or updated assumptions under development by Princeton Economic Research Inc (PERI) for EIA.Cost and performance: use updated data to DOE Power Technologies databook 2003, which will be available soon
Landfill Gas	Potential: EPA landfill methane outreach program database; Cost and performance: EIA/AEO2004 (based on EPA assumptions)
Biomass	Need to address the sustainably harvested issue and emissions limits (per CT RPS); use state fuel supply curves from ORNL and Antares for energy crops, and ag, forestry, urban, & mill residues (used in NEMS in aggregated way); or NREL county specific data they presented to NESCAUM - WE WILL BE LOOKING AT THIS ISSUE AND COMMENTING FURTHER
Solar	Cost and performance: DOE Power Technologies Databook; need to account for T&D benefits.
Combined heat and power	Talk to ACEEE or New England Power for work on New England CHP potential; consider a CHP plant type with limits or a supply curve - WE WILL BE LOOKING AT THIS ISSUE AND COMMENTING FURTHER
Distributed Generation	Give T&D credit and discuss limitations of the model
Fuel Cells	Give T&D credit and use today's data (CT Clean Energy Fund), not EIA data
Renewable energy facilities built to meet existing policies (e.g. state RPS and funds)	Build the projected renewable development from RPS programs and funds into the reference case; UCS has developed projections that could be used.
Existing efficiency programs	Does the ISO forecast incorporate existing programs? We believe it does and it should
Demand response	Demand response should be included both in terms of an elasticity - reduces demand with very high prices, and as an "efficiency plant" that can bid into the marketplace (this plant should have limits and a supply curve) - WE WILL BE LOOKING AT THIS ISSUE AND COMMENTING FURTHER
Curtailment / reduced elec. usage	
Price driven efficiency improvements	

	Recommendations / Comments from Environmental Groups
Carbon offsets	MORE INFORMATION AND DISCUSSION NEEDED ON THIS ISSUE BEFORE WE CAN COMMENT (EPA SUPPLY CURVES NORMALLY USED BY ICF NEED THOROUGH REVIEW AND DISCUSSION); SENSITIVITIES SHOULD BE CONSIDERED
Characteristics (types, requirements)	
Price curve by type	
Allowances	A thorough discussion of how or if IPM can address allowance allocation is needed
Auction v. allocation	
Fixed allocation versus output-based allocation	Can the model look at an output based allocation and its impacts on dispatch/company decision making
Impact on new builds	
Impact on renewables	
Impact on efficiency programs	

Requested Model Results

Calibration run - 2000 or 2001 (actual data is available)
Annual data or every five years through 2025, if possible
Results in as much detail as possible (output files)
Generation by type. state, and region
Capacity additions by type, state, and region
Emissions (CO_2, SO_2, NO_x, HG, Particulates, etc) by unit, type, state, and region
Emissions (averages) allocated to states based on state demand
Emission allowance prices
Renewable energy certificate prices
Renewable energy cost curves for 2004, 2010, and 2020
Natural gas prices
Electricity revenues by sector, state, and region
Production costs by region and generation type
Wholesale electricity prices by sector, state, and region
Consumer electricity bills by sector, state, and region
Leakage (imports and exports from the policy region)
- Power / emissions flows
- New builds (coal) outside the region due to leakage

Identify and produce results to satisfy cost-benefit modeling needs (REMI)

Potential Model Runs & Process

Background Research & Review of Previous Modeling Work	Because modeling work has been completed in both New York and Connecticut climate processes, an effort should be made to review this work, identify any issues, and learn from successes and mistakes; In particular, the leakage results from the CT modeling process should be reviewed with particular attention to transmission assumptions and coal unit new builds just outside the RGGI region
1: Pre-reference case	Same as 2a, below, but the first run year should end in 2000 so that the performance of the model can be compared to recent generation and emissions data

	Recommendations / Comments from Environmental Groups
THOROUGH REVIEW OF RESULTS BEFORE MOVING ON	The model results and inputs should be thoroughly reviewed to identify any problems, corrections should be made and comments solicited; this should take a couple of weeks to allow for review and feedback
2-a: Reference case	Business as usual: include the RPS programs that are law and all best guess changes in policy over the next two or three years at the federal level (3P, at a minimum clear skies)
2-b: Reference case w/ no RPS	Conduct a model run that does not include the various RPS programs so that we can assess the contribution they make
2-c: Reference case w/ gas sensitivity	Same as Reference case 1-c, but with high priced gas and oil
2-d: Reference case w/ nuclear relicensing sensitivity	Same as Reference case 1-c, but with a portion of the nuclear plants not being relicensed (chosen based on plant age) MORE WORK NEEDED HERE
3-a: RGGI policy case 1 (small region)	Same as Reference case 1-c, but with an allowance based cap and trade program on power plants in New England, NY, and NJ following the NEG/ECP targets
3-b: RGGI policy case 1 (large region)	Same as 3-a: RGGI policy case 1, but add PA, MD, and DC
THOROUGH REVIEW OF RESULTS BEFORE MOVING ON	The model results should be thoroughly reviewed and summarized; after review and a discussion of the implications of the results, the next set of model runs should be identified; this should take a couple of weeks to allow for review and feedback
Subsequent runs, to be determined	