Assessing Emission Reductions from Energy Efficiency

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Introduction

- GETF has worked to help states and localities find ways to demonstrate and measure the air quality benefits associated with the use of energy efficiency and renewable energy (EERE)
  - Some applications must adhere to the requirements of state and federal air quality planning processes
- GETF received funding from the Energy Foundation to identify existing tools and examine their capabilities

Project Purpose

What does this project do?

- Evaluate and compare the potential of each tool for demonstrating the air quality benefits of EERE projects
- Examine whether and how such models and templates may help a state or local agency include such projects in air quality planning processes
- Identify how EPA can assist states and localities in this endeavor

Project Goals

Why are we doing this? What do we hope to accomplish ultimately?

- Put EERE on a more level playing field with traditional emission reduction technologies
- Motivate greater and faster adoption of EERE through demonstrating contribution to air quality
- Improve public/ecological health and economic vitality by achieving additional criteria pollutant and GHG emission reductions
- Help state agencies and other stakeholders more credibly and consistently communicate the air quality benefits of EERE technologies

Changing Circumstances

The original concept for this project is no longer applicable.

- In 2003, Energy Foundation and GETF envisioned that an alliance of states would go to EPA with a request to use one particular model or tool.
- This was based on the belief that EPA was providing insufficient support to states seeking to use EE/RE in SIPs.
  - No model or tool explicitly approved
  - Perception that 2000 guidance on NOx Budget Trading Program set-asides was not supported, and no new guidance
  - No functional set-aside programs
- Energy Foundation and GETF also assumed that one model could be demonstrated as sufficiently rigorous

Recent EPA Actions

- Since 2003, EPA has been *extensively* involved in supporting states and localities in developing and using tools to incorporate EE/RE into SIPs.
  - Development of emissions quantification methodology (Art Diem's ERCOT work)
  - Support of development of other methods (eCalc, MIT)
  - Guidance documents released 8/04 and 9/04
  - Support of use of EE/RE in SIPs through Texas pilot in Energy, Environment, and Transportation (EE&T) Integration Initiative
  - Proposed approval of MD/VA SIP credit for wind power
  - Ongoing reviews of emissions modeling tools/methodologies

Approaches to Emissions Modeling

- **Dispatch Modeling**
- **Capacity Expansion**
- **Proportionate Responsibility**
- **Direct Identification**

Approaches to Emissions Modeling

Dispatch Modeling

- Energy efficiency reduces operation of existing plants
- PROSYM often used for dispatch modeling
- NEMS also has dispatch modeling capability
- Often seen as the most analytically rigorous methodology
- Most applicable to short-term measures
- Uses marginal rates – these are often difficult to determine
- Major initiatives may complicate the modeling

Approaches to Emissions Modeling

Capacity Expansion

- Energy efficiency reduces need to build new baseload plants
- NEMS often used for modeling future capacity additions
- Emission reductions largely determined by future "grid average" factors
- Emissions factors are not static; generally decrease over time
  - Exceptions include areas where baseload has substantial nuclear or hydropower capacity; few additions expected in these resources
- Includes assumptions for retirement of existing plants
- Most applicable to long-term view (planning and goals)

Approaches to Emissions Modeling

Proportionate Responsibility

- Typically the easiest approach to employ and hardest to defend
  - Not really an approach to emissions modeling per se
  - Rather, a logical framework for using a "grid average" approach
- "Grid average" rates are a feature of many tools
  - Suggested for calculating "carbon burden" of an organization in the WRI Greenhouse Gas Protocol
  - "Supplier average" rather than "supplier marginal" used in power labeling - supplier is judged on their overall performance
  - No existing user can claim to be the marginal customer
- Not necessarily useful for SIP purposes… but use in other contexts can create inconsistencies

Approaches to Emissions Modeling

Direct Identification

- The hardest approach to employ and easiest to defend
  - Identifies specific plants affected, according to dispatch schedule
  - Requires information from energy providers and grid operator
- Energy providers and grid operators often reluctant to provide data
  - Proprietary information, possible competitive disadvantage
  - "Not our job"
- Used in Maryland SIP revision to account for wind power benefits
- August 2004 EPA guidance document indicates that this is an acceptable approach
- Not modeling and so not forward-looking – but "true-up" must be conducted for any tool

Options for Emissions Modeling Tools

- Tools assessed in detail in Phase I:
  - Clean Air and Climate Protection Software (CACPS) program developed by STAPPA/ALAPCO and ICLEI
  - Ozone Transport Commission's Emission Reduction Workbook version 2.0 (OTC Workbook)

Phase I Findings

- CACPS and OTC Workbook are transparent, flexible, and easy to use
- Guidelines for planning purposes or evaluating the relative benefits of various measures – not for demonstrating SIP adequacy
- Unexpected changes in cost of natural gas can significantly affect accuracy of models
- Post-2001 state policies not included in the models (as in NC or TX) may have dramatic effects on air quality

Phase I Conclusions

- *Insufficient baseline data* for reliable assessment of each model
  - In most areas, have only eGRID data through 2000 for "grid average"
  - Analysis of marginal rates by period is done by ISO-NE – would be useful if others did this as well
- Where comparing "apples to apples" – using marginal rates from both models – assumptions regarding emissions trading lead to significantly different results

Phase I Conclusions

- State actions can impact the effect of EERE
  - Initiatives such as SB5 may, over a few years, reduce demand enough to avoid the need for a baseload plant
  - Legislation such as Clean Smokestacks Act will avoid possible adverse consequences from EE (credit trading paradox)
  - Initiatives such as Regional Greenhouse Gas Initiative may alter grid operation *and* provide an opportunity to apply models to generate tradable credits

Phase I Conclusions

- CACPS and OTC Workbook can be used for a variety of purposes
  - Estimating effect of various policies or legislation
  - Establishing goals and developing plans
  - Designing appropriate incentives
  - Establishing allowance trading for emissions where EPA regulations do not apply
- Not SIP crediting

Phase I Recommendations

- Establish a Basis for Comparison of models
  - Better historical data, ISO analysis of marginal rates
- Periodically Revise Models
  - Prohibitively expensive to re-do models every time any state passes a new law – perhaps 5-7 year timeframe?
  - Need source of funding

Phase II Models Reviewed

- Emerging tools assessed in overview in Phase II:
  - EPA ERCOT methodology
  - eCalc
  - MARKAL (particularly NE-MARKAL)
  - Energy 2020
  - ADER
  - MIT PV Assessment
  - ERT/RSG Methodology
- Not assessed in as much depth as Phase I models

Phase II Assessments

- EPA ERCOT methodology
  - Developed by Art Diem of EPA
  - Infers activity cycle (baseload, load-following, peaking) from hours of activity per year
  - Accounts for transmission between areas
- eCalc methodology
  - Includes both energy modeling and emissions modeling
  - Emissions modeling is based on Diem's work
  - Associates each county with one or more energy suppliers, and each supplier with marginal generation facilities in one or more counties
  - Accounts for import/export of power among different suppliers
  - Extensive energy modeling capability

Phase II Assessments

- MARKAL
  - NE-MARKAL “toolbox” mentioned by participants at March 2004 meeting
  - Suited for longer-term planning
- Energy 2020
  - Used by Massachusetts DTE and some others
  - Missouri noted difficulty with this system
  - Apparently a good large-scale model, but labor-intensive
- States seemed more interested in identifying impact of specific small-scale measures – none asked GETF to assess impact of, say, RPS or building codes

Phase II Assessments

- ADER
  - Marginal calculation uses IPM but otherwise similar to that in CACPS (which uses NEMS) or OTC Workbook (which uses PROSYM)
  - Emissions by 11 different time periods – greater temporal specificity than either CACPS or OTC Workbook
  - EPA guidance suggests that tools giving emission reductions by region are not sufficient for SIP purposes
  - Like CACPS and OTC Workbook, could be used for CO_2 assessment as long as measures do not affect system more than the marginal decrement used in IPM during development

Phase II Assessments

- MIT PV Assessment
  - Uses hourly data to determine whether plants are at full load, spinning reserve, standby, or turning on/off in each hour
  - Accounts for reduced part-load efficiencies
  - Is based on actual plant emissions and so could be disaggregated to the county level
  - Needs for expansion:
    - Clean Air Markets data complete and formatted for easier entry
    - Data on operation of nuclear and hydroelectric units
    - Annual “true-up” followed by model revision
    - Expand to other types of energy (get profiles on wind and different types of EE)

Phase II Assessments

- ERT/RSG Methodology
  - Used in Maryland SIP revision and other instances
  - Based on identification of specific power plants that will be affected by a given action (wind farm in this case)
  - Accounts for transmission constraints on a case-by-case basis
  - Requires support from energy provider and/or grid operator

Phase II Conclusions

- The tools using historical data seem best suited to EPA's guidance, especially when used in a set-aside with annual true-up
  - MIT PV Assessment
  - ERT/RSG Methodology
- eCalc attempts mid-term planning (to 2007 and 2012)
  - In 2004 used an 80% discount across-the-board from 1998 emissions
  - In 2005 will use specific factors based on EPA modeling
  - Allows for use outside of set-aside framework
- These tools do not allow for long-term planning or assessment of large-scale measures

Phase II Recommendations

1. Continue to support the use of the ERT/RSG methodology as in the Maryland SIP revision
   - GETF has filed letter of support for EPA accepting this revision
   - Future needs include convincing utilities to provide their dispatch schedules and convincing ISOs to provide data on transmission constraints
   - EPA should determine what actions it can take to facilitate expansion of this tool

Phase II Recommendations

2. Approve SIP credits requested by TCEQ and ESL using eCalc
   - Now that eCalc is operational, ESL and TCEQ plan in FY 2004/2005 to seek approval of SIP credits identified through eCalc for measures taken under Senate Bill 5
   - EPA has been instrumental in developing this tool
   - GETF believes the result has been a success
   - At the same time, continue to provide feedback to improve the accuracy of eCalc

Phase II Recommendations

3. Support the use of MIT and ERT/RSG methodologies within a set-aside framework for SIP revisions
   - GETF believes that each of these approaches meets the requirements set out by EPA (as well as eCalc, but that is already being used in the one state where it applies)
   - Also, provide guidance on set-asides in Clean Air Interstate Rule, including guidance on the recommended length of eligibility for a project to receive credits through a set-aside
   - Ongoing comparisons of models by Synapse and by EPA/NREL may better inform this judgment and identify additional acceptable methodologies

Phase II Recommendations

4. Work with developers to expand state-specific tools
   - MIT, eCalc, and ERT/RSG
   - Developers say their tools can readily be applied to other areas
   - In programs such as EE&T Integration Pilot, continue to evaluate accuracy of tools
   - Develop a form or script to convert existing EPA data into the format needed for input into these tools
   - Evaluate the accuracy of these tools when applied to other states
   - Provide technical support and/or cost-sharing to states seeking to customize eCalc
   - States concur that EPA does very good work here – see if additional resources could be allocated for this

Phase II Recommendations

5. Together with DOE and the National Laboratories, conduct an evaluation of high-level energy system models
   - Compare the results of model runs among AMIGA, IPM, and NEMS, with the scenarios as identical as possible given the nature of the inputs to each model
   - This was recommended in an EPA/OAR report to Congress, “Economic Analysis of a Multi-Emissions Strategy,” October 31, 2001

Phase II Recommendations

6. Update existing tools and information resources, particularly eGRID
   - eGRID is used in specific models and is also used in a less structured way for identifying emissions from power plants
   - Clean Air Markets data is also an important information resource to maintain
   - Work with PUCs and air quality offices to ensure that GAT systems support analysis of emission reductions

Phase II Recommendations

7. With NREL and DOE, develop emissions factors for non-woody biomass
   - Specifically, develop factors for crop waste, energy crops (e.g. switchgrass), and poultry litter
   - Extend NSR "presumption of benefit" exemption to biomass projects other than coal-to-wood substitution
   - Without accepted factors for modeling, states cannot show presumption of benefit

Phase II Recommendations

8. With NREL and DOE, conduct analysis of the hourly dispatch of nuclear and hydroelectric facilities
   - Although they do not need to report emissions to Clean Air Markets, these sources indirectly impact air quality by altering the dispatch of fossil units
   - Better data will improve accuracy of tools such as MIT PV Assessment methodology

Phase II Recommendations

9. With NREL and DOE, develop superior data on renewable energy production profiles
   - Include derivation of estimates of year-to-year variability
   - This will enable expansion of MIT's tool to other energy resources
   - Will also enable EPA to better judge SIP revisions based on renewable energy development
   - Wind should be a primary focus—ESL notes that hourly-averaged data is important
   - For solar, beam and diffuse thermopile-type solar sensors rather than global horizontal measurements from PV-type solar sensors

Phase II Recommendations

10. Convene a conference to bring together energy modelers and tool developers
    - Following the EPA/NREL peer review of methodologies
    - Participants would discuss their tools and explain how they can be used with a SIP
    - Participants would identify key data needs where EPA, DOE, and NREL could provide support
    - Conference would provide an additional opportunity for peer review

More a vision than a recommendation…

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