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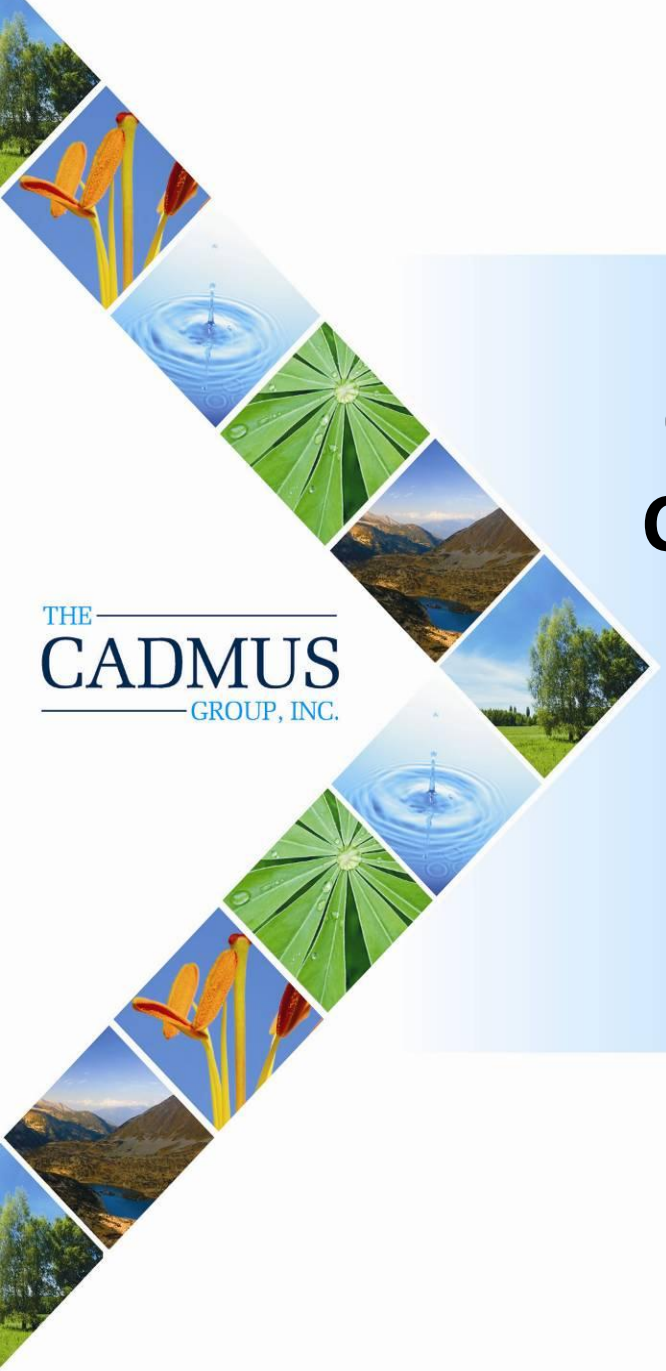

THE CADMUS GROUP, INC.

Wisconsin's Approach to Quantifying Emission Impacts of Clean Energy Initiatives (Focus on Energy)

Tech Forum Website

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Overview

- Background and Goals of Wisconsin's EE Programs and Evaluation
- New Developments
  - Data Sources and Guidelines
  - Combining Energy and Emissions Measurement
  - The Timing Dimension
- Identifying Generation on the Margin
- Key Overall Result
- Emissions Impacts in the B/C Analysis
- Conclusions and Implications

Background and Goals

- The state of Wisconsin has a statewide portfolio of programs to deliver energy efficiency to rate-payers (Focus on Energy)
  - The program evaluation team calculates emission factors to provide accurate environmental impact estimates – which are then used in the Benefit-Cost analysis for the programs
    - *Using the emission rates and evaluation-verified gross electricity savings estimates, the Focus programs together potentially avoided 8,692,490 pounds of NO_X; 10,727,209 pounds of SO_X; 6,649,663,697 pounds of CO_2; and over 41.5 pounds of mercury from inception to December 31, 2010 (See Table 2-23 of the Focus on Energy Evaluation Annual Report (2010), Revised June 17, 2011)*

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Goals for the Programs

- Evaluation of the programs must:
  - Document and measure the energy savings
  - Identify ways to improve the programs

- In addition, environmental benefits are an essential objective
  - Quantifying displaced generation emissions is the key emphasis

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New Developments

- In Wisconsin's recent Quadrennial Planning Process, joint intervenor input has advocated for:
  - Use of carbon values to assess DSM savings through application to time-differentiated periods of utility usage that reflect the carbon intensity of the units operating at the margin at that time
- The technical approach in Wisconsin has evolved over time to account for this critical dimension of timing – variations in both emission rates and energy savings across 8,760 hours of the year

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The Timing Dimension Refinement

A default emission rate, an average across all hours of the year, may be adequate for some purposes, however…

- Applying an average value to actual program savings ignores the fundamental fact that actual EE program savings are not distributed equally across the year – instead they are timed to the use of energy consuming technologies
- This is important because the marginal emission rate also fluctuates significantly, and systematically, over each day and across the year

The movement of these two relationships, emission rate and savings rate, relative to one another creates a complex pattern – *which is missed when an average annual emission factor is applied to annual savings*

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Combined With Another Key Principle…

Identifying marginal generation

The Wisconsin evaluation has sought better ways of identifying the operating margin in order to improve the accuracy of the emission factor estimate

Identifying Marginal Generation

Energy efficiency programs displace generation that is "on the margin"

- The last generation called up by dispatchers – typically the most expensive per MWh at a given level of demand
- Since plants with different dispatch orders use different fuels and have different emission rates, it is important to identify "the margin"

Thus, correctly identifying the margin is critical to an accurate estimation of emission rates

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And Combined With a Third Feature…

- Because different EE programs promote different technologies to different types of end users, resulting in energy savings at different times of the day
- To get the estimate right we need to allocate both savings and emissions across all 8,760 hours of the year

  This critically depended on savings load shapes provided from Wisconsin's EE program planning tools

Data Sources and Guidelines - Wisconsin

Our emission estimates are based on the EPA's Office of Air and Radiation *Acid Rain Hourly Emissions* data:

- CO_2 SO_x & NO_x; hourly load; primary and secondary fuel types
- 8760 data
- Stack monitoring
- About 3,300 emitting entities

But:

- Does not include nuclear, hydro, or renewables
- Does not include Canada

Approach aligned with the World Resources Institute's *Guidelines for Quantifying GHG Reductions from Grid-Connected Electricity Projects* (July 2007)

- The extent of the electrical transmission and distribution grid where a project is situated is the proper geographic area for estimating effects
- Emission reductions occur on the operating margin – i.e., the last generation called up by energy dispatchers

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What We Found With Our Approach

We believe a more accurate emission rate can be estimated by matching the amount of energy saving in a given hour to the emission rate for that hour

- The evaluation reporting to the state of Wisconsin refers to the approach as ***time of savings*** (TOS) emission factors

Bringing more information to bear provides an intrinsically more precise emission factor estimation

What effect does this have on emission factors?

Approaches Vary Significantly by Pollutant

- Findings underscore the point that EFs derived from an average of all generation tend to exaggerate emissions

Emission Factors from Three Different Accounting Approaches

Estimation Approach	CO_2	NO_x	SO_2	HG
Average of all load	2,346	4.1	10.9	0.0000570
Average of marginal load	1,957	2.7	4.2	0.0000153
Time of savings	1,801	2.6	3.8	0.0000080

- The reason is that the emissions of all base load generation are included in the estimate even though they are not displaced by energy savings during a large portion of the year
  - For Wisconsin, this base load generation is generally higher in pollutant emissions than is gas-fired generation that follows load

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Emissions Impacts in Benefit/Cost Analysis

The Wisconsin EE programs benefit-cost analyses assign costs and benefits on the basis of four Locational Marginal Price (LMP) periods

- To obtain an emission rate for each period we calculated an average of the emission rates across all hours of each LMP period
- These displaced emissions are added to the benefit column of programs that have savings in each period
- With 8,760 data we can easily change the period definitions to accommodate future definitions

Advantages to Quantifying this EE Benefit

Emissions rate estimation that effectively balances need for precision against cost

- Uses US EPA data
- Realistic estimate of the operating margin
- 8760 analysis
- A consistent definition of the operating margin that can be broadly applied to different geographies

"Things that are measured tend to improve."

Professor John Kenneth Galbraith

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