PA Consulting Group

Subject	**Focus on Energy Evaluation**
	Emission Factors Update
To	Oscar Bloch, Public Service Commission of Wisconsin
	cc Kathy Kuntz, WECC
From	Eric Rambo and Bryan Ward, PA Consulting Group
	Acknowledgement: Ralph Prahl, Prahl & Associates, contributed critical review and analysis
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This memo updates ongoing work by the Wisconsin Focus on Energy (Focus) evaluation team to estimate emission factors for electric generation affected by Focus programs. It is part of the ongoing development of inputs to the Focus overall benefit-cost analyses. The memo provides new estimates of emission factors, based on a slight modification of our previous approach, including an estimate for the year 2007. Prior estimates ran only through 2006. These represent the average hourly rate of emission. This is an average of the marginal rate of emissions in each hour, averaged across all hours.

We also estimate emission rates for 2007 that are calculated in a new way, based on the apportionment of program energy savings over each hour of the year. Thus, we associate an emission rate for each hour with energy savings estimated for that hour. The energy savings are based on energy savings load shapes developed by Focus. With this approach, the annual emission factor is properly weighted by the timing of the savings. We call these *time-of-savings* (TOS) emission factors. We believe the TOS emission factors provide an additional degree of accuracy in the estimation of avoided emissions. We recommend that estimates derived from this approach these be used for the purposes of Focus benefit/cost calculations in the upcoming 2009 semiannual report and subsequent evaluations.

Additionally, this memo updates mercury (Hg) emission numbers, which were not updated in the last emissions report. Finally, it compares Focus emission factors with emission factors derived from reporting of the Governor's Taskforce on Global Warming.

Background

The Focus evaluation team uses emission factors to estimate environmental impacts from Focus on Energy net energy savings, in the form of displaced power plant emissions. Emission factors are used to convert energy inputs (i.e., fuels used to generate electricity) and generation of pollutants (i.e., CO_2, NO_x, SO_2, and Hg). Factors are reported in pounds of pollutant per megawatt hour of generation.

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The Focus team has aligned its method for estimating emission rates with recommendations of the Greenhouse Gas Protocol Initiative (GHG Protocols). This protocol, developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), has become the most broadly accepted accounting standard for understanding, quantifying, and managing greenhouse gas emissions.[1] One implication of adherence to the GHG Protocol is that emission factor calculations are based on generation data specific to the geography of the Focus energy efficiency programs. Secondly, emission factors are estimated for plants operating on the margin—plants most likely to remain off-line as a result of a reduction in demand/consumption resulting from Focus programs. Emission factors derive from the Environmental Protection Agency's (EPA) Office of Air and Radiation's "Acid Rain Hourly Emissions Data," which is produced from actual stack monitoring. Appropriate allowance prices for displaced emissions are then used for the benefit-cost and economic impact analyses, including a forecast of future prices to the year 2026.

For this report, the Focus team is reporting emission factors for six years of EPA data, spanning from 2002 to 2007. As before, we estimated the emission rate for all plants serving the grid that provides electricity to Wisconsin consumers. We define this grid by the two North American Reliability Corporation (NERC) regions that cover the state: the Midwest Reliability Organization (MRO; prior to 2005 MAPP) and the Reliability First Corporation (RFC; prior to 2006 MAIN).

Marginal plants are identified by their *rate of use*; that is, the average length of time in hours that a generating unit remains on once it is brought online. Peaking units, which are brought on for only a short time, have a short rate of use; base-load plants that remain on for hundreds of hours or more have a long rate of use. We divide the population of generating units into five groups, averaging less than six hours, six to twelve hours, twelve to twenty-four hours, twenty-four to ninety-six hours, and more than ninety-six hours, each time they are dispatched. We define marginal emissions in each hour as those produced by the set of generating units in the group with the shortest rate of use.

Annual Average Emissions

In a previous report, the evaluation team produced annual emission factors based on an average across all marginal plants.[2] For this memo, we have averaged across all marginal plants within each hour, and then averaged across all hours. This seems a better approach, reporting an emission rate for an average hour of the year. Table 1 shows emission rates for CO_2, NOx, SO_2, and Hg, by year, from 2002 to 2007. The general tendency has been a decline in emission factors, over time. The increase from 2005 to 2006 is related to shifting NERC boundaries, which has brought older, more polluting coal generation onto the margin.[3]

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[1] World Resources Institute and the World Business Council for Sustainable Development. "Guidelines for Quantifying GHG Reductions from Grid-Connected Electricity Projects." 2007.

[2] Eric Rambo, Bryan Ward, and David Sumi. *Focus on Energy Evaluation: Quantifying Environmental Benefits of Focus on Energy: Emission-rate Estimates 2002 to 2006.* October 28, 2008.

[3] Changes in NERC regions have had a significant effect on emission factors because they redraw the boundaries of the grid and incorporate a new mix of fuels. The table below shows the number of

Table 1. Annual Average of Hourly Emissions at the Generating Margin, 2002 to 2007

Year	Pollutant (Lbs/MWh)			
	CO_2	NO_x	SO_2	Hg
2002	2,031	3.6	5.8	0.0000153
2003	2,194	3.9	6.9	0.0000115
2004	2,088	3.1	3.7	0.0000069
2005	1,757	2.3	2.5	0.0000056
2006	1,957	3.0	4.8	0.0000070
2007	1,821	2.7	4.2	0.0000153

For most pollutants, averaging units by hour yields a higher emission rate than averaging units across all hours. In the previous memo (see footnote 2), the 2006 rate for CO_2 was reported as 1,700 lbs/MWh; i.e., 13 percent lower than the number reported here. The 2006 NO_x rate was previously 3 percent lower and the SO_2 rate was 43 percent lower. The emission rate for mercury runs counter to this tendency; the 2006 rate was 31 percent higher using the previous averaging approach. The differences in the emission rates are a function of the weight given to coal-fired plants, which produce more of all pollutants, and in particular to the weight given to coal-fired plants by location because these plants emit more or less mercury depending on the origin of coal that is burned.

Time of Savings Emission Factors

Whether averaged across all units or across hours, a significant amount of information is lost in the averaging process. The EPA data allow an 8,760 hour accounting of pollutants. Insofar as energy savings can be assigned to hours of the day and days of the year, a more accurate TOS emission rate can be established by matching the amount of energy savings in a given hour to the emission rate for that hour.

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operating units by NERC region and fuel type from 2002 to 2007. We have used shading to show where the change in regions takes place. Clearly, the change from MAIN to RFC was dramatic in the increase in the numbers of units factored into emission rates.

Number of Operating Units by Fuel Type and NERC Region, 2002 to 2007

NERC Region	Fuel	2002	2003	2004	2005	2006	2007
MAIN/RFC	C	105	106	107	83	273	280
MAIN/RFC	NG	180	181	187	207	396	555
MAIN/RFC	OIL	14	24	23	21	130	147
MAPP/MRO	C	69	71	70	89	114	98
MAPP/MRO	NG	26	31	41	66	80	85
MAPP/MRO	OIL	1	1	1	4	3	3

The facilities in MAPP and MRO were stable during the period with only six of 109 facilities dropping out and 27 new facilities introduced to the region. (Facilities often have more than one operating unit.) The facilities in MAIN and RFC were less stable. In addition to many facilities introduced in 2006 with the switch to RFC, 49 percent of the MAIN facilities dropped out with the changing regional boundaries. The facilities in MAPP and MRO were stable during the period with only 6 of 109 facilities dropping out and 27 new facilities coming online.

Load shapes provided to Focus by Integral Analytics for use in their DSMore™ planning tool were used for this purpose.[4] The available load shapes for Business Programs were heating, cooling, lighting, and a default load shape for each business program (agriculture, commercial, schools & government, industrial). For the Residential programs, the available load shapes were heating, cooling, lighting, and an HVAC heating-and-cooling load shape. We assigned load shapes to the measure categories used in benefit-cost analysis. Because this analysis does not separate business program measures into heat and cooling categories but rather combines them into an HVAC category, we combined heating and cooling load shapes for business programs for this analysis.[5]

Renewables pose some special problems in this assignment. For solar hot water, the energy savings occur when energy would have been consumed and not when the energy is collected or generated. Since we do not have a residential hot water loadshape, we substituted the residential lighting loadshape. Though not a perfect fit, it seems better than the residential default load shape—which would be the other option—because it is not so much dominated by cooling load and generally reflects hours of the day when household consumption takes place. For solar electric, we estimated an insolation load shape from the National Solar Radiation Database.[6] For the renewable measure categories wind, biomass combustion, biogas and other, a flat load shape was assigned. For these savings we applied the average annual emission rate for business measures or residential measures, depending on which sector predominates program activity for a given technology. Table 2 indicates the assignment of load shapes to programs and measure categories.

Table 2. Load Shapes and Measure Categories Used in the Analysis

Program Area	Program	Measure Category	Load Shape
Business	Agriculture	HVAC	AG_HVAC
Business	Agriculture	CFL	AG_LIGHT
Business	Agriculture	Other Lighting	AG_LIGHT
Business	Agriculture	Manufacturing Process	AG_DEFAULT
Business	Agriculture	Motor	AG_DEFAULT

[4] For more information on these load shapes see Tim Hennessy, Colin Rickert, Miriam Goldberg, Ryan Barry, KEMA Inc., and Ralph Prahl. *Focus on Energy Evaluation: Review of Business Programs Load Shapes.* October 15, 2009.

[5] The DSMore load shapes are represented as average kW saved by hour of the day, for weekdays and weekend days, by month of the year. Thus, rather than 8,760 values there are 24 x 2 x 12 = 576 values. Load shapes represented as a percentage of annual consumption were created by simulating an 8,760 year, summing all savings, and dividing each hour's savings by the sum. To create an HVAC load shape from heating and cooling, the savings values in the two load shapes were summed prior to 8,760 simulation, then percentaging was performed.

[6] We gathered hourly insolation data in watts per square meter from three data gathering stations located in Madison, Milwaukee, and Stevens Point, for the years 2001 to 2005. We averaged the hourly data across all locations and years to obtain an average hourly insolation in watts per square meter. We then calculated the percentage of annual watts occurring in each hour of the year to estimate an insolation load shape.

See: http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/hourly/list_by_state.html.

Program Area	Program	Measure Category	Load Shape
Business	Agriculture	Other	AG_DEFAULT
Business	Commercial	Building Shell	COM_HVAC
Business	Commercial	HVAC	COM_HVAC
Business	Commercial	CFL	COM_LIGHT
Business	Commercial	Other Lighting	COM_LIGHT
Business	Commercial	Motor	COM_DEFAULT
Business	Commercial	Other	COM_DEFAULT
Business	Industrial	Building Shell	IND_HVAC
Business	Industrial	HVAC	IND_HVAC
Business	Industrial	CFL	IND_LIGHT
Business	Industrial	Other Lighting	IND_LIGHT
Business	Industrial	Manufacturing Process	IND_DEFAULT
Business	Industrial	Motor	IND_DEFAULT
Business	Industrial	Other	IND_DEFAULT
Business	Schools & Government	Building Shell	SCH_HVAC
Business	Schools & Government	HVAC	SCH_HVAC
Business	Schools & Government	CFL	SCH_LIGHT
Business	Schools & Government	Other Lighting	SCH_LIGHT
Business	Schools & Government	Motor	SCH_DEFAULT
Business	Schools & Government	Other	SCH_DEFAULT
Renewables	Renewables	Biogas	FLAT (Business average)
Renewables	Renewables	Biomass-Combustion	FLAT (Business average)
Renewables	Renewables	Other	FLAT (Business average)
Renewables	Renewables	Wind	FLAT (Residential average)
Renewables	Renewables	Solar Water Heating	RES_LIGHT
Renewables	Renewables	Solar Electric	RES_SOLAR
Residential	ACES	Other	RES_DEFAULT
Residential	EHCI	SEER 14+	RES_COOL
Residential	EHCI	ECM Furnace	RES_HEAT
Residential	EHCI	Other	RES_DEFAULT
Residential	ENERGY STAR	CFL	RES_LIGHT
Residential	ENERGY STAR	Other Lighting	RES_LIGHT
Residential	ENERGY STAR	Clothes Washers	RES_DEFAULT
Residential	ENERGY STAR	Other	RES_DEFAULT
Residential	HPES	Air Sealing	RES_HVAC
Residential	HPES	Attic Insulation	RES_HVAC
Residential	HPES	Sidewall Insulation	RES_HVAC
Residential	HPES	Other	RES_DEFAULT
Residential	THPES	Other	RES_DEFAULT
Residential	WESH	ECM Furnace	RES_HEAT
Residential	WESH	Home Certification	RES_DEFAULT
Residential	WESH	Other	RES_DEFAULT

Using these load shapes, emission factors were calculated in the following way. Annual energy savings for the year 2007 (the year of our most recent emission factor data), for each measure category, were multiplied by the annual percent savings in each hour in the appropriate load shape. Those hourly savings were multiplied by the emission factor in each hour to obtain a quantity of avoided emissions in each hour. The emission factor is estimated to be the total avoided emissions divided by the total energy savings. These load shape factors, expressed in pounds of pollutant per MWh energy savings, are aggregated across programs to represent a rate for the business, renewable, and residential portfolios, and for Focus as a whole.

Table 3 shows emission factors by load shape. Each measure category represented in Table 2 can be assigned an emission factor based on its appropriate load shape.

Emission factors for NO_x vary relatively little from one load shape to another—only about a tenth of a pound per MWh around the mean. This pollutant is less sensitive to the fuel that is predominant on the margin. The values for CO_2, SO_2, and mercury vary somewhat more by load shape, on the order of three percent to four percent around the mean for SO_2 and five percent or more for mercury. Emission rates for CO_2 are quite consistent except for residential heating and cooling and solar. We expect that business sector heating and cooling would also show significant CO_2 variation if heating and cooling were separated into separate load shapes rather than collapsed into a single HVAC load shape. These pollutants vary according to the predominant fuel on the margin. In particular, coal generation produces more pollutants than natural gas, oil, wood, and other fuels. When coal-powered generation is on the margin, emission rates are higher.

Table 3. Emission Factors by Load Shape

Load Shape	Pollutant (Lbs/MWh)			
	CO_2	NO_x	SO_2	Hg
AG_HVAC	1,803	2.7	3.9	0.0000137
AG_LGHT	1,795	2.6	3.9	0.0000136
AG_TOTL	1,797	2.7	3.9	0.0000139
COM_FLAT	1,817	2.7	4.1	0.0000147
COM_HVAC	1,808	2.6	3.9	0.0000136
COM_LGHT	1,796	2.6	3.8	0.0000134
COM_TOTL	1,780	2.6	3.9	0.0000132
IND_HVAC	1,833	2.7	4.1	0.0000146
IND_LGHT	1,802	2.6	3.9	0.0000138
IND_TOTL	1,795	2.6	3.9	0.0000137
RES_COOL	1,641	2.7	4.5	0.0000109
RES_FLAT	1,817	2.7	4.1	0.0000147
RES_HEAT	1,908	2.6	3.6	0.0000158
RES_HVAC	1,783	2.6	3.9	0.0000134
RES_LGHT	1,801	2.6	3.8	0.0000135
RES_SOLAR	1,662	2.5	3.3	0.0000092
RES_TOTL	1,783	2.6	3.9	0.0000134

Load Shape	Pollutant (Lbs/MWh)			
	CO_2	NO_x	SO_2	Hg
SCH_HVAC	1,808	2.6	3.9	0.0000134
SCH_LGHT	1,794	2.6	3.8	0.0000133
SCH_TOTL	1,775	2.6	3.8	0.0000130
TOTL_TOTL	**1,801**	**2.6**	**3.8**	**0.0000136**

The TOTAL load shape (i.e., "TOTL_TOTL", above) represents an aggregate of avoided emissions across all programs, divided by the aggregated energy savings. This is an intrinsically more precise way to represent the emission factor than the other approach, which averages across all units and all hours. How different are its values? Table 4 shows a comparison among three different approaches to calculating emission factors. The top row shows rates calculated as an hourly average of all generation, without accounting for the margin. The second row shows the rate as calculated at the beginning of this memo, as an average across all units on the margin in any hour, and then across all hours. The third row shows the TOS emission rate calculated as the kWh saved in every hour times the emission rate for that hour. Table 4 also shows the economic value of the difference in the way the emission rates are calculated. In these columns, each cell represents the dollar value of the difference between the first-year avoided emissions as calculated in that row and as calculated in the row above. We have only shown values for pollutants that currently are included in the benefit/cost analysis.

Table 4. Comparison of 2007 Emission Factors by Estimation Approach

Measurement Type	Pollutant (Lbs/MWh)					
	CO_2	NO_x	NO_x Value of Difference	SO_2	SO_2 Value of Difference	Hg
Average all load	2,346	4.1		10.9		0.0000570
Average marginal load	1,957	2.7	$224,744	4.2	$352,624	0.0000153
TOS	1,801	2.6	$7,530	3.8	$17,354	0.0000080

The effects of the estimation approach vary quite significantly by pollutant. Going from *all load* to *average marginal load* (which are the 2007 factors reported in Table 1) results in a 61 percent reduction in the emission rate for SO_2 and mercury, about a 52 percent reduction for NO_x and a 17 percent reduction for CO_2. Going from *average marginal* to *TOS* yields a much smaller reduction in the emission rate: 22 percent for mercury, ten percent for SO_2, four percent for NO_x and eight percent for CO_2. The first-year economic value of the difference in avoided emissions is one way of identifying how much it matters whether emission factors are calculated in one way or the other. The dollar value per pound of pollutant is for 2007, for so-called "economic emissions," where an actual market exists for the pollutant[7]. The difference between *all load* and *average marginal load* is $577,358. This represents a 48 percent reduction in the total value of avoided emissions calculated as *all load*. Stepping from average

[7] Bryan Ward and Eric Rambo. PA Consulting Group. *Focus on Energy Evaluation Method for 2006 Re-Estimation of Emissions Factors and Allowance Prices*. January 5, 2007.

marginal load to *TOS savings*, the difference in economic value is only $24,883. Nevertheless, this represents a four percent reduction in the total value of avoided emissions.

This finding underscores the point that emission factors derived from an average of all generation tend to exaggerate avoided emissions. The reason is that the emissions of all base load generation are included in the estimate even though it is not displaced by energy savings during a large portion of the year. This base load generation is generally higher in pollutant emissions than in gas-fired generation that follows the load during most of the year. The Focus team has consistently sought better ways of identifying the operating margin in order to improve the accuracy of the emission factor estimate.

A more salient question is whether the added effort of matching savings with emissions on an hourly basis—thus moving from an average across all hours to a TOS estimate—is worth the additional effort. The findings reported in Table 3 would suggest the value is perhaps not worth the effort if load shapes must be developed specifically for the avoided emissions estimate. However, for Focus these load shapes are already developed as an important input to the b/c analysis more generally, used to assign avoided costs to energy savings. Once they have been developed, it is relatively easy to apply the load shapes to avoided emissions as well. Hence, there is no strong argument against the resulting added precision, however small it may be. On balance we believe the TOS approach represents a worthwhile improvement in emissions estimates and should become standard for Focus evaluations. Beyond question, to a large extent the value of this additional effort hinges on the quality of the load shapes that are available for apportioning savings.

Mercury Emissions

The 2008 report on emission factors did not include mercury values because they could not be produced in time for posting.[8] We have remedied that omission in this memo. Here we discuss our approach, which follows the approach discussed in the 2004 Focus report on emissions.[9]

The majority of mercury emissions from electric generation come from coal-burning facilities. The mercury content of coal varies depending on the geological formation from which the coal is extracted. To estimate mercury emission factors, we use fuel source information for coal-burning facilities that serve the Wisconsin grid. This data, submitted to the FERC by electric utilities on form FERC 423 (also EIA 423), includes the state of origin of coal and its energy content. This information is combined with data on the mercury content of coal collected in an extensive study conducted by the EPA in 2000.[10] We estimate an average mercury content per

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[8] Eric Rambo, Bryan Ward, and David Sumi, PA Consulting Group. *Focus on Energy Evaluation: Quantifying Environmental Benefits of Focus on Energy: Emission-rate Estimates 2002 to 2006.* October 28, 2008.

[9] Carmen Best, David Sumi, Bryan Ward, and Karl Hausker, PA Consulting Group. Focus on *Energy Evaluation Estimating Seasonal and Peak Environmental Emission Factors*, Appendix A. May 21, 2004. This discussion draws heavily from that report.

[10] U.S. EPA, 2000, *ICR Data Analysis* Presentation for NWF, (September 2000). Public Outreach. http://www.epa.gov/ttn/atw/combust/utiltox/nwf_9_8.pdf. Last accessed March 12, 2009.

trillion BTUs of fuel consumption for coal consumed by utilities serving the Wisconsin grid. Average mercury content by year is represented in Table 5.

Table 5. Mercury Content of Coal Consumed by Wisconsin Grid Utilities, by Year

Year	Trillion BTUs (Tbtu)	Pounds	Lbs / Tbtu
2002	742	2,960	3.99
2003	793	3,167	3.99
2004	837	3,314	3.96
2005	772	3,059	3.96
2006	2,273	21,688	9.54
2007	2,158	20,377	9.44

Other fuels, such as fuel oil and natural gas, contain minute amounts of mercury as well. We use EPA estimates of average mercury content per trillion BTUs for these fuels. The large shift in mercury content between 2005 and 2006 represents a change in the NERC regions serving Wisconsin. The shift from MAIN to RFC brought more Eastern coal, which is higher in mercury content, onto the grid.

The amount of mercury emitted by coal-fueled facilities is affected by the type of boiler used and by emission control devices installed for NO_x and SO_x emission reduction. This information is recorded on EPA's acid rain data. The EPA has summarized these effects with the development of emission modification factors (EMF). An EMF reflects the ratio of outlet mercury concentration to inlet mercury concentration and depends on the type of boiler, the control technologies installed at the plant, and may also consider the type of fuel. The percentage of mercury reduction achieved compared to the inlet rate during combustion and flue-gas treatment is (1-EMF). We assumed that all of the mercury in the fuel is released into the flue gas.

Mercury in the Flue Gas (after combustion)	×	EMF	=	Mercury Released to the Atmosphere	15% less mercury leaving the system than entered the system.
100	×	**0.85**	**=**	**85**	

For example, an EMF of 0.85 means that the mercury released is 15 percent less than mercury entering the system. An EMF of 1 means the same amount of mercury that entered the system was released to the atmosphere.

For this research, we have continued to use the EMF values developed for the 2004 report, cited above. We updated the emission factor estimates by using current-year source coal reporting and by using our refined approach to identification of marginal plants.

Comparison of Focus Estimates with Estimates from the Governor's Task Force on Global Warming

In April 2007, Wisconsin Governor James Doyle created a special task force to examine the effects of global warming on the state and to develop a plan for reducing the state's greenhouse gas emissions. Included in the July 2008 "Report to the Governor" is an estimate of greenhouse gas emissions from electricity generation in Wisconsin.[11] This estimate derives from the "Wisconsin Greenhouse Gas Emissions Inventory Report," prepared by the World Resources Institute (WRI) for the task force. [12] A second emission rate estimate can be taken from a Reference Case modeling projection of emissions and consumption developed for the task force. [13] Table 6 shows a comparison of these derived estimates with CO_2 emission factors reported here.

Table 6. Comparison of Emissions Factor Estimates for Wisconsin Energy Consumption

Source	Year	Emissions (Tons CO_2) [14]	Total Generation (GWH)	Derived Emission Factor (Tons CO_2 / MWh)
WRI Emission Inventory	2003	47.3	60,122	0.79
Focus on Energy All Load	*2003*			*1.15*
Focus on Energy Marginal Load	*2003*			*1.10*
Task Force Reference Case	2004	50.3	60,445	0.83
Focus on Energy All Load	*2004*			*1.13*
Focus on Energy Marginal Load	*2004*			*1.04*

The emission factors for CO_2 derived from task force emission and consumption numbers diverge substantially from the CO_2 emission factors developed for Focus. To make sense of this it is important to note that the task force numbers have been created for a different purpose. The framework of the task force emission estimate is energy generated within the state of Wisconsin rather than for the entire electric grid serving Wisconsin. This is the maximum reach of statewide policy and thus a reasonable scope for the estimate. That does not contravene the fact that energy generated in Wisconsin is not all consumed here, and that energy consumed in Wisconsin is not all generated here. Moreover, the task force estimates are based on total generation and not generation at the margin. This has the effect of reducing the emission factor because it includes in the denominator significant load from nuclear and hydro-electric sources that do not produce CO_2. Again, this is perhaps a reasonable point of

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[11] Governor's Task Force on Global Warming. *Final Report to Governor Jim Doyle*. July 2008.

[12] *Wisconsin Greenhouse Gas Emissions Inventory and Projections*. Prepared by the World Resources Institute for the Wisconsin DNR and the Governor's Task Force on Global Warming. June 25 2007. The WRI estimates generation and emissions with their Climate Analysis Indicators Tool (CAIT-US) (www.cait.wri.org). CAIT-US uses state-level data from the Energy Information Administration (EIA) to estimate emissions and electricity generation.

[13] *Modeling of Global Warming Strategies for the State of Wisconsin: Modeling Inputs and Assumptions for Reference and Policy Cases*. Prepared by ICF Consulting Canada, Inc. for the Wisconsin DNR and the Governor's Task Force on Global Warming. July 14, 2008. The Reference Case model uses data from the National Electric Energy Data System (NEEDS) database. Unlike the state-level EIA data used for the Inventory report, NEEDS includes plant-specific information for each generating site in the state, including emissions data from the EPA U.S. Inventory Report.

[14] We have converted metric tons of emissions as reported by the task force to the 2,000 pound short ton we use in our reporting.

view from the standpoint of benchmarking and regulating emissions; however, it could lead casual or uninformed readers to a misunderstanding of the potential effect on emissions of energy savings. The task force has not reported an emission factor and thus cannot be said to have cultivated this misunderstanding; but it is important to place the task force emissions reporting in a clear light relative to the analysis reported here.