



Mercury Emissions from Coal-fired Power Plants

Public Health and Welfare Finding Pursuant to
Section 285.27(2)(b), Wisconsin Statutes

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This document is available on-line at <http://dnr.wi.gov/air/toxics/mercury/rule.htm>.

Mercury Finding Pursuant to Section 285.27 (2)(b), Wisconsin Statutes

Finding

A revised mercury emission standard for coal-fired electrical generating units is necessary to provide adequate protection of public health and welfare from the mercury risk in Wisconsin.

Overview

The Wisconsin Department of Natural Resources proposes to adopt administrative rules for a revised emission standard for mercury. In the absence of a federal standard promulgated under section 112 of the Clean Air Act, the Department may promulgate a standard if it finds that a standard is needed to provide adequate protection of public health and welfare. This document contains the written documentation to support the finding that a revised standard for mercury is needed for coal-fired electric generating units (EGUs), as required under Wis. Stats. 285.27(2)(b) (*Appendix A*).

This document includes the following four sections that correspond to the elements for which written documentation supporting the finding are required:

- Section 1 - Identify sources of mercury and populations potentially at risk.
- Section 2 - Assess whether exposures to mercury are above a level of concern.
- Section 3 - Evaluate options to control risks from mercury exposures.
- Section 4 - Compare mercury emission standards proposed with those from neighboring states.

On May 18, 2005, the federal Clean Air Mercury Rule (CAMR) requiring emission reductions from coal-fired EGUs was promulgated by the United States Environmental Protection Agency (EPA) under section 111 of the Clean Air Act. The purpose of regulations developed under section 111 is to ensure that emission standards for significant sources reflect advancements in air pollution control technology. Therefore, section 111 emission standards are not directed specifically at public health protection. On the other hand, regulations developed under section 112 are focused on protecting public health and welfare.

On February 8, 2008, the Washington D.C. Court of Appeals vacated the CAMR as well as EPA's removal of coal-fired EGUs from the list of source categories under section 112, the Hazardous Air Pollutant section, of the Clean Air Act (*State of NJ v. EPA*, D.C. Ct. App. No. 05-1097). In 2005, the EPA had removed coal-fired EGUs from the section 112 source category list in order to regulate the emissions through a cap and trade program under section 111. The Court found that the EPA's action was "unlawful" and therefore coal-fired EGUs cannot be regulated under section 111 unless EPA makes the finding that "emissions from no source in the category or subcategory concerned ... exceed a level which is adequate to protect public health with an ample margin of safety and no adverse environmental effect will result from emissions from any source." This

decision vacates the CAMR. It is not clear, when, and in what manner, EPA will address mercury emissions from coal-fired EGUs. The EPA or other parties that intervened in the case may petition for reconsideration or rehearing. The deadline for petitions is March 24, 2008.

Thus, to date, federal mercury rules have not been promulgated under section 111 or 112 of the Clean Air Act. If EPA promulgates emission limitations for hazardous air pollutants pursuant to section 112, Wisconsin is required to promulgate similar emission limitations for hazardous air pollutants, as required under Wis. Stat. 285.27(2)(a). In the absence of a federal standard promulgated under section 112, the Department may promulgate a standard if it finds that a standard is needed to provide adequate protection of public health and welfare, as required under Wis. Stat. 285.27(2)(b).

The Department is proposing a revision to the mercury emission requirements affecting coal-fired EGUs in the current state mercury rule, Chapter NR 446, Wis. Adm. Code. This finding supports a revision to the state's current mercury emission standard that provides protection of public health and welfare.

Background

Mercury moves through the environment contaminating aquatic food webs and posing a health threat to humans and wildlife that consume fish. Mercury from natural and man-made sources is released to the atmosphere, where it is transported and deposited in terrestrial and aquatic ecosystems. Bacteria in lakes and waterways convert mercury to a more toxic form, methylmercury, which bioaccumulates and biomagnifies in fish. Bioaccumulation is the build-up of a substance in an organism from the surrounding air or water, or through the consumption of contaminated food. Biomagnification means that concentrations of a substance increase at successively higher levels of the food chain. Methylmercury concentrations in fish may be 10 million times higher than those found in water. Exposure to methylmercury from eating sufficient quantities of contaminated fish is known to affect human health and development and is associated with a decline in wildlife populations.

Mercury Contamination in Wisconsin's Environment

The Department's earliest examination of mercury contamination began in 1970. This included fish sampling in the Wisconsin River where known sources of mercury were a concern. Department studies, in 1972, examined mercury concentrations in upland game such as white-tailed deer and cottontail rabbits. These studies found that mercury concentrations were very low in these mammals, which were all herbivores. A 1978 study found much higher mercury levels in fish-eating mammals, such as mink, as did a 1976 through 1979 study of fish-eating birds, such as eagles and loons. Significantly, these early studies showed a direct relationship between mercury concentrations found in predators and their prey. The Department continued to expand monitoring in the 1980s to include more lakes as a result of reports of elevated mercury in fish from lakes remote from known sources of mercury. Wisconsin began to issue mercury-based

consumption advisories in 1985 after the department identified elevated mercury levels in sport fish harvested from several northern lakes.

In 2001, the state changed its mercury advice to people on how they can safely eat fish caught from Wisconsin's inland waters contaminated with mercury. The changes reflected the latest scientific findings and the recommendation of the Wisconsin Department of Health and Family Services to use values that better protect human health. As a result, all inland waters in Wisconsin have the same general consumption advice on how many meals of certain species people can safely eat to keep their mercury exposure at or below acceptable risk levels. Consumption frequency recommendations provided for sensitive populations including pregnant women and young children, age 15 and younger as well as for adult men and older women are intended to prevent over-exposure to methylmercury and are calculated using the mercury levels found in Wisconsin fish. In addition, more stringent advice is provided for species from lakes where higher concentrations of mercury have been documented. In 2007, 93 lakes required advice more stringent than the general advice.

Adequacy of the Federal Clean Air Mercury Rule¹

Coal-fired EGUs are the largest human-caused source of mercury air emissions in the United States, accounting for over 40 percent of all domestic human-caused mercury emissions. EPA has estimated that about one quarter of U.S. emissions from coal-fired EGUs are deposited within the contiguous U.S. and the remainder enters the global cycle. Coal-fired EGUs in Wisconsin account for approximately 60% of our stationary source mercury emissions according to 2005 air emission inventory data.

EPA previously made a determination in December 2000 that it "was appropriate and necessary" to regulate mercury emissions from coal-fired EGUs through the hazardous air pollutant provisions in section 112 of the Clean Air Act. This determination was based upon a study mandated by section 112(n)(1)(A) of the Clean Air Act, as well as subsequent information and consideration of alternative feasible control strategies. It found that mercury emissions from EGUs, which are the largest domestic source of mercury emissions, present significant hazards to public health and the environment.

In 2005, EPA, in parallel with the promulgation of the CAMR, developed regulations that revised their December 2000 finding and removed EGUs from the list of source categories that need to be addressed under section 112. The rejection by EPA of their December 2000 determination and promulgation of the CAMR under section 111 of the Clean Air Act was widely criticized by state and local air quality agencies and nongovernmental organizations as inappropriate and inadequate in terms of protecting public health and welfare. The regulation of coal-fired EGUs under section 111 allowed the EPA to use a cap and trade program. In contrast, section 112 requires unit-by-unit controls on a shorter timeframe.

¹ This rule was promulgated by EPA but has since been vacated by a federal court. However, the rule was in place as Wisconsin prepared its draft mercury rule revisions and it provides important context to Wisconsin's rulemaking.

A number of states have proceeded to address public health concerns by establishing laws and regulations that achieve more mercury reductions sooner than the CAMR would have achieved for coal-fired EGUs in their jurisdiction. Most of these states also rejected the national trading program EPA developed as a compliance option for state's to meet the CAMR. According to the Congressional Research Service, as of July 2006, 13 states have programs that require reductions in mercury emissions of 80% to 90% with effective dates from 2007, at the earliest, to 2015.

Proposed Revisions to the Current State Mercury Rule - April 2007

At their April 2007, meeting the Natural Resources Board authorized public hearings on revisions to the current state mercury rule in response to three separate but related actions. This included promulgation of the federal CAMR in May 2005, a directive from Governor Doyle in August 2006 to further reduce mercury emissions, and a January 2007 citizen petition requesting revisions to Chapter NR 446.

The CAMR, now vacated, required the reduction of mercury emissions from new and existing coal-fired EGUs through a cap on mercury emissions expressed as an annual state emission budget that includes two phases of reductions. The initial phase was to begin in 2010 and continue until 2017. The second phase was to begin in 2018 and continue indefinitely. Wisconsin's budget during the first phase (2010 to 2017) was 0.890 tons (1,780 pounds) of mercury per year and declined to 0.351 tons (702 pounds) of mercury per year in 2018 and every year thereafter. State mercury budgets were permanent caps regardless of growth in the electrical sector. A national mercury emissions trading program was developed by EPA as an option for states to meet their CAMR state mercury emission budget.

Governor Doyle's directive issued on August 25, 2006, requires the Department to develop a rule achieving a 90% reduction of mercury emissions from coal-fired power plants. The Citizen Petition was submitted on January 22, 2007, to the Department and Natural Resources Board under provisions in s. 227.11(2)(a) and 227.12(1) and (2), Wis. Stats., and NR 2.05 Wis. Adm. Code. The petition requested the Department and Board to conduct rulemaking proceedings to revise and adopt rules that require a 90% to 95% reduction in of mercury to the air from coal-fired EGUs in the state by January 1, 2012.

The Department is proceeding with this rulemaking to address Governor Doyle's directive and to respond to the January 2007 citizen petition. This public health and welfare finding supports development of a mercury control standard which addresses the Governor's Directive and the citizen petition.

Finding Summary

The following summary statements are the key conclusions from the written documentation that supports the finding that a revised mercury emission standard for

coal-fired EGUs is necessary to protect public health and welfare from mercury exposure.

1. Health experts worldwide have identified the reduction of mercury exposures as a major public health goal.
2. The Wisconsin Department of Health and Family Services, federal governmental organizations, and international governments and institutions have identified women of child-bearing age, infants and children as the populations at greatest risk from elevated mercury exposure.
3. Recent research has identified mercury effects on the immune system and a potential role of mercury exposure in elevating the risks of heart disease and heart attacks in adults.
4. In the United States, the majority of mercury exposure to people and wildlife occurs from eating mercury contaminated fish. Increased fish consumption is related to an increase of mercury in the body, usually measured in the blood or hair.
5. Wisconsin has issued mercury-based sport-fish consumption advisories for people of all ages since 1985.
6. Nationally, about 5-10% of women of childbearing age have elevated mercury levels in their blood that poses a potential risk to unborn children. These risks include developmental effects such as lower performance on language, attention and memory tests and adverse effects in vision and motor functions. Two Wisconsin studies have found elevated mercury levels in approximately 6% of women of childbearing age.
7. A 2004 survey of hair mercury concentrations in Wisconsin residents showed that 29% of men and 13% of women had mercury levels above the Wisconsin and National guideline value of 1 ppm. The United States Environmental Protection Agency has determined that hair mercury concentrations in excess of 1 ppm are a level of concern for adverse effects.
8. A survey conducted by the Wisconsin Department of Health and Family Services in 1999 found that more than 90% of Wisconsin women between the ages of 18 to 45 include fish in their diets and that approximately one-third of them consume sport-caught fish.
9. It is estimated that approximately 437,000 men and women in Wisconsin are exposed to mercury above the safe level established by the United States Environmental Protection Agency.
10. Fish eating birds and mammals in Wisconsin are at risk of adverse health effects from mercury contamination and laboratory studies demonstrate that mercury levels typically found in the environment can cause negative impacts on fish reproductive success.
11. Wisconsin based studies have found that reduced atmospheric mercury deposition results in lower levels of fish contamination in sensitive lakes. Fish mercury levels in Little Rock Lake, Vilas County, decreased by 30% between 1994 and 2000, coinciding with a similar decrease in atmospheric mercury loading over the same time period. The authors attributed the change in mercury loading to decreased emissions of mercury from commercial and industrial sources in the region.

12. This pattern of lowered mercury deposition rates has also been observed in Minnesota. A study of 176 lakes in Minnesota found decreasing trends in mercury deposition and during that time, mercury levels in fish dropped in 87 lakes, stayed the same in 45 lakes and increased in 44 lakes.
13. Evidence from Europe, the state of Washington, the northeastern United States and southeastern Canada shows that if mercury emissions are reduced, there can be a significant lowering of mercury levels in fish and wildlife.
14. Studies where isotopes of mercury have been added to research plots to track where the mercury ends up, have generally found that mercury and methylmercury concentrations in sediments, water, plant and animal life were all linearly related to this added mercury deposition. This suggests that increases (and decreases) in mercury will affect concentrations in sediments, water, plant and animal life as well.
15. Since several studies in the U.S., Canada and Europe have shown that local and regional reductions in mercury emissions led to lower rates of atmospheric mercury deposition and lower concentrations of mercury in air, rain, water and fish, it is reasonable to conclude that reducing mercury sources in Wisconsin will have positive effects on the environment and public health.
16. The State of Michigan estimates that about half of the mercury emitted from coal-fired power plants is readily deposited and a recent study has identified atmospheric reactions enhancing the tendency for local and regional mercury deposition.
17. The most significant stationary source category of mercury emissions in Wisconsin is coal-fired EGUs currently accounting for 62.5% of stationary source mercury emissions. After a planned conversion in 2009 to a mercury free chlor-alkali production process at ERCO Worldwide, coal-fired EGUs will continue to be the largest stationary source of mercury air emissions in Wisconsin but the proportional share will increase to 86% of total mercury air emissions.
18. Emission control technologies are commercially available to reduce mercury releases from the types of coal-fired EGUs operating in Wisconsin. Additional technologies, suitable for commercial application, will be available within the next seven years.
19. Air pollution control technology used to reduce particulate matter, nitrogen oxides and sulfur dioxide from coal-fired EGUs can also be effective at reducing mercury emissions. However, since their effectiveness varies by coal types, between units and within units over time, mercury specific control techniques are necessary to achieve consistent and effective mercury removal particularly for subbituminous coal-fired EGUs.
20. With the development of mercury specific technologies including Toxecon®, halogenated activated carbons, and oxidizing chemicals a 90% or greater mercury removal efficiency is feasible for bituminous and subbituminous coal-fired EGUs in Wisconsin.
21. The cost of fly ash disposal is still an issue that must be weighed in the selection of a mercury control approach for existing EGUs.
22. The costs of commercially available and emerging mercury control technologies for coal-fired EGUs are reasonable in comparison to the costs to control conventional pollutants, including particulate matter, nitrogen oxides and sulfur dioxide.

23. Twenty-two states have or are proposing requirements that achieve more mercury emission reductions than the vacated federal CAMR.
24. Among the states in EPA's Region 5, Illinois, Michigan and Minnesota are proposing or have adopted requirements more stringent than Wisconsin's current rule affecting coal-fired EGUs.
25. In recognition of the advancements that have occurred in mercury control technology since the development of the current state mercury rule in 2003, including improved effectiveness and lower cost, it is appropriate to establish a revised mercury rule that will achieve greater mercury emission reductions from coal-fired EGUs.
26. Proposed revisions to the state mercury rule in chapter NR 446, Wis. Adm. Code, adopt a mercury emission standard that is comparable to the mercury emission standards for coal-fired EGUs in neighboring states.
27. Wisconsin, like Illinois, Michigan and Minnesota is requiring large coal-fired EGUs to achieve a 90% reduction based on mercury in coal combusted. Dates by which compliance with this mercury emission standard is required varies from 2009 to 2021. In part, this variation can be attributed to the availability of multipollutant reduction options that extends the mercury reduction compliance date in exchange for reductions in sulfur dioxide and nitrogen oxide.
28. Substantial reductions in sulfur dioxide and nitrogen oxide emissions would, however, be achieved by 2015 under the multipollutant option included in the proposed revisions. These reductions will help to lower mercury contamination levels in fish due to the link between acid rain and methylmercury production as demonstrated by experimental studies on Little Rock Lake, Vilas County. These reductions will also address other critical air quality concerns including fine particles, haze, and ground level ozone.
29. Wisconsin, like Illinois and Michigan, will include mercury emission standards for new coal-fired EGUs or power plants.
30. Developing a revised emission standard for coal-fired EGUs to protect public health under the provisions of s. 285.27(2)(b) Wis. Stats. is the most appropriate option to achieve significant mercury emission reductions from stationary sources since coal-fired EGUs are the stationary source category that accounts for the majority of mercury emissions in Wisconsin.

Section 1 - Identify sources of mercury and populations potentially at risk (“A public health risk assessment that characterizes the types of stationary sources in this state that are known to emit the hazardous air contaminant and the population groups that are potentially at risk from the emissions.” - s. 285.27(2)(b)1., Wis. Stats.)

Stationary Sources in Wisconsin that are Known to Emit Mercury

Wisconsin air emission inventory data indicates that three major types of stationary sources are responsible for mercury air emissions in the state:

1. Coal-fired electrical generating units.
2. ERCO Worldwide chlor-alkali facility in Port Edwards.
3. Industrial coal-fired power boilers.

According to 2005 air emission inventory data, a total of 4,140 pounds of mercury was released into the environment from stationary air pollution sources. Of this total, 2,586 pounds (62.5%) came from coal-fired electrical generating units and 1,139 pounds (27.5%) from the chlor-alkali facility in Port Edwards, Wisconsin. Another 195 pounds (4.7%) came from coal-fired power boilers located at industrial facilities in the state.

Wisconsin’s sole chlor-alkali facility, ERCO Worldwide, has announced that it will undergo modifications to eliminate its mercury cell technology by the end of 2009. The proportionate share of mercury emissions from coal-fired electrical generating units in Wisconsin will significantly increase (percent from this source will go from 62.5% to 86% of state emissions) and they will remain the largest mercury stationary source category in Wisconsin (**Table 1.1**).

Table 1-1 Wisconsin Stationary Source Mercury Emission Sources

Stationary Source Category	2005 Mercury Emissions - Pounds	Number of Processes**	Pounds Mercury Emissions per Process	Contribution of Mercury Emissions Statewide	
				w/ Chlor-alkali	w/o Chlor-alkali
ERCO Chlor-alkali Production	1,139	1	1,139	27.5%	
Solid Fuel-fired Electrical Generating Units*	2,586	62	42	62.5%	86.2%
Industrial, Institutional and Commercial Solid Fuel Boilers	195	74	2.6	4.7%	6.5%
Sludge Drying and Combustion	95	5	18.9	2.3%	3.2%
Foundry	55	5	10.9	1.3%	1.8%

Stationary Source Category	2005 Mercury Emissions - Pounds	Number of Processes**	Pounds Mercury Emissions per Process	Contribution of Mercury Emissions Statewide	
				w/ Chlor-alkali	w/o Chlor-alkali
Waste Incineration	34	5	6.7	0.8%	1.1%
Natural Gas and Oil Combustion	18.5	553	0	0.4%	0.6%
Remaining Categories	18.3	13	1.4	0.4%	0.6%
	4,140	718	5.8		

Wisconsin DNR Air Emissions Inventory - 2005, Bureau of Air Management.

*Solid fuel EGU boilers are primarily coal-fired but other reported fuels include coke, tires, biomass, and paper pellets.

**Firing of different fuels is reported as separate processes for the same unit therefore there may be multiple reported processes for a single emission unit (e.g. a boiler burning coal and coke have two reported processes in the air emission inventory). The one exception is the ERCO chlor-alkali production which has nine separate reported processes but for purposes of this analysis they are considered one process.

Population Groups that are Potentially at Risk from Mercury Exposure

Women, infants and children are especially susceptible to the neurological effects of mercury based on research regarding mercury health effects (*Knobeloch et al., 2006; EPA, 2007*). For people as well as for fish eating birds and mammals, the majority of mercury exposure comes from fish consumption. “Wisconsin has issued mercury-based sport-fish consumption advice to people of all ages since 1985” (*Knobeloch et al., 2006*). *In utero* exposures to methylmercury have been linked to developmental effects such as lower performance on language, attention and memory tests and have also been associated with adverse effects in vision and motor functions (*Mergler et al., 2007*).

In addition, mercury has effects on the immune system. There is recent evidence that suggests that exposure to methylmercury at concentrations currently being measured may result in an elevated risk of cardiovascular disease and heart attacks (in men and possibly in women as well) to a significant fraction of the population (*Mergler et al., 2007*).

Section 2 - Assess whether exposures to mercury are above a level of concern (“An analysis showing that members of population groups are subjected to levels of the hazardous air contaminant that are above recognized environmental health standards or will be subjected to those levels if the department fails to promulgate the proposed emission standard for the hazardous air contaminant.” - s. 285.27(2)(b)2., Wis. Stats.)

Population Groups Exposed Mercury Contamination in Wisconsin above Recognized Health Standards

The EPA’s reference dose is the value chosen to represent the best estimate of a “safe” level of exposure to methylmercury. The EPA reference dose of 0.1 ug/kg/day corresponds to a blood mercury level of 5.8 ug/L (ppb) and a hair mercury level of approximately 1 ug/g (ppm) (**Table 2-1**). The reference dose is based on human studies and is intended to protect against the neurodevelopmental effects of prenatal exposure as well as potential effects of this toxin on the cardiovascular system and aging nervous system (*Knobeloch et al., 2006; EPA, 2007; Mergler et al., 2007*).

Table 2-1 EPA Levels of Concern in Humans – Equivalent levels of concern expressed as daily intake, blood levels and concentration in hair (Knobeloch et al. 2006).

Micrograms per kilogram per day (ug/kg/day)	Blood Concentration in micrograms per liter of blood (ug/L) = parts per billion	Hair Concentration in micrograms per gram (ug/g) = parts per million
0.1	5.8	1

The EPA’s reference dose was evaluated in 2000 by the National Research Council and by the World Health Organization in 2003. Both organizations endorsed the EPA’s reference dose as the appropriate methylmercury exposure standard (*US National Research Council 2000; WHO-JEFCA 2003*). The State of Wisconsin Department of Health and Family Services has accepted the EPA reference dose as the best available health benchmark and currently uses it to develop Wisconsin’s fish consumption advisories.

Health experts worldwide have identified the reduction of mercury exposures as a major public health goal. At the Eighth International Conference on Mercury as a Global Pollutant, the panel on “Health Risks and Toxicological Effects of Methylmercury” made the following recommendation:

“[T]o preserve human health, all efforts need to be made to reduce and eliminate sources of exposure, through regulation and dissemination of information”(Mergler et al., 2007).

A survey of hair mercury levels in 2,031 Wisconsin residents showed that 29% of men and 13% of women had mercury levels above EPA’s established level of concern for mercury of 1 ppm (*Knobeloch et al., 2007*). It is estimated that approximately 437,000

men and women in Wisconsin are exposed to mercury above the safe level established by the United States Environmental Protection Agency (*Knobeloch, 2005*). Because of the increased popularity of fish as a source of dietary protein, a significant percentage of the U.S. population may be at risk of methylmercury-induced health problems. A case report series authored by Knobeloch et al., 2006, summarizes information for several Wisconsin residents who were found to have high blood or hair mercury levels after they ate repeated meals of contaminated commercial or locally-caught fish. Some of these individuals described vague symptoms such as mental confusion, sleep difficulty, balance problems or visual disturbances that improved after their mercury levels returned to normal.

Nationally, about 5-10% of women of childbearing age have elevated mercury levels in their blood that poses a potential risk to unborn children (*McDowell et al., 2004*). A separate study of Wisconsin women estimated that about 6% of women of childbearing age had elevated mercury levels (*Knobeloch et al., 2005*). A survey conducted by the Wisconsin Department of Health and Family Services in 1999 found that more than 90% of Wisconsin women between the ages 18 and 45 include fish in their diets and that approximately one-third of them consume sport-caught fish (*Knobeloch et. al., 2005*).

Symptoms of clinical toxicity such as vision problems, hypertension, and tremors have been associated with blood mercury levels above 50 ug/L (*Agency for Toxic Substances and Disease Registries 1999*). There have been a few cases in Wisconsin where fish consumption has been associated with blood concentrations in the range of 50 ug/L (*Knobeloch et. al., 2006*).

Mercury Contamination in Wisconsin Wildlife Populations

Due to a combination of mercury loading and ecological sensitivity many Wisconsin lakes, especially in northern Wisconsin, have elevated levels of mercury in fish. Fish-eating birds and mammals have exposures in the same range that experimental studies have shown to cause behavioral, neurological and reproductive system effects (*Scheuhammer et al., 2007*).

Large regions of Wisconsin are considered to be highly sensitive to atmospheric mercury deposition. Lakes in sensitive regions typically share the following characteristics:

- Low alkalinity, low pH lakes that are not drainage lakes (i.e., they do not have a significant river flow into and out of the lake).
- Wetlands, land uses and water level fluctuations that enhance the ability of deposited mercury to be converted into methylmercury.
- Food chains with predatory fish, such as walleye, musky and largemouth bass, that bioaccumulate the methylmercury to high levels (*Munthe et al., 2007; Watras et al., 2006; Meyer, 2006; Rasmussen et al., 2007*).

Loon diets that contain fish with mercury levels above 0.2 parts per million have been shown to have adverse effects such as reduced reproductive success (*Evers et al., 2007; Scheuhammer et al., 2007; Burgess & Meyer, 2008*). Wisconsin loons nesting on acidic lakes (pH < 6.3), with higher methylmercury concentrations in fish, showed reduced reproductive success compared to loons elsewhere in Wisconsin (*Meyer et al., 1995; Meyer et al., 1998*). Loon chicks have been shown to be particularly sensitive to methylmercury exposures such that fish mercury levels above 0.4 ppm are a concern (*Scheuhammer et al., 2007*). In addition to reproductive toxicity, mercury is also suspected of affecting bird survival due to immune suppression (*Scheuhammer et al., 2007; Kenow et al., 2007*). Studies of loons suggest that exposure to fish with a methylmercury concentration above 0.2 ppm may be responsible for reduced reproduction and survival rates. Fish in many Wisconsin lakes are above 0.2 ppm (*Evers et al., 2007*). Population modeling suggests that loon populations will benefit from reductions in mercury loading to lakes where they feed and nest (*Meyer, 2006*). It is likely that other fish-eating species will also benefit.

Mink and otter, two piscivorous (fish eating) mammals, have been identified as susceptible to mercury toxicity. It is probable that current environmental exposures are sufficiently high to have neurological and reproductive effects (*Scheuhammer et al., 2007*).

Wild piscivorous fish may also be at risk from elevated methylmercury exposure and toxicity as well. These types of fish include sport fish like musky and walleye. Effects of concern at environmentally relevant exposure levels (less than 1 ppm) include impairment of fish behavior, gonadal development, production of sex hormones and reproduction (*Scheuhammer et al., 2007*). A study of Wisconsin perch found that methylmercury levels in the eggs were within the range of mercury effects levels derived from laboratory toxicity studies (*Hammerschmidt, 1999*), which suggests the potential for reproductive effects occurring in Wisconsin fish populations.

Relationship between Mercury Emissions and Mercury Contamination

Several lines of evidence show that there is a positive relationship between mercury emissions and mercury contamination in Wisconsin. Evidence further indicates that a measurable response to changes in mercury deposition can occur over time-scales of less than one year.

Sediment cores from lakes in Minnesota and Wisconsin show that atmospheric mercury deposition increased by roughly three-fold with increasing industrial activity throughout most of the 20th century (*Swain and Engstrom, 1992; Fitzgerald et al., 1998*). After 1990, declines in mercury deposition coincided with a regional decrease in the industrial and commercial use of mercury and reduced smelting activity (*Engstrom and Swain, 1998; Watras et al., 2000*). Along with declining mercury deposition, there have been contemporaneous reductions in the concentration of mercury in water and fish (*Hrabik and Watras, 2002; MPCA, 2006; Rasmussen et al., 2007; Watras and Morrison, 2008*).

Studies on Little Rock Lake in Vilas County showed that when atmospheric mercury deposition to the lake declined by roughly 40% between 1994 and 2000, there were similarly large declines for mercury in water and fish (*Hrabik and Watras, 2002*). These findings implied that the bioaccumulation of mercury depended more on the deposition of “new” mercury than on the remobilization of “old” historically-deposited mercury stored in sediments and watershed soils. Similar findings have been reported for Devils Lake in Forest County (*Watras and Morrison, 2008*).

The findings for Little Rock Lake and Devils Lake are supported by two field studies that document reductions in fish mercury across northern Wisconsin. Rasmussen et al. (2007) reported that mercury in walleye have decreased on average by 5% per decade since 1982. Similar findings were reported by Madsen and Stern (2007) using an independent set of Wisconsin fish data compiled by native tribes.

Field experiments in Canada support the Wisconsin studies. In these experiments mercury isotopes were added to lake water to track its movement into the aquatic food chain. The experiments showed that added mercury moved rapidly into lower levels of the food chain and then were rapidly transferred to higher trophic levels, including fish (*Orihel et al., 2006; Harris et al., 2007*). Together with the Wisconsin studies, these experiments confirm that increases and decreases in the deposition of “new” mercury can have substantial and rapid effects on food chain contamination.

Although mercury is a global problem, it has local and regional dimensions. Field studies in Washington state, Ohio, Sweden and Germany show that mercury emissions influence mercury deposition near sources (0 – 500 miles). Mercury deposition near Seattle, Washington declined significantly after mercury emissions from local waste incinerators were reduced (*Prestbo et al., 2006*). In southern Sweden, mercury concentrations in air, rain and fish declined after the reduction of large mercury emission sources in eastern Germany during the early 1990s (*Johansson et al., 2001; Munthe et al., 1995; 2001*). In eastern Ohio, the major contributor to mercury in rain was found to be local and regional coal combustion (*Keeler et al., 2006*).

Due to the influence of certain co-factors, the ecological response to mercury deposition can vary from lake-to-lake and from time-to-time. Sulfate reducing bacteria are known to mediate the conversion of atmospherically-deposited mercury to methylmercury, so factors that affect the abundance and activity of these bacteria affect mercury bioaccumulation. For example, when sulfate was added experimentally to Little Rock Lake, methylmercury production and fish contamination increased substantially (*Watras et al., 2006*). After the experiment when concentrations of sulfate declined over time, methylmercury concentrations also declined. Thus, acid rain (which is enriched in sulfate) can exacerbate or ameliorate the effects of atmospheric mercury deposition (*Gilmour and Henry, 1991; Watras and Morrison, 2008*).

Fluctuating water levels also affect methylmercury production in lakes, which implies that climate change and land use are other important co-factors. When a small wetland in Canada was experimentally flooded, concentrations of methylmercury in water and

aquatic organisms increased due to the general stimulation of bacterial activity (*St. Louis et al., 2004*). Similarly, when water levels in Little Rock Lake declined during dry conditions from 1998-2007, concentrations of methylmercury increased due to drought-induced increases in sulfate (*Watras and Morrison, 2008*).

The chemical forms and reactions of mercury in the atmosphere determine the relationship between mercury emission and deposition. Atmospheric mercury consists of at least three different forms: particulate mercury, reactive gaseous mercury and zero-valent mercury (abbreviated as HgP, RGM and Hg⁰). Particulate mercury (HgP) and reactive gaseous mercury (RGM) are readily deposited via rainfall or adhere to the surface of leaves, branches, soil and water. Zero-valent mercury (Hg⁰) is less readily deposited; and, therefore, it constitutes most of the mercury in the air. The State of Michigan estimates that emissions from coal-fired power plants comprise 50% Hg⁰, 30% RGM and 20% HgP, which implies that about half of the emitted mercury is readily deposited (*Sills et al., 2007*). However, a recent study shows that Hg⁰ undergoes atmospheric reactions that convert it to RGM and/or HgP enhancing the tendency for local and regional deposition (*Lindberg et al., 2007*).

Based on the studies above and in consultation with Wisconsin-based as well as other national and international mercury research, it is reasonable to conclude that if mercury sources in Wisconsin reduce their mercury emissions, a local benefit will be seen in reduced mercury contamination in fish and wildlife. In addition, northern Wisconsin lakes in ecologically sensitive regions (e.g., low alkalinity, low pH) should show a fairly rapid response to decreased mercury deposition loadings, although there are many variables (such as sulfate deposition, land use, water table fluctuations, bioavailability, and the food chain within a given lake and watershed) that can affect the timing for observing any changes in contaminant levels in fish and wildlife (*Lindberg et al., 2007; Munthe et al., 2007; Watras et al., 2006; Evers et al., 2007; Watras et al., 2008*). Certainly the type of coal burned by a coal-fired power plant and the type of pollution control at the facility makes a difference in terms of the species of mercury emitted and where deposition occurs, but there are a large number of studies that conclude local and regional source controls are important to reduce local mercury deposition impacts.

Section 3 - Evaluate options to control risks from mercury exposures “An evaluation of options for managing the risks caused by the hazardous air contaminant considering risks, costs, economic impacts, feasibility, energy, safety, and other relevant factors, and a finding that the chosen compliance alternative reduces risks in the most cost-effective manner practicable.” - s. 285.27(2)(b)3., Wis. Stats.)

Stationary Sources of Mercury Emission

Because of their high proportionate share of mercury emissions it is appropriate to develop a revised emission standard to control of mercury emissions from coal-fired EGUs to manage mercury risks in Wisconsin. Section 1 identified coal-fired EGUs and the ERCO Worldwide chlor-alkali facility as the stationary sources that account for the majority of mercury air emissions in Wisconsin (**Table 1-1**). After conversion to a mercury-free chlor-alkali process is accomplished by ERCO Worldwide, coal-fired EGUs represent 86% of the 2005 mercury emissions. The remaining 14% of mercury emissions are emitted by many small combustion and industrial processes at numerous stationary sources.

In addition to the significant contribution of mercury emissions there are several additional critical considerations which support the adoption of a revised mercury emission standard for coal-fired electrical generating units.

- *Cost-effectiveness* - The amount of mercury emitted from each stationary source is significantly higher for EGUs than any other source category, with the exception of the ERCO chlor-alkali plant (**Table 1-1**). On average, EGUs emit 42 pounds per process. The source categories with the next highest emission intensities are sludge drying and combustion and foundry furnaces. Both source categories have annual emissions a fraction of EGUs and emission intensities less than half that of the EGU source category. Although other factors are relevant, the mercury emission intensity measured as pounds per process as well as the quantity of mercury emissions in comparison to other source categories are indicators of a cost-effective emission reduction opportunity. Other than coal-fired EGUs, there are no other major stationary source categories with as significant mercury reduction potential.
- *Mercury Reduction Potential in Other Source Categories* - Mercury emissions from several of the largest mercury emitting categories are already required to meet state or federal mercury emission standards requiring control technology to achieve a high level of mercury reductions. For example, municipal solid waste incinerators must meet a federal hazardous air pollutant standard requiring 80% to 90% mercury control efficiency. A federal hazardous air pollutant standard is under development for industrial, institutional and commercial solid fuel boilers.

Developing a revised emission standard for coal-fired EGUs to protect public health under the provisions of s. 285.27(2)(b) Wis. Stats. is the most appropriate option to achieve significant mercury emission reductions from stationary sources since coal-fired

EGUs are the stationary source category that accounts for the majority of mercury emissions in Wisconsin.

Mercury-containing Products

Mercury-containing products are another significant source of mercury discharge to Wisconsin's environment. Product disposal can result in mercury discharge to air, land and water. Eliminating mercury use in products and proper recycling are the approaches that can successfully address this source of mercury contamination. All significant discharges of mercury to the environment are important to address and a comprehensive state program includes actions that limit mercury emissions from stationary sources as well as proper management of mercury-containing products. It should be noted that the Department's authority under s. 285.27(2)(b) Wis. Stats. is confined to addressing stationary source mercury emissions.

Mercury Controls for Coal-fired Electrical Generating Units

Outlined below are the mercury control technologies that are or soon will become commercially available for coal-fired EGUs in Wisconsin. These control technologies applied alone or in combination can effectively achieve cost effective mercury emission reductions from coal-fired EGUs. Mercury control technology that effectively reduces mercury from coal-fired EGUs is commercially available now. Additional technologies, suitable for commercial application, will be available within the next seven years. In 2004, EPA announced that optimized multipollutant control (mercury, nitrogen oxides and sulfur dioxide) would be available after 2015 achieving 90% to 95% mercury control for all coal types. In 2006, EPA restated that it now believes that 90% to 95% control may be available for most, if not all, coal types between 2010 and 2015 (*USEPA, 2005*).

Coal-fired Electrical Generating Units in Wisconsin

In Wisconsin, electrical energy is primarily provided by coal combustion and the principal coal types used are subbituminous and bituminous. Other solid fuels, in small amounts, are also used for electrical generation including petroleum coke, tires, paper pellets and biomass. Subbituminous coal firing accounts for 84% of the solid fuel generating capacity. Large EGUs, greater than 150 megawatts (MW) account for 77% of our existing coal electrical generating capacity (**Table 3-1**).

Table 3-1 Coal-type, Capacity and Existing Air Pollution Control Systems

Control System Configuration	Capacity in Megawatts		
	Bituminous	Subbituminous	Total
<i>Electric Generating Units > 150 MW</i>			
Fabric Filter		338	338
Electrostatic Precipitator - cold side		2,442	2,442
Electrostatic Precipitator - hot side		558	558
Electrostatic Precipitator + Fabric Filter	349	366	715
Electrostatic Precipitator +		1,234	1,234

Selective Catalytic Reduction + Wet Flue Gas Desulfurization			
Electric Generating Units > 25 MW < 150 MW			
Fabric Filter	345		345
Electrostatic Precipitator - cold side	361	614	975
Electrostatic Precipitator - hot side		219	219
Mechanical Cyclone	30		30
All Electric Generating Units			
> 150 MW	349	4,938	5,287
> 25 MW < 150 MW	736	833	1,569
Total	1,085	5,771	6,856

Unit Size in Megawatts	Percent by Coal Type		
	Bituminous	Subbituminous	Percent by Megawatts
> 150 MW	7%	93%	77%
> 25 MW < 150 MW	47%	53%	23%
Percent by Coal Type	16%	84%	

The majority of large coal-fired EGUs in the state, greater than 150 MW, were originally fired with bituminous coal. However, these units have been converted to lower sulfur subbituminous coal to reduce acid deposition in the state. Currently, over 90% of the coal combusted by EGUs greater than 150 MW is subbituminous. EGUs less than 150 MW combust equal amounts of bituminous and subbituminous coal and are also the units primarily engaged in burning other solid fuels like petroleum coke, tires, paper pellets and biomass.

Coal-fired EGUs in the state are currently equipped with fabric filters or electrostatic precipitators to control particulate matter emissions. Several Wisconsin electric utilities are in the process of installing control technologies for sulfur dioxide and nitrogen oxides to address ozone, fine particulate and haze. Large EGUs are the center of this control technology effort because they are generally Wisconsin's newer units and will generate electricity for years into the future and therefore, appropriate for additional investments. For subbituminous coal-fired EGUs, a typical approach that is being considered is dry flue gas desulfurization (lime injection followed by a fabric filter). However, utilities in the state may elect or need to install a wet flue gas desulfurization on their subbituminous units. One state utility has this type of system in operation with a selective catalytic reduction system (SCR) to remove nitrogen oxides. Electric utilities in the entire eastern United States are undergoing these changes.

In Wisconsin, the focus is on mercury control technologies suitable for large EGUs burning subbituminous coal and compatible with the multipollutant control systems approaches under consideration.

Mercury Control Technology

Control technologies that are currently in use to limit nitrogen oxides, particulate matter and sulfur dioxide from coal-fired EGUs can also remove mercury. However the

effectiveness varies considerably between units and within a unit over time ranging from 0% to 99%, (*DOE, 2006*). Effectiveness also varies by coal type. Therefore, mercury specific control techniques are required to achieve consistent and effective mercury removal particularly for subbituminous coal-fired EGUs.

Summarized below are the three basic control strategies for reducing mercury. A growing number of technologies are becoming available under the mercury oxidation and absorption approaches that can achieve 90% control of mercury emission from bituminous and subbituminous coal-fired EGUs.

1. REDUCING MERCURY CONTENT OF COAL

Fuel substitution offers an effective but, limited approach to reducing mercury emissions. Subbituminous coal is known to contain less mercury than bituminous coal and petroleum coke contains considerably less mercury than any coal type. In addition, biomass and natural gas are fuels with insignificant mercury content. Coal washing and processing can lower mercury content. Coal washing can result in 30% mercury removal. A thermal treatment process is under development that is anticipated to remove 90% of the mercury in coal. Advanced methods of coal cleaning are being developed that show 60% to 80% mercury removal (*Chang, 2007*). One commercially marketed fuel, K-fuel, is subbituminous coal processed to improve combustion qualities and remove up to 70% of the mercury content (*Levin, 2007*).

2. MERCURY OXIDATION

Mercury in an oxidized form readily attaches to particulate matter in boiler exhaust gases and is captured by particulate air pollution control equipment. The amount of oxidized mercury in the exhaust gas of a coal-fired EGU is a function of the chlorine content of coal. In general, bituminous coals have higher chlorine content than subbituminous coals and there is considerable variability within coal types and considerable variability in chlorine contents in coal from the same mine.

Currently, the various combinations of coal types and particulate control equipment used by EGUs result in mercury removal that ranges from 0% to 99%, (*DOE, 2006*). A fabric filter system for control of particulates performs the best with mercury control efficiencies up to 99% for bituminous coal and 50% to 87% for subbituminous coal. Electrostatic precipitators for particulate control have shown similar effectiveness at mercury removal on bituminous coal however, for subbituminous coal mercury removal effectiveness is less with considerably more variability in performance. In general, the combination of subbituminous coal and electrostatic precipitators for particulate control achieve lower mercury control efficiencies than the combination of bituminous coal and fabric filter particulate control systems. As previously described, Wisconsin's large units (> 150 MW) are primarily fired by subbituminous coal with lower chlorine content.

Mercury in an oxidized form is also water soluble and therefore can be captured by a wet scrubber designed to reduce sulfur dioxide emissions. Capture of mercury by wet

scrubbers also varies considerably in mercury removal effectiveness ranging from 4 to 91% (DOE, 2006). The higher efficiencies are typical of the higher chlorine content bituminous coals while subbituminous coals are mainly at the lower range of effectiveness. For both coal types, higher removal efficiencies can be achieved by wet scrubbers that are preceded by Selective Catalytic Reduction (SCR) for nitrogen oxides control. Mercury oxidation is an additional benefit of this nitrogen oxides control technology.

The development of methods to enhance and consistently oxidize mercury is a high priority because the oxidized mercury can be removed using existing control equipment with minimal added cost. An additional advantage of oxidation is that it is an approach that does not impact fly ash like activated carbon sorbent technology. Improvements in mercury oxidation are occurring through two approaches; oxidizing catalyst beds and injection of halogen chemicals (e.g. chlorine). Both approaches are anticipated to improve mercury oxidation such that consistent 80% to 90% mercury removal efficiency is achieved for all coal types.

Specially formulated oxidizing catalysts are demonstrating 80 to 90% oxidation rates on all coal types (Chang, 2007). Strategies are being developed for injecting chemicals in a manner to augment the results of the oxidation catalyst to achieve higher, long term reductions (DOE, 2006). A catalyst vendor is reporting availability of a hybrid catalyst designed for nitrogen oxide reduction and capable of mercury oxidation of 95% for low chlorine coals (Gretta, 2007).

Oxidation techniques are currently capable of achieving 80% or greater mercury removal efficiency. The focus of development is now on achieving 90% mercury removal at specific coal-fired power plants. In general this is less of a challenge for fabric filter based systems which already achieve better results for low chlorine subbituminous coals. On the other hand, wet scrubber systems may require on-site testing to develop the specific strategy for a 90% mercury removal.

3. MERCURY ABSORPTION

Mercury absorption is a commercially available control technology and capable of achieving removal efficiencies of 90% or greater. According to the Institute for Clean Air Companies, 42 activated carbon injection systems for mercury control have been contracted for subbituminous coal-fired EGUs in the United States (ICAC, 2007). Of these contracts, 22 are for fabric filter systems. Three of these activated carbon injection systems are already in operation. Activated carbon injection ahead of electrostatic precipitators accounts for the remaining 20 contracts reported by ICAC. The pollution control industry believes that sorbent injection in combination with a fabric filter can readily achieve mercury removal rates in the 90% range with proper design. And injection ahead of an electrostatic precipitator can achieve 70% to 90% mercury control depending upon plant and control device characteristics (Campbell, 2007).

Absorption can be equally effective on oxidized and non-oxidized forms of mercury. Absorption is the physical capture of mercury with a compatible material. Capture of mercury already occurs in boiler exhaust gases by mercury absorption from unburned carbon created from coal combustion. Although activated carbon injection installations are occurring, improvement of mercury absorption approaches is desirable to address fly ash reuse concerns and increase mercury removal effectiveness for coal-fired EGUs in Wisconsin.

In the initial development of activated carbon as a sorbent for mercury control, high mercury removal efficiencies were achieved on bituminous coals but performance on subbituminous coals was mixed. For subbituminous coals 90% mercury removal efficiency with a fabric filter was achievable but activated carbon injection followed by an electrostatic precipitator was limited to 60% removal efficiency. High injection rates of activated carbon were required to obtain some of these results. From a multipollutant control perspective, fabric filters systems with lime injection for sulfur dioxide removal (dry flue gas desulfurization) lessened the effectiveness of the activated carbon at capturing mercury for subbituminous coals.

These early results indicated that high mercury removal efficiencies could only be achieved by using activated carbon injection with a fabric filter dedicated to particulate and mercury control. The development of Toxecon® evolved as a result. In this approach, a small compact fabric filter is installed specifically to remove mercury. WE-Energies has installed and operated a Toxecon® system at their Presque Isle facility in Michigan since February 2006. This installation is the initial long term evaluation of this mercury absorption approach. 90% mercury removal efficiency has been achieved. Valuable operating experience applicable to the use of Toxecon® on other coal-fired EGUs has also been gained (*Chang, 2007*).

Another viable mercury absorption approach, halogenated activated carbons (HACs), is in the research and testing phase in parallel with the development of Toxecon®. HACs are specialized activated carbons that are effectively demonstrating 90% or greater mercury removal efficiency in most subbituminous coal trials without Toxecon®. This has even been measured in dry flue gas desulfurization systems, (*DOE, 2007*). The exception is the lower mercury removal efficiency experienced in hot-side electrostatic precipitator systems where HACs could only achieve 70% removal. This type of electrostatic precipitator configuration is used for particulate control at four coal-fired EGUs in Wisconsin. A Toxecon® system may still be an appropriate option for these units. The development of HACs has also improved the performance of Toxecon® and as an additional benefit reduced amount of sorbent needed to achieve high removal efficiencies.

Another absorption technology development involves the injection of halogen salts, merclean® or KNX®, with activated carbon to improve mercury removal efficiency. Other than for hot-side electrostatic precipitators, tests have shown mercury removal efficiency of 95% on the same EGU achieving 90% in some cases with lower sorbent injection rates (*Sjostrom, 2006; DOE, 2007*).

With the development of Toxecon®, halogenated activated carbons, and oxidizing chemicals a 90% or greater mercury removal efficiency is feasible for bituminous and subbituminous coal-fired EGUs in Wisconsin. However, the cost of fly ash disposal is still an issue that must be weighed in the selection of a mercury control approach for existing EGUs, since it can add considerable cost to the control technology.

Fly Ash Use and Disposal

A critical issue for many of the electric utilities in Wisconsin is the affect of activated carbon on the reuse of fly ash as a concrete additive. Activated carbon makes the fly ash unusable for this purpose. As a result, fly ash contaminated with activated carbon would require placement in a landfill. This is primarily an issue for large subbituminous coal-fired EGUs, greater than 150 megawatts. The older, smaller, coal-fired EGUS in the state generally operate at lower combustion efficiency and as a result have high unburned carbon levels that already make the fly ash unsuitable for concrete. The type of coal combusted also has an effect on the suitability of fly ash. Fly ash from bituminous coal-fired EGUs does not have the right chemical characteristics for use as a cement additive. To date, research and testing has determined that mercury captured by activated carbon is very stable in fly ash and not very likely to be released into the environment (*Sjostrom, 2006*).

For Wisconsin's large coal-fired EGUs there are two options available for avoiding fly ash impacts:

1. A Toxecon® system or dry scrubbing fabric filter system used for sulfur dioxide control with sorbent injection for mercury control.
2. An oxidation catalyst or chemical injection with an existing fabric filter or a wet scrubber system.

Under the first option, the bulk of fly ash (> 95%) is collected by existing particulate control equipment and the remaining fly ash (< 5%) captured in the added fabric filter may require disposal. Under the second option, there is no added carbon and therefore no fly ash contamination.

Where a dry scrubbing fabric filter system is being used for sulfur dioxide control the resulting product is typically disposed of in a landfill. Therefore there is no added impact due to mercury control. Dairyland Power Cooperative is slated to install spray dry adsorption on units at their Genoa and J.P. Madgett Power Plants after existing electrostatic precipitators (*Dairyland, 2007*). Other EGUs in Wisconsin for which this may be a chosen mercury control include Wisconsin Public Service Corporation Weston 3 and units at WE Energies Valley Power Plant. Weston 4, a new coal-fired unit currently under construction will install the combination of spray dry adsorption and mercury absorption respectively for sulfur dioxide and mercury removal.

Other alternatives to activated carbon injection are being evaluated that would address the contamination of fly ash concern and be effective at coal-fired power plants using either a fabric filter or electrostatic precipitator as the primary particulate control system. Although not at the point of commercial application like activated carbon injection, the tests of activated carbon and mineral based absorbents that are not fly ash contaminants are demonstrating effective mercury removal (*IEPA, 2006*). For hot side electrostatic precipitators high temperature mineral based absorbents are at the testing stage (*Levin, 2007*).

An approach similar to Toxecon® is being evaluated where activated carbon is injected into the back portion of an existing electrostatic precipitator after the majority of fly ash has already been collected. A 50% to 80% mercury removal is expected from this approach (*Chang, 2007*). Techniques are also being developed to remove or effectively treat carbon in fly ash to make it suitable for use in cement.

There are mercury control technologies currently available and emerging that minimize fly ash reuse concerns and still achieve a 90% mercury removal.

Costs of Mercury Controls

The cost of mercury control technology applicable to coal-fired EGUs found in Wisconsin are reasonable and cost-effective. These technologies, including sorbent injection with a Toxecon® system or with existing particulate control equipment, are commercially available and will be capable of achieving 90% reduction. Similar control efficiencies can be achieved at lower cost when mercury control is integrated into a multipollutant control systems. Multipollutant approaches are preferred because environmental and public health benefits can be achieved at lower costs.

National Energy Technology Laboratory Mercury Control Technology Field Testing Program

The United States Department of Energy's (DOE) National Energy Technology Laboratory (NETL) initiated mercury control technology research for coal-fired EGUs in the early 1990s. The research and testing of promising control technologies by the NETL accelerated beginning in 2000 with a goal of establishing cost-effective mercury control technology capable of achieving 90% or greater mercury capture that is ready for commercial demonstration by 2010.

The NETL has managed field tests of mercury control technologies at 50 electric generating facilities over the past seven years. Primarily because of the success of their research the NETL reported that as of October 2007, over 70 full-scale activated carbon injection systems have been ordered for installation on coal-fired EGUs (*DOE/NETL, 2008*). These installations have the potential to remove more than 90% of mercury from coal at a cost that is as low as \$10,000 per pound mercury removed.

Control Technology Cost

Table 3-2 presents mercury control costs determined during development of the existing state mercury rule, adopted in 2004, and costs based on the review for this finding of available mercury control technologies appropriate for Wisconsin coal-fired EGUs including the recent advancements in mercury absorption and oxidation approaches. Multipollutant control approaches integrating mercury control are included in the cost evaluation. All include consideration of the cost of fly ash disposal, where appropriate. The comparison of updated mercury controls with costs developed for the 2004 rule demonstrate that control costs have decreased while control effectiveness has increased.

Table 3-2 Estimated Mercury Control Technology Costs

<i>Mercury Control Technology</i>	<i>EGU Size and Expected Mercury Control Efficiency</i>	<i>Mercury Control Cost COE (cents/kWh)</i>	<i>Cost Reference</i>	<i>Fly ash Impact</i>
2004 Wisconsin State Rule Technology Assessment				
Toxecon®	Units > 150 MW @90%	0.19 – 0.30	Technical Support Document for the Existing State Mercury Rule	None
Activated Carbon Injection in Advance of Existing Particulate Control Equipment	Units < 150 MW @60 to 80%	0.06 – 0.16		Landfill
System Average	86% to 91%	0.19 – 0.25		
2008 Update – Mercury Control Technology				
Toxecon®	Large Units @90%	0.12 – 0.24	EPRI & DOE	None
Activated Carbon or Halogenated Activated Carbon Injection in Advance of Existing Particulate Control Equipment	ESP – Cold @90%	0.05 - 0.12	DOE	Activated Carbon – Landfill ^c Cement Friendly Halogenated – None ^c
	Fabric Filter @90%	0.04 - 0.12 ^a	DOE	
	ESP – Hot @50% to 90%*	0.08 - 0.15 ^b	EPRI	
2008 Update – Integrated Multipollutant and Mercury Control Technology				
Halogenated Activated Carbon Injection with Dry Flue Gas Desulfurization	90 – 95%	0.04	DOE	None
Selective Catalytic Reduction / Oxidation Catalyst with Wet Flue Gas Desulfurization	80 – 90%	< 0.1	EPRI	None

COE – This cost represents the incremental cost to generating electricity.

^a Lower cost is from injection with a dry FGD system. The upper cost is assumed to be no more than the cost of injection with an electrostatic precipitator system.

^b Control levels for sorbent injection following hot-side ESP is expected to be in the 50-70% range. An option is to convert from hot-side to a cold-side ESP for achieving 90% control using normal sorbents.

The cost of this option is estimated based on the cost of sorbent injection for a cold-side ESP plus 0.03 cents/kWh added for converting a hot-side ESP to a cold-side configuration.

^c Most smaller units are not anticipated to generate fly ash sold for cement reuse and therefore no fly ash impacts. But in the case where fly ash is sold Sorbent Technologies has developed and demonstrated a cement friendly halogenated sorbent (C-PAC). This sorbent achieves 90% mercury removal with no impact on fly ash use in cement (Nelson, 2007). The cost of C-PAC is assumed to be similar to other halogenated sorbents.

Under the 2004 rule the overall mercury control cost varied from 0.19 to 0.25 cents per kilowatt-hour (cents/kWh) at mercury removal efficiencies ranging from 86% to 91%. In the 2004 rule, units less than 150 MW were evaluated on the basis of controlling mercury through activated carbon injection without a Toxecon® system. The addition of a fabric filter dedicated to mercury control was determined to be too costly at that time.

Now the cost of a Toxecon® system and sorbent injection with existing particulate control equipment are equitable with costs in the range of 0.04 to 0.24 cents/kWh and both approaches achieving 90% mercury removal for all Wisconsin EGUs regardless of size. These costs are based on DOE estimates from recent full-scale testing specifically targeted to enhance mercury control and reduce costs (DOE, 2007).

The cost of sorbent injection alone for small EGUs with a hot-side electrostatic precipitator maybe as high as 0.24 cents/kWh while achieving a 70% mercury removal efficiency (Levin, 2007). A lower cost option is to convert the electrostatic precipitator to a cold-side configuration with a cost of approximately 0.15 cents/kWh. This situation applies to two EGUs comprising 293 MW out of 833 MW of our small unit capacity (Table 3-2). However, the installation of dry flue gas desulfurization systems at both units is being considered for control of sulfur dioxide emissions. Mercury control cost for this multipollutant control system is comparable to or below mercury control costs for other configurations.

Another significant reduction in control cost is the current availability of the multi-pollutant options. The mercury portion of multi-pollutant control costs could be as little as 0.04 to 0.1 cents/kWh while providing mercury removal efficiencies in the range of 80% to 95%. The lower end of this range reflects the mercury removal efficiency anticipated on a wet scrubber. It is expected that wet scrubber systems can improve mercury control performance to a 90% removal with the application of an appropriate mercury oxidation approach.

Cost-effectiveness

Cost-effectiveness of mercury control is determined by comparing the estimated mercury control costs in Table 3-2 to control technology cost targets set by the Department of Energy (DOE) for mercury control and control costs incurred by electric utilities for other pollutants like nitrogen oxides, particulate matter and sulfur dioxide (Levin, 2007) (Table 3-3).

Table 3-3 Reference Control Costs

	<i>Cost of Electricity (cents/kWh)</i>		<i>Expected Control Level</i>	
	<i>Mercury Only</i>	<i>Total</i>	<i>Mercury</i>	<i>SO₂ / NO_x / Particulate</i>
DOE and EPRI Reference Control Costs				
Mercury Control Cost Target (25% to 50%)	0.11 – 0.23		70%	
Wet Flue Gas Desulfurization		0.9 – 1.2		95% – 98%
Sulfur Dioxide Control Dry Flue Gas Desulfurization		1.0 – 1.4		90% – 95%
Nitrogen Oxides Control Selective Catalytic Reduction		0.5 – 0.7		90%

The goal of the DOE research and development program is to ensure that cost-effective and reliable mercury control is available for the existing coal-fired EGUs (DOE, 2007). DOE set a cost target equivalent to 25% to 50% of the costs estimated in 1999 of \$50,000 to \$70,000 per pound of removed mercury for achieving a 70% reduction (DOE, 2007). As presented in Table 3-3, these DOE cost targets relate to an added cost of electricity (COE) on the order of 0.11 to 0.23 cents per kilowatt-hour (kWh). The reference mercury control costs are well below the reference costs for controlling other pollutants, 0.5 to 1.4 cents/kWh.

In addition, the updated mercury controls presented in Table 3-2 demonstrate that in all cases costs are comparable to or are well within the DOE cost target set for a 70% mercury removal. It should also be noted that, with limited exception, these updated costs reflect controls achieving a 90% mercury removal and exceed the DOE cost-effectiveness target. Based on these comparisons, a 90% control of mercury from coal-fired EGUs is cost-effective. Additional reductions in cost and achievement of higher mercury removal efficiencies will likely occur as emerging technologies become commercially available and commercially available technologies become more widespread.

Section 4 - Compare mercury emission standards proposed with those from neighboring states (“A comparison of the emission standards for hazardous air contaminants in this state to hazardous air contaminant standards in Illinois, Indiana, Michigan, Minnesota, and Ohio” - s. 285.27(2)(b)4., Wis. Stats.)

Summary of Wisconsin’s Current Mercury Rule

Citizen interest and concern about mercury contamination in Wisconsin’s environment significantly influenced the development of Wisconsin’s current mercury rule that became effective October 1, 2004 (*Chapter NR 446, Wis. Adm. Code*). A citizen petition, received in May 2000 and amended in November 2000, from a broad-based group of concerned individuals prompted the department to develop rules to limit mercury air emissions from coal-fired utility boilers. Petition signers included public health professionals, legislators from both major political parties, fishing organizations, Native American Tribes and environmental groups.

Wisconsin’s current rule requires the state’s four major utilities, Alliant Energy, Dairyland Power Cooperative, WE Energies and Wisconsin Public Service Corporation, to reduce their mercury emissions from their existing units in two phases using a baseline determined in 2005. A 40% reduction is required by 2010 and a 75% reduction is required by 2015. In addition, a mercury emission cap, based on actual operating data collected as part of the baseline determination, becomes effective on January 1, 2008.

The rule also establishes a goal of 80% reduction by 2018 to encourage additional progress. Collectively, the state’s four major utilities operate 42 coal-fired EGUs. Wisconsin’s rule does not require a specific control technology. Instead, each utility can select the approach it determines most cost-effective and best meeting their system needs.

The average cost for each homeowner was determined to be \$20 annually to meet the 80% reduction goal. Total cost for the four major utilities in the state to meet the 80% goal was estimated to be \$100 million annually (*Wisconsin DNR, 2003*). By 2015, the state’s regulation could prevent 2,000 pounds of mercury from being released into the air every year.

Proposed Revisions to Wisconsin’s Current Mercury Rule

In recognition of the advancements that have occurred in mercury control technology since the development of the current state mercury rule in 2003, including improved effectiveness and lower cost, it is appropriate to establish a revised mercury rule that will achieve greater mercury emission reductions from coal-fired EGUs. Based upon mercury emission information established in the current state rule, the proposed revisions could prevent 4,400 pounds of mercury from being emitted from coal-fired EGUs in the state (**Table 4-1**).

The proposed revisions will achieve more reductions, affect more coal-fired EGUs in the state and, unlike the current rule; new coal-fired EGUs must meet a stringent mercury control technology standard. Under the current state mercury rule four electric utilities are affected, Alliant Energy, Dairyland Power Cooperative, WE Energies and Wisconsin Public Service Corporation, and the 42 units they operate. The proposed revisions will cover an additional six units operated by four additional utilities, Madison Gas & Electric Company, Manitowoc Public Utilities, Mid-American Energy Company and Xcel Energy.

Under these revisions, the state’s large coal-fired EGUs (150 MW and greater) must comply with one of two compliance paths to achieve a 90% mercury emission reduction. Small coal-fired EGUs (> 25 MW and < 150 MW) must reduce their mercury emissions to a level defined as Best Available Control Technology (BACT).

Table 4-1 Estimated Annual Mercury Emissions from Existing and New Coal-Fired Electrical Generating Units in Wisconsin – Pounds per Year

Existing Coal-fired EGUs

Size Range in Megawatts	Megawatts	Mercury in Coal	Mercury Control Currently Achieved	Annual Mercury Emissions	Annual Emissions Under Proposed Rule		Mercury Removed From the Environment
					@90%	@80%	
>150 MW	5,083	2,831	10%	2,559	283		2,548
>25 to <150 MW	1,465	527	12%	463	105		422
	6,548	3,358		3,022	388		2,970

New Coal-fired EGUs Under Construction

	Megawatts	Mercury in Coal	Permitted Mercury Control	Annual Mercury Emissions	Annual Emissions Under Proposed Rule		Mercury Removed From the Environment
Elm Road Generating Station	1,200	1,144	90%	114	114		
Weston 4	519	418	83%	71	42		
	1,719	1,563		185	156		1,406
Total	8,267	4,920		3,207	544		4,376

Below is a detailed summary of the more stringent state mercury reduction requirements.

2010 - 2014 Current Mercury Rule Reduction Requirement

Beginning January 1, 2010, the state’s four major utilities must reduce mercury emissions by 40% from the baseline established under provisions in the current state mercury rule. This reduction applies to the 42 existing coal-fired electrical generating units (EGUs) operated by Alliant Energy, Dairyland Power Cooperative, WE Energies and Wisconsin Public Service Corporation.

New EGU Emission Standards

After the effective date of the rule, new coal-fired EGUs must meet Lowest Achievable Emission Rate (LAER) for mercury emissions. In no case shall the permitted mercury reduction be less than 90% removal of mercury from coal combusted.

Large EGU Mercury Emission Standard

By January 1, 2015 existing coal-fired EGUs with nameplate capacity of 150 MW or greater must achieve a 90% mercury reduction, as measured from mercury in coal combusted, or limit the concentration of mercury emissions to 0.0080 pounds mercury per gigawatt-hour. Compliance must be demonstrated annually on a unit-by-unit basis. However, large units under common ownership or control can average to meet the mercury emission standard.

Small EGU Mercury Emission Standard

By January 1, 2015 existing coal-fired EGUs with a nameplate capacity greater than 25 MW but less than 150 MW must achieve a level of mercury emissions defined as Best Available Control Technology (BACT). Owners or operators would propose BACT for small units within 24 months of the effective date of the rule. Owners or operators have the option to decide if units in this size range are placed in the large unit compliance pathway.

Large EGU Multipollutant Option

Under this alternative, EGUs with nameplate capacity of 150 MW or greater must achieve NO_x and SO₂ reductions beyond those currently required by federal and state regulations, as well as attain a delayed 90% mercury emission reduction standard. Owners and operators must designate which EGUs with 150 MW or greater nameplate capacity will follow the multipollutant option within 24 months after the effective date of the rule. Large EGUs that are not designated for the multipollutant option will, by default, be required to achieve the large EGU mercury emission standard.

Under the multipollutant option, affected EGUs must achieve a nitrogen oxides (NO_x) emission standard of 0.07 pounds per million BTU and a sulfur dioxide (SO₂) emission standard of 0.10 pounds per million BTU by January 1, 2015. An additional six years to achieve a 90% mercury emission standard is provided to EGUs included in a multipollutant reduction approach. Compliance must be demonstrated annually on a unit-by-unit basis. However, large units under common ownership or control can average to meet the NO_x, SO₂, or mercury emission standard.

An interim mercury reduction requirement is established that targets January 1, 2015 to achieve a 70% mercury reduction as measured from the mercury content of coal combusted or limit the concentration of mercury emissions to 0.0190 pounds mercury

per gigawatt-hour. Beginning January 1, 2018 an 80% mercury reduction as measured from the mercury content of coal combusted or limit the concentration of mercury emissions to 0.0130 pounds mercury per gigawatt-hour must be achieved. By January 1, 2021 a 90% mercury reduction, as measured from mercury in coal combusted, or limit the concentration of mercury emissions to 0.0080 pounds mercury per gigawatt-hour is required.

The reduction in emissions expected from the large and small EGU mercury emission requirements and the large EGU multipollutant option are presented in **Table 4-2**. If all large EGUs elected to achieve a 90% mercury reduction by 2015 mercury emissions would be approximately 536 pounds per year. If all large EGUs elected to follow the multipollutant option mercury emissions would still be reduced to 536 pounds however, this is not achieved until 2021. Substantial reductions in sulfur dioxide and nitrogen oxide emissions would however be achieved by 2015 under the multipollutant option. These reductions of pollutants other than mercury have significant benefit to Wisconsin and address other critical air quality concerns including fine particles, haze, and ground level ozone.

Table 4-2 – Estimated Mercury, Nitrogen Oxides (NOx) and Sulfur Dioxide (SO2) Reductions from the Proposed Wisconsin Mercury Reduction Rule

Mercury Emissions - 90% Mercury and Multipollutant Compliance Paths (pounds per year)

Year	All Large Units 90% by 2015 Small Units BACT @ 80%	All Large Units Multipollutant @ 70%, 80% & 90% Small Units BACT @ 80%
2015	536	1,102
2018	536	819
2021	536	536

Nitrogen Oxides and Sulfur Dioxide Emissions - Multipollutant Compliance Path (tons per year)

Pollutant	2005 Emissions	2015 Estimated Emissions	
		All Large Units Mercury Pathway	All Large Units Multipollutant Pathway
Nitrogen Oxides	39,599	27,718	14,966
Reduction from 2005		30%	62%
Sulfur Dioxide	118,153	89,213	21,422
Reduction from 2005		24%	82%

Early Emission Reduction Credits

For the multipollutant pathway, reductions in excess of mercury emission reduction requirements, certified by the Department, can be used to meet a portion of the annual allowable mercury emissions. Early mercury emission reduction credits can be used for up to 5% of the annual allowable emission total, in pounds, to achieve compliance with the 70%, 80% and 90% mercury reduction standard. Reductions achieved greater than the 70% or 80% mercury emission standard and the 2010 requirement for the major utilities to reduce emissions 40% from a baseline established under the existing state rule also

qualify as early mercury emission reduction credits. Early emission reduction credits are not transferable to another utility.

Review of Rule Requirements

A review of rule requirements during 2010 to 2014 will be conducted to evaluate mercury control technology and consider if the schedule to achieve 90% on EGUs 150 MW and larger is appropriate. An element of this review will be a determination whether additional compliance flexibility is warranted to achieve the January 1, 2021, 90% mercury emission reduction standard under the alternative multipollutant option.

Summary of State Mercury Programs in EPA's Region 5

In addition to Wisconsin, the other states in EPA's Region 5 include Illinois, Indiana, Michigan, Minnesota, and Ohio. Below is a summary of the rules or laws in effect or under development in these states to reduce mercury air emissions from coal-fired power plants. A Region 5 state mercury program summary table is included in the appendices (**Appendix B**). Among the states in EPA's Region 5, Illinois, Michigan and Minnesota are proposing or have adopted requirements more stringent than the CAMR would have achieved including more mercury emission reductions sooner. Illinois and Michigan declined participation in EPA's national trading program. Ohio and Indiana developed regulations to adopt EPA's national trading program to meet CAMR requirements.

Indiana – On October 3, 2007 the Indiana Air Pollution Control Board adopted a state regulation that parallels the model rule EPA developed for states to meet the CAMR (326 IAC 24-4). Indiana coal-fired EGUs were allowed to participate in EPA's national trading program. The schedule and amount of mercury reductions required in their regulation matched the mercury emission budget set for Indiana in the CAMR.

Ohio - Ohio regulations to address the CAMR became effective in May 2007 (OAC 3745-108). Like Indiana, Ohio adopted EPA's model rule to implement the CAMR. Ohio planned to achieve their annual mercury emission budget according to the schedule established in the CAMR. Their regulations required mercury reductions greater than the state emission budget EPA established and compliance would have been achieved through EPA's national trading program.

Illinois - Regulations that became effective in December 2006 require coal-fired EGUs in operation as of December 31, 2008 to reduce mercury emissions by 90% as measured from the mercury content of coal combusted or achieve an output based emission standard of 0.008 pounds mercury per gigawatt-hour (35 Ill. Adm. Code 225). Compliance for either standard is determined on a rolling 12-month average. These reductions must be achieved by January 1, 2009 unless a system-wide multipollutant approach is employed. Emission averaging with other units is allowed until December 31, 2013 provided each unit involved achieves a 75% mercury emission reduction or meets an emission standard of 0.02 pounds mercury per gigawatt-hour.

Under a system-wide multipollutant approach, compliance with the control standard for mercury is extended until January 1, 2015. Limitations for nitrogen oxides and sulfur dioxide must also be achieved. This is a permanent commitment and opting out of this compliance option is not allowed. Units planned for permanent retirement can be exempted provided notice is given and unit shutdown occurs no later than June 30, 2011.

Illinois declined participation in EPA's national trading program. For compliance demonstration the emission monitoring requirements included in the federal CAMR are required.

New power plants, beginning January 1, 2009 must achieve on a rolling 12-month average a 90% reduction of mercury from coal combusted or achieve an output based emission standard of 0.008 pounds mercury per gigawatt-hour upon start-up. This requirement does not apply to replacement of units at an existing power plant. A temporary technology standard is available for new power plants that can extend the mercury compliance date until December 31, 2018. The temporary standard requires Best Available Control Technology (BACT) for nitrogen oxides, particulate matter, and sulfur dioxide emissions and application of an approved mercury control technology.

Michigan - The State of Michigan is developing a regulation to address mercury emissions from their coal-fired electric utilities. Michigan Governor Granholm directed the Michigan Department of Environmental Quality to develop a rule to reduce mercury emissions from coal-fired electric utilities 90 percent by 2015. Public comments on a draft rule were accepted in fall 2007 (*SOAHR 2005-038 EQ*).

Under this proposal, existing coal-fired EGUs must reduce mercury emissions by 90% as measured from the mercury content of coal combusted or limit the concentration of mercury emissions to 0.008 pounds mercury per gigawatt-hour by January 1, 2015. Compliance can be achieved on unit-by-unit bases or through plant-wide or system-wide averaging. The compliance approach can be different from year-to-year. A multipollutant proposal that achieves at least a 75% reduction as measured from the mercury content of coal combusted is available as an alternative. Small units, defined as those that emit less than 9 pounds of mercury emissions annually, can comply under an alternative plan. A request for system-wide averaging or a multipollutant approach can be disapproved if local mercury impacts are demonstrated. New units, constructed after January 30, 2004 must install BACT for mercury which achieves mercury reductions at least as stringent as the standard for existing units.

Beginning in 2010 annual emission caps are established for each unit through the distribution of the mercury emission budget EPA set for Michigan in the CAMR. The procedure for setting emission caps for each unit considers the highest three-year heat input average from the most recent five-year period. In 2015 and beyond, annual unit specific caps are set based on BACT, an approved alternative compliance approach, or either 90% reduction from a baseline based on mercury in coal combusted or output

based emission standard of 0.008 pounds per gigawatt-hour annual average. In 2016 and 2017 emission caps for existing units can be adjusted to account for exceptional circumstances that may prevent a unit from achieving compliance (e.g. unavoidable delay in the installation of control equipment). Units affected do not receive mercury allowances. Instead mercury emission caps are established by procedures that ensured that the CAMR state mercury emission budget was not exceeded. Retired units do not receive a mercury emission cap.

Minnesota - The Minnesota Mercury Reduction Act enacted in May 2006 establishes a 90% mercury removal requirement for the six largest EGUs in the state (*H.F. No. 3712.3*). This requirement is expected to reduce statewide mercury emissions from coal-fired power plants in Minnesota 70% by 2015.

The reductions are based on a determination of mercury emissions using the monitoring methods and procedures established in the CAMR and must include at least six months of measurements. For those units equipped with a spray dryer and fabric filter for control of air contaminants, a mercury control plan is required by December 31, 2007, and must be implemented by December 31, 2010. If an owner has two dry scrubbed units, implementation at one unit must be achieved by December 31, 2009. For those units equipped with a wet scrubber for control of air contaminants, plans are required by December 31, 2009 and implementation must occur by December 31, 2014. Deadline extensions are allowed however, final compliance cannot be extended more than 12 months.

The plans required must identify the controls necessary to achieve a 90% reduction in emissions. The required mercury reduction level is fixed in a permit after completion of a start-up period. Emission monitoring data and consideration of expected performance in the upcoming five-year period are considered in establishing the permitted mercury reduction level.

The Minnesota Pollution Control Agency reviews plans and makes recommendations to the Minnesota Public Utilities Commission which has approval authority. Owners can recover costs for monitoring, control equipment, construction, operation and maintenance, relevant studies and other related costs incurred prior to plan approval. Multipollutant control proposals submitted with a mercury plan may also qualify for cost recovery.

National Response of States to the Federal Clean Air Mercury Rule

As of December 7, 2007, 20 states adopted or considered requirements that prohibit or restrict interstate trading of mercury emissions as EPA allowed as an option in the CAMR and 21 states have or proposed requirements that would have achieved more mercury emission reductions than the CAMR (*NACAA Table, December 2007*). State programs in 22 states were mostly consistent with EPA's CAMR model rule that allowed participation in the national mercury trading program. Below is a list of the states in each of these response categories.

- *20 States have or are proposing requirements that prohibit or restrict interstate trading of mercury emissions*
Arizona, California, Colorado, Connecticut, Delaware, Florida, Idaho, Illinois, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New Mexico, New York, Oregon, Pennsylvania, Vermont, Virginia & Washington
- *22 States have or are proposing requirements that achieved more mercury emission reductions than the CAMR*
Arizona, California, Colorado, Connecticut, Delaware, Georgia, Illinois, Maryland, Massachusetts, Michigan, Minnesota, Montana, New Hampshire, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Utah, Virginia & Washington, Wisconsin
- *22 States planned to adopt EPA's Model Rule that is no more stringent than CAMR and allowed interstate trading of mercury emissions*
Alabama, Alaska, Arkansas, Hawaii, Indiana, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Nebraska, Nevada, North Dakota, Ohio, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, West Virginia & Wyoming

Comparison of Wisconsin's Mercury Emission Standards to Mercury Emission Standards in Other States in EPA's Region 5

Below is a summary of similarities and differences between the mercury emission standards and control requirements for coal-fired EGUs in Wisconsin as compared to the other states in EPA's Region 5; Illinois, Indiana, Michigan, Minnesota, and Ohio. The comparison addresses mercury emission reduction requirements and schedules, multipollutant alternatives, and compliance flexibility. A detailed summary and comparison of the Region 5 states mercury emission standards for coal-fired EGUs is included in Appendix B.

Wisconsin, like Illinois, Michigan and Minnesota, is proposing to require large coal-fired EGUs to achieve a 90% reduction based on mercury in coal combusted. Compliance with this mercury emission standard in these state requirements varies from 2009 to 2021. In part this variation can be attributed to the availability of multipollutant reduction options that extends the mercury reduction compliance date in exchange for reductions in sulfur dioxide and nitrogen oxide. Each of these four states has built-in to their requirements compliance flexibility such as emission averaging and less restrictive requirements for small EGUs.

Illinois, Michigan, and Wisconsin have included specific mercury emission standards for new coal-fired EGUs or power plants.

Mercury Emission Reduction Requirements and Schedule

Illinois, Michigan and Minnesota all have law or regulations that require a 90% reduction based on mercury in coal combusted for large EGUs in their states. Michigan requires compliance by January 1, 2015. Illinois requires compliance with their mercury

emission standard by July 1, 2009 and Minnesota established a compliance date of December 31, 2010 or December 31, 2014 depending upon the type of sulfur dioxide or nitrogen oxide emission control system being used. The Minnesota Emission Reduction Act of 2006 only affects six EGUs located at the state's three largest power plants however; this will result in a 70% reduction in mercury emissions from all coal-fired EGUs in this state. The mercury emission standard proposed for Wisconsin requires large EGUs to achieve a 90% mercury reduction, as measured from mercury in coal combusted, by January 1, 2015.

In Indiana and Ohio there are no specific mercury reduction requirements for coal-fired EGUs. These states developed regulations to meet the now vacated CAMR through participation in EPA's national trading program.

More restrictive requirements for new coal-fired EGUs or new coal-fired power plants have been established in Illinois and in Michigan. In Illinois new coal-fired power plants, after January 1, 2009, are required to meet the state's 90% mercury reduction requirement upon start-up with the ability to meet a temporary technology standard until January 1, 2019. New coal-fired EGUs in Michigan, after January 1, 2004, must achieve the state's 90% mercury reduction requirement with the possibility that a more stringent requirement may be imposed. The Wisconsin proposal for new coal-fired EGUs is similar to Michigan's requiring mercury emissions to be controlled to a level defined as Lowest Achievable Emission Rate but in no case less than 90% removal of mercury from coal combusted. This new unit requirement in Wisconsin would become effective upon rule promulgation.

Multipollutant Alternatives

All coal-fired EGUs participating in the Illinois multipollutant option may delay compliance with the 90% mercury emission standard until January 1, 2015 provided that specific sulfur dioxide and nitrogen oxide limitations are met. Michigan also offers a multipollutant option with sulfur dioxide and nitrogen oxides emission standards that lowers the mercury reduction requirement from 90% to 75% mercury removal from coal combusted but does not alter the January 1, 2015 compliance date.

The Wisconsin multipollutant proposal requires sulfur dioxide and nitrogen oxide reductions by January 1, 2015 and allows participating EGUs until January 1, 2021 to achieve the 90% mercury standard. An interim mercury standard for these EGUs must be achieved by January 1, 2018.

Compliance Flexibility

Averaging among coal-fired EGUs can be used to demonstrate compliance with the 90% mercury emission standard in Illinois until December 31, 2013 provided that each unit achieves a 75% reduction of mercury in coal combusted. An individual unit or multiple units may demonstrate compliance with the Illinois mercury emission standard by demonstrating that actual emissions are less than allowable emissions over a rolling

12-month period. These alternative compliance demonstrations are limited to EGUs under common ownership or operation. Illinois exempts coal-fired EGUs that will be permanently shutdown by December 31, 2010 or December 31, 2011, if a new construction is involved.

In Michigan compliance can be demonstrated unit-by-unit, power plant-wide or system-wide at the choice of an owner or operator. The compliance approach can also change from year-to-year at the owner or operators discretion with advance notification. Small coal-fired EGUs, with mercury emissions less than 9 pounds per year, can propose an alternative reduction plan. Technical or economic exceptions to the mercury emission standard may also be provided.

Minnesota allows up to a 12-month extension to their compliance dates and units that are equipped with wet scrubbers to reduce sulfur dioxide emissions can substitute a different unit for a targeted unit in their mercury control law.

Under the Wisconsin rule proposal, coal-fired EGUs under common ownership or control may average to achieve the proposed mercury emission standard or multipollutant requirements for sulfur dioxide and nitrogen oxide.