BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
	)	R06-25
PROPOSED NEW 35 ILL. ADM. CODE 225	)	Rulemaking – Air
CONTROL OF EMISSIONS FROM	)	
LARGE COMBUSTION SOURCES (MERCURY)	)	

PC#6297

NOTICE

TO: Dorothy Gunn
Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph St., Suite 11-500
Chicago, IL 60601-3218

SEE ATTACHED SERVICE LIST

PLEASE TAKE NOTICE that I have today filed with the Office of the Clerk of the Illinois Pollution Control Board the POST-HEARING COMMENTS OF ENVIRONMENT ILLINOIS AND ENVIRONMENTAL LAW AND POLICY CENTER, a copy of which is herewith served upon you.

ENVIRONMENTAL LAW AND
POLICY CENTER

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Dated: September 20, 2006

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POST-HEARING COMMENTS OF ENVIRONMENT ILLINOIS AND ENVIRONMENTAL LAW AND POLICY CENTER

NOW COME Environment Illinois and the Environmental Law and Policy Center ("ELPC"), by and through their respective attorneys, pursuant to 35 Ill. Adm. Code § 102108, and offer the following POST-HEARING COMMENTS in the above-captioned proposed rule:

I. Introduction

Environment Illinois and the Environmental Law and Policy Center (collectively, "Environmental Advocates") strongly support the proposed mercury rule now before the Illinois Pollution Control Board (hereinafter "IPCB"), including the Multi-Pollutant Standard. The record now before the IPCB clearly demonstrates the public health and environmental benefits to Illinois that will be achieved by deeper, faster reductions of mercury emissions from Illinois coal-fired power plants than under the federal CAMR alone. This record includes the comprehensive case presented by IEPA with the testimony of a dozen expert witnesses and thousands of pages of supporting exhibits and other documents, the case presented by Environmental Advocates through their expert witness and comments, and in excess of 6000 public comments. The record is clear that these additional reductions can be achieved using available technology and without creating disproportionate costs to electric generating units ("EGUs") or consumers, especially in light of the regulatory flexibility mechanisms of the rule. The feasibility of achieving these reductions is underscored by the willingness of Ameren and

Dynegy, the second and third largest operators of coal-fired EGUs in Illinois, to support the proposed rule.

Illinois EPA's rulemaking proposal is consistent with CAMR, which provides an option for states to develop their own regulatory approaches to control mercury from coal-fired power plants. 70 *Fed. Reg.* 28632; see also, 42 U.S.C. § 7416. At the same time, Illinois EPA's rulemaking proposal is more advanced and targeted than CAMR in protecting the health, safety and welfare of Illinois residents, preserving and enhancing Illinois' natural environment for future generations, and mandating deeper mercury reductions that are nonetheless achievable for regulated entities operating in this state.

The critical issue in this case is not whether Illinois EPA is justified in regulating mercury emissions from coal-fired power plants. After all, even CAMR, which the opponents prefer, does this. Rather, the remaining issue is whether the Illinois EPA proposal will produce public health and environmental benefits through deeper, faster reductions than those mandated under CAMR in a manner that is reasonable for regulated entities to achieve. In these comments, the Environmental Advocates focus on evidence in the record about Illinois-specific factors which provide ample justification for going beyond CAMR using the Illinois EPA proposal.

These comments are accompanied by numerous documents to be added to the record of these proceedings. In order to expedite review of these documents, the Environmental Advocates are providing a complete bibliography of all the documents, followed by summaries of the most important information in each document, sorted by topic.

II. Mercury Threatens Illinois Ecosystems, Illinois Residents and Illinois Wildlife.

Long before CAMR and this rulemaking, Illinois specifically identified mercury as a major threat to the health of Illinois residents and the quality of Illinois ecosystems. The Illinois Department of Public Health has established mercury advisories for all water bodies in Illinois due to the levels of methylmercury in predator fish. (Pre-filed testimony of James Ross, at 5, see also TR. 6/12 at 57; TR. 6/14 at 97). In addition, there are 61 river segments (1,034 miles) and 8 lakes (6,264 acres) that are listed as impaired waters due to mercury levels, triggering Illinois' obligations to impose Total Maximum Daily Load requirements that originate in the Clean Water Act. (Pre-filed testimony of James Ross, at 5 – 6). Up to three-quarters of tested water bodies have fish with mercury levels that justify a fish consumption advisory. (TR. 6/12 at 67). This determination is made using U.S. Food & Drug Administration Action Levels adapted into the "Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory" by Illinois and seven other Great Lake states. (Pre-Filed testimony of Thomas C. Hornshaw, Ph.D., at 2). In fish tissue sampling conducted between 1988 and 2001, two-thirds to three-quarters of all bass and walleye from Illinois waters have mercury levels that would justify a consumption advisory. (TR. 6/13 at 71).

A fish consumption advisory cautions against eating more than one fish meal per week. (TR. 6/13 at 31). However, because this is only an advisory, there is no legal mechanism actually preventing people from eating any amount of mercury-containing fish from Illinois waters. Indeed, the Illinois Department of Natural Resources issues approximately 700,000 fishing licenses annually. (TR. 6/12 at 61). One sub-population that is especially susceptible to mercury, children, can fish without obtaining a license. (TR. 6/16 at 63). In his testimony, Dr. Thomas Hornshaw identifies several studies of the fish consumption patterns of anglers,

including a study of Illinois anglers conducted between 1987 to 1993, which demonstrate anglers will consume unhealthy quantities of fish even though advisories exist. (Pre-Filed testimony of Thomas C. Hornshaw, Ph.D., 4-5). Dr. Hornshaw concludes, "This review of fish consumption literature provides convincing evidence that sport anglers may consume amounts of sport-caught fish that could allow them and their families to exceed health-based limits for chemical contaminants in their catch." *Id.* at 5.

Even if no consumer ate mercury-contaminated fish caught in an Illinois waterway, there would still be a basis for regulating mercury emissions from coal-fired power plants. In his testimony, Dr. Michael Murray identified emerging research on the destructive impacts of mercury on a variety of animal species. Of course, unlike human receptors, animals cannot attempt to avoid intake of mercury-containing food sources. Dr. Murray identified a Noah's Ark of species for which research suggested a risk from mercury exposure, including mallard ducks, loons, belted kingfishers, blue herons, ring-necked pheasants, thrush, insectivorous passerines, 13 species of freshwater fish, many insect consuming mammals, mink, otters and aquatic insects. (TR. 8/14 at 71-75). Notably, this is the list for which research exists; it is not the list of all potentially harmed animal receptors.

Because of well-documented conditions in Illinois waterbodies and fish, and the associated risks to Illinois anglers, fish consumers and wildlife, there is a strong justification to develop an Illinois-specific regulatory approach to control mercury.

III. Mercury Deposition in Illinois Will Be Substantially Reduced Under the Proposed Illinois Rule at a Rate Much Faster and Greater Than What Would Be Achieved Under CAMR Alone.

Before considering the contribution of Illinois coal-fired power plants to mercury loading in Illinois, it is important to emphasize that the IPCB is authorized to, and frequently will, issue regulations that:

- control only one source category among several that are sources of a pollutant;
- control emissions into only one medium like air;
- control emissions because of a potential threat to human health or the environment, without any showing of actual damage that has already occurred;
- control emissions from a source category even if this may not lead to a direct or one-to-one reduction in the exposure rate of any receptor or group of receptors;
- control emissions from a source category even if its relative contribution to cumulative emissions of a pollutant is comparatively small; and/or
- implement requirements that originate under one statute, even if other statutes could also address other aspects of controlling a pollutant.

When measured next to the facts in the record, the Illinois EPA's mercury pollution reduction proposal greatly exceeds the threshold for regulatory activity.

Illinois' coal-fired power plants are the largest unregulated anthropogenic source of mercury emissions in the state. According to the National Emissions Inventory, as much of 71% of Illinois mercury emissions are from Illinois coal-fired power plants, significantly in excess of the U.S. average of 44% (TR. 6/12 at 47, Technical Support Document, at 33-34). Illinois' next largest source of mercury emissions is the commercial/industrial boiler category, which accounts for 11% of the total. *Id.* at 33. By comparison to the national average and other contributing

sources within the state, Illinois coal-fired EGUs are a hugely disproportionate contributor of mercury air emissions. This fact alone, largely uncontested in this rulemaking, provides a powerful justification for the development of an Illinois-specific rule mandating deeper, faster reductions from this source category than required under CAMR.

Concomitantly, reducing mercury emissions from Illinois coal-fired power plants in a manner consistent with the proposed Illinois rule will substantially reduce mercury deposition in Illinois. According to the opponents' own expert on mercury deposition, Krish Vijayaraghavan, the Illinois rule will result in lower mercury deposition in Illinois than under the federal approach alone. This additional reduction will occur throughout Illinois, will occur very soon after the Illinois rule becomes effective, and can be quantified. More specifically, Mr. Vijayaraghavan testified:

- from 2006 to 2010, if the 2010 CAIR/CAMR rule alone, is implemented there will be a 5.3 percent decrease in mercury deposition in Illinois (TR. 8/21 p.m. at 1422);
- from 2006 to 2010, if the proposed Illinois rule is implemented, there will be a 9.5 percent decrease in mercury deposition, which is an additional 4.2 percent decrease in deposition as compared to 2010 CAIR/CAMR (TR. 8/21 p.m. at 1422, 1433);
- the deeper reductions under the Illinois rule will occur throughout the entire state of Illinois (TR. 8/21 p.m. at 1462);
- under the CAIR/CAMR rule alone, Illinois will have to wait 10 additional years to experience reductions roughly equivalent to the reductions achieved under the proposed Illinois rule in 2010 (TR. 8/21 p.m. at 1432); and

- the TEAM model predicts that, in the single year of 2010 alone, there will be 321 fewer pounds of mercury deposited in Illinois under the proposed Illinois rule than under 2010 CAIR/CAMR alone (TR. 8/21 p.m. at 1497).

Mr. Vijayaraghavan's estimate that, in the year 2010, there will be 321 fewer pounds of mercury deposition under the Illinois rule than under CAMR/CAIR alone is significant confirmation that Illinois-specific benefits will be achieved. Although CAIR/CAMR eventually produces roughly equivalent reductions by 2020, there would be ten years during which the Illinois rule would generate greater reductions than CAIR/CAMR alone. The cumulative effect over a period of ten years would be thousands fewer pounds of mercury deposited in the environment under the Illinois rule. This is especially significant because mercury is persistent, bioaccumulative and toxic in the environment.

Illinois EPA developed a comparison between the available mercury allowances under CAIR/CAMR until 2018 and the anticipated mercury emissions under the Illinois rule starting in 2009. This comparison is necessary to demonstrate to U.S. EPA that the proposed Illinois rule will meet the CAMR reduction target for Illinois. Illinois estimates that under CAMR, Illinois would have a 3,000-pound-per-year emissions cap that could be used or traded by Illinois coal-fired EGUs. Under the proposed Illinois rule, mercury emissions are expected to be roughly 1,000 lbs. per year. (TR. 6/19 at 46).

Just as importantly, reducing mercury from Illinois coal-fired EGUs is likely to have a local impact in reducing mercury deposition. Dr. Gerald Keeler testified that mercury deposition attributable to coal-fired EGUs can occur in close proximity to the plants themselves. These close-in mercury deposition levels are particularly elevated during periods of intense precipitation, but routinely occur as dry deposition as well. Dr. Keeler's testimony was based

upon the report analyzing of mercury wet deposition in Steubenville, Ohio, of which he was one author.

Since the conclusion of the public hearings, the Illinois EPA filed Dr. Keeler's peer-reviewed paper, "Sources of Wet Deposition in Eastern Ohio, USA", by Keeler, Landis, Norris, Christianson and Dvonch, as published in Environmental Science & Technology on the web on 09/08/2006. In keeping with Dr. Keeler's testimony before the IPCB, this paper concludes that a multi-year, multi-faceted analysis of mercury wet deposition in Steubenville "...consistently point[s] toward the dominant influence by local and regional coal burning sources." *Id.* at G. The Steubenville study employs a receptor-based model that measures actual mercury concentrations in precipitation, and then attributes these concentrations to source categories using two different techniques (PMF and Unmix) that do not rely on source profiles or emission inventories, but instead rely on sample concentrations of analytes that are closely associated with emissions from different categories of sources. *Id.* at B. Both the PMF and Unmix statistical analyses determined that approximately 70% (69% and 73%, respectively) of mercury wet deposition in Steubenville was attributable to the coal combustion source category. *Id.* at D and F. By correlating mercury concentrations in precipitation with local meteorological conditions, for example stagnant conditions that minimized any influence by distant sources, the authors were able to conclude the data indicate "...a strong local and regional source influence." *Id.* at G. Mr. Vijayaraghavan testified that the results of the Steubenville study were consistent with the results of his own modeling exercise for Steubenville. (TR. 8/21 p.m. at 1404).

Using very different methods, both the proponents through Dr. Keeler and the opponents through Mr. Vijayaraghavan respectively, have provided important evidence that reducing

mercury emissions from Illinois coal plants is likely to result in a reduction in mercury deposition in Illinois itself.

IV. The Proposed Rule is Technically Achievable, Economically Feasible, and Reasonable.

As an initial matter, it is extremely difficult for the remaining opponents to this rule to argue that the rule is not technically or economically feasible when Ameren and Dynegy, the second and third largest operators of Illinois coal-fired power plants, now support the rule and are committed to complying with its terms. Moreover, during the pendency of these proceedings, on August 10, 2006, the operator of a single facility, Springfield City, Water, Light and Power, agreed to a negotiated PSD permit which included a requirement to comply with the output-based or percentage reduction numeric standard in the proposed rule. (Construction Permit, PSD Approval, NSPS Emission Units, issued to City of Springfield by the Illinois EPA, at 4-12 (August 10, 2006), available online at http://yosemite.epa.gov/r5/il_permit.ns.) It is also notable that despite the opportunity to do so, the remaining opponents have presented no facility-specific or companywide information about the projected costs of compliance. This was made very clear during the testimony of Midwest Generation's witness, William DePriest, when he testified that he had prepared cost estimates, but was not at liberty to share this analysis (this information is "kind of off bounds", TR. 08/17 p.m. at 1058; witness unwilling to provide information about specific companies, *Id.* at 1069; witness refuses to provide cost estimate information that exists in work done for utilities in the state of Illinois, *Id.* at 1065).

Perhaps just as importantly, there are at least nine features in the Illinois EPA proposal which provide substantial flexibility to regulated entities. These mechanisms are:

1. allowing a regulated entity to choose to comply using an output-based standard, .008 lbs/gwh, or a percentage reduction, 90%;

2. allowing a regulated entity to elect to comply using any combination of techniques and technologies to meet an output-based or reduction standard, ranging from coal selection and preparation techniques, to mercury-specific pollution control devices and sorbents, to pollution control equipment that will reduce an array of pollutants including mercury, to achieving compliance under multiple regulatory initiatives (proposed Section 225.233);
3. providing regulated entities with almost three years before compliance is required;
4. allowing compliance to be determined on a 12-month rolling average;
5. allowing owners of multiple EGUs to choose to comply by averaging among units during the first phase or the regulatory program (through 2013), and allowing owners of single EGUs to average with other similarly situated operators;
6. allowing a complete opt-out for units the regulated entity decides to shutdown;
7. allowing a regulated entity to choose to use the Temporary Technology Based Standard ("TTBS") to set aside 25% of its units from meeting a numeric standard until 2015, upon a showing that these units are optimizing ACI mercury control equipment and meeting other operational requirements;
8. allowing a regulated to choose an integrated pollution control strategy which will control mercury and other pollutants through the Multi-Pollutant Standard ("MPS"), thus complying with the proposed Illinois rule and other near-term regulatory requirements; and,
9. providing for the same alternative mercury monitoring requirements contained in the federal CAMR, including the use sorbent trap monitoring devices as well as newer CEM systems.

Notably, very few of the opponents' experts included any evaluation of these flexibility mechanisms as part of their testimony. For example, James Marcetti's testimony on economic modeling did not account for either the TTBS or the MPS (TR. 8/18 p.m. at 1308-1309).

The Illinois proposal also provides practical flexibility to regulated entities to decide how to achieve mercury reductions. Appropriately, the IPCB now has a very complete record on activated carbon injection systems. These units can be relatively inexpensive ($1-3 million in initial installation costs), can be installed quickly (six months from order to installation, TR. 6/22 a.m. at 137), can be installed while the plant operates (*Id.*), are easily integrated with existing pollution control equipment (often requiring only a port in the ductwork between the boiler and existing pollution control equipment, TR. 6/23 p.m. at 470-71) and have relatively low operating costs (advanced halogenated sorbents cost 90 cents/lb, TR. 6/22 a.m. at 85).

Activated carbon injection units are designed to achieve in excess of 90% mercury removal once optimized consistent with operations at specific facilities. (Pre-filed Testimony of James Staudt, Ph.D. at 6-7). There is a great deal of testimony before the Board regarding the actual removal efficiency of ACI systems. However, the technical feasibility of this rule is not dependent on use of ACI alone to meet the standards imposed by the rule. The record contains several other examples of practical, existing technologies and techniques to reduce mercury that can be used alone or in combination with ACI systems. Ultimately, the proposed rule allows the operator to decide how to combine options to meet mercury removal requirements (TR. 6/22 a.m. at 196). These technologies and techniques include:

- Using a very low mercury coal that, coupled with a .008 lbs./gwh emission standard, can achieve 50-80% of the required reduction. (TR. 6/23 at 452-452). Another, related possibility is to blend with lower mercury coals. *Id.* It is already common for facilities to

use coal selection, preparation (washing, for example) and blending techniques; these techniques could be applied in order to minimize emissions of a new pollutant, mercury. (Pre-filed Testimony of James Staudt, Ph.D. at 3).

- Employing/enhancing existing pollution control technologies. For facilities using or planning to install scrubbers, it is likely no additional mercury-specific controls will be required (TR. 6/21 a.m. at 134). Fabric filters, ESPs, FGD systems, and SCR systems can remove or enable the removal of mercury as a co-benefit of controlling other regulated pollutants (Pre-filed testimony of James Staudt, Ph.D. at 3-4). ACI systems would work in combination with these existing systems to provide additional mercury removal efficiency.
- Monitoring existing facility performance. At every facility, there is already unmeasured mercury removal using existing pollution control equipment. The actual rate of removal or emission rate has not been determined because there has been no regulatory requirement to do so.

Because of this flexibility and the relatively low cost of installing and operating ACI systems, it is not surprising that Dr. Ezra Hauzman characterized the cost to owners of Illinois coal plants as almost negligible. According Dr. Hauzman, the total additional annual control costs associated with the Illinois rule are $33 million. (Dr. Ezra D. Hausman, Pre-Filed Testimony, at 8). In order to provide a context, Dr. Hausman points out that the total cost to fuel electric power plants in Illinois is almost 2 billion dollars per year. *Id.* at 12. Also by point of comparison, the average cost increase for Illinois coal plants under the Illinois EPA proposal is $0.375/MWh, a trivial amount when compared to the current retail price of electricity in Illinois, roughly $65.00/MWh. There is reason to believe the impact on consumers would be close to

zero. Because Illinois utilities do not own the coal plants and the EGU's are competing in an auction process with other generators, there is no existing means by which Illinois consumers could be directly charged even the *de minimus* additional costs that would result from adopting this rule. Consequently, Dr. Hausman estimates the total additional cost to consumers to be between $0 and $11 million. *Id.* at 8.

V. The Proposed Rule Will Not Impact the Integrity of the CAIR Proceedings

The Ameren and Dynegy proposals contain a Multi-Pollutant Standard, involving reductions of pollutants, NOx and SO2, that would not be otherwise regulated under the mercury rule at issue in this proceeding. These reductions are obviously being proposed with an eye toward future possible regulations of such pollutants, including proposed regulations being considered in the upcoming CAIR rulemaking before the Board.

The Hearing Officer requested guidance on how the MPS and the inclusion of it in a final mercury rule would affect the CAIR rulemaking. First, the MPS is one avenue of compliance in the proposed mercury rule. Therefore, selection of the MPS is voluntary, as regulated entities may select any one of the proposed avenues of compliance in the mercury rule (although once an entity selects the MPS, compliance with the limits contained therein is obviously mandatory). Therefore, the mercury rule contains no mandatory NOx or SO2 reductions that must be made by all entities subject to the rule.

Second, while the MPS anticipates that NOx and SO2 reductions would be consistent with or in excess of the requirements that will be imposed under CAIR, the MPS does not dictate that companies undertaking the MPS be viewed as in compliance with CAIR. Once the CAIR limits are set, it is certainly possible or even likely that utilization of the MPS will result in compliance with CAIR, but that is not mandated in the MPS.

Third, while the goal of the MPS is to begin to address CAIR requirements in addition to mercury reductions, that does not predetermine the outcome of the CAIR proceedings. The MPS can certainly be informative as to what those reductions might be. In the joint statement, the parties "anticipate[d] that the installation and operation of pollution control equipment required to achieve the NOx and SO2 standards under the revised Proposed New Section 225.233 will achieve more reductions in NOx and SO2 emissions than are required under the Clean Air Interstate Rule or 'CAIR'." But, once again, that is only anticipated and the outcome is not mandated in the MPS or in any way binding on the CAIR rulemaking. Through the CAIR rulemaking, the Board is at free to make a determination as to what reductions will be required of regulated entities. The MPS places no restrictions on the Board as to what the reductions must be.

Fourth, regulated entities that elect to utilize the MPS would need to comply with both the requirements of the MPS and the proposed CAIR. Such entities would be required to comply with both the CAIR cap and trade requirements and the numeric emission limits of the MPS. Regulated entities will need to both hold sufficient allowances each year under CAIR and emit NOx and SO_2 at a rate equal to or less than the numeric emission limits of the MPS. Obtaining additional CAIR allowances would be required when necessary to comply with CAIR even if actual emissions rates meet the requirements of the MPS. Finally, in order for the MPS to protect air quality in fact, it does not allow the trading of allowances that are generated as a result of measures taken to comply with the NOx and SO_2 emission standards.

In sum, the MPS can inform the CAIR rulemaking and would appropriately be considered in the CAIR rulemaking but does not predetermine any outcome of the CAIR rulemaking. Additionally, the MPS proposal is designed to work within the CAIR requirements

and regulated entities will need to comply with both, especially since different limits will be set under both.

VI. Conclusion

In sum, the Environmental Advocates strongly support the proposed rule now before the Illinois Pollution Control Board, including the Multi-Pollutant Standard. The record before the IPCB amply supports the rule and demonstrates the public health and environmental benefits to Illinois of the deeper, faster reductions of mercury emissions resulting from the proposed rule compared to those under the federal CAMR alone. The record is clear, especially in light of Ameren's and Dynegy's support of the proposed rule, that these reductions can be achieved with available technology, at reasonable cost, and through utilization of the regulatory flexibility mechanisms built into the rule.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I, the undersigned, certify that on this 20th day of September, 2006, I have served by hand delivery the attached NOTICE OF FILING and POST-HEARING COMMENTS OF ENVIRONMENT ILLINOIS AND ENVIRONMENTAL LAW & POLICY CENTER upon the following persons:

Dorothy Gunn
Clerk
Illinois Pollution Control Board
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And by first-class mail with postage thereon fully prepaid and affixed to the following persons:

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Faith E. Bugel

Dated: September 20, 2006

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Dr. Mark Cohen, *Atmospheric Deposition of Mercury to the Great Lakes*, Presentation at An Ecosystem Approach to the Health Effects of Mercury to the Health Effects of Mercury in the Great Lakes Basin – Clearly International Conference Center, Windsor, Ontario, (2003). ***See tab 23.***

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Chapter 6.0 – Regulatory Activities – Federal and Other States

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Chapter 8.0 – Technical Feasibility of Controlling Mercury Emissions from Coal-Fired Power Plants in Illinois

Proveen Amar, Northeast States for Coordinated Air Use Management (NESCAUM), *Mercury Emissions From Coal Fired Power Plants – The Case For Regulatory Action*, (2003). ***See tab 7.***

Emily Figdor, U.S. Public Interest Research Group Education Fund, *Reel Danger: Power Plant Mercury Pollution and the Fish We Eat* (2004). ***See tab 3.***

Paul J. Miller & Chris Van Atten, Commission for Environmental Cooperation of North America, *North American Power Plant Air Emissions* (2004). ***See tab 4.***

National Wildlife Federation, *Controlling Mercury from Power Plants: Current state of knowledge* (2003). ***See tab 27.***

Supryia Ray, Illinois PIRG Education Fund, *Made in the U.S.A.: Power Plants and Mercury Pollution Across the Country* (2005). ***See tab 5.***

Larry Schweiger et al., National Wildlife Federation, *Getting the Job Done: Affordable Mercury Control at Coal-Burning Power Plants* (2004). ***See tab 16.***

State and Territorial Air Pollution Program Administrators (STAPPA) & Association of Local Air Pollution Control Officials (ALAPCO), *Regulating Mercury from Power Plants: A Model Rule for States and Localities* (2005). ***See tab 26.***

Chapter 9.0 – Economic Modeling

National Wildlife Federation, *Controlling Mercury from Power Plants: Current state of knowledge* (2003). ***See tab 27.***

Supryia Ray, Illinois PIRG Education Fund, *Made in the U.S.A.: Power Plants and Mercury Pollution Across the Country* (2005). ***See tab 5.***

State and Territorial Air Pollution Program Administrators (STAPPA) & Association of Local Air Pollution Control Officials (ALAPCO), *Regulating Mercury from Power Plants: A Model Rule for States and Localities* (2005). ***See tab 26.***

James Staudt, Andover Technology Partners, *Mercury Control From Coal-Fired Electric Utility Plants – A Review of Technology Status and Cost* (2006) (Presentation). ***See tab 28.***

Chapter 10.0 – Other Relevant Issues and Additional Considerations

Dr. Mark Cohen, *The Atmospheric Transport and Deposition of Mercury to the Great Lakes*, Collection of Graphics for IJC Air Quality Board (2004).

I. SUMMARY

In this presentation, a collection of graphics are provided that include an inventory of receptors (great lakes and other large bodies of water in the US and Canada) that are analyzed in a study of mercury deposition resulting from US and Canadian sources and relying on 1996 meteorological data and 1999 source emissions data from the US EPA. Specifically included are graphics on the results in the Great Lakes and detailed graphical results for Lake Erie and **Lake Michigan**.

II. INFORMATION RELEVANT TO IPCB HEARING SCHEDULE

Chapter 2.0 – Background Information on Mercury

- Pie graph of sources of anthropogenic reactive gas (RGM) mercury from the great lakes area. *Id.* at 7.

Chapter 5.0 – Deposition

- Graphs showing fraction of and total amount of deposition in bodies of water including Great Lakes arising from US coal fired electricity utility facilities. (1999) *Id.* at 15, 17.
- Graphs ranking Top 25 contributors of mercury deposition directly to the Great Lakes broken down by individual sites. (1999) *Id.* 22-27.
- Graph of Lake Michigan is included and many Illinois coal fired power plants are major contributors.
- Map of Great Lakes region showing Top 25 contributors by source of mercury deposition directly to the Great Lakes. *Id.* at 29.
- Map of Great Lakes region showing geographical distribution of direct deposition to Lake Michigan. *Id.* at 43. The purple and red coloring shows that Illinois is a major contributor.

Dr. Mark Cohen et al., *Modeling the atmospheric transport and deposition of mercury to the Great Lakes*, Environmental Research 95 (2004).

I. SUMMARY

This paper discusses a model developed (a special version of the NOAA-HYPSPLIT_4 model) and used to estimate the atmospheric fate and transport of mercury in a North American modeling domain. Model results were found to be reasonably consistent with wet deposition measurements in the Great Lakes region and with independent measurement-based estimates of deposition to Lake Michigan. Of particular significance is the finding that coal combustion was generally found to be the largest contributor to atmospheric mercury deposition to the Great Lakes (see below) and that the Chicago region "stands out" as a major contributor to mercury deposition in Lake Michigan (see quote below).

II. INFORMATION RELEVANT TO IPCB HEARING SCHEDULE

Chapter 2.0 - Background Information on Mercury

- 3 Classes of Atmospheric Mercury *Id. 248*:
  1) Elemental Mercury Hg[0]
  2) Particulate Mercury Hg[p]
  3) Water Soluble or Reactive Gas HG[II]
- "The predominant form in the atmosphere is generally elemental mercury (Hg 0)." *Id.* at 248.
- "The great majority of the mercury in the atmosphere (~ 95%) is in the elemental form" *Id.* at 248.
- "Each of the above forms of mercury can be transformed into the other in the atmosphere" *Id.* at 248.
- Fig. 4 is a graph of the total Mercury Emissions from U.S. and Canadian anthropogenic sources. *Id.* at 252.

Chapter 5.0 - Deposition of Mercury

- How is Mercury Deposited to the Great Lakes.
  - Indirectly
    - Portion Deposited into Lakes Watershed and subsequentlytransported to Lakes.
  - Directly
    - Discharge into the Lakes and its tributaries from polluting facilities.
      - Fig. 10 shows the overall-model estimated deposition of mercury to each of the Great Lakes. *Id.* at 259.
      - Fig. 13 illustrates the geographical distribution of mercury contributions , where the emissions and contributions are shown as a function of distance from each lake. *Id.* at 262.
- "For Lake Michigan, the contribution form **the *Chicago region*** stands out, due to its significant emissions and proximity to the lake." (referring to graph in supplemental materials) *Id.* at 262

- "Overall, coal combustion in the United States was found to be the most significant source category contributing mercury through atmospheric deposition to the Great Lakes." *Id.* at 263-264.

Emily Figdor, *Reel Danger: Power Plant Mercury Pollution and the Fish We Eat,* U.S. Public Interest Research Group Education Fund (August 2004).

I. SUMMARY

This report analyzes the first available data from the US EPA's ongoing National Study of Chemical Residues in Lake Fish Tissue, a four-year study of 268 chemicals in fish from a representative sample of 500 lakes and reservoirs in the continental U.S. Included in the analysis are the first two years of EPA's quality-assured data, which includes fish from 260 lakes and reservoirs collected in 1999-2000 and 2001. Below are the key findings from the report. Also contained in this document is general background information on mercury.

II. INFORMATION RELEVANT TO IPCB HEARING SCHEDULE

- Key findings from analyzing the data from U.S. EPA's ongoing National Study of Chemical Residues in Lake Fish Tissue, a four-year study of 268 chemicals in fish from a representative sample of 500 lakes and reservoirs in the continental U.S. are the following: *Id.* at 1.

  - All of the fish samples were contaminated with mercury.
  - Fifty-five (55) percent of the fish samples were contaminated with mercury at levels that exceed EPA's "safe" limit for women of average weight who eat fish twice a week. In 29 states, mercury levels in at least half of the fish samples exceeded this limit.
  - Seventy-six (76) percent of the fish samples exceeded the safe mercury limit for children of average weight under age three who eat fish twice a week; 63 percent of fish samples exceeded the limit for children ages three to five years; and 47 percent of the fish samples exceeded the limit for children six to eight years.
  - Predator fish, or fish at the top of the aquatic food chain, had the highest average levels of mercury. Smallmouth bass, walleye, largemouth bass, lake trout, and Northern pike had the highest average mercury concentrations.
  - Eighty (80) percent of the predator fish samples contained mercury levels exceeding EPA's safe limit for women. In 18 states, 100 percent of the predator fish samples exceeded this limit.

Chapter 5.0 – Mercury Deposition

- "EPA estimates that 60 percent of the mercury deposited in the U.S. comes from domestic manmade sources" *Id.* at 7.
- "The highest deposition rates in the U.S. occur in the southern Great Lakes, the Ohio Valley, the Northeast, and scattered areas in the South. In regions where deposition is high, **local and regional sources** are the main cause of elevated mercury concentrations." *Id.* at 7.

Paul J. Miller & Chris Van Atten, Commission for Environmental Cooperation of North America, *North American Power Plant Air Emissions* (2004).

I. SUMMARY

Contains specific air pollutant information for individual fossil fuel–fired power plants across North America. Also includes the environmental performance of each power plant in terms of the amount of pollution emitted per unit of electricity produced.

II. INFORMATION RELEVANT TO IPCB HEARING SCHEDULE

Chapter 2.0 – Background Information on Mercury

- Figure 3.6 on page 19 shows the geographic distribution of power plant mercury emissions in North America.
- Table 3.9 beginning on page 54 shows U.S. mercury power plant emission for 2002, sorted by annual emissions.

Chapter 8.0 – Technical Feasibility of Controlling Mercury Emissions from Coal-Fired Power Plants in Illinois

- "Extensive field tests in the United States have demonstrated that existing pollution control equipment, such as SO_2 scrubbers and post-combustion NO_x controls, can achieve significant levels of mercury control. According to the United States EPA, the average levels of mercury control range from 0 percent to 98 percent, depending on the exact characteristics of the power plant and the coal used." *Id.* at 19.

Supryia Ray, Illinois PIRG Education Fund, *Made in the U.S.A.: Power Plants and Mercury Pollution Across the Country* (2005).

I. SUMMARY

Analyzes 2003 EPA data on mercury air emissions from power plants.

II. INFORMATION RELEVANT TO THE IPCB HEARING SCHEDULE

Chapter 2.0 – Background Information on Mercury

- Appendix A.1, which shows the 100 counties with the highest power plant mercury air emissions, has Illinois counties at 30, 47, 62, 66, 81, and 100. *Id.* at 22.

Chapter 3.0 – Mercury Impacts on Human Health

- "The Mt. Sinai School of Medicine, which assessed the economic impact of U.S. power plant mercury emissions on the developing fetal brain, found that such emissions cost $1.3 billion per year in diminished economic productivity due to loss of IQ." *Id.* at 19.
- "The Harvard Center for Risk Analysis, which monetized both neurological and cardiovascular impacts of reducing power plant mercury emissions using targets in the Bush administration's "Clear Skies" initiative, estimated benefits ranging up to $3.5 billion annually at an emissions level of 26 tons of mercury per year and $5.2 billion annually at 15 tons per year. The estimates included benefits associated with IQ increases as well as avoided cardiovascular events and premature mortality." *Id.* at 19.
- "...the EPA's own water office, which assessed the benefits of reducing U.S. mercury emissions by 30-100% and likewise included both neurological and cardiovascular impacts, estimated benefits in the Southeastern U.S. ranging from $600 million to more than $2 billion." *Id.* at 19.

Chapter 8.0 – Technological Feasibility of Controlling Mercury Emissions From Coal-Fired Power Plants in Illinois

- "Numerous full-scale tests of activated carbon injection (ACI), a control technology that has reduced mercury emissions from medical and municipal waste incinerators by more than 90% since the mid-90s, have shown similar success in reducing power plant mercury emissions. Examples include Alabama Power's multiunit Gaston plant, which obtained up to 90% reductions for a boiler burning bituminous coal; Sunflower Electric's Holcomb Station in Kansas, which reported reductions in excess of 90% on subbituminous coal; and Great River Energy's Stanton Station in North Dakota, which reported up to 81% control with untreated carbon and up to 96% control with brominated carbon on a boiler burning lignite coal. As two power company representatives, the Electric Power Research Institute, the U.S. Department of Energy, and ADA-ES, a leading pollution control company, concluded: "Recent full-scale field tests have proven the effectiveness of activated carbon injection for reducing mercury emissions. The technology is ideally suited for use on existing coal-fired boilers..." *Id.* at 18.

- "...mercury control technology for power plants is commercially available today. Several power plants have already agreed to install such technology to reduce mercury emissions." *Id.* at 19.

Chapter 9.0 – Economic Modeling

- "Using EPA data, the National Wildlife Federation (NWF) estimated that installing mercury control technology to achieve 90% mercury reduction at power plants would cost the average household about 69 cents to $2.14 per month in five coal-dependent states: Illinois, Michigan, Ohio, Pennsylvania, and North Dakota." *Id.* at 19.

Michael Shore, Environmental Defense, *Out of Control and Close to Home: Mercury Pollution from Power Plants* (2003).

I. SUMMARY

Analysis of emission trends and recent modeling of how mercury is transported and deposited into soil and water, leading to the conclusion that the majority of mercury is deposited locally.

II. INFORMATION RELEVANT TO IPCB HEARING SCHEDULE

Chapter 2.0 – Background Information on Mercury

- Figure B on page 5 lists Illinois as the state with the fourth highest mercury emissions.

Chapter 4.0 – Mercury Impaired Waters in Illinois

- Figure 2 on page 8 shows the fish advisories for all 50 states. The impact of mercury on Illinois is well illustrated.

Chapter 5.0 – Deposition of Mercury

- "Atmospheric mercury pollution that has reacted and combined with other pollutants tends to deposit locally or regionally, while unreacted mercury (elemental) tends to enter the global atmospheric pool, enabling it to be deposited virtually anywhere in the world." *Id.* at 11.
- "At hot spots, local sources within a state commonly account for 50% to 80% of the mercury deposition (Figure 5 [which ranks Illinois as the fourth-highest state for mercury hot spots]). In-state sources contribute more than 50% of the pollution to sites in the top 8 worst hot spot states." *Id.* at 12.
- "An ambitious analysis of mercury pollution, deposition and fish contamination in Florida provides on-the-ground evidence that corroborates the importance of local sources. Because of tighter standards on medical and municipal waste incinerators that took effect in mid-1992, South Florida's total estimated local emissions of mercury declined by about 93% between 1991 and 2000. During this same period, mercury deposited via rain and other precipitation declined in South Florida by about 25%. Concentrations of mercury in large mouth bass have also decreased significantly, 60–75% since the early 1990s. These data strongly suggest that reducing local mercury pollution will lower concentrations in local water bodies, and in turn reduce contamination in fish and the risk of human exposure." *Id.* at 12.

Proveen Amar, Project Manager, *Mercury Emissions From Coal Fired Power Plants – The Case For Regulatory Action*, NESCAUM (Northeast States for Coordinated Air Use Management) (2003).

I. SUMMARY

This article makes a very persuasive case for adopting a stringent mercury reduction standard at the federal level, prior to enactment of CAMR. An outline of the information included in this document is set forth in the TOC and specific information relevant to the hearing schedule, particularly the issue of Human Health Impacts, Deposition, and Technical Feasibility is below.

II. INFORMATION RELEVANT TO IPCB HEARING SCHEDULE

Chapter 3.0 - Mercury Impacts on Human Health

- "Widespread methylmercury contamination, **primarily as a result the deposition of mercury from the atmosphere**, has resulted in elevated levels of mercury in fish. In fact, methylmercury contamination in fish is so pervasive in the U.S. that health departments in 45 states and American Samoa have issued freshwater fish consumption advisories." *Id.* at 1-3.
- A survey in 1999-2000, the National Health and Nutrition Examination Survey, conducted by the Centers for Disease Control and Prevention, "revealed that one in 12 women of childbearing age (8%), tested above EPA's safe" level of mercury. "This translates to 4.7 million women of childbearing age with elevated levels of mercury and approximately 322,000 newborns who are at risk of neurological effects from being exposed *in utero* to methylmercury." *Id.* at 1-6 through 1-7.
- "The EPA, the Centers for Disease Control and Prevention, the National Research Council of the National Academy of Sciences, and the World Health Organization have all determined that potentially significant public health risks exist from widespread exposure to methylmercury." *Id.* at 1-2.

Chapter 5.0 - Mercury Deposition

- Table 2.1 – EPA National Emissions Inventory for Mercury by Source. *Id.* at 2-2.
- "EPA has estimated that roughly 66 percent of all of the Mercury deposited in the U.S. comes form U.S. sources." *Id.* at 2-4.
- Figure 2.2 Total Mercury Deposition – "the most highly impacted areas are the southern Great Lakes ..." as shown by the region in red. *Id.* at 2-5.
- "Mercury is emitted form power plants in different chemical species, with each species having a different fate in the atmosphere. Climate, wind direction and terrain also play a role in the transport of mercury. For this and other reasons, it is difficult to model deposition patterns or to predict the transport patterns of emissions." *Id.* at 2-7.
- "[I]t is evident that reduction from domestic emissions sources – and power plants in particular, are critical." *Id.* at 2-7.

Chapter 8.0 – Technical Feasibility of Controlling Mercury

- Figure 4.2 – Percent Mercury Removal vs. Activated Carbon Injection Rate – this is a graph of the amount of mercury removal that resulted from ACI injection at various coal fired power plants conducted in tests sponsored by the Department of Energy (DOE.) Notably, the power plants burning subbituminous and bituminous coal, the coal which most Illinois plants use, in combination with a fabric filter demonstrated >90% capture rates. *Id.* at 4-5.
- **"Full-scale demonstrations of ACI-technology indicate that mercury removal of over 90 percent is feasible..."** *Id.* at 4-9.

Joshua T. Cohen, *A Summary of the Major Studies of Prenatal Mercury Exposure and Cognitive Function* (2004).

I. SUMMARY

This provides a summary of the methods and results of the major studies measuring the effects of prenatal mercury exposure on cognitive function. The most useful section is the one devoted to tables, which summarizes the results of the studies nicely.

II. INFORMATION TO THE IPCB HEARING SCHEDULE

Chapter 3.0 – Mercury Impacts on Human Health

- The WISC-III test, the California Verbal Learning Test (CVLT), and the Boston Naming Test (BNT) evaluate the cognitive domain. *Id.* at 5.
- According to the Faroe Islands study, a "10X increase in cord blood Hg effect was equivalent to a developmental delay of: Boston Naming – 5 mos.; WISC-R digit span – 8 mos.; Cal[ifornia]Verbal Learning [Test] – 6-7 mos. ; Cont[inuance] Perf[ormance] Test – 5 mos." *Id.* at 11.
- According to the Faroe Islands study, a "10-fold increase in cord-wholeblood Hg corresponded to the equivalent of a 3-wk reduction in gestational age" in two-week-old children. *Id.* at 15.
- According to the Seychelles Islands study, when a mother has a mercury concentration of 10 μg/g at birth, "mercury [is] associated with a two week delay in age at first walking" for male children. *Id.* at 19.
- In the New Zealand study, the "proportion of children in the high exposure group with abnormal or questionable DDST [Denver Developmental Screening Tests] results statistically exceeded the corresponding proportion in the low exposure group." *Id.* at 25.

Environmental Protection Agency, *Revision of December 2000 Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units and the Removal of Coal- and Oil-Fired Electric Utility Steam Generating Units From the Section 112(c) List; Final Rule*, Federal Register Vol. 70, No. 59 15994 (2005).

I. SUMMARY

Rule and explanation for removing coal- and oil-fired Utility Units from the section 112(c) list.

II. INFORMATION RELEVANT TO IPCB HEARING SCHEDULE

Chapter 3.0 – Mercury Impacts on Human Health

- "Methylmercury is a well-established human neurotoxicant. Methylmercury that is ingested by humans is readily absorbed from the gastrointestinal tract and can cause effects in several organ systems." *Id.* at 16011.
- "The best studied effect of low level exposure is the ability of methylmercury to cause subtle, yet potentially important neurodevelopmental effects." *Id.* at 16011.
- "Large prospective epidemiological studies have reported that prenatal methylmercury from environmental exposures has been associated with poor performance on neurobehavioral tests in children. These include tests that measure attention, visual-spatial ability, verbal memory, language skills, and fine motor function." *Id.* at 16011.
- "Some recent epidemiological studies in men suggest that methylmercury is associated with a higher risk of acute myocardial infarction, coronary heart disease and cardiovascular disease in some populations." *Id.* at 16011.

Lynn R. Goldman & Michael W. Shannon, *Technical Report: Mercury in the Environment: Implications for Pediatricians*, Pediatrics Vol. 108 No. 1 197 (2001).

I. SUMMARY

Describes the process by which the various forms of mercury are taken into the body, effects, and treatments.

II. INFORMATION RELEVANT TO IPCB HEARING SCHEDULE

Chapter 3.0 – Mercury Impacts on Human Health

- "Elemental mercury readily vaporizes at room temperature. When inhaled, elemental mercury vapor easily passes through pulmonary alveolar membranes and enters the blood, where it distributes primarily to the red blood cells, central nervous system (CNS), and kidneys." *Id.* at 198.
- "At high concentrations, mercury vapor inhalation produces acute necrotizing bronchitis and pneumonitis, which can lead to death from respiratory failure." *Id.* at 198.
- "Early nonspecific signs include insomnia, forgetfulness, loss of appetite, and mild tremor and may be misdiagnosed as psychiatric illness. Continued exposure leads to progressive tremor and erethism, a syndrome characterized by red palms, emotional lability, and memory impairment. Salivation, excessive sweating, and hemoconcentration are accompanying autonomic signs. Mercury also accumulates in kidney tissues, directly causing renal toxicity, including proteinuria or nephrotic syndrome. Isolated renal effects may also be immunologic in origin." *Id.* at 198.
- "Consumption of fish is the primary route of exposure to organic mercury for children older than 1 year." *Id.* at 199.
- "Most organic mercury compounds are readily absorbed by ingestion and inhalation and through the skin, except for phenylmercury, which is not well absorbed after ingestion or dermal contact. In general, organic mercury compounds are lipid soluble, and 90% to 100% is absorbed from the gastrointestinal tract. They appear in the lipid fraction of blood and brain tissue. Organic mercury readily crosses the blood-brain barrier and also crosses the placenta. Fetal blood mercury levels are equal to or higher than maternal levels. Methylmercury appears in human milk." *Id.* at 200.
- "Signs of toxicity from acute [methylmercury] exposure progress from paresthesias and ataxia to generalized weakness, visual and hearing impairment, and tremor and muscle spasticity to coma and death." *Id.* at 200.

Illinois Department of Natural Resources, *2005 Illinois Fishing Information* (2005).

I. SUMMARY

An up-to-date summary of fishing regulations in Illinois to explain the intent of the Fish and Aquatic Life Code (Chapter 515, Illinois Compiled Statutes). Also, the booklet presents site specific regulations organized by water area.

II. INFORMATION RELEVANT TO THE IPCB HEARING SCHEDULE

Chapter 3.0 – Mercury Impacts on Human Health

- "Methyl mercury is extremely toxic to humans and causes many adverse health effects. Health effects associated with eating methyl mercury-contaminated fish include impaired central nervous system function, kidney damage and failure, and gastrointestinal damage with higher methyl mercury exposure, and development delays in children with lower exposure. A recent report by the National Academy of Sciences concluded that the population at highest risk for adverse health effects is the children of women who eat large amounts of fish and seafood during pregnancy. This is due to the greater sensitivity of the developing nervous system of infants." *Id.* at 41.

Chapter 4.0 – Mercury Impaired Waters in Illinois

- Page 41 also contains a table showing the Illinois bodies of water that are included in a special mercury advisory because of high mercury levels.
- "In order to protect the most sensitive populations, pregnant or nursing women, women of childbearing age, and children less than 15 years of age are advised to eat no more than one meal per week of predator fish. This advisory is based on recent studies of families in several countries that eat many meals of fish having various amounts of methyl mercury, along with the most recent mercury data from predator fish at sample points throughout the state." *Id.* at 41.

Paul Jakus, Meghan McGuinness & Alan Krupnick, Resources for the Future, *The Benefits and Costs of Fish Consumption Advisories for Mercury* (2002).

I. SUMMARY

Estimates of cost to fisherman if health advisory for Mercury were put in place on Chesapeake Bay. Also estimates the health effects of such an advisory. This study is very specific to Chesapeake Bay and offers little general information.

II. INFORMATION RELEVANT TO IPCB HEARING SCHEDULE

Chapter 3.0 – Mercury Impacts on Human Health

- "MeHg has been associated with adverse cardiovascular effects, such as increased blood pressure and abnormal cardiac function. Two recent studies focus specifically on the relationship between low-level dietary exposure to MeHg and cardiovascular health, one of which finds evidence of a link between mercury uptake and all-cause mortality." *Id.* at 80.
- "Blood pressure in childhood is an important determinant of hypertension risk later in life, and prenatal methylmercury exposure has been linked to increased blood pressure in children." *Id.* at 81.

Kathryn R. Mahaffey, Robert P. Clickner & Catherine C. Bodurow, *Blood Organic Mercury and Dietary Mercury Intake: National Health and Nutrition Examination Survey, 1999 and 2000*, Environmental Health Perspectives, Vol. 112, No. 5, 562 (2004).

I. SUMMARY

Analyzes mercury intake in American women based on fish consumption and race.

II. INFORMATION RELEVANT TO THE IPCB HEARING SCHEDULE

Chapter 3.0 – Mercury Impacts on Human Health

- "Based on the distribution of BHg concentrations among the adult female participants in 1999–2000 NHANES and the number of U.S. births in 2000, > 300,000 newborns each year in the United States may have been exposed *in utero* to methyl mercury concentrations higher than those considered to be without increased risk of adverse neurodevelopmental effects associated with methyl mercury exposure." *Id.* at 562.
- "Women who eat fish and/or shellfish at least twice a week have average BMHg concentrations seven times greater than women who reported no fish/shellfish consumption in the previous 30 days." *Id.* at 565.
- "Analyses of total diet by the U.S. Food and Drug Administration (U.S. FDA) indicate that fish and shellfish are almost exclusively the source of Hg (specifically MHg) in the U.S. diet (Gunderson 1995; U.S. FDA 2000)." *Id.* at 567.

Kathryn R. Mahaffey, *Methylmercury: Epidemiology Update* (2004) (Presentation).

I. SUMMARY

Update on major studies done in 2003/2004 that measure the effect of mercury on the human body.

I. INFORMATION RELEVANT TO THE IPCB HEARING SCHEDULE

Chapter 3.0 – Mercury Impacts on Human Health

- "Estimate at least 300,000 newborns in US each year with in utero blood [Hg] greater than 5.8 μ/L." *Id.* at 1.
- "Blood mercury concentrations were 7 X higher among women who reported eating 9+ fish/shellfish meals within past 30 days (i.e., 2 or more times per week) compared with women who reported no fish/shellfish consumption in the past 30 days (Mahaffey et al., 2003)." *Id.* at 3.
- "Cord:maternal ratio for blood [Hg] ranges from > 3 to less than 1. Average ~ 1.7 to 1.8. New Japanese data indicate ratio of 1.6 for cord : maternal pairs." *Id.* at 4.
- "Number of US births in 2000: 4,058,814 (*National Vital Statistics Reports*). 1 : 1 ratio of cord to maternal blood [Hg], i.e., 5.8 cord to 5.8 maternal, 7.8% of women had total blood [Hg] >/= 5.8, ~ 300,000 newborns each year > 5.8 ug/L (Mahaffey et al., 2003). 1.7 : 1 ratio of cord to maternal blood [Hg], i.e. 5.8 cord to ~ 3.5 maternal, 15.7% of women had total blood [Hg] >/= 3.5 ug/L, ~ 630,000 newborns each years >/= 5.8 ug/L cord blood." *Id.* at 5.
- **"Yokoo et al. 2003.** Reduced function on tests of fine motor speed and dexterity and on tests of verbal memory among adult Amazonian villagers exposed to methylmercury." *Id.* at 5.
- **"Beuter and Edwards, 2003**. Cree Indians. Additional studies among adults showed difficulty with accuracy and sharpness of visual fixation and pursuit in dynamic eye movements." *Id.* at 5.

Glenn Rice & James K. Hammitt, *Economic Valuation of Human Health Benefits of Controlling Mercury Emissions from U.S. Coal-Fired Power Plants* (2005).

I. SUMMARY

This report describes the results of a comprehensive study to estimate the health benefits of reducing mercury emissions from coal-fired power plants in the United States. Section 1.1 contains a lot of information about atmospheric mercury deposition, but it does not appear to be very helpful because it suggests that the majority of mercury does not deposit locally.

II. INFORMATION RELEVANT TO THE IPCB HEARING SCHEDULE

Chapter 3.0 – Mercury Impacts on Human Health

- Figure ES-1 shows a "Spectrum of Certainty of Causal Association of Health Effect with Mercury Exposure with Estimated Benefit Overlay in Millions ($M) and Billions ($B) of Dollars (2000$)," which is useful to show some of the health and economic benefits of reducing mercury emissions. *Id.* at xix.
- "Once ingested, roughly 95% of the methylmercury entering the gastrointestinal tract is absorbed. This compound passes through the lining of the gut to the liver and enters the blood stream where it primarily binds red blood cell proteins, quickly distributing from blood to the liver, as well as the kidney and skin. Methylmercury appears to pass the adult blood brain barrier by binding to a thiol group on cystiene, which is then recognized by a neutral amino acid carrier protein (Aschner, 1989); entry into the brain tissues can lead to adult neurotoxicity. In pregnant females, methylmercury can also bind and pass through the placenta tissues; it may also enter placental tissues through an active transport process via an amino acid carrier protein. Stern and Smith (2003) report that methylmercury levels in cord blood are higher than levels in maternal blood; the reason(s) for this observation have not been fully explained. The blood brain barrier does not effectively occlude methylmercury from the brain tissue of the fetus. Entry into these brain tissues likely leads to the neurocognitive deficits observed in some children exposed to methylmercury." *Id* at 22.
- "Exposures to these high levels of mercury led to severe neurological effects in adults, children and fetuses; however, the neurotoxicity hat was associated with intrauterine exposures (i.e., severe cerebral palsy, delayed walking and talking) occurred at lower doses than the doses that resulted in adult effects (summary discussions in NRC, 2000; U.S. EPA, 2001b,c). For example, asymptomatic mothers (i.e., mothers in whom no neurological effects were observed) bore affected children indicating that the developing fetal nervous system was more vulnerable to methylmercury than the mature maternal nervous system." *Id.* at 26.
- "A statistically significant association was reported between high maternal mercury exposure and decreased test scores on the McCarthy Scale of Children's Abilities in the perceptual and motor domains. Results of the linear multiple regression analyses showed significant associations between high maternal mercury exposure and decreased performance on three neurological tests." *Id.* at 28.
- "In summary, NRC (2000) and, more recently, a subset of the committee (Stern et al., 2004) have concluded that, based on evidence from two of the three studies, low dose *in utero*

exposures to methylmercury likely lead to subtle but measurable neurological effects in children." *Id.* at 35.

- "In a re-analysis of the New Zealand cohort study (Kjellstrom et al., 1989), Crump et al. (1998) reported a decrease of 0.5 IQ points on the Wechsler Intelligence Scale for Children-Revised Full Scale IQ for each increase of 1 ppm methylmercury in average maternal hair during pregnancy." *Id.* at 86.
- "We note that Mahaffey et al. (2004) report that roughly 8% of children may be born to women whose methylmercury intake exceeds the threshold of 0.1 μg/kg day." *Id.* at 91.

Chapter 5.0 – Deposition of Mercury

- "Thus, when a mix of Hg^0, Hg^{II} and Hg_p is released from an anthropogenic source, Hg^{II} and Hg_p are thought to deposit locally and regionally around the source." *Id.* at 5.

Larry Schweiger et al., National Wildlife Federation, *Getting the Job Done: Affordable Mercury Control at Coal-Burning Power Plants* (2004).

I. SUMMARY

Provides an alternative perspective on the economic feasibility of reducing mercury pollution from power plant smokestacks nationwide. NWF recaps existing studies showing the effectiveness and availability of mercury control technology. Using EPA data, NWF then estimates the cost of installing and operating this technology across entire state power plant fleets.

II. INFORMATION RELEVANT TO THE IPCB HEARING SCHEDULE

Chapter 4.0 – Mercury Impaired Waters in Illinois

- "Anglers in the Great Lakes states have faced fish consumption advisories for nearly three decades. Illinois' current mercury advisory applies to fish caught in all inland waters, as well as in the Great Lakes. People are warned to limit consumption of popular species such as bass and walleye. Cleaning up mercury pollution is essential to protect Illinois' 1,237,000 anglers, and the more than $598 million dollars they spend on fishing each year." *Id.* at 29.

Chapter 5.0 – Deposition of Mercury

- "Computer modeling done by the U.S. EPA found that for a site in the Chicago area, 63 percent of the mercury deposition was attributable to Illinois sources, and 41 percent of Illinois emissions were predicted to fall instate." *Id.* at 29.

Chapter 8.0 – Technological Feasibility of Controlling Mercury Emissions From Coal-Fired Power Plants in Illinois

- "Tests completed to date show that: (1) Greater than 90 percent mercury control is possible at plants equipped with ACI and a fabric filter burning bituminous and subbituminous coals and (2) At least 80 percent control is possible for plants burning lignite coal using ACI and a fabric filter, with higher reductions likely with a modified activated carbon or higher activated carbon injection rates." *Id.* at 16.
- "We assume that activated carbon injection and a polishing fabric filter would be needed to reliably reach 90 percent mercury capture at coal-fired boilers in Illinois. For 10 boilers at four plants, we assume that advanced dry scrubbers are needed. In general, this methodology likely results in an overestimation of costs because new technology will soon be available. For example, Illinois' Powerton plant was the site of a test activated carbon injection with a COHPAC fabric filter which achieved over 90 percent mercury control." *Id.* at 28.
- "The average Illinois residential electricity customer uses 773 kilowatt hours (kWh) of energy per month and pays a $65 utility bill. Illinois' 21 plants can be retrofitted to achieve 90 percent control, while costing Illinois consumers only $0.69 more per month, on average. Commercial businesses would pay about $5.82 more on an average bill of $549, while the average $28,826 industrial bill would increase $305.47 monthly." *Id.* at 28-29.

- Estimated costs of controlling mercury at Illinois' coal-fired power plants, and the resulting impacts on electricity bills, are given in table 10. *Id.* at 29.

Rebecca Stanfield, IPIRG, *Mercury Contamination in Illinois, Lake Michigan Forum*(2006)(Presentation).

I. SUMMARY

Excellent summary of studies that have found a significant health impact from exposure to mercury as well as studies that explore mercury deposition.

II. INFORMATION RELEVANT TO IPCB HEARING SCHEDULE

Chapter 3.0 – Mercury Impacts on Human Health

- "2000 NAS report – Concludes that risk of neurological damage to children from chronic, low-dose prenatal exposure to methylmercury, likely to be sufficient to result in an increase in number of children who require special ed." *Id.* at 4.
- "2004 U.S. EPA estimates doubled previous estimates of the number of children exposed in the womb to levels of mercury that are sufficiently high to cause neurotoxic effects to 630,000 based on increasing evidence that mercury concentrates in the umbilical cord." *Id.* at 4."2004 Harvard School of Public Health – Concluded that damage to children's brain function caused by exposure in womb is likely irreversible." *Id.* at 4."September 2005 Mt. Sinai School of Medicine study published in American Journal of Industrial Medicine estimates 1500 children per year born with sufficient neurological damage to cause mentally retarded, estimated cost to economy of $2 billion annually." *Id.* at 4.
- "Mercury exposure can affect multiple organ systems, including nervous system, heart and immune system throughout lifespan." *Id.* at 5.
- Higher mercury levels associated with increased risk of heart attacks. *Id.* at 5.
    - Eliseo Guallar et al, "Mercury, Fish Oils, and the Risk of Myocardial Infarction," New England Journal of Medicine, 347 (22), 1747-1754, November 28, 2002.
    - Ellen Silbergeld, Dept. of Environmental Health Sciences and Epidemiology, Johns Hopkins University, Bloomberg School of Pubic Health.
    - Edna Yokoo et al, "Low Level Methylmercury Expsure Affects Neuropsychological Function in Adults," Environmental Health, 2(8), June 2003.

Chapter 4.0 – Mercury Impaired Waters in Illinois

- "13 bodies of water with "special" advisory based on monitoring – Sensitive populations (Children under 15, pregnant or nursing women, women of childbearing age) warned to eat no more than 1 meal per month, and EVERYONE advised to eat no more than one meal per week." *Id.* at 7.

Chapter 5.0 – Deposition of Mercury

- "Air deposition is the most significant contributor to mercury in our waterways (U.S. EPA Report to Congress). Coal burning power plants account for 41% of the mercury in our waterways." *Id.* at 10.
- "In Illinois, coal combustion bears even more of the blame for the problem -- 60% of the air emissions; power plants emit more than 7000 lbs per year." *Id.* at 11."Mercury deposits locally, AND it can also travel long distances. 66% of mercury deposited in the U.S. comes from U.S. sources." *Id.* at 12.
- "Determining factors: When power plants emit mercury in an oxidized or particulate-bound phase, it deposits locally. When they emit Hg as a gaseous elemental phase, it travels far before being oxidized and deposited." *Id.* at 12.NOAA scientist Mark Cohen, extensive modeling work on mercury deposition into the Great Lakes:
    - Of the top 25 contributors, 22 were in the region/states adjacent to the lake.
    - 16 are coal-burning power plants.
    - 14 were located in Illinois, Indiana, Michigan or Wisconsin.
    - 7 were Illinois plants (Fisk, Crawford, Powerton, Will County, Waukegan, Joliet 29). *Id.* at 13.

Florida Department of Environmental Protection, ***Integrating Atmospheric Mercury Deposition with Aquatic Cycling in South Florida: An approach for conducting a Total Maximum Daily Load analysis for an atmospherically derived pollutant*** **(2003).**

I. SUMMARY

Presents the results of a pilot project designed to evaluate the technical feasibility, given the present state of knowledge of mercury cycling in the environment, of calculating an atmospherically driven total maximum daily load (TMDL) for mercury for the Florida Everglades. This study is extremely scientific and difficult to translate to layman's terms. It is also very specific to Florida.

II. INFORMATION RELEVANT TO THE IPCB HEARING SCHEDULE

Chapter 4.0 – Mercury Impaired Waters in Illinois

- "In the absence of changes to the system other than mercury loading (e.g. changes in sulfur cycling, nutrient cycling, or hydrology), a reduction of about 80% of current total annual mercury atmospheric deposition rates would be needed for the mercury concentrations in a 3-year old largemouth bass at WCA 3A-15 to be reduced to less than Florida's present fish consumption advisory action level of 0.5 mg/kg (parts per million)." *Id.* at iii.

Large Lakes Research Station, ***Lake Michigan Mass Balance Project: Mercury Results***

I. SUMMARY

Analysis of mercury in Lake Michigan based on 1994-95 data. The study finds that the major source of mercury to the lake is atmospheric deposition. This presentation is full of useful graphs.

II. INFORMATION RELEVANT TO THE IPCB HEARING SCHEDULE

Chapter 4.0 – Mercury Impaired Waters in Illinois

- "Mercury concentrations in lake trout have been following a similar pattern of decline as seen in the sediment core. Note that since the late 1970's the concentrations seems to have leveled-off. The U.S. EPA target for unrestricted consumption of fish is shown here. Note that all of the composites exceed this target." *Id.* at 5.

Chapter 5.0 – Deposition of Mercury

- "This graphic shows predicted atmospheric mercury deposition for 2001 from EPA's air model called CMAQ (Community Mesoscale Air Quality Model). Note the higher predicted deposition fluxes in the southern part of the Lake Michigan basin compared to the rest of the U.S." *Id.* at 9.

Marcia T. Willhite, ***Mercury Impaired Waters and the TMDL Process*** (Presentation).

I. SUMMARY

Discusses the difficulty of assigning a TMDL to mercury because few impaired waterways have point source discharges and asserts that the best way to control mercury in Illinois waterways is to control atmospheric mercury.

II. INFORMATION RELEVANT TO THE IPCB HEARING SCHEDULE

Chapter 5.0 – Deposition of Mercury

- Slides 11-15 contain graphical illustrations of mercury reductions in the fish populations of other states as they have reduced mercury emissions.
- "Reduction of atmospheric sources of mercury from within Florida has led to ~ 80% declines in mercury in Everglades fish and wildlife in less than 15 years since peak deposition." Slide 16."To the extent that mercury emissions are in the reactive form (RGM) one can expect to see benefits at local or regional scale within years to decades." Slide 16.

Clean Air Task Force, *Local Impacts of Mercury from Coal-Fired Power Plants* (2003).

I. SUMMARY

Lists and explains various factors that affect mercury deposition and risk of exposure.

II. INFORMATION RELEVANT TO THE IPCB HEARING SCHEDULE

Chapter 5.0 – Deposition of Mercury

- "Elemental mercury can be transported over very long distances with global air masses. The atmospheric residence time of elemental mercury is in the range of months to roughly one year. The global pool of mercury is almost entirely elemental mercury." *Id.* at 1.
- Oxidized mercury and particulate-bound mercury have a shorter atmospheric lifetime than elemental mercury and will deposit by wet or dry deposition within roughly 50 to 500 miles. *Id.* at 1.
- Page 2 contains a table that shows the "Effect of Air Pollution Control Device on Mercury Speciation."
- "Characteristics of the boiler influence the amount of mercury emitted and its dispersion in the atmosphere. These characteristics include the size (in MW) of the facility and how much coal it burns, stack height and the type of air pollution control device in place. Tall stacks typically cause the plume to disperse further from the facility. As noted above, different types of control devices capture the different mercury species to varying degrees. A large plant burning coal will have more mercury emissions on a mass basis than a smaller plant." *Id.* at 3.
- "More mercury is deposited locally in a humid site compared to an arid site. Stack height also affects local deposition. Facilities with shorter stacks will have more local deposition than those with taller stacks. Of course, the smaller coal plants have lower emissions, so the mass of emissions deposited locally by a small plant may still be smaller than emissions deposited from a large plant, even though on a percentage basis the smaller plant has higher deposition." *Id.* at 4.
- "The impact of the deposited mercury emissions depends on the proximity of the plant to an ecosystem where the mercury will be methylated, accumulated in the food chain and ingested by susceptible populations." *Id.* at 4.
- Table 3 on page 5 shows the "Results of EPA's Mercury Exposure Analysis for Individual Power Plants." *Id.* at 5.

Dr. Mark Cohen, *Atmospheric Deposition of Mercury to the Great Lakes*, Presentation at An Ecosystem Approach to the Health Effects of Mercury to the Health Effects of Mercury in the Great Lakes Basin – Clearly International Conference Center, Windsor, Ontario, (2003).

I. SUMMARY

In this document, a bullet-point presentation of the following topics are provided: the atmospheric process for mercury, general questions regarding atmospheric deposition of mercury, the methodological approach used to predict atmospheric deposition, and preliminary results of the atmospheric modeling analysis.

II. INFORMATION RELEVANT TO IPCB HEARING SCHEDULE

Chapter 5.0 - Mercury Deposition

- Three forms of atmospheric mercury – *Id.* at 3.
  1) Elemental
     - 95% of Atmospheric Mercury
     - not very water soluble
     - long atmospheric lifetime (.5 – 1 yr.)
     - globally distributed
  2) Reactive Gaseous Mercury (RGM)
     - a few percent of total in atmosphere
     - oxidized mercury Hg(II)
     - very water soluble
     - short atmospheric lifetime (1 week or less)
     - local and regional effects
  3) Particulate Mercury Hg(p)
     - a few percent of total Hg
     - Hg compounds associated with atmospheric particulates
     - moderate atmospheric lifetime (perhaps 1~2 weeks)
     - local and regional effects

- **"Atmospheric deposition *almost certainly* plays a very significant role in the mercury contamination of the Great Lakes"** *Id.* at 8.
  - Description of the Methodology used for modeling atmospheric deposition.
    - Start with atmospheric mercury emissions inventory
      - Perform atmospheric fate and transport modeling of these emissions (using a modified version of NOAA's HSYPLIT model)
      - Keep track of source-receptor information during the modeling
      - Evaluate the modeling by comparison of the predictions against ambient monitoring data
      - If model is performing satisfactorily, report

source-receptor results from the simulations - (Similar to earlier work with dioxin and atrazine).

- A graph showing the percent of total emissions or Deposition of Mercury Arising From Within Different Distance Ranges From Each of the Great Lakes (including Lake Michigan). *Id.* at 32. This is evidence that the percent of deposition in Lake Michigan is greatest at shortest distances – meaning coal fired power plant emissions located nearest to Lake Michigan, which would include Illinois plants, have the greatest effect on total mercury deposition in Lake Michigan.

Hubbard Brook Research Foundation, *Comments on the U.S. Environmental Protection Agency's, "Proposed National Emissions for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units"* (2004).

I. SUMMARY

Provides key examples from the literature and ongoing studies regarding the cycling, effects, and management of mercury in the environment. These comments suggest that special attention should be paid to the timing and levels of mercury emissions reductions, as well as any cap and trade proposal for mercury pollution.

II. INFORMATION TO THE IPCB HEARING SCHEDULE

Chapter 5.0 – Deposition of Mercury

- "Given its many species, mercury can be a local, regional and global pollutant with short (1-2 days) or long (1-2 years) residence times in the atmosphere. Consequently, it can deposit locally or travel long distances depending on its form (Dastoor and Larocque 2004). The potential for mercury to act as a global pollutant does not obviate the need for local, regional and continental control efforts in addressing the problem of mercury deposition (Engstrom and Swain 1997)." *Id.* at 4-5.
- "Taken together, recent research on the dynamics of elemental mercury, including elemental mercury emitted by domestic electric utilities, suggests that its atmospheric residence time can be significantly decreased in certain environments, and it can therefore contribute to local and regional mercury pollution." *Id.* at 6.
- "With respect to the oxidized forms of mercury, it is generally assumed that they are not reduced to elemental mercury in the atmosphere. Current information suggests, therefore, that oxidized mercury is not likely to enter the global pool, but rather is more likely to be deposited regionally or locally." *Id.* at 6.
- "Nevertheless, most research indicates that mercury sources in the U.S. are the largest contributor to mercury deposition in the U.S." *Id.* at 6.
- "A recent project funded by the New York State Energy Research and Development Authority (NYSERDA 2002) assessed the contributions of local, regional and global mercury sources to mercury deposition in New York State. For three study areas in New York (the Adirondacks, Catskills and Finger Lakes), the report shows that mercury emissions within the U.S. are the largest single source of mercury deposition (NYSERDA 2002)... These results are consistent with the 1997 Mercury Report to Congress which estimated that approximately 60 percent of the mercury deposited in the U.S. originates in the U.S., with the remaining 40 percent coming from the global reservoir (EPA 1997)." *Id.* at 6.
- "Stated another way, 46 percent of the mercury deposited within the U.S. that originates within the U.S. (and is therefore subject to U.S. law) is likely to come from electric utility emissions." *Id.* at 8.
- Table 3 includes useful information on the wildlife effects of mercury pollution. *Id.* at 9-10.
- "Moreover, it is important to note that some ecosystems are more mercury-sensitive than others because of substantial differences in mercury transport (cf Hurley et al. 1995), net

methylation (Benoit et al. 2003), and bioaccumulation rates among ecosystems. Wiener et al. (in press) define mercury-sensitive environments as those that include wetlands, low-alkalinity or low pH lakes, surface waters with nearby wetlands, and dark-water lakes and streams. They note that these ecosystems can experience "significant methyl mercury contamination of fish and wildlife in upper trophic levels" with relatively small inputs of total mercury (<1 to 10 g Hg/ha) (Wiener et al. in press)." *Id.* at 12.

- "Lake sediments in several regions of the U.S. document a period of mercury enrichment from 1850 through the 1960s and 1970s (Fitzgerald et al. 1998, Engstrom and Swain 1997, Lorey and Driscoll 1999, Kamman and Engstrom 2002). These studies all suggest that over the past 20-30 years mercury deposition has decreased in association with reductions in total U.S. mercury emissions. These patterns demonstrate a strong relationship between emissions of mercury from sources within the U.S. and mercury levels in U.S. lakes. This relationship was confirmed by Engstrom and Swain (1997) by using lake sediments from a range of sites to track the environmental response to changes in emissions. With this method, they showed that decreased mercury deposition in the Upper Midwest is attributable to reductions in emissions from U.S. sources (Engstrom and Swain 1997)." *Id.* at 13.
- "...two studies in northern Wisconsin also link changes in mercury deposition and ecosystem mercury. Watras et al. (2000) observed that decreases in the mercury concentrations in a seepage lake were related to decreases in atmospheric mercury deposition. In 2002, they reported a rapid decline in mercury in fish as mercury inputs to the system declined (Hrabik and Watras 2002). Based on this and other information, Hrabik and Watras (2002) concluded that even though there is a large reservoir of mercury in lake sediments and in decomposing organisms, newly deposited mercury dominates bioaccumulation processes in their study lakes (Hrabik and Watras 2002)." *Id.* at 13.
- "This finding was confirmed by a study in Wisconsin, which indicated that inputs of "new" mercury strongly control the level of mercury in surface waters and biota. In other words, bioaccumulation of mercury in ecosystems such as the Wisconsin lakes is more dependent on new inputs of mercury from the atmosphere than the recycling of previously deposited mercury. Therefore, it is the newly added mercury from emissions that is of primary importance in aquatic ecosystems and the sooner these inputs are reduced, the greater impact these reductions will have on ecosystem recovery (Hrabik and Watras 2002)." *Id.* at 16.

State and Territorial Air Pollution Program Administrators (STAPPA) & Association of Local Air Pollution Control Officials (ALAPCO), *Regulating Mercury from Power Plants: A Model Rule for States and Localities* (2005).

I. SUMMARY

The goal of the report is to provide state and local governments the tools needed to obtain reductions in mercury emissions required to meet the requirements of the Clean Air Act (CAA). The Model Rule would protect public health using technologies that are available and rapidly entering the commercial market.

I. INFORMATION RELEVANT TO THE IPCB HEARING SCHEDULE

Chapter 5.0 – Deposition of Mercury

- "In some areas of the country, mercury emissions from coal-fired power plants may account for as much as 80 percent of the mercury deposited, according to recent studies by the Electric Power Research Institute (EPRI). According to EPRI, the portion of mercury deposition from coal-fired plants ranges from 10 to 80 percent depending on the region. EPA's own modeling shows that in many areas of the country where there are coal-fired power plants, those plants account for more than half of mercury deposition." *Id.* at 14.
- "Gaseous elemental mercury may move long distances with air masses and resides in the atmosphere usually until it oxidizes, which can take up to a year. The reactive and particulate-bound forms of mercury – oxidized mercury and mercury adsorbed to particles – stay in the atmosphere for a few days and are usually deposited within 50 to 100 miles of a source by wet or dry deposition." *Id.* at 15.
- "Field studies show a direct relationship between mercury deposition and mercury levels in fish. The findings indicate that reducing domestic emissions of reactive mercury compounds can lower mercury concentrations in fish in the United States, regardless of distribution of contributions from natural and foreign sources." *Id.* at 15.
- "Changes in atmospheric mercury deposition can rapidly affect concentrations in fish, according to a 2002 study by Wisconsin researchers. The research team found a 10-percent decrease in deposition corresponded with a 5-percent decrease in mercury levels in fish tissue." *Id.* at 15.
- "...researchers suggest that the amount of mercury added to an ecosystem from new sources, rather than that already trapped in sediment, is the main determinant of how much mercury is introduced into the food chain." *Id.* at 15.

Chapter 8.0 – Technological Feasibility of Controlling Mercury Emissions From Coal-Fired Power Plants in Illinois

- "Field tests of the most highly developed mercury control technology, known as sorbent injection, have achieved mercury capture of up to 95 percent at coal-fired power plants. Sorbent injection (typically Activated Carbon Injection) and other advanced technologies have not yet been permanently installed at power plants because no law requires it. But 95-percent capture rates have now been demonstrated in short-term tests for all ranks of coal,

bituminous, subbituminous and lignite. Chemically enhanced sorbents make high rates of removal of all species of mercury achievable even with low-rank coals." *Id.* at 25.

- "Large-scale field tests of ACI on coal-fired electric generating units have demonstrated removal rates of 90 percent and higher. Although no ACI unit has been installed commercially on an EGU yet, 90-percent and higher mercury capture with ACI is feasible. The technology involves very little capital equipment: a silo to hold the sorbent, and hose, nozzles and pumps to inject it into the flue gas ducts. Tests on such ACI systems continue to show improvement. The removal rates may be further improved when the technology is used along with such additional controls as a fabric filter, or "bag house," used for PM control. Some vendors are currently offering ACI to electric generating plant customers and two sales have so far been reported." *Id.* at 26.
- "The efficiency of ACI in removing mercury from lower ranks of coal, such as subbituminous and lignite, has clearly caught up with ACI's success rate in removing mercury from bituminous coal. In a leading approach, the injection of halogenated sorbents into the gas stream of units burning lower ranks of coal can enable ACI to attain results comparable to those with bituminous coals. Carbon sorbents impregnated with bromine or iodine compounds enhance capture of mercury on subbituminous western coals, which contain lower chlorine levels and are therefore more challenging to clean." *Id.* at 26.

Chapter 9.0 – Economic Modeling

- "The capital costs of installing ACI are two orders of magnitude less than the capital costs of equipment used to control oxides of sulfur or NO_x Recent data from field testing sponsored by NETL indicate that the average cost of controlling mercury will range from 0.2 to 0.8 mills/KWh. Based on this estimate, mercury control would add 15 to 60 cents per month to a typical 750 KWh residential electric bill. Taking into account capital and operating costs of ACI, one state agency has estimated the cost of mercury control for its ratepayers at less than $10 per year." *Id.* at 26.
- "At a Wisconsin state hearing, one participant may have summed it up best when he pointed out that, having paid $20 for his annual fishing license, he would be happy to pay a similar amount if necessary to be able to eat the fish he caught." *Id.* at 27.

National Wildlife Federation, *Controlling Mercury from Power Plants: Current state of knowledge* (2003).

I. SUMMARY

Information on the method and effectiveness of ACI for mercury capture.

I. INFORMATION RELEVANT TO THE IPCB HEARING SCHEDULE

Chapter 8.0 – Technological Feasibility of Controlling Mercury Emissions from Coal-Fired Power Plants in Illinois

- "The technology that has undergone the most extensive testing is activated carbon injection (ACI). If a plant is already operating an electrostatic precipitator (ESP), carbon is injected in the flue gas upstream of the ESP. Achieving 90% mercury removal from power plants will most likely require the additional installation of a small fabric filter downstream of the carbon injection system." *Id.* at 1.
- "If burning bituminous or subbituminous coals, the combination of a fabric filter and ACI can achieve 90% mercury removal." *Id.* at 1.
- "If burning lignite, in addition to installing a fabric filter, flue gas cooling will likely be required to achieve 90% capture." *Id.* at 1.
- "Preliminary results at PG&E's Brayton Point plant, which burns bituminous coal and is equipped with two electrostatic precipitators, showed 90% control at high activated carbon injection rates." *Id.* at 1.
- "At Southern Company's Gaston Plant (Alabama Power), which burns bituminous coal and is equipped with a COHPAC fabric filter, 85% control was achieved using activated carbon on a continuous basis, with short-term removals averaging more than 90%." *Id.* at 1.
- "At We Energies' Pleasant Prairie plant, which burns Powder River Basin subbituminous coal and is equipped with an electrostatic precipitator, over 70% mercury control was measured at the highest activated carbon injection rate tested. Higher capture efficiency is likely if a fabric filter is used in conjunction with the activated carbon technology." *Id.* at 2.
- "At Otter Tail Power Company's Big Stone plant in South Dakota, which burns subbituminous coal, the Advanced Hybrid Particulate Collector (which combines aspects of ESPs and fabric filters) was found to capture nearly 90% of total mercury, at a low activated carbon injection rate." *Id.* at 2.
- "A North Dakota lignite-fired boiler equipped with a baghouse measured over 90% mercury control using iodine impregnated carbon, and 70% mercury control using activated carbon at the highest injection rate tested." *Id.* at 2.

Chapter 9.0 – Economic Modeling

- "ACI for all coal types is estimated to cost about .4 mills/KWh (4% of I cent)." *Id.* at 1.
- "Installation of a fabric filter is estimated at $40-$55/kW." *Id.* at 1.
- "It is estimated that over the long run, it will be more economical to install a fabric filter than to use higher carbon injection rates with an electrostatic precipitator to achieve 90% removal: $700,000 vs. $2 million over a 20yr amortization period." *Id.* at 1.

James Staudt, Andover Technology Partners, *Mercury Control From Coal-Fired Electric Utility Plants – A Review of Technology Status and Cost* (2006) (Presentation).

I. SUMMARY

A very useful review of the capability and cost of available mercury control technologies with emphasis on ACI.

II. INFORMATION RELEVANT TO THE IPCB HEARING SCHEDULE

Chapter 9.0 – Economic Modeling

- Slide 13 has a useful table on the cost of sorbent injection. The table shows that ACI could be installed in about 6 months for a cost of about $2/KW. *Id.* at 7.
- Slide 16 has a graph showing that the cost of sorbent is low and mercury removal is high. *Id.* at 8.
- Slide 24 has a graph showing that the cost of sorbent is low and mercury removal is high. *Id.* at 12
- "Sorbent injection system only – capital cost has almost negligible contribution to generation cost – mostly sorbent. *Id.* at 12.

Dr. Mark Cohen, *Local and Regional Deposition Impacts of Atmospheric Mercury Emissions*, Presentation at Mercury Rule Workgroup Meeting PA Department of Environmental Protection, (2005).

I. SUMMARY

This is a presentation given to the Mercury Rule Workgroup Meeting of the PA Department of Environmental Protection. Included herein is a bullet point and graphical presentation of the local and regional impacts of atmospheric mercury emissions focusing primarily on the difficulties in determining the exact impacts via monitoring and modeling techniques. Specifically included is the following: the difficulty in accurately determining local and regional impacts of mercury deposition because of the dependency on the amount of mercury emitted, stack height having an effect on proximal deposition, the dependency on the form emitted, the dependency on the distance and direction of the source emitted, the episodic nature of emissions (on a day-to day basis), the dependency on plume chemistry, the measurement based evidence (including examples, advantages, and limitations), the modeling based evidence (including examples, advantages and limitations). Of particular significance is the evidence tending to show the overestimation of global impacts and the underestimation of local and regional impacts in the CAMQ results used in the development of the CAMR rule (more information provided below).

II. INFORMATION RELEVANT TO IPCB HEARING SCHEDULE

Chapter 5.0 – Deposition

- CMAQ results used in the development of the CAMR rule.
  - Possible underestimation of local and/or regional impacts in CMAQ Mercury modeling done in support of CAMR. *Id.* at 65.
  - .36 km grid used in the development of CAMR too coarse to capture local results, they are artificially diluted. *Id.* at 65.
  - Possible overestimation of local and/or regional impacts in CMAQ Mercury modeling done in support of CAMR. *Id.* at 66.
  - Strong influence of boundary conditions appears that Reactive Gas Mercruy (RGM) may have been specified too high on the boundary due to an inconsistency in physics/chemistry. *Id.* at 66.
  - Two reactions included in CMAQ oxidizing elemental HG(0) to RGM may have been **significantly overestimated**." *Id.* at 66.

Larry Schweiger et al., *Getting the Job Done: Affordable Mercury Control at Coal-Burning Power Plants,* National Wildlife Federation (2004).

I. SUMMARY

This document persuasively argues, with supporting evidence, the technical feasibility and affordability of controlling 90% of mercury emissions. This article specifically addresses the shortcomings of CAMR prior to its enactment.

II. INFORMATION RELEVANT TO IPCB HEARING SCHEDULE

Chapter 3.0 – Mercury Impacts on Human Health

- "In January 2004, a U.S. EPA scientist released new research estimating that nearly one in six
  U.S. women of childbearing age has mercury levels in her blood above what is considered safe for an unborn child, doubling previous estimates. This new estimate equates to **approximately 630,000 newborns** each year who may have been exposed to unsafe levels of mercury *in utero*." *Id.* at 7.

Chapter 8.0 – Technical Feasibility

- Key Findings. *Id.* at 6
  "Mercury emissions can be controlled by 90 percent at power plants burning bituminous, subbituminous, and lignite coals"
  "Mercury emissions can be controlled by 90 percent at power plants burning bituminous, subbituminous, and lignite coals"
  "In our five case study states, all of which rely significantly on coal, achieving 90 percent mercury control could cost the average residential customer 69 cents to approximately $2.14 a month, depending on the state."
  "Commercial and industrial increases were similarly reasonable—between 1 and 3 percent increases in electric bills."
  "For the most common configurations, the cost of achieving 90 percent control is only slightly higher than achieving 70 or 80 percent control."
  "The findings reinforce similar cost estimates made by equipment manufacturers, the Department of Energy, and the EPA."

Zachary Corrigan, *Fishing for Trouble – How Toxic Mercuiry Contaminates Fish in U.S. Waterways*, U.S. PIRG Education Foundation (2004).

I. SUMMARY

This paper argues for 90% reduction of mercury from power plants and argues against having less stringent requirements recommended by the Bush Administration prior to promulgating CAMR. Specifically included are statewide advisories on fish consumption as well as advisories in lakes and rivers and the threat mercury contamination poses to recreational fishing and the public health in general.

II. INFORMATION RELEVANT TO IPCB HEARING SCHEDULE

Chapter 4.0 – Illinois Impaired Waters

- Table B shows that 100% of lake waters in Illinois are under advisory. *Id.* at 10.
- Table L breaks down, by State, the economic value received from recreational fishing. Illinois receives $598,376,000. *Id.* at 19.