

Appendix G

Mercury

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Appendix G

Mercury

Introduction

Mercury is considered separately from other air pollutants because it has been the subject of a special MPCA initiative, studied intensively, and its emissions quantified separately. Mercury emissions associated with electricity production and consumption in Minnesota are reported here, in accordance with Minnesota statute §116.925.

1.0 Sources and Emissions

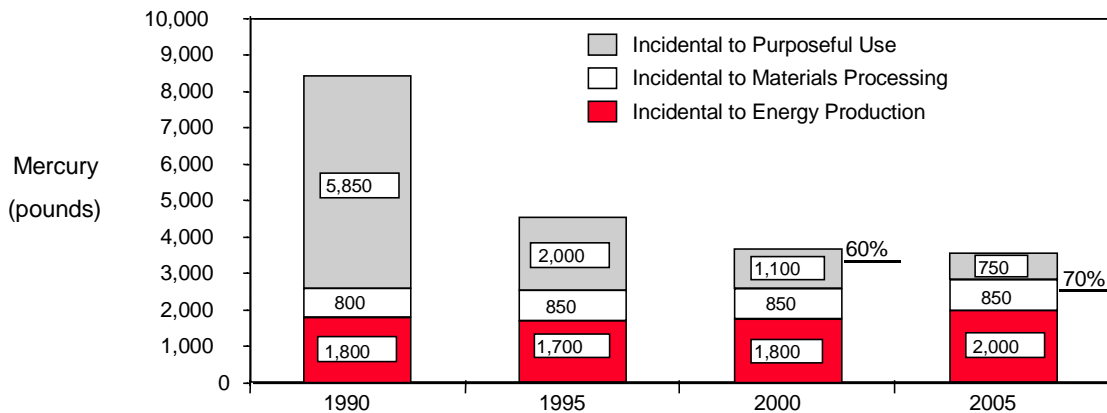
Nearly all (98 percent) of the mercury in Minnesota lakes comes from the air; very little comes from direct water discharges. Of the mercury deposited in Minnesota, about 90 percent is originally emitted by sources outside the state. A roughly equivalent amount of mercury, generated by Minnesota sources, leaves the state.

Nationally, the primary human-made sources of mercury are:

- incidental emissions from energy production (mainly from burning coal, which contains trace amounts of mercury);
- emissions from the disposal, use or manufacture of mercury-containing products or industrial wastes; and
- incidental emissions from processing mineral resources containing trace amounts of mercury (e.g., lead, iron or copper ores and limestone).

In 1990, air emissions of mercury from human activities in Minnesota were estimated to be about 8,500 pounds annually. About 70 percent of this mercury was from intentional use, 20 percent was incidental to energy production and 10 percent was from minerals processing. By 1995, total air emissions of mercury had decreased to 4,600 pounds a year as a result of reduced use of mercury in paint, batteries and fungicides; and decreased emissions from waste combustors. Emissions from other sources have remained relatively constant and are projected to remain constant or to increase, as shown in Figure 1.

Figure 1. Past mercury emissions in Minnesota, and projections for 2000 and 2005. Horizontal lines indicate the goals of a 60% reduction by 2000 and 70% reduction by 2005.



2.0 Ecological and Human Health Impacts

In spite of its well-documented toxicity to the human central nervous system, mercury continues to be used widely. Recent studies have revealed that small amounts of atmospheric mercury pollution can lead to mercury being deposited in remote lakes. There, the mercury can concentrate in fish tissue enough to make eating the fish hazardous to humans and wildlife. As a result, the Minnesota Department of Health advises citizens to limit their consumption of fish from many lakes. The MPCA and EPA internet sites contain more information on the impacts of mercury in the environment.

MPCA: <http://www.pca.state.mn.us/air/mercury-effects.html#health>

EPA: <http://www.epa.gov/grtlakes/bns/mercury/index.html#Heath>

3.0 Reduction Initiatives

3.1 State Action

In 1999, following a two-year advisory council process, the Minnesota Pollution Control Agency (MPCA) recommended, and the Minnesota Legislature passed, a comprehensive mercury reduction law. That law includes the following items:

- Specific statewide mercury reduction goals,
- Reduction strategies, and
- Requirements for progress report submittal to the Legislature in 2001 and 2005.

The purpose of the initiative is to identify and implement appropriate actions for the MPCA and others to ensure that mercury releases continue to decline.

The mercury reduction law established statewide goals aimed at reducing mercury releases to Minnesota's air and water by 60 percent (compared to 1990 levels) by the end of year 2000 and by 70 percent by the end of 2005. The 60% reduction goal could be met by reducing mercury releases from intentional uses, such as thermometers, electric switches, and other products, and by improving the collection infrastructure for mercury-containing wastes. These are generally the most cost-effective approaches for reducing releases. To meet the 70% reduction goal, some coal-fired power plants and taconite-processing facilities will need to reduce their mercury emissions. Figure 1 shows the projections.

Ongoing reduction strategies include:

- encouraging voluntary commitments to reduce or work toward reducing mercury emissions;
- advancing strategies at the national level that will reduce mercury releases in other states as well as in other countries;
- strategies to persuade businesses and consumers to reduce their purchases and use of mercury-containing products and to encourage proper collection and disposal of mercury-containing hazardous waste;
- research on mercury sources and transport, options for reducing releases, and impacts on human health and wildlife; and
- requiring wastewater dischargers to begin measuring mercury using new, low-level monitoring procedures.

One of the statewide mercury reduction strategies, the MPCA voluntary agreement program, challenges the private sector and other mercury sources to come up with their own innovative, cost-effective ways to reduce mercury releases. The MPCA is responsible for verifying and tracking results. The program is designed to minimize direct "command and control" regulations and resulting inefficiencies. Experimental reduction techniques and innovative research efforts are encouraged. Guidelines have been developed for the voluntary program.

Fourteen industrial mercury sources within the state are actively working toward reducing current or future mercury emissions through agreements filed with the MPCA. Participating facilities include electric utilities, taconite facilities, sewage treatment facilities, the state's major steel mini-mill, and the two major oil refineries. Over the next year, smaller mercury sources will be actively recruited into the program.

The industries have proposed numerous long-term research efforts, pilot projects, and long-term reduction efforts. Many industries have proposed or are carrying out actions that will lead to some mercury release reductions over this year and next.

The MPCA is currently involved with several other mercury reduction projects, including:

- Cooperative state project with Ramsey County, North Star Steel, and other counties to reduce the amount of mercury in auto scrap and other scrap that is released when the steel is recycled (reduction potential: 80-100 pounds per year.);
- Mercury in schools reduction partnership to find mercury stored or spilled in schools as well as in medical and industrial facilities. This program seeks to reduce the potential for children and teachers to be exposed to elemental mercury and at the same time reduce the amount of this mercury that is released into the environment. The program is evaluating several innovative mercury detection techniques.
- Ongoing efforts to integrate mercury reduction efforts under one statewide mercury policy that addresses air, water and land releases.
- Cooperative project with EPA Region 5 and others to assess new electronic communication tools that would provide: (1) better management of currently dispersed mercury information—on program progress, health risks, current research, for example; (2) better methods to quickly and effectively communicate relevant portions of this information to the public; and (3) better ways to allow the public to comment on program plans and progress.

3.2 Federal Action

The Clean Air Act requires the U.S. EPA to study toxic air pollution from power plants to determine the necessity of additional regulations to protect public health. EPA reported its study on pollutants from electricity generation to Congress in February 1998. That study concluded that of all toxic pollutants examined, mercury posed the greatest concern for public health. The Clean Air Act also requires EPA to determine whether to proceed with the development of regulations.

On December 14, 2000 EPA announced its decision to regulate mercury air emissions from power plants. EPA will propose regulations by December 2003 and will begin developing those regulations shortly. Industry, the public, and state, local and tribal governments will have an opportunity to participate in the process. Then, EPA is expected to issue final regulations by December 2004. More information is available on EPA's mercury web site at: <http://www.epa.gov/mercury>.

As the federal regulatory process controlling mercury emissions from coal-fired power plants proceeds, another approach is being explored. Over the next two years, work will likely continue on a combined strategy to address all of the major pollutants emitted by power plants, including mercury, sulfur dioxide, nitrogen oxides and carbon dioxide. A comprehensive strategy that addresses all of these pollutants together will provide more certainty and flexibility to the electricity generation industry, making it the most cost-effective way to control the emissions.

3.3 Measuring Progress

The desired environmental outcome for the mercury reduction effort is reduced mercury contamination of Minnesota's fish.

Success will be measured through:

1. tracking the estimated annual rate of release of mercury emissions to air and water in the state,
2. analyzing atmospheric mercury deposition by measuring mercury in precipitation and lake sediments, and
3. measuring mercury concentrations in fish.

4.0 Mercury Emissions from Electricity Generation

In 1997 a state law took effect that requires the producers and retailers of electricity to report on the amount of mercury emitted through the generation of electricity (section §116.925). The MPCA is required by the law to summarize this emission information in its biennial air toxics report to the Minnesota Legislature. Emissions from 1998 and 1999 emissions are summarized in Tables 1 and 2. Note that some data has not yet been submitted. The data will be updated on the MPCA internet site as the data is received (<http://www.pca.state.mn.us>).

Minnesota law exempts certain electricity generation facilities from reporting mercury emissions: 1) those that operate less than 240 hours per year, 2) combustion units less than 150 million British thermal units (Btu) per hour, and 3) generation units with a maximum output of less than or equal to 15 megawatts.

Submissions from over 20 generation units in Minnesota are summarized in Table 1. The major fuel for most units was coal, although some facilities depend on municipal solid waste for fuel.

The law also requires Minnesota retailers and wholesalers of electricity produced outside Minnesota to report mercury emissions associated with production; the information is summarized in Table 2.

About 40 Minnesota distribution cooperatives, which distribute electricity to consumers but do not generate any electricity, are required to report mercury emissions associated with the generation of the electricity that they distribute, most of which was generated in North Dakota, South Dakota, and Wisconsin. The information is provided to the distribution cooperatives by their suppliers, Great River Energy, Dairyland Power, Minnkota Power, and East River Electric Power Cooperative. The normalized mercury emissions per megawatt-hour from each supplier (milligrams per megawatt-hour, mg/MWh) are variable because of varying amounts of electricity purchased from the grid and from the use of hydroelectric power.

Table 1. Reported 1998 and 1999 emissions of mercury from non-exempt electrical production facilities in Minnesota.

| Company | Facility | Major Fuel Type(s) | 1998 Electricity Produced (MWh) | 1998 Mercury Emissions (lb) | 1998 Mercury Emissions per Megawatt-hour (mg/MWh) | 1999 Electricity Produced (MWh) | 1999 Mercury Emissions (lb) | 1999 Mercury Emissions per Megawatt-hour (mg/MWh) |
|---|------------------------------|--------------------|---------------------------------|-----------------------------|---|---------------------------------|-----------------------------|---|
| Blandin Paper Company | Grand Rapids Boilers 5,6 | coal, wood, ties | NA | NA | NA | NA | NA | NA |
| Champion International Corporation | Sartell Mill #3 boiler | coal, bark, sludge | NA | NA | NA | NA | NA | NA |
| Hennepin Energy Resource Corporation | Minneapolis waste-to-energy | MSW | NA | NA | NA | NA | NA | NA |
| LTV Steel Mining Company | Taconite Harbor Power Plant | coal | NA | NA | NA | NA | NA | NA |
| Minnesota Power | Boswell Unit 1 | coal | 323,468 | 18.0 | 25 | 386,085 | 8.0 | 9 |
| Minnesota Power | Boswell Unit 2 | coal | 393,537 | 22.0 | 25 | 439,644 | 9.0 | 9 |
| Minnesota Power | Boswell unit 3 | coal | 2,143,278 | 115.0 | 24 | 2,206,999 | 113.0 | 23 |
| Minnesota Power | Boswell Unit 4 | coal | 3,556,331 | 197.0 | 25 | 3,140,045 | 178.0 | 26 |
| Minnesota Power | Laskin Unit 1 | coal | 292,135 | 18.0 | 28 | 570,634 | 19.0 | 15 |
| Minnesota Power | Laskin Unit 2 | coal | 285,537 | 18.0 | 29 | combined with unit 1 | | |
| Northshore Mining Company | Silver Bay Power Plant | coal | NA | NA | NA | NA | NA | NA |
| NSP | AS King 1 | coal, gas, wood | 2,843,610 | 48.5 | 8 | 3,471,370 | 35.7 | 5 |
| NSP | Black Dog 3 | coal | 519,680 | 17.4 | 15 | 1,493,820 | 45.1 | 14 |
| NSP | Black Dog 4 | coal | 1,074,160 | 32.9 | 14 | combined with unit 3 | | |
| NSP | High Bridge 5 | coal, gas | 573,250 | 23.8 | 19 | 496,989 | 15.7 | 14 |
| NSP | High Bridge 6 | coal, gas | 1,061,880 | 40.8 | 17 | 782,899 | 22.9 | 13 |
| NSP | Red Wing 1 Waste-to-Energy | wood, RDF | 69,904 | 166.6 | 1081 | 69,103 | 160.0 | 1050 |
| NSP | Red Wing 2 Waste-to-Energy | wood, RDF | 70,158 | 159.4 | 1031 | 59,457 | 135.0 | 1030 |
| NSP | Riverside 6/7 | coal | 1,110,980 | 55.0 | 22 | 774,869 | 35.0 | 20 |
| NSP | Riverside 8 | coal | 1,636,390 | 47.9 | 13 | 1,539,980 | 45.0 | 13 |
| NSP | Sherco 1 | coal | 4,130,940 | 157.2 | 17 | 4,238,380 | 117.5 | 13 |
| NSP | Sherco 2 | coal | 4,780,060 | 185.3 | 18 | 5,104,380 | 146.2 | 13 |
| NSP | Sherco 3 (NSP owned portion) | coal | 4,092,157 | 191.1 | 21 | 3,507,986 | 56.3 | 7 |
| NSP | Wilmarth 1 Waste-to-Energy | RDF, gas | 71,343 | 15.5 | 99 | 69,884 | 6.7 | 43 |
| NSP | Wilmarth 2 Waste-to-Energy | RDF, gas | 77,658 | 20.5 | 120 | exempt | | |
| Otter Tail Power Company | Hoot Lake Plant Unit 2 | coal | 342,657 | 18.8 | 25 | 312,911 | 17.2 | 25 |
| Otter Tail Power Company | Hoot Lake Plant Unit 3 | coal | 330,855 | 18.8 | 26 | 355,716 | 19.9 | 25 |
| Rochester Public Utilities | Silver Lake 3 | coal | NA | NA | NA | NA | NA | NA |
| Rochester Public Utilities | Silver Lake 4 | coal | NA | NA | NA | NA | NA | NA |
| Southern Minnesota Municipal Power Agency | Austin NE Power Plant | coal | NA | NA | NA | NA | NA | NA |
| Southern Minnesota Municipal Power Agency | Sherco 3 (SMMPA-owned) | coal, oil | 2,416,573 | 123.7 | 23 | 2,035,404 | 44.2 | 10 |

Notes

MSW is municipal solid waste.

RDF is refuse-derived fuel, which is sorted and processed municipal solid waste.

NA indicates that data was either not available or not submitted to the MPCA.

Table 2. Reported 1998 and 1999 emissions of mercury from electrical production facilities outside Minnesota for which the electricity was likely consumed in Minnesota. Electricity and mercury figures for each company and facility are prorated to the amount of electricity likely consumed in Minnesota.

| Reporting Organization | Facility or Supplier | Major Fuel Type(s) | 1998 Electricity Consumed in Minnesota (MWh) | 1998 Mercury Emissions (lb) | 1998 Mercury Emissions per Megawatt- hour (mg/MWh) | 1999 Electricity Consumed in Minnesota (MWh) | 1999 Mercury Emissions (lb) | 1999 Mercury Emissions per Megawatt- hour (mg/MWh) |
|--|---|---------------------|--|--------------------------------------|--|--|--------------------------------------|--|
| Interstate Power Company, Marshalltown, IA | Dubuque 1, Dubuque IA | bituminous coal | NA | NA | NA | NA | NA | NA |
| Interstate Power Company, Marshalltown, IA | Dubuque 5, Dubuque IA | bituminous coal | NA | NA | NA | NA | NA | NA |
| Interstate Power Company, Marshalltown, IA | Lansing 3, Lansing IA | bituminous coal | NA | NA | NA | NA | NA | NA |
| Interstate Power Company, Marshalltown, IA | Lansing 4, Lansing IA | subbituminous coal | NA | NA | NA | NA | NA | NA |
| Interstate Power Company, Marshalltown, IA | Louisa 1/Louisa Co. IA | subbituminous coal | NA | NA | NA | NA | NA | NA |
| Interstate Power Company, Marshalltown, IA | ML Kapp 2, Clinton IA | subbituminous coal | NA | NA | NA | NA | NA | NA |
| Interstate Power Company, Marshalltown, IA | Neal 4, Sioux City IA | subbituminous coal | NA | NA | NA | NA | NA | NA |
| NSP | Bay Front 1, 2, 5 (1998), 5 (1999) | coal, gas wood, RDF | 343,783 | 11.2 | 15 | 139,019 | 4.1 | 13 |
| NSP | French Island 1 waste-to-energy, La Crosse WI | RDF, wood | 34,970 | 4.4 | 57 | exempt | | |
| NSP | French Island 2 waste-to-energy, La Crosse WI | RDF, wood | 46,505 | 8.2 | 80 | 32,464 | 12.0 | 168 |
| Otter Tail Power, Fergus Falls, MN | Big Stone Plant, Big Stone Lake, SD | subbituminous coal | 842,738 | 47.8 | 26 | 966,462 | 24.3 | 11 |
| Otter Tail Power, Fergus Falls, MN | Coyote Plant, Beulah, ND | lignite coal | 516,302 | 60.9 | 54 | 517,163 | 60.4 | 53 |
| People's Cooperative Power Assn. | Dairyland Power Cooperative | coal | N/A | N/A | N/A | N/A | N/A | N/A |
| Tri-County Electric Cooperative | Dairyland Power Cooperative | coal | N/A | N/A | N/A | N/A | N/A | N/A |
| Freeborn-Mower Cooperative Services | Dairyland Power Cooperative | coal | N/A | N/A | N/A | N/A | N/A | N/A |
| Agralite Electric Cooperative | Great River Energy | lignite coal | 135,345 | 6.3 | 21 | 131,376 | 6.0 | 21 |
| Arrowhead Electric Cooperative | Great River Energy | lignite coal | 48,389 | 3.2 | 30 | 53,228 | 3.6 | 31 |
| Benco Electric Cooperative | Great River Energy | lignite coal | NA | NA | NA | NA | NA | NA |
| Brown County Rural Electrical Assn. | Great River Energy | lignite coal | 107,184 | 5.2 | 22 | 109,057 | 5.4 | 22 |
| Connexus Energy | Great River Energy | lignite coal | 1,561,431 | 106.2 | 31 | 1,635,474 | 110.5 | 31 |
| Cooperative Light and Power | Great River Energy | lignite coal | 74,041 | 1.0 | 6 | 77,672 | 1.0 | 6 |
| Crow Wing Power | Great River Energy | lignite coal | N/A | N/A | N/A | N/A | N/A | N/A |
| Dakota Electric Assn. | Great River Energy | lignite coal | 1,382,019 | 94.0 | 31 | 1,457,174 | 98.5 | 31 |
| East Central Electric Assn. | Great River Energy | lignite coal | 659,588 | 44.8 | 31 | 683,902 | 46.2 | 31 |
| Federated Rural Electric | Great River Energy | lignite coal | 134,413 | 6.0 | 20 | 133,817 | 5.9 | 20 |
| Goodhue County Cooperative Electric Assn. | Great River Energy | lignite coal | 75,708 | 5.2 | 31 | 76,833 | 5.2 | 31 |
| Itasca-Mantrap Co-op. Electrical Assn. | Great River Energy | lignite coal | 122,319 | 8.3 | 31 | 136,345 | 9.2 | 31 |

Table 2. Continued.

| Reporting Organization | Facility or Supplier | Major Fuel Type(s) | 1998 Electricity Consumed in Minnesota (MWh) | 1998 Mercury Emissions (lb) | 1998 Mercury Emissions per Megawatt- hour (mg/MWh) | 1999 Electricity Consumed in Minnesota (MWh) | 1999 Mercury Emissions (lb) | 1999 Mercury Emissions per Megawatt- hour (mg/MWh) |
|--|---------------------------------------|--------------------|--|--------------------------------------|--|--|--------------------------------------|--|
| Kandiyohi Power Cooperative | Great River Energy | lignite coal | N/A | N/A | N/A | N/A | N/A | N/A |
| Lake Country Power | Great River Energy | lignite coal | 530,766 | 36.1 | 31 | 556,780 | 37.6 | 31 |
| Lake Region Electric Cooperative | Great River Energy | lignite coal | 300,259 | 15.2 | 23 | 307,559 | 15.6 | 23 |
| McLeod Cooperative Power Assn. | Great River Energy | lignite coal | 143,563 | 9.0 | 28 | 144,462 | 9.0 | 28 |
| Meeker Cooperative Light & Power Assn. | Great River Energy | lignite coal | 124,473 | 6.7 | 25 | 128,430 | 7.0 | 25 |
| Mille Lacs Electric Cooperative | Great River Energy | lignite coal | 8,281,585 | 527.2 | 29 | 8,667,605 | 550.7 | 29 |
| Minnesota Valley Electric Cooperative | Great River Energy | lignite coal | 372,022 | 25.3 | 31 | 397,889 | 26.9 | 31 |
| Nobles Electric Cooperative | Great River Energy | lignite coal | 106,431 | 3.5 | 15 | 104,782 | 3.4 | 15 |
| North Itasca Electric Cooperative, Inc. | Great River Energy | lignite coal | 32,511 | 1.8 | 25 | 40,068 | 2.7 | 31 |
| Redwood Electric Cooperative | Great River Energy | lignite coal | 55,055 | 1.7 | 14 | 54,372 | 1.7 | 14 |
| Runestone Electric Assn. | Great River Energy | lignite coal | 167,419 | 8.1 | 22 | 171,642 | 8.3 | 22 |
| South Central Electric Assn. | Great River Energy | lignite coal | 110,621 | 4.9 | 20 | 110,290 | 4.8 | 20 |
| Stearns Electric Assn. | Great River Energy | lignite coal | NA | NA | NA | NA | NA | NA |
| Steele-Waseca Cooperative Electric | Great River Energy | lignite coal | 165,942 | 11.3 | 31 | 179,424 | 12.1 | 31 |
| Todd-Wadena Electric Cooperative | Great River Energy | lignite coal | 129,478 | 6.7 | 23 | 133,920 | 6.9 | 23 |
| Wright-Hennepin Cooperative Electric Assn. | Great River Energy | lignite coal | NA | NA | NA | NA | NA | NA |
| Clearwater-Polk Electric Cooperative | Minnkota Power Cooperative | lignite coal | NA | NA | NA | 66,447 | 4.8 | 33 |
| North Star Electric Cooperative | Minnkota Power Cooperative | lignite coal | NA | NA | NA | 104,454 | 7.5 | 33 |
| PKM Electric Cooperative | Minnkota Power Cooperative | lignite coal | NA | NA | NA | 104,877 | 7.5 | 33 |
| Red Lake Electric Cooperative | Minnkota Power Cooperative | lignite coal | NA | NA | NA | 108,974 | 7.8 | 33 |
| Red River Valley Cooperative Power Assn. | Minnkota Power Cooperative | lignite coal | NA | NA | NA | 115,022 | 8.3 | 33 |
| Roseau Electric Cooperative | Minnkota Power Cooperative | lignite coal | NA | NA | NA | NA | NA | NA |
| Wild Rice Electric Cooperative | Minnkota Power Cooperative | lignite coal | NA | NA | NA | 203,932 | 14.6 | 33 |
| Beltrami Electric Cooperative | Minnkota Power Cooperative | lignite coal | NA | NA | NA | 395,283 | 28.4 | 33 |
| Lyon-Lincoln Electric Cooperative | East River Electric Power Cooperative | N/A | 75,507 | N/A | N/A | 74,570 | N/A | N/A |
| Minnesota Valley Coop. Light & Power Assn. | East River Electric Power Cooperative | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Renville Sibley Cooperative Assn. | East River Electric Power Cooperative | N/A | 94,430 | N/A | N/A | 112,987 | N/A | N/A |
| Traverse Electric Cooperative | East River Electric Power Cooperative | N/A | 43,996 | N/A | N/A | N/A | N/A | N/A |

Notes

RDF is refuse-derived fuel, which is sorted and processed municipal solid waste.

NA indicates that data was either not available or not submitted to the MPCA.

Mercury emissions per megawatt-hour calculations for the cooperatives may vary in part due to consumption of hydroelectric power