# University of Minnesota Steam Service Facilities Environmental Impact Statement

## Report To The Minnesota Legislature

January 1996



Minn. Stat. 116G.15

## Introduction

Minnesota Statutes, Section 116G.15, paragraph (a), requires a report to the legislature on the results of any environmental impact statement (EIS) completed within a specific timeline on proposed projects located within a specific section of the Mississippi River Critical Area.

The statute requires the report to list any alternatives to the proposed project that are determined by the EIS to be (1) economically less expensive, and (2) environmentally superior to the proposed project.

The report must also identify any legislative actions that may assist in the implementation of environmentally superior alternatives.

The University of Minnesota Steam Service Facilities EIS falls under this statutory provision. Therefore, the Minnesota Environmental Quality Board (EQB), as the governmental unit responsible for the preparation and adequacy determination for the EIS, submits this report in compliance with Minnesota Statutes, Section 116G.15, paragraph (a).

This report is necessarily a brief summary of the EIS results. The EIS contains extensive additional detailed information on methodology and results, with maps and photographs of the affected areas.

The report is organized in the following six sections:

Section 1. Summary and Conclusions
Section 2. The University's Proposed Project
Section 3. EIS Alternatives
Section 4. Electricity Cogeneration
Section 5. Environmental Comparison
Section 6. Financial Comparison

## Section 1. Summary and Conclusions

**No Significant Differences In Air Pollution Emissions, Except Mercury**

There are only minor differences between the estimated "point-source" emissions due to the proposed project and the alternatives, for most air pollutants. Differences in emission rates depend as much on assumptions regarding pollution control technology, fuel sulfur content–and on whether emissions are adjusted for electricity cogeneration–than on whether a particular facility is primarily coal-fired or natural gas fired.

Estimated mercury emissions from primarily coal-fired plants are higher than from primarily natural gas fired plants. However, the mercury emissions projected for the University' proposed project are minor compared to other regional mercury sources. Determining what constitutes an "acceptable" level of mercury emissions from a new University steam plant is largely an non-quantifiable policy issue.

**No Environmentally Superior Alternative Definitively Demonstrated By EIS**

The results of the EIS do not definitively demonstrate that there is an environmentally superior alternative to the University's proposal.

The proposed project and each alternative has environmental advantages and disadvantages, depending on the pollutant of concern, facility operation, the benefits of cogeneration, and the perceived value of the Mississippi Riverfront for an alternative use.

**Other Alternatives Feasible, But EIS Not Designed To Provide Final, Detailed Project Costs**

The EIS feasibility analysis indicates that there are a number of technically and economically feasible alternatives to the University's proposed project. However, the EIS financial projections are two years old, and were not designed to definitively determine whether there are alternatives that are less expensive than the University's proposed project. The EIS financial results, therefore, should not be used for that purpose.

**The University's Proposed Project is Environmentally Superior to the Existing Facilities**

The University's proposed renovation project is environmentally superior to the existing facilities. Further delay in implementing a renovation project is itself a significant environmental impact.

The Minnesota Pollution Control Agency (MPCA) intends to begin processing the University's current permit. Under the permit proposed by the MPCA, however, the facility will be required to burn a minimum of 70% natural gas annually for the life of the permit, with no use of petroleum coke. (See attached MPCA letter, dated Jan. 18, 1996)

## Section 2. The University's Proposed Project

**Existing Minneapolis Steam Facilities Located Along Mississippi River**

The University's Minneapolis campus is heated by two separate steam facilities: the "Southeast Plant" and the "Main Plant." The two steam plants are located at either end of an approximately half-mile stretch of the Mississippi River between the University's East Bank Campus and the St. Anthony Falls Riverfront.

The Southeast Plant building, located near the north end of the Stone Arch Bridge, was built in 1903 and is on the National Register of Historic Buildings.

The St. Paul campus has one steam plant, located on campus between the main educational building complex and a student housing area.

All three plants have been operated since 1992 by the University's steam vendor, Foster Wheeler Twin Cities, Inc.

**The Existing Steam Plants Burn Mostly Coal**

The fuel mix for the Minneapolis campus is currently about 85% coal, 10% natural gas, and small amounts of fuel oil.

The coal for the Minneapolis plants is delivered by rail to the Main Plant, where it is stored outdoors. Coal is then delivered by truck as necessary to the Southeast Plant. The Southeast Plant also has a smaller outdoor coal bunker of its own.

At Minneapolis, ash is no longer temporarily stored outside, but is stored inside near the Main Plant until it is shipped to a landfill.

At the St. Paul Plant, the fuel mix is currently about 60% coal, 35% natural gas, and 5% fuel oil. Coal is delivered to the St. Paul Plant by truck and is stored outdoors behind the plant.

**The University's Proposed "Fuel Flexible" Renovation Would Cogenerate Electricity and Burn Coal, Natural Gas, and Fuel Oil**

The University's proposed steam plant renovation project is defined by the 1992 construction contract between the University and Foster Wheeler, Twin Cities, Inc.

At the Minneapolis Campus, the Southeast Heating Plant would be modified, and the Main Plant would be retired. Steam would be produced primarily by three new boilers installed at the Southeast Plant: one new solid-fuel boiler known as a circulating fluidized bed boiler (CFB), and two new gas/oil-fired package boilers. The existing coal boilers would also be retained.

Although a range of fuels could be used at the Southeast Plant, based on current fuel price forecasts, coal is likely to be the primary fuel over the long-term.

The new CFB would likely be used to meet the "base-load" steam demand, while use of the new gas/oil boilers would fluctuate, depending on steam load.

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**University Proposal Includes Enclosed Coal Delivery and Storage System**

Since the EIS was completed, the University modified its project to include full enclosure of the coal delivery and storage facilities near the Main Plant. Also, under the current proposal, the coal for the Southeast Plant would be delivered via a conveyor in an existing underground tunnel that connects the two plants. "Fugitive" coal dust emissions in the area would thereby be virtually eliminated.

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**St. Paul Plant Would Burn Natural Gas and Fuel Oil**

The University is proposing to convert the St. Paul Plant to primarily natural gas and fuel oil. The existing boilers (coal and gas/oil) would be used for peaking and backup. On-site storage of a backup supply of eastern coal would continue following renovation.

Because most of the controversy regarding the proposed project concerns the continued use of coal at the Minneapolis Campus, this report focuses on the Minneapolis Campus

# Section 3. EIS Alternatives

**A Wide Variety of Alternatives Were Addressed in EIS Screening Analysis**

The EIS initially examined the feasibility and air emissions of thirteen different alternatives to the University's proposed project. These alternatives include variations in boiler equipment, electricity cogeneration capability, and plant location. The following alternatives were analyzed:

**Minneapolis Campus**

- A primarily-coal plant similar to the University's proposal, but located off-river
- A primarily natural-gas fired, steam-only facility, at either the Southeast Plant or the Main Plant
- A primarily natural-gas fired electricity cogeneration plant, located at either the Southeast Plant or at an off-river site
- A natural gas based cogeneration system at the Southeast Plant that would also use the existing coal boilers
- A very large natural-gas based electricity cogeneration facility, located at the Southeast Plant or off-campus
- A "No Action" or Deferred Construction alternative

**Combined Campus (Shut Down Existing Facilities)**

- An alternative in which the University would purchase all of its steam from third parties through a "thermal network" of new or extended steam lines. The steam would be produced from various sources located entirely off-campus
- A new plant located between the St. Paul and Minneapolis campuses that would serve both campuses

**St. Paul Campus**

- Continued primary use of coal
- Natural gas electricity cogeneration, with coal boilers retained
- Natural gas, fuel oil steam-only plant without coal

**EIS Did Not Independently Design an On-River "Fuel Flexible" Plant**

An on-river, primarily coal facility similar to the University's proposal was not independently designed for the EIS. The detailed contract between Foster Wheeler and the University was used for the equipment description and costs for the proposal.

**Alternatives Selected For Detailed Design Emphasize Cogeneration**

In addition to the proposed project, five Minneapolis alternatives and one St. Paul alternative were selected for more detailed review based on their environmental potential.

**Minneapolis Campus**

- Primarily natural-gas fired cogeneration facility at the Southeast Plant, with fuel oil backup, and no coal
- Primarily natural-gas fired cogeneration facility at an off-river site, with fuel oil backup, and no coal.
- Primarily natural-gas fired cogeneration facility at the Southeast Plant that uses the existing coal boilers and a new gas/oil package boiler for peaking loads.
- Primarily coal-fired plant with a CFB and gas/oil package boilers for peaking loads; similar to the University's proposal, but located off-river
- The "No Action" alternative

**St. Paul Campus**

A steam-only natural gas, fuel oil plant similar to that proposed by the University, but with a smaller new gas/oil package boiler.

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**Alternatives Described Further in Table 1 and Appendix A**

A table outlining the various alternatives analyzed in the EIS–including some that were not selected for detailed review but that have some environmental potential–is provided in Table 1. A more detailed description of each alternative selected for detailed analysis is also provided in Appendix A.

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**A Steam-Only Natural Gas Plant Analyzed, But Not in Detail**

A natural gas, fuel-oil facility without cogeneration was assessed in the screening study. Depending on future natural gas prices and retail electricity rates, a steam-only facility may be less expensive than a natural-gas, combustion-turbine based cogeneration facility. However, a steam-only natural gas plant was not selected for detailed analysis for several reasons:

- It was not cost effective to prepared detailed designs for all the screening level alternatives.
- Baseload gas/oil cogeneration plants have regional environmental and energy efficiency benefits compared to steam-only plants.
- Cogeneration facilities burn more fuel than steam only plants, so for EIS purposes, they represent the "worst case" localized air quality impacts for a natural gas, fuel oil facility.

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**Off-Campus Third Party Alternatives Described in EIS, But Not Analyzed In Detail**

Broader-scope alternatives such as the third party "thermal network" concept suggested by the Minneapolis Energy Center, or the future very-large natural gas based cogeneration system suggested by Minnegasco (See January 27, 1995 comment letters on draft EIS) were not analyzed in detail in the EIS, but are described and briefly assessed in EIS Chapter 4. (For example, the MEC off-campus proposal was the only suggested alternative that entirely decommissioned the St. Paul campus heating plant.)

These alternatives were not evaluated in detail partly because of the difficulty of modeling or estimating air emission impacts in the same way as that completed for other detailed alternatives and–for the suggested future very-large cogeneration facility–the uncertainty in assessing future financing structure and costs.

# Table 1

## Summary of Minneapolis Campus Steam Plant Alternatives in EIS

| | Location | Boilers (Cogeneration Capcty) | 1999 Fuel Mix | 1999 Elect. (mW-Hrs) | Coal Handling |
|---|---|---|---|---|---|
| Case A | Southeast Plant | CFB<br>Gas/Oil<br>(15 MW Steam Turbine) | 75-83% Coal<br>16-24% Gas<br>2% Oil | 65,500 | Riverfront Enclosed |
| Case B | Southeast Plant | Gas Turbine<br>CFB<br>Gas/Oil<br>(37 MW Steam & Combustion Turbine) | 50% Coal<br>46% Gas<br>4% Oil | 223,500 | |
| Alt. 1 | Southeast & Main | Existing Coal Boilers<br>( No Cogen) | 97% Coal | 0 | Riverfront Enclosed |
| Alt.2 | Southeast | Gas/Oil<br>(No Cogen) | 91.7% Gas<br>8.3 % Oil | 0 | Eliminated |
| Alt. 3 | Southeast | Gas Turbine<br>Existing Coal<br>Gas/Oil<br>(22.5 CT) | 62% Gas<br>32% Coal<br>6% Oil | 187,000 | Riverfront Enclosed |
| Alt. 4 | Southeast | Gas Turbine<br>Gas/Oil boiler<br>(22.5 CT) | 92% Gas<br>8% Oil | 187,000 | Eliminated |
| Alt. 6 | Off-River | CFB<br>Gas/Oil<br>(17 Mw Steam) | 76% Coal<br>22% Gas<br>2% Oil | 60,000 | Riverfront Enclosed |
| Alt. 7 | Off-River | Gas Turbine<br>Gas/Oil<br>(22.5 CT) | 92% Gas<br>8% Oil | 187,000 | Eliminated |
| Alt.5<br>Large Gas Cogen<br>Minnegasco | Off-Campus | Large Gas Turbine<br>(250 MW CT or Combined Cycle) | 92% Gas<br>8% Oil | 2 Million+ | Eliminated |
| New Alt. 9<br>MEC Third Party | Off-Campus | New & Existing Gas/Oil<br>+ Existing NSP Coal<br>St. Paul<br>(No Cogen) | About:<br>72% Gas<br>20% Coal<br>8% Oil | 0 | Riverfront Eliminated<br>+NSP High Bridge Plant |

## Section 4. Electricity Cogeneration

**Cogeneration More Efficient Than Producing Electricity and Thermal Energy Separately**

One important–but difficult to quantify–environmental benefit of district energy systems involves the potential for *cogeneration* of electricity and thermal energy in one process. Cogenerating electricity with steam or hot water for heating and cooling is more efficient than producing electricity and thermal energy separately.

The University currently heats its buildings by making steam in boilers and sending the steam out to the campus. The steam is then returned as hot water. Steam production, by itself, is relatively efficient: modern boilers typically can convert fuel energy into steam at about 80% efficiency.

Large district heating systems like the University's, however, also present an opportunity to produce <u>electricity</u> efficiently. Typical electric-utility plants convert only about 33% of fuel energy into electricity due to the large amount of heat that is usually wasted following electricity generation. Cogeneration systems improve overall energy efficiency by first producing electricity, and then using the "left-over" thermal energy for an industrial process or in a district energy system like the University's.

**Two Basic Types of Cogeneration Systems Described**

The University's proposed "Case A" cogeneration project and a similar EIS alternative produce electricity using a *steam turbine*. High pressure steam is first produced in boilers and then forced through a back pressure steam turbine to produce electricity. The resulting lower pressure steam is then sent to the campus. Typically, large coal fired utility plants use steam turbines.

Most of the EIS cogeneration alternatives selected for detailed review, however, include a natural gas or fuel oil fired *combustion turbine*. Electricity is first produced by burning liquid or gaseous fuel in the jet-engine like turbine, and the hot exhaust gases are used to fire a "waste heat" boiler to make steam or hot water–which is then used for heating and cooling. Plants that combine both types of processes to produce electricity are sometimes called "combined cycle" facilities.

Combustion turbine cogeneration facilities produce more electricity for a given steam load than steam turbine based facilities, but they require more expensive fuels like natural gas or distillate fuel oil. Less expensive solid fuels like coal or petroleum coke are not usually used in combustion turbines, but gasification systems for these fuels are in commercial development.

# Section 5. Environmental Comparison

The EIS contains a large amount of information comparing the environmental impacts and energy efficiencies of the proposed project and various alternatives.

This report focuses on the following areas:

- Localized Air Pollution Impacts
- Predicted Air Pollution Emission Rates
- Potential Benefits of Electricity Cogeneration
- Land Use Considerations

**Worst-Case Modeled Concentrations of Criteria Pollutants Similar for All Alternatives**

Standard air pollution computer models were used to estimate "worst-case" impacts on local air quality due to the proposed project and the alternatives. The computer modeling indicates that for "criteria" pollutants–those for which federal and state standards are currently in place–neither the proposal nor any alternative is likely to exceed state or federal air quality standards.

The worst-case modeling is based on the assumption that all plant equipment would be operating all year long at maximum capacity, using the highest emitting fuel. The maximum emissions from a natural gas, fuel oil plant, for example, assume that fuel oil would be used 100% of the time, all year long.

At these theoretical maximum emission rates–or at likely air quality permit limits–there would be little difference between any project options.

**For Air Toxics, Annual Concentrations Within Regulatory Guidelines**

Again, at theoretical maximum emissions, computer modeling indicates that concentrations of air toxics varied little between the proposal or any of the alternatives.

Modeled worst-case concentrations of nickel did exceed MPCA air concentration limits for gas/oil cogeneration plants, but annual fuel oil limits could be accepted to avoid any regulatory difficulties. All other modeled toxic concentrations were within regulatory guidelines even at maximum emission rates.

There was no indication that the proposal or any alternative would create, by itself, an unacceptable local health risk as long as emission controls were operated as designed.

Worst-case modeling of mercury emissions, however, did indicate that coal-fired alternatives add a small increment of mercury to local lakes, compared to no-coal alternatives.

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**Predicted Air Pollution Emissions Also Used To Compare Alternatives**

Since "worst-case" local impacts are similar, any differences in air pollution impacts between steam plant alternatives can only be distinguished by estimating the overall amount of air pollution that a facility is likely to emit during actual plant operation.

In the EIS, these "predicted" emissions were those that would result from operating plant equipment to meet the anticipated steam load, *using the least-cost fuel first*.

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**Predicted Emissions Depend on Input Assumptions**

Unfortunately, there is no universally accepted method for predicting actual plant emissions. Furthermore, for most pollutants–and particularly for sulfur dioxide–predicted "point-source" emission rates depend more on fuel oil grade, pollution control equipment, and fuel mix than on whether the facility is primarily coal or natural gas.

For example, sulfur dioxide emissions from natural gas, fuel oil plants are almost entirely due to fuel oil use during natural gas interruption. Depending on the sulfur content and annual percentage of fuel oil assumed, the comparative ranking of alternatives will vary.

Numerous different fuel and fuel mix permutations are possible. However, in the EIS, emissions of criteria pollutants were estimated for each alternative using three sets of fuel mix assumptions:

- a low sulfur scenario
- a base case scenario (financial projection's fuel mix)
- a higher sulfur fuel scenario.

Table 2, below, shows the results of the EIS emissions analysis for the EIS base-case sulfur scenario for selected pollutants. Table 3 compares the EIS low-sulfur estimates for the University's proposal compared to the higher sulfur scenario for the gas/oil plants.

Differences between the proposal and the alternatives for carbon monoxide, particulates, and volatile organic carbon, and most air toxic emissions, not shown in the Table 2, were comparatively minor. (See EIS for details on these pollutants).

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Table 2. Predicted Annual Emission Rates–Base Case Scenario
Same fuel mix used in EIS financial projections:
0.05% Sulfur #2 Fuel Oil, 0.5% Sulfur Coal

**(Tons Per Year)**

| | $SO_2$ | $NO_x$ | $CO_2$ | Mercury (lb/yr) |
|---|---|---|---|---|
| **Gas/Oil Steam-Only*** | 13 | 87 | 180,000 | 0 |
| **Gas/Oil Cogen Plant** | 10 | 272 | 250,000 | 0.2 |
| **University's "Case A"** | 123 | 341 | 290,000 | 16 |
| **Gas Cogen W/ Existing Coal Boilers** | 126 | 827 | 320,000 | 10 |
| **No Action (Existing Boilers)** | 606 | 1440 | 300,000 | 19 |

* In the EIS, this alternative assumed 1.0% sulfur residual fuel oil and 90% sulfur removal with wet scrubbers

Table 3. Predicted Emission Rates: Lowest Sulfur Scenario for Coal Plants,
Compared To Higher Sulfur Oil (0.5%) in Gas/Oil Plants
(0.5% S Fuel Oil, 0.3% S Coal, UofM fuel Mix for Case A, including 5% wood)

**(Tons per Year)**

| | $SO_2$ | $NO_x$ | $CO_2$ | Mercury (lb/yr) |
|---|---|---|---|---|
| **Gas/Oil Steam-Only*** | 13 | 87 | 180,000 | 0 |
| **University's "Case A"** | 66 | 292 | 286,000 | 16 |
| **Gas/Oil Cogen Plant** | 79 | 272 | 250,000 | 0.2 |
| **Gas Cogen W/ Existing Coal Boilers** | 178 | 827 | 320,000 | 10 |
| **No Action (Existing Boilers)** | 607 | 1439 | 300,000 | 19 |

* Assumes 1.0% S residual fuel oil and 90% sulfur removal with wet scrubbers. Annual $SO_2$ emissions would be about 60 tons per year using 0.5% No. 2 fuel oil without wet scrubbers.

**Predicted $SO_2$ And $NO_x$ Emissions Low for Gas/Oil Plants, But All Are Much Lower Than Existing Plants**

Table 2 and Table 3 illustrate the differences that occur when coal and fuel oil sulfur percentages are varied.

Under the assumptions in Table 2, sulfur dioxide emissions–while low for all alternatives–are nearly negligible for the natural gas based alternatives.

However, under the assumptions in Table 3–when 0.5% sulfur fuel oil is assumed for gas/oil plants–the University's coal-based proposal with a CFB has $SO_2$ emissions similar to or slightly lower than those of the gas/oil cogeneration plants.

Thus, both coal and natural gas proponents can claim that their chosen facility has "lower emissions" based on EIS results.

$NO_X$ emissions from the CFB-based proposal are also similar to that from natural gas cogeneration alternatives, although $NO_X$ emissions from a steam-only gas/oil plant are lowest. There are not significant differences between the proposed project and the alternatives: most have annual $NO_X$ emissions at least five times lower than the existing plants.

Overall, predicted $SO_2$ and $NO_x$ emissions from the proposed project or any alternative are far lower than from the existing plants (No Action). (Although the "No Action" has comparatively low predicted particulate emissions.)

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**$SO_2$ and $NO_X$ From Coal and Gas Plants Similar Largely Because of Low CFB Emissions**

There are not large differences in "criteria" emission rates between the primarily coal and primarily natural gas alternatives for the following reasons:

- Natural gas contains only negligible amounts of sulfur, but during natural gas supply interruptions fuel oil must be used. Sulfur dioxide emissions from firing fuel oil can be high.
- $SO_2$ and $NO_X$ emissions from the proposed circulating fluidized bed boiler are reduced compared to those from conventional coal boilers
- $NO_X$ emissions from natural gas combustion turbines are similar to that from the CFB.

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**Additional Emission Controls Possible For Proposal And Alternatives**

Some additional considerations are also important:

- Cogeneration alternatives will have higher point source emissions than steam-only plants because of the extra fuel consumed to produce electricity.
- The lowest predicted point-source emissions of most pollutants are from a steam-only natural gas, fuel oil plant (no cogeneration).
- Additional, effective, emission controls for $NO_X$ (and other pollutants) are also possible for the proposal and alternatives. Changing add-on emission controls could result in yet another somewhat different "ranking" of alternatives.

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**Predicted Criteria Emissions Similar for Proposal and Alternatives in St. Paul**

In St. Paul, predicted emission of most criteria pollutants are similar because both alternatives assume the use of natural gas and fuel oil exclusively.

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**Trace Metal Emissions From Coal Effectively Controlled, Except Mercury**

Predicted annual emissions of non-criteria pollutants are similar for all options with the exception of mercury and a few other air toxics. (See estimated mercury emissions in Table 2 above)

Extensive federal research on air toxics emissions from coal plants is ongoing, but recent results indicate that trace metal emissions from coal plants are similar to or only slightly higher than those from gas/oil facilities for most pollutants. The particulate controls required for coal boilers effectively remove most trace metals, which are adsorbed onto the particulates.

Mercury, however, is transformed into a gas at lower temperatures than other trace-metal air pollutants, and is therefore not removed as effectively. Mercury is a regional concern because of its tendency to bioaccumulate in fish.

Overall, predicted mercury emissions are closely related to coal use. Natural gas, fuel oil plants emit only negligible amounts of mercury based on current information. The "No-Action" alternative generally would have the highest emission rates for trace metals, including mercury, because of its higher reliance on coal.

The University has maintained that, as compared to conventional coal boilers, the lower operating temperatures of CFB's would be expected to result in 40% to 50% mercury removal rates. Although this emission reduction is possible, no detailed documentation of consistent mercury control in CFB's was submitted to the EQB during the EIS process.

Finally, predicted formaldehyde emissions were highest for gas/oil cogeneration plants (high formaldehyde emissions were estimated for the combustion turbines).

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**Regional Energy Efficiency And Air Quality Implications May Be As Important As Point-Source Emissions**

Focusing too narrowly on point-source emissions as the only benchmark for environmental superiority may be somewhat misleading. First, the predicted point-source emissions from the University's proposed project or almost any alternative would be significantly lower than those from the existing facilities. Second, the complex–and sometimes irrelevant–debate over precise fuel mix expectations and likely pollution control technologies should not necessarily overshadow other important but difficult to quantify energy efficiency and energy policy issues.

For example, the energy efficiency benefits of electricity cogeneration are not quantified through calculations of "out the stack" emission rates. Cogeneration increases point-source air emissions, but reduces area-wide air emissions because less fuel is needed to produce the same quantities of thermal and electric energy in a cogeneration plant than would separate facilities operating independently.

Therefore, the EIS attempted to quantify the air pollution benefits of cogeneration, as described below.

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**EIS Uses One Method To Estimate Potential Air Quality Benefits Of Cogeneration**

Emission rates in the EIS adjusted for cogeneration are shown in Table 4 below. These emission rates assume that electricity produced by a cogeneration plant would result in an equivalent reduction of electricity production at NSP coal plants. The emission rate estimates are then adjusted accordingly.

All the cogeneration alternatives, including Case A, have lower adjusted $SO_2$ emissions than the gas/oil alternative without cogeneration.

Also, global warming issues were raised by a number of commenters on the EIS. Estimated emission rates of $CO_2$, the primary greenhouse pollutant, are shown in Tables 2 and 3, and again in Table 4, adjusted for "cogeneration credits."

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Table 4. Predicted Annual Emission Rates–Base Case Scenario
Adjusted For Cogeneration Credits: 0.05% Sulfur #2 Fuel Oil; 0.5% Sulfur Coal

**(Tons Per Year)**

| | $SO_2$ | $CO_2$ | Mercury (lb/yr) |
|---|---|---|---|
| **Gas/Oil Only Cogen Plant** | -570 | 46,000 | -13 |
| **University's "Case A"** | -105 | 210,000 | 11 |
| **Gas Cogen With Existing Coal Boilers** | -454 | 110,000 | -4 |
| **Gas/Oil Steam-Only** | 13 | 180,000 | 0 |
| **No Action (Existing Boilers)** | 606 | 300,000 | 19 |

**Cogeneration Credit Evaluation Open To Debate**

This type of "cogeneration credit" calculation, however, is not legally enforceable in a permit. The calculations also require speculation on future electricity demand, and speculation regarding the long-term fuel and technology mix of the utility whose electrical production is "displaced" by the cogeneration project.

Without some sort of adjustment, though, cogeneration plants are simply evaluated as facilities that burn more fuel and produce more emissions than non-cogeneration plants.

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**Long-Term Cogeneration Policy Debate Is Outside Scope of EIS**

Some opponents to the University's proposed project–based on comments on the DEIS–maintain that the largest negative impact of the proposal may be that the comparatively high construction costs for the CFB-based plant will, in effect, greatly reduce or eliminate the possibility of a future, interconnected, metro-wide district heating and cooling system, of which the University could otherwise be a key component.

The related long-term vision is that the thermal energy for such a system–either steam or hot water–would be largely supplied by distributed electricity cogeneration plants. The potential benefits of such a metro-wide cogeneration system are addressed briefly in EIS Chapter 10.

The long-term feasibility of such a plan, or the feasibility of any large cogeneration alternative that includes the University, also inevitably involves complex speculation on future electricity "retail wheeling" or electric-utility restructuring. Such complex, energy policy issues were considered to be mostly outside the scope of the EIS, and were addressed only briefly.

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**Stormwater Runoff From Riverfront Plants Does Not Enter River**

Stormwater from coal storage areas at the Minneapolis campus discharges into the municipal sewer system. At both Minneapolis and St. Paul, coal ash is now stored indoors and then directly hauled to a licensed landfill. There was no indication at either campus that coal use under the existing or proposed facilities would result in runoff into the Mississippi River or other water bodies.

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**No Indication of Major Contamination Found at Riverfront Site**

At the Riverfront Site, coal, ash, and fuel-oil storage could present contamination concerns, but the soil samples were within regulatory limits, and fuel oil storage tanks on the site currently show no evidence of leaking. No indication of historical contamination of the riverfront site was found, although there are leaking fuel tanks in the surrounding neighborhood, and the fuel oil stored on site always presents a risk.

At the Alternative Minneapolis Campus Site, creosote compounds in the soil currently are being cleaned up.

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**Land near Riverfront Site is Historically and Recreationally Important To Local Community**

The land around the Minneapolis campus riverfront site is an important historical and recreational resource. The neighborhood closest to the riverfront plants includes residential, industrial, retail areas. Hennepin Bluffs Park and the historic Stone Arch Bridge are located just west of the site. The affected residential community has expressed a strong interest in opening up the Mississippi Riverfront near the steam plants to recreational or other uses.

The land around the off-river site (as assumed in the EIS) is primarily University facilities and parking lots, with residential areas about one-half mile away.

Daycare centers are located near both the existing and alternative off-river sites.

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**University Modifications Will Eliminate Any Fugitive Coal Dust Problems**

Since completion of the EIS, the University has committed to completely enclosing the riverfront coal delivery, storage, and transport system as part of the proposed project. This would virtually eliminate any fugitive dust problems due to coal or any traffic problems due to coal trucks.

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**Plant Operation Would Conflict with Some Plans for Trails and Parkways**

The primary remaining riverfront land use conflict associated with the proposal, then, is due to the space needed to deliver and store coal. As planned, the existing coal storage areas at both the Main and Southeast Plants restrict or preclude most of the reasonably safe bicycle and pedestrian routes to the area below the riverfront bluff.

The Main Plant coal storage area, even covered, would also restrict potential riverfront routes above the bluff, between the University campus and the St. Anthony Falls Riverfront area.

A substantially modified riverfront coal delivery and storage system might allow more innovative riverfront designs than the current proposal, but such a solution has not yet been identified. The EIS did not study this issue in detail.

Constructing a natural gas, fuel oil plant on the riverfront would eliminate the space requirement problems associated with coal, but the fuel oil tanks would remain.

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**Proposed Project Not Prohibited by Riverfront Land Use Plans**

There are no specific riverfront policies–in either the federal Mississippi River National Recreation Area (MNNRA) plan or in the University's Critical Area Plan–that prohibit the University's proposed project or alternatives.

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**An Off-River Site Would Open Up Riverfront Access, But Could Create Other Problems**

Constructing a plant at an off-river site would open up the riverfront to a larger number of potential parkway and recreational options.

Renovation of the Southeast Plant for non-steam plant uses, however, may prove to be difficult because of the size, age, and open interior structure of the building. The EIS did not include any studies on the building re-use issue.

Moving the steam facilities off-river would also eliminate an opportunity to integrate the continued historical use of the Southeast Plant with other recreational or other riverfront plans.

Finally, the enhanced value of a "reclaimed" riverfront area, with or without the steam plants, depends largely on non-quantifiable value judgments regarding potential alternative uses, and on the potential for future funding of riverfront improvements and building renovation.

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## Section 6. Financial Comparison

A major issue identified during the EIS public "scoping" process involved the feasibility of potentially environmentally superior alternatives to the University's proposed project. All the alternatives considered in the EIS are technically feasible. So a detailed evaluation of financial feasibility was undertaken.

This section of the report describes the EIS financial results in the following order:

- Purpose of Financial Projections
- Major Assumptions
- Results

**EIS Financial Projections Not Designed To Determine Lowest Cost Alternative**

The intent of the EIS financial projections is to evaluate the financial feasibility of potentially environmentally superior alternatives to the University's proposed project.

The alternatives selected for detailed review in the EIS–and the scope of financial and engineering analyses–would have been different if the purpose of the financial analysis was to determine the lowest cost alternative to the University.

**EIS Financial Projections Out of Date, And Designed For Initial Feasibility Assessment**

The EIS financial projections were completed in April, 1994, nearly two years ago. Fuel cost and retail electricity projections, in particular, may have changed significantly since early 1994.

Also, the construction costs for the EIS alternatives are intended to provide a consistent basis for evaluating the economic feasibility of potential alternatives to the proposed project. They are not intended to provide detailed, final design-and-build cost estimates for those alternatives.

If the EIS financial projections were to be used for a final cost comparison for decision making purposes, updated fuel price, electricity, and steam load forecasts would be necessary, along with more detailed construction designs for the alternatives.

**Financial Projection Results Depend on Input Assumptions**

The 25-year financial projections for any steam plant alternative consist of the following four major components:

- Construction Costs
- Operating and Maintenance Costs (O&M)
- Value of Cogenerated Electricity (deducted)
- Fuel Costs (50% to 75% of total costs)

Each of these cost components, in turn, are made up of a large number of individual assumptions and projections. Varying the input assumptions, of course, will lead to different results. For example, steam plant cost projections are particularly "sensitive" to changes in projected fuel prices, because fuel makes up such a large percentage total costs.

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**Proposal's Construction And Operating Costs Based on Detailed Contract**

The University's proposed project is defined by a complex contract for steam and electricity that contains detailed designs and technology-specific construction costs. The contract also defines fixed and variable operating and maintenance rates. Therefore, the present value construction and non-fuel operating costs for the University's proposed contract are based on the detailed University contract with its steam vendor.

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**Alternatives Costs Based On University Construction and Operation**

The cost projections for the EIS alternatives, on the other hand, are based on the University's constructing and operating the steam plants. The University's contract was not applied to the EIS alternatives because the contract with Foster Wheeler, Inc. is technology specific to the "Case A" and "Case B" proposals.

The construction costs for the alternatives are professional cost estimates based on conceptual-level designs completed for the EIS. The EIS designs are not as detailed as those prepared for the University's proposed project. The construction costs of the alternatives also assume the University would construct the plants using the traditional method of hiring an architect, engineer, and contractor separately.

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**Fuel Prices The Same Under The Contract and For The Alternatives**

Fuel costs are a "pass through" to the University under the Foster Wheeler contract. Therefore, the fuel price assumptions are identical for the proposed project and alternatives.

The University contract, however, contains fuel efficiency and electrical production guarantees. Thus, the contract provides a "cap" on the amount of fuel used, but does not guarantee the price of fuel. In the EIS calculations, therefore, fuel efficiencies for the University's proposal are based on the contract.

For the EIS alternatives, fuel consumption and electricity production are not based on the contract, but on engineering calculations and vendor quotes.

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**All Other Variables Consistent For Proposal and Alternatives**

All assumptions and methodologies for steam loads, fuel prices, escalation rates, and other key variables and sensitivities were consistently used to evaluate and compare the costs of the University's proposal under its contract with the estimated costs of the alternatives.

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**EIS Assumes University Would Use Cogenerated Electricity**

The value of cogenerated electricity was estimated assuming the University would use the electricity to reduce retail purchases, rather than selling it to NSP.

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**Costs of Alternatives Compared To Costs Of Proposed Project To Assess Financial Feasibility**

In the EIS, the estimated costs of the alternatives—constructed and operated by the University—are compared to the costs of the University's proposed Case A under its vendor contract. This comparison provides one benchmark for assessing the economic feasibility of the alternatives designed for the EIS. Actual prices, for both the University's proposal and the alternatives, will inevitably differ from long-range projections.

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**Financial Results Include Costs of Both Campuses**

Table 5 shows the projected costs of each Minneapolis campus alternative combined with the gas/oil only St. Paul Campus alternative (Alt. No. 13). The Minneapolis "No Action" alternative is also shown combined with the costs of the St. Paul campus "No Action" Alternative (Alt. No. 11).

Results in Table 5 are presented as 25-year total "present value" costs in 1994 dollars.

The costs of the two campuses are combined in order to compare the alternative's projected costs to the proposed project's, which are combined under the University contract.

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**Coal Alternatives Cost Less Than Natural Gas Alternatives, But All Are Less Than Proposed Project**

The EIS results indicate that alternatives that use coal would have lower total costs than those that exclusively used natural gas and fuel oil. The difference in projected total 25-year costs between the lowest and highest cost renovation alternative is about 10%. Sensitivity analysis of the discount rate, price escalation rate, steam load, electricity escalation rate, and the differences between fuel and electricity escalation rates only slightly affected the rankings of alternatives.

When comparing the EIS consultant's estimated costs of the alternatives–constructed and operated by the University– to those calculated for the proposed project through the University contract, all combinations of alternatives were found to have lower costs than the University's Case A. There is about a 13% difference in projected 25-year total costs between the lowest cost renovation alternative and those of the proposed Case A project.

**TABLE 5. PRESENT VALUE OF COMBINED ALTERNATIVES**
**Financial Projections**
**Present Value 1/1/94 ($ in Millions)**

| Description | EIS ID Number | Minneapolis | St. Paul | Total |
|---|---|---|---|---|
| No Action | Alt. Nos. 1 & 11 | 245.3 | 80.6 | 325.9 |
| No Action W/ St. Paul Gas/Oil | Alt. Nos. 1 & 13 | 245.3 | 102.2 | 347.5 |
| On-River Gas Cogen W/ Coal | Alt. Nos. 3 & 13 | 256.6 | 102.2 | 358.8 |
| On-River Gas Cogeneration | Alt. Nos. 4 & 13 | 285.9 | 102.2 | 388.1 |
| Off-River "Fuel Flexible" | Alt. Nos. 6 & 13 | 264.2 | 102.2 | 366.4 |
| Off-River Gas Cogeneration | Alt. Nos. 7 & 13 | 298.5 | 102.2 | 400.7 |
| University Proposal | Case A | | | 411.2 |
| University Proposal | Case B | | | 426.2 |

**EIS Financial Projections Disputed by The University and Minnegasco**

Minnegasco, in its comments on the draft EIS, dated January 27, 1995, indicated that the EIS projections for natural gas prices, which are based on 1994 federal forecasts, are too high. Minnegasco indicated that an actual guaranteed 25-year natural gas price would be significantly less expensive than that estimated in the EIS.

On the other hand, the University, in their draft EIS comments dated January 27, 1995, maintained that the construction costs and operating costs assumed for the alternatives are unrealistically low. The University also commented that the EIS assumed rate of increase for both western coal prices and retail electricity rates are too high.

Further, the University maintained in its January 1995 comments that the EIS improperly compares the University contract-based costs with the costs of the University operating the plants. The University maintains that the financial value of shifting construction and operating risks to Foster Wheeler, Inc. should have been accounted for in the financial comparisons.

No methodology or suggested overall financial value to apply to the University contract guarantees, however, was provided by the University during the EIS process.

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**University and Minnegasco Cost Projections From EIS Comments Included In Appendix B**

To illustrate how revised fuel cost or other assumptions can affect total project costs, Minnegasco's revised cost estimates from their final EIS comments, dated August 17, 1995 (which are based on their January 27, 1995 natural gas price offer), are attached in Appendix B.

The University's cost comparisons included in their January 27, 1995 DEIS comments are also attached in Appendix B. (The University's cost projections in their DEIS comments are based on a wide variety of different assumptions than that used in the EIS. The University's January, 1995 estimates did use the same fuel prices as did the DEIS, despite University concerns that DEIS estimates of future western coal prices were too high and natural gas prices too low.)

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**Updated University of Minnesota Financial Projections Provided In Appendix C**

Finally, the University of Minnesota has recently updated their steam service facilities financial projections. The University's updated cost projections for the proposed project and their selected alternatives, from *University of Minnesota, Twin Cities Campus Steam Service Facilities Recommendations*, December 7, 1995, are presented in Appendix C, attached to this report. (The University's updated cost projections are in 1996 dollars; the EIS projections are in 1994 dollars).

The University administration also presented cost projections for some new variations on their proposed Case A project, but the updated figures for these alternatives are not provided in Appendix C.

# Appendix A

Descriptions of EIS Alternatives Selected For Detailed Analysis

| | |
|---|---|
| **Alternative No. 1 Is the Minneapolis "No-Build" Option** | Under Alternative No. 1, construction at the Minneapolis Campus would be deferred until 2001, when new coal-fired boiler capacity would be installed in the Southeast Plant. All boilers capable of burning coal would be dispatched first. |
| **Alternative No. 3 Would Cogenerate Electricity with Natural Gas and Burn Coal** | Under Alternative No. 3, the Southeast Plant would be modified, and the Main Plant would be retired. Electricity would be produced by combustion turbines using natural gas or fuel oil, and steam would be produced first with waste-heat boilers, then by existing coal-fired boilers, followed by new gas/oil fired boilers. Coal operations would remain, but be enclosed. |
| **Alternative No. 4 Would Cogenerate Electricity and Burn Natural Gas and No. 6 Fuel Oil** | Under Alternative No. 4, the Southeast Plant would be modified to 100% gas/oil, and the Main Plant would be retired. Electricity would be produced by combustion turbines, and steam would be produced by waste heat and gas/oil fired boilers. All coal boilers would be retired |
| **Alternative No. 6 Would Cogenerate Electricity and Burn Coal, Off-River** | Under Alternative No. 6, a new plant similar to the University's proposed Case A would be constructed at an off-river site, with entirely enclosed coal handling operations. Both existing Minneapolis plants would be retired. Electricity would be produced by a non-condensing steam turbine, and steam would be produced by a fluidized bed boiler and gas/oil boilers. |
| **Alternative No. 7 Would Cogenerate Electricity and Burn Gas/Oil Off-River** | Under Alternative No. 7, a new gas/oil cogeneration plant would be constructed at an off-river site, and both existing Minneapolis plants would be retired. Electricity would be produced by combustion turbines, and steam would be produced by waste heat and gas-oil-fired boilers. |
| **St. Paul Alternative No. 13 Would Burn Natural Gas and No. 2 Fuel Oil** | Under Alternative No. 13, the St. Paul Plant would be modified. Coal storage and use would be eliminated. Electricity would not be produced, and steam would be produced by new and existing gas/oil boilers. |

# Appendix B

Minnegasco Figures from FEIS Comments, August 17, 1995

**PRESENT VALUE OF COMBINED ALTERNATIVES**
Present Value 1/1/94 ($ in Millions)

| Description | EIS ID Number | Minneapolis | St. Paul | Total |
|---|---|---|---|---|
| No Action | Alt. Nos. 1 & 11 | 245.3 | 80.6 | 325.9 |
| No Action W/ St. Paul Gas/Oil | Alt. Nos. 1 & 13 | 245.3 | 102.2 | 347.5 |
| On-River Gas Cogen W/ Coal | Alt. Nos. 3 & 13 | 256.6 | 102.2 | 358.8 |
| On-River Gas Cogeneration | Alt. Nos. 4 & 13 | 245.7 | 95.6 | 341.3 |
| Off-River "Fuel Flexible" | Alt. Nos. 6 & 13 | 264.2 | 102.2 | 366.4 |
| Off-River Gas Cogeneration | Alt. Nos. 7 & 13 | 258.3 | 95.6 | 353.9 |
| University Proposal | Case A | | | 411.2 |
| University Proposal | Case B | | | 426.2 |

University of Minnesota/ Foster Wheeler, Inc. Financial Projections:
Joint Comments on DEIS, January 27, 1995 (p. 21)

**PRESENT VALUE OF COMBINED ALTERNATIVES**
Present Value 1/1/94 ($ in Millions)

| Description | EIS ID Number | Mpls. | St. Paul | Total |
|---|---|---|---|---|
| No Action | Alt. Nos. 1 & 11 | N/A | N/A | 459.6 |
| No Action W/ St. Paul Gas/Oil | Alt. Nos. 1 & 13 | N/A | N/A | N/A |
| On-River Gas Cogen W/ Coal | Alt. Nos. 3 & 13 | N/A | N/A | 442.0 |
| On-River Gas Cogeneration | Alt. Nos. 4 & 13 | N/A | N/A | 468.4 |
| Off-River "Fuel Flexible" | Alt. Nos. 6 & 13 | N/A | N/A | 450.5 |
| Off-River Gas Cogeneration | Alt. Nos. 7 & 13 | N/A | N/A | 494.9 |
| University Proposal | Case A | N/A | N/A | 426.1 |
| University Proposal | Case B | N/A | N/A | 458.0 |

# Appendix C

## University of Minnesota Steam Plant Updated Financial Projections Case A And Selected EIS Alternatives

(from Figure No. 6, December 7, 1995 *Steam Service Facility Recomendations*)

PRESENT VALUE OF COMBINED ALTERNATIVES
Present Value 7/1/96 ($ in Millions)

| Description | EIS ID Number | Minneapolis | St. Paul | Total |
|---|---|---|---|---|
| On-River Gas Cogeneration | Alt. Nos. 4 & 13 | | | 482 |
| Off-River "Fuel Flexible" | Alt. Nos. 6 & 13 | | | 475 |
| Off-River Gas Cogeneration | Alt. Nos. 7 & 13 | | | 493 |
| University Proposal | Case A | | | 441 |

# Minnesota Pollution Control Agency

January 18, 1996

Ms. Sue Markham
University of Minnesota
Associate Vice President, Facilities Management
250B Shops Building
319 15th Avenue
Minneapolis, Minnesota 55455

RE: Air Emission Permit for the University of Minnesota Steam Service Facilities

Dear Ms. Markham:

The purpose of this letter is to inform you that the Minnesota Pollution Control Agency (MPCA) would like to resume working on the permit for the proposed University of Minnesota Steam Service Facilities. In order to begin processing the permit application, the University of Minnesota must commit to the following:

- The facility would be required to burn a minimum of 70 percent natural gas on an annual basis, for the life of the permit. The 70 percent figure for natural gas reflects the fact that natural gas service is interruptable .

- The facility would be allowed to have a fuel flexibility option. However, petroleum coke would not be a fuel option now or in the future.

- The air emission permit would not be issued until after the legislature has adjourned its regular session sine die in 1996.

520 Lafayette Rd. N.; St. Paul, MN 55155-4194; (612) 296-6300 (voice); (612) 282-5332 (TTY)
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The above permit conditions along with the fact that the permit application is one and a half years old and the dynamic nature of our work would result in the need for the University to submit a supplemental permit application. Please contact Dave Beil of the Air Quality Division at 612/296-7810, to discuss the supplemental permit application.

We look forward to working with you to complete the permit for your facility.

Sincerely,

Charles W. Williams
Commissioner

CWW:smm

cc: The Honorable Phyllis Kahn, Minnesota State Representative
James Payne, Popham Haik Schnobrick Kaufman LTD
James Sebesta, Sebesta Bloomberg & Associates
Rebecca Rom, Faegre & Benson