POLICY ANALYSIS SERIES

ISSUES RELATED TO STATE HOSPITALS / NO. 2

MINNESOTA STATE HOSPITAL ENERGY USE AND COST

I. INTRODUCTION

In 1984, the Minnesota Legislature directed the State Planning Agency to prepare a study and plan regarding the state hospital system (Laws of Minnesota, Chapter 654, Section 19, Subdivision 3:6). One of the provisions of the statute is to "analyze the energy efficiency of the buildings." This paper is one of a series of reports that will summarize the results of the study and plan. The purpose of this paper is to compare energy use, energy efficiency, and cost for each of the eight state hospitals for the past five years.

II. METHODOLOGY

The main sources of information for this analysis were a series of maxi-energy audit reports conducted by several independent contractors on behalf of the Minnesota Department of Administration. A maxi-energy audit is defined as: an evaluation of a facility to assess its current energy-using equipment and practices and to identify measures to improve energy efficiency.

Audits were completed by five separate consultant firms: (1) Ellerbe Associates (1978, 1979a, 1979b); (2) Michaud, Cooley, Hallberg, Erickson & Associates (1978, 1979); (3) Oftedahl, Locke, Broadston & Associates (1979); (4) Orr-Schelen-Mayerson & Associates (1979); and (5) Sam Stewart & Associates and Ann Pawlak & Associates (1979).

In addition to audits, information was also received from the Department of Administration, Energy Conservation Division and the Department of Human Services.

The Department of Administration, Energy Conservation Division, maintains an automated information system which monitors the consumption and cost of energy for all of the state hospitals. This system was installed in 1979 and utilized 1973 as a base year. During his first term in office,

Governor Perpich established an objective to reduce energy use by 15%. This automated system allows monitoring of energy by measuring consumption per square foot adjusted for degree days[1] at each geographic region. This measurement would be valid under most circumstances; however, the majority of hospitals have reduced their utilization of building space as a result of their declining resident/patient population. The Department of Administration, Energy Conservation Division's data do not reflect this reduction of building space thereby making comparisons difficult. This traditional method of determining the energy efficiency of the state hospitals is also limited in that the Legislature has not authorized energy efficiency improvements which have a payback[2] of more than five years.

The above sources collect and analyze data for separate and distinct purposes. Their purposes may or may not relate to each other or provide information for operational purpose to the state hospital system as a whole, e.g., energy cost, analysis of energy cost and use over a period of time. Also, some of the information within the data system have not been kept current. Therefore, the data have been updated to reflect the current conditions at the state hospitals and have been integrated to provide information for operational purposes.

There are several other limitations in comparing energy use among the state hospitals. Listed below are some variables that affect energy management. These limits are in alphabetical order (not in priority order):

Boiler Efficiency: The average cumulative efficiency of boilers at all state hospitals was 65% in FY '83 while the efficiency at Moose Lake was 93% (Department of Administration, 1984). This variation can easily change consumption of fuel for space heating and nonheating fuel (e.g., cooking, hot water heating, etc.) use by 10% to 20%.

Construction Efficiency: Although many of the recommendations to increase the efficiencies of the state hospitals have been implemented, efficiency varies according to the building practices at the time of their original construction.

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[1]Degree Day - In a single 24-hour period, degree days are the difference between the mean (average) temperature and 65° F.

[2]Payback - A simple payback is the cost of implementing an energy efficiency improvement divided by the first year energy savings derived from the improvement.

Cost of Energy: While the price of energy may provide incentives for making improvements in the efficiency of a hospital, they also provide a disincentive. Historically, the Legislature has only approved energy improvements which have a payback of five years or less; therefore, hospitals which pay low energy prices may not be able to make some energy improvements because the lower the energy price the longer the paybacks. The result is that state hospitals with lower energy prices will tend to have higher levels of energy use per resident; yet their energy cost will be comparable to or lower than the other state hospitals.

Energy Supplier: The cost of energy for the same fuel type varies depending upon the source of the energy. Investor-owned utilities are cheaper than cooperatives. Willmar and Fergus Falls purchase their electricity directly from the Western Area Power Administration which provides the least expensive electricity per kwh[3] of any source.

Fuel Type: The cost of energy varies depending upon the type of fuel utilized. The two state hospitals which have converted to coal pay less per MMBTU[4] than those using natural gas.

Leased Buildings: Several of the hospitals lease unused buildings. The electricity and space heating may not be metered separately.

Vacated or Partly Vacated Declining populations at the hospitals have resulted in excess building space that requires extra energy for heating. Depending upon the specific hospital, 5% to 18% of the available space is not currently being utilized. (American Appraisal Company, 1983).

Winter Severity: The energy use figures in this report are adjusted to the normal winter heating degree days for each hospital. Since space heating needs are greater at state hospitals with more severe winters, their energy use may be greater than other state hospitals.

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[3]Kwh (kilowatt hour) - A unit of measuring the amount of electric energy consumed.

[4]MMBTU (Million BTU) - A British Thermal Unit; the amount of energy required to raise one pound of water one degree Fahrenheit; used as standard measure of energy.

III. RESULTS

The results of this analysis will be presented in eight sections. The first section will present an individual analysis, in alphabetical order, of each state hospital's energy use. The subjects/titles of the other sections are as follows:

B. Energy use by residents/patients;

C. Energy use by square foot/by degree day/by MMBTU;

D. Energy use and cost by square foot of building space;

E. Energy cost as a percentage of operating cost;

F. Electric and fuel cost at each state hospital;

G. Energy cost per resident/patient; and,

H. Energy improvements.

For purposes of this report, census figures from November 30, 1983, have been used in most calculations.

A. INDIVIDUAL ANALYSES

Anoka State Hospital

Anoka State Hospital was first occupied in 1902 and was the fourth state hospital in Minnesota. Anoka currently has 22 main structures on 243.5 acres of land located in Anoka County, a suburb of Minneapolis and St. Paul (American Appraisal Company, 1983). As of November 1983, the hospital had 323 patients, an 11% decline from 1979 (Department of Human Services, 1983). Anoka's energy consumption and cost are slightly higher than other state hospitals. The average energy consumption per patient in 1983 was 247.7 MMBTU for all state hospitals; Anoka's was 257.0 MMBTU per patient. Anoka's cost per patient ($1,185) was also higher than the average for all other state hospitals ($1,085).

Although Anoka has reduced its energy consumption per patient by 25% over the last five years, its energy cost per patient has risen 44% per patient. One of the factors attributed to the reduction of energy consumption per patient is the cumulative boiler efficiency which is 86% compared to the average of 76% for all state hospitals. During the review and comment period, officials at Anoka State Hospital noted that one of the reasons for their slightly higher than average energy use was the requirement to heat vacant buildings.

Anoka purchases electricity from the city of Anoka at 3.71 cents per kwh which is slightly less than the average of 3.97 cents per kwh for all state hospitals. Natural gas is purchased from the North Central Public Service Co. for $4.40 per MMBTU which is higher than the average $3.85 per MMBTU for all state hospitals (Department of Administration, 1984).

Brainerd State Hospital

The first building on the Brainerd State Hospital campus was opened in 1958 making Brainerd the most recently constructed state hospital. The campus was completed by 1967 and has 16 main structures on 198 acres of land (American Appraisal Company, 1983). Brainerd is located in Crow Wing County and on the average has the second highest number of days requiring heating. As of November 1983, Brainerd had 463 residents/patients, a 15% decline from 1979 (Department of Human Services, 1983). Recent census figures indicate that this decline has continued, with the average daily census for FY '84 listed as 450 residents/patients.

Brainerd State Hospital has the highest energy cost per resident/patient of all state hospitals at $1,378. There are several factors causing this highest per resident/patient energy cost. Electricity is purchased from Brainerd Water and Light for 5.4 cents per kwh and the Minnesota Gas Company supplies gas for $4.36 per MMBTU. These charges are the third highest among all hospitals--the average for all hospitals is 3.9 cents per kwh for electricity and $3.85 per MMBTU for natural gas--and combined with Brainerd's extremely low boiler efficiency of 72% contribute to the high energy cost per resident/patient (Department of Administration, 1984).

The actual energy consumption per resident/patient at Brainerd is 227 MMBTU which is less than the average for all hospitals of 247.7 MMBTU per resident/patient. There has been a marked decline in the number of residents/patients from 1979 to 1983; this has caused Brainerd to have an 8.7% reduction in energy consumption per resident/patient. During that same period, the energy cost per resident/patient rose 40%.

Brainerd State Hospital is currently negotiating a shared savings contract with Honeywell Co. which should reduce its energy consumption and cost. A shared savings contract is one in which a private company provides the funding and makes improvements that make a facility more energy-efficient in return for a portion of the cost savings over a specified period of time.

Cambridge State Hospital

Cambridge State Hospital was first occupied in 1925. The majority of buildings were constructed between 1925 and 1937; however, larger buildings which contain over half of the square footage were constructed after 1953. The campus has 26 main structures on 245 acres of land located in Isanti County approximately 50 miles north of St. Paul (American Appraisal Company, 1983). As of November 1983, Cambridge had 484 residents - a decline of 11% since 1979 (Department of Human Services, 1983).

The energy cost per resident of $1,083 is slightly below the average ($1,085), but the energy consumption per resident is 306 MMBTU compared with the average of 247 MMBTU. Although the per resident energy consumption at Cambridge increased 62% from 1979 though 1983, its energy cost per resident increased 33%. The reason for the smaller cost per resident increase was the conversion to soft coal. Cambridge uses coal for most of its fuel consumption during the winter months and natural gas for about half of its fuel use during the rest of the year. Equipment problems during the conversion to coal reduced its cumulative boiler efficiency to 55% compared to the average of 76%.

Electricity is purchased from East Central Electrical Association for 6.01 cents per kwh (Department of Administration, 1984). This is the second highest price for electricity among all hospitals and is 51% higher than the average of 3.97 cents per kwh for all state hospitals. The cost for heating is $2.40 per MMBTU which is 37% lower than the average of all state hospitals at $3.85 per MMBTU (Department of Administration, 1984).

Faribault State Hospital

Faribault State Hospital was established in 1881 making it the second oldest state hospital in the system. It is the largest state hospital with 52 main structures on 760 acres of land (American Appraisal Company, 1983). The oldest building on the campus is the power plant built in 1896. Faribault is located in Rice County.

As of November 1983, Faribault had the largest population with 717 residents (Department of Human Services, 1983), this, however, was a decline of 12% from 1979 to 1983.

Although $634,600 has been spent over the last five years on improving energy efficiency, Faribault still has the second highest cost of energy per resident ($1,365) among all the state hospitals. This is far above the least expensive state hospital, (Willmar, $742 per resident/patient) and 25.8% above

the average of all state hospitals. The energy consumption per resident of 273 MMBTU is only slightly above the average of 248 per MMBTU.

Faribault purchases electricity from Northern States Power for 3.68 cents per kwh which is below the average rate for all state hospitals (3.97 cents per kwh) (Department of Administration, 1983). Northern States Power is also the supplier of natural gas at a rate of $4.14 per MMBTU (Department of Administration, 1984). The rate is only 7% higher than the average for all state hospitals ($3.85 per MMBTU).

Although the energy costs are high, they would be much higher if Faribault had not recently reduced its use of fuel oil from 58% in 1979 to zero use in 1983. One of the major reasons for this high energy cost is due to its large and underutilized facility causing Faribault to be the third largest per resident user of energy. Fergus Falls, which has the highest use of energy per resident, burns coal for heating which is much cheaper ($1.96 per MMBTU) than Faribault ($4.14 per MMBTU).

Through the five year period from 1979 through 1983, Faribault has managed to keep its energy consumption per resident fairly steady with only an 8% increase, but its cost per resident rose 44%.

Fergus Falls State Hospital

Fergus Falls State Hospital was first occupied in 1890 and is the third oldest state hospital. It currently has 40 main structures, the majority of which were built between 1890 and 1923. Fergus Falls has 320 acres of land of which 164 acres are leased as farmland (American Appraisal Company, 1983).

Although Fergus Falls' energy consumption per resident/patient is the highest of all state hospitals at 362.4 MMBTU per resident/patient compared to the average of 227 MMBTU, the cost per resident is the second lowest ($746 compared to the average of $1,085). Fergus Falls has managed to keep its energy cost extremely low despite a 17% decline in population from 1979 to 472 residents/patients in November, 1983 (Department of Human Services, 1984). During the five year study for this analysis (1979 to 1983) the energy use per resident/patient increased 9%. At the same time the energy cost per resident/patient increased 6% which gave Fergus Falls the lowest cost increase per resident/patient among all the state hospitals for the same period.

The most significant cause of the low per resident/patient energy cost is the extremely low cost of electricity at 1.12 cents per kwh (the lowest of all state hospitals), and the

use of coal for heating at a cost of $1.96 per MMBTU (also the lowest for all state hospitals) (Department of Administration, 1984). Both of these low costs are far below the averages for all state hospitals which are 3.97 cents per kwh and $3.85 per MMBTU respectively.

Fergus Falls' high energy use per resident/patient is due to the low cost of its energy. The Legislature has not authorized the funding for energy efficiency improvement because the improvements would have a payback of more than five years.

Moose Lake State Hospital

Moose Lake State Hospital was first occupied in May of 1938. It currently has 23 main structures located on 175 acres of land (American Appraisal Company, 1983).

The campus is located southwest of Duluth in Carlton County. This is the coldest location among the state hospitals with 9265 degree days. Moose Lake has the highest per unit energy cost among all the state hospitals. Its electrical cost is 6.22 cents per kwh compared to the average of 3.97 cents per kwh and natural gas is $4.98 per MMBTU compared to the average of $3.85 per MMBTU (Department of Administration, 1984). Electricity is purchased from Moose Lake Water & Light and gas is purchased from the Inter City Gas Co. Despite its cold geographic location and having the highest cost for energy, Moose Lake's energy cost per resident/patient ($1,057) is less than the average for all the state hospitals ($1,085 per resident/patient). The less than average per resident/patient energy cost is in part due to having an extremely efficient boiler. The average boiler efficiency is 76%; Moose Lake's is 93% efficient (Department of Administration, 1984).

The efficient use of energy at Moose Lake is further evidenced by the second lowest energy consumption per resident/patient among the hospitals (164 MMBTU per resident/patient compared to the average of 247.75 MMBTU per resident/patient). Willmar has the lowest energy consumption at 163 MMBTU, but Moose Lake is located in an area that is much colder than Willmar. Moose Lake has 9265 heating degree days whereas Willmar has 8332.

During the five year period from 1979 through 1983, the energy consumption at Moose Lake only increased 5.7%, which was the lowest per resident/patient increase among all the state hospitals. During the same period, however, costs increased 52% per resident/patient which was the largest such increase among all the state hospitals. Moose Lake experienced a small (6%) resident/patient population reduction during the same period and by November 1983, had 440 resident/patients (Department of Human Services, 1983).

St. Peter State Hospital

St. Peter maintains two hospitals. The state hospital, originally built in 1866 was the first state hospital in Minnesota and the Security Hospital, which was completed in 1982, is the state's newest facility. Although the original campus is the oldest in the state system, it is in good physical condition because of a major replacement and renovation program that has been completed during the past 20 years. While the two institutions are in many ways separate and distinct, they do utilize the same energy resources such as heating, laundry, etc., and because of this will be treated as a single entry for the purposes of this report.

St. Peter is located approximately 70 miles south of the Twin Cities on 744 acres of land, of which 220 acres are leased out (American Appraisal Company, 1983). The campus houses 35 main structures, including the new security hospital, and is located in Nicollet County. This location affords St. Peter 7748 heating degree days, lowest of all the state hospitals. Although St. Peter was the only hospital to experience a slight resident/patient increase (6%) during the study period, it had a 1.7% decline in per resident/patient energy use. St. Peter's 229 MMBTU per resident/patient is less than average of 247 MMBTU per resident/patient, however, its energy cost of $1126 per resident/patient is above the average ($1085) for the state hospitals. This per resident/patient cost of energy represents a 38% increase over the study period.

A major reason for this slightly above average cost is in part due to the extraordinary use of electricity at the security hospital. Because of security precautions, the security hospital is 100% climate-controlled at all times. Regardless of the weather, the security hospital cannot open windows to take advantage of mild weather conditions. Therefore, St. Peter's per resident/patient electrical use is higher than any other state hospital; while the security hospital only represents 15% of the building space, it utilized 30% of the electricity for the entire complex.

St. Peter's energy consumption will improve in the near future as its cumulative boiler efficiency of 77% will increase as a result of the planned installation of a small summer boiler.

St. Peter's electricity cost is average at 3.99 cents per kwh and its natural gas is slightly above average ($4.16 compared with $3.85) (Department of Administration, 1984). Electricity is purchased from the St. Peter Municipal Utilities and Northern States Power is the natural gas supplier.

Willmar State Hospital

Willmar State Hospital is located 100 miles west of the Twin Cities in Kandiyohi County. It received its first patient in 1912 and has 39 main buildings on 158 acres of land (American Appraisal Company, 1983).

Willmar has the lowest cost per resident/patient ($742) of all the state hospitals. This figure is far below the average ($1,085) and 46% below the high of Brainerd State Hospital ($1,378).

Willmar achieves this lowest cost per resident/patient because it also consumes the least amount of energy per resident/patient of 163 MMBTU which is slightly less than 164 at Moose Lake, but significantly below the average of 248 MMBTU per resident/patient.

Willmar's energy efficiency is a result of a well maintained and managed energy system. Although Willmar's electrical costs are the second lowest at 1.6 cents per kwh, its natural gas consumption of $4.38 MMBTU is above the average of $3.85 MMBTU (Department of Administration, 1984). In addition, they have a slightly above average boiler efficiency of 80%.

While the population at Willmar declined 5% to 544 residents in November 1983 (Department of Human Services, 1983), its energy use per resident/patient only rose slightly (2.7%). Like most hospitals, Willmar experienced energy price increases, causing its energy cost per resident/ patient to increase 48% during the same five year period. Willmar, like Fergus Falls, buys its electricity directly from a wholesale supplier - the Western Area Power Administration.

B. ENERGY USE BY NUMBER OF RESIDENTS

Because the resident/patient population at the state hospitals fluctuates daily, it is necessary for the purposes of the study to utilize a constant resident count. An arbitrary date of November 30, 1983, was chosen. This is the census for one given day and does not reflect the average daily population for the entire year.

As can be seen in Table 1, St. Peter State Hospital is the only state hospital to experience an increase (4%) in its resident/patient population, due in part to the stability of the minimum prison population. Fergus Falls (17% decline) and Brainerd (15% decline) experienced the greatest percentage loss in their resident/patient count.

TABLE 1

POPULATION OF MINNESOTA STATE HOSPITALS 1979 - 1983
(Population as of November 30 each year)

	1979	1980	1981	1982	1983	% Change 79-83
Anoka	363	320	319	313	323	-11%
Brainerd	545	519	499	489	463	-15%
Cambridge	532	514	511	507	484	- 9%
Faribault	815	782	784	749	717	-12%
Fergus Falls	569	545	553	549	472	-17%
Moose Lake	469	459	492	509	440	- 6%
St. Peter	560	576	590	620	582	+ 4%
Willmar	578	570	569	589	544	- 6%

Source: Department of Human Services. (1983, January). Factbook: State hospitals and nursing homes. St. Paul: Mental Health Bureau.

The decline in resident/patient population creates increased demands for improved energy efficiencies at each state hospital in order to slow the rise in per resident costs. Table 2 indicates the change in energy use per resident for each state hospital. Anoka State Hospital experienced the greatest decline in energy use per patient (24.5%) with Brainerd State Hospital experiencing a decline of 8.1%. Cambridge State Hospital was at the other extreme with a 62.4% increase in energy consumption per resident. Part of this large increase is due to its lower boiler efficiency as it converted to the use of coal as its heating fuel.

Overall, there was an average decline in energy use per resident of 4.8% during the years of the study.

TABLE 2

MMBTU ENERGY USE PER RESIDENT FY '79 - '83

	1979	1980	1981	1982	1983	% of Change
Anoka	340.3	303.0	276.0	276.1	256.6	- 24.5%
Brainerd[a]	309.0	301.6	298.8	285.2	283.7	- 8.1%
Cambridge[a]	206.7	254.6	336.2	336.6	335.8	+ 62.4%
Faribault[a]	288.1	378.5	424.0	363.4	313.1	+ 8.6%
Fergus Falls	330.5	339.4	348.4	327.0	362.4	+ 9.6%
Moose Lake	173.6	152.2	176.5	161.5	163.8	- 5.6%
St. Peter[a]	232.4	229.4	242.1	212.8	228.7	- 1.5%
Willmar[a]	173.5	177.4	197.0	182.0	178.3	- 2.7%

[a]Cost figures are not adjusted to reflect the extraordinary cost of the regional laundry facilities.

C. ENERGY USE BY SQUARE FOOT/BY DEGREE DAY/BY MMBTU

In Minnesota, with up to 10,000 heating degree days, as compared to 2,000 - 3,000 in southern areas of the country, the climate clearly affects energy consumption. Within the state the annual number of heating degree days varies, and of course, the state hospitals' annual number of degree days vary according to geographic location. The use of degree days combined with energy consumption and square footage permit comparison that accounts for the differences in heating at each state hospital. Table 3 shows the range of degree days among the state hospitals. Moose Lake (9265) and Brainerd (9163) are located in the coldest region of the state whereas St. Peter (7748) and Faribault (7811) are located in the southern part of the state.

TABLE 3
AVERAGE HEATING DEGREE DAYS AT
MINNESOTA STATE HOSPITALS

State Hospital	Average Number of Heating Degree Days
Anoka	8250
Brainerd	9163
Cambridge	8764
Faribault	7811
Fergus Falls	8790
Moose Lake	9265
St. Peter	7748
Willmar	8332

Source: National Oceanic and Atmospheric Administration. (1982). Climatological data of Minnesota. Asheville, North Carolina: National Climatic Center.

An accepted measure for determining the energy efficiency of any facility is the MMBTU/Square Feet/ Degree Day calculation. Table 4 was derived by dividing the amount of annual energy usage of MMBTU's at each state hospital by the number of square feet (at each state hospital), and dividing that number by the heated degree days. In general, the lower the number, the more efficient the energy use.

TABLE 4
MMBTU/SQ. FT./DEGREE DAY OF
MINNESOTA STATE HOSPITALS FY '83

Anoka	.00251
Brainerd	.00173
Cambridge	.00264
Faribault	.00305
Fergus Falls	.00259
Moose Lake	.00157
St. Peter	.00224
Willmar	.00209

Under most circumstances the measurement of energy efficiency as a function of MMBTU/square foot/degree day would be an accurate performance measure; however, there are two major factors which affect the validity of the measure.

First, the Legislature has not authorized funding for energy improvements for the state hospitals which have a payback of more than five years; therefore, those state hospitals which have low unit fuel costs might be prohibited from making improvements which would lower their energy use figures.

Second, the general population decline at the state hospitals has caused some vacancies in part or all of some of the buildings at the state hospitals. However, in order to prevent deterioration many of the buildings continue to be heated.

D. ENERGY USE AND COST BY SQUARE FOOT OF BUILDING SPACE

Comparing the energy use and cost per square foot of building space illustrates the problem of a state hospital having low per unit (e.g. per kwh or MMBTU) energy costs yet has high energy usage.

Fergus Falls State Hospital has the lowest per square foot cost (48 cents) among the state hospitals, but it has the third highest energy use per square foot. This fact is clearly the result of having an extremely low cost for heating and electricity. These low per unit energy costs do not make some energy improvements cost-effective. However, it is possible to draw some conclusions as to the energy management practices of a state hospital. Willmar has both low energy usage (174.88 MMBTU) and low energy costs (79 cents per square foot) and gets the maximum use of its energy for the least amount of money.

Faribault State Hospital, with the highest energy usage per square foot (238.4 MMBTU) and the highest cost per square foot ($1.19) provides an opportunity for additional energy efficiency practices.

Table 5 provides a profile of usage and cost per square foot by state hospital.

E. ENERGY COST AS A PERCENTAGE OF OPERATING COST

The combined annual energy cost for all state hospitals is $13,462,398; however, as large as this figure is, it only represents 3.7% of the annual total operating cost of all the state hospitals. However, the figure represents 35.9% of

TABLE 5

ADJUSTED ENERGY USE AND COST PER SQUARE FOOT
IN MINNESOTA STATE HOSPITALS FY '83

State Hospital	Sq. Ft.[a]	Total MMBTU	Total Cost	Total MMBTU Per Sq. Ft.	Total Cost Per Sq. Ft.
Anoka	368,738	76,468	$397,676	207.37	$1.0780
Brainerd	659,843	105,101	$658,165	159.28	$0.9974
Cambridge	638,937	148,200	$521,165	231.94	$0.8156
Faribault	821,529	195,884	$958,050	238.43	$1.1863
Fergus Falls	759,541	173,454	$364,460	228.36	$0.4790
Moose Lake	497,764	72,408	$481,681	145.46	$0.9670
St. Peter	727,834	126,520	$654,635	173.83	$0.9062
Willmar	508,269	88,889	$404,988	174.88	$0.7962

[a]Square footage figures are adjusted to reflect current use of building space. Total cost and use are adjusted to remove the extraordinary use and cost of the regional laundry facilities.

cost less personnel cost. If the resident/patient populations continue to decline, per resident/patient energy use and cost will rise unless countermeasures are undertaken to curtail energy use and cost. This problem will be compounded as costs continue to rise. The continuing decline in resident/patient population and rise in the price of energy could also cause the cost of energy to rise as a percentage of total operating cost.

Fergus Falls and Willmar have the lowest energy cost as a percentage of operating cost, 2.4% and 2.9%, respectively. Fergus Falls' low cost can be attributed to its very low per unit cost of energy. Willmar's low cost is probably due to energy management practices and the low cost of energy.

Table 6 indicates that St. Peter has the highest energy cost (4.9%) as a portion of total operating cost; however, St. Peter's energy cost as a portion of operating cost less personnel cost drops to the third lowest among all state hospitals (33.5%) following Fergus Falls (24.9%) and Willmar (29.7%). Brainerd, with its energy costs (48.0%) as a portion of operating cost less personnel, has opportunities for energy improvement.

F. ELECTRIC AND FUEL COSTS AT EACH HOSPITAL

The cost for electricity and fuel at each state hospital varies considerably (as shown on Table 7). These costs are a function of the supplier of energy and in most instances are not negotiable (Department of Administration, 1984).

Fergus Falls (01.12 cents) and Willmar (01.66 cents) per kwh have the lowest electrical cost of all state hospitals. They achieved the low cost because they purchase electricity directly from the wholesaler, the Western Area Power Administration.

Moose Lake (6.22 cents) and Cambridge (6.01 cents) per kwh have the highest cost of electricity. Moose Lake buys its electricity from the municipal utility, Moose Lake Water & Light. Cambridge buys its electricity from a local cooperative.

The major differences in fuel price is more a function of the type of fuel than the supplier. Fergus Falls and Cambridge burn soft coal (lignite) as their principal heating fuel source. The cost per MMBTU, $1.96 and $2.40 respectively, are far below the other hospitals. The next least expensive price of fuel for a state hospital is $4.14 per MMBTU for natural gas at Faribault.

TABLE 6

ENERGY COST AS A PERCENTAGE OF OPERATING COST
OF MINNESOTA STATE HOSPITALS FY '83[a]

State Hospital	Total Energy Cost	Total Operating Cost	Percent	Total Operating Cost Less Personnel Cost	Percent
Anoka	$ 397,676	$ 10,663,740	3.7%	$ 1,152,250	34.4%
Brainerd	756,586	17,176,433	4.4%	1,762,489	48.0%
Cambridge	597,958	18,040,825	3.3%	1,649,713	36.2%
Faribault	1,509,753	26,138,824	4.2%	2,537,451	43.4%
Fergus Falls	361,460	15,260,189	2.4%	1,458,718	24.9%
Moose Lake	481,681	12,260,187	3.9%	1,360,122	35.3%
St. Peter	684,657	13,845,891	4.9%	2.037,717	33.5%
Willmar	443,562	15,446,595	2.9%	1,503,938	29.7%
TOTAL	$4,836,333	$128,864,461		$13,462,398	

Average Total Energy Cost of Total Operating Cost = 3.7%.

Average Total Energy Cost of Total Operating Cost Less Personnel Cost = 35.9%

SOURCE: Department of Finance, 1984.

[a]Cost figures are not adjusted to reflect the extraordinary cost of the regional laundry facilities.

TABLE 7

ENERGY UNIT COST AT EACH STATE HOSPITAL FY '83

State Hospital	Energy Use Per Resident in MMBTUs	Energy Cost Per Resident in 1982 $	Electric Rate $ Per Kwh	Fuel Price $ Per MMBTU	Principal Fuel Source
Anoka	257	$ 1,185	$0.0371	$4.40	Natural Gas
Brainerd[a]	227	1,378	0.0540	4.36	Natural Gas
Cambridge[a]	306	1,083	0.0601	2.40	Coal/Natural Gas
Faribault[a]	273	1,365	0.0368	4.14	Natural Gas
Fergus Falls	363	746	0.0112	1.96	Coal
Moose Lake	164	1,057	0.0622	4.98	Natural Gas
St. Peter[a]	229	1,126	0.0399	4.16	Natural Gas
Willmar[a]	163	742	0.0166	4.38	Natural Gas
AVERAGE	248	$ 1,085	$0.0397	$3.85	

SOURCES: Department of Administration, Energy Conservation Division. (1984). Department of Human Services, Mental Health Bureau. (1983). Fact book: State hospitals and nursing homes.

[a]Figures are adjusted to factor out the extraordinary cost of the regional laundry facilities. In addition, use and cost for Faribault were adjusted to reflect some short-term technical difficulties in the provision of steam to the Braille School.

G. ENERGY COST PER RESIDENT/PATIENT

The direct comparison between state hospitals is complicated by many variables affecting the management of energy at the state hospital, e.g. declining resident population; vacated or partially vacated buildings, cost of energy, physical condition of buildings, boiler efficiency, etc. One measure which reflects the ability to manage energy cost and somewhat mitigate the advantages and disadvantages of energy cost and consumption is the cost of energy per resident. The following table is presented in 1982 dollars because of the inflation rate.

TABLE 8

ENERGY COST PER RESIDENT AT EACH MINNESOTA STATE HOSPITAL FY '83

State Hospital	Energy Cost Per Resident (1982 $)	State Hospital	Energy Cost Per Resident (1982 $)
Willmar[a]	$ 742	St. Peter[a]	$1,126
Fergus Falls	$ 746	Anoka	$1,185
Moose Lake	$1,057	Faribault[a]	$1,365
Cambridge[a]	$1,083	Brainerd[a]	$1,378

[a]Extraordinary cost and use for the regional laundry facilities have been factored out.

As can be seen in Table 8, Willmar ($742) and Fergus Falls ($746) operated as the least expensive state hospitals on a per resident/patient basis. Fergus Falls benefits greatly by utilizing the cheapest fuel, soft coal, and electricity which is purchased at a wholesale rate from the Western Area Power Administration. This inexpensive fuel has caused Fergus Falls to be somewhat inefficient in its fuel use. Because the fuel and electric cost are so cheap, it is not cost-efficient to retrofit the physical facilities there. Willmar also benefits from inexpensive electricity it purchases from the Western Area Power Administration. However, like most state hospi- tals, it uses more expensive natural gas for heating and nonheating use. Willmar has managed to use the least amount of energy per resident/patient. This fact causes Willmar to have the lowest energy cost per resident/patient of all state hospitals.

Brainerd ($1,378) and Faribault ($1,365) are at the other extreme with their per resident/patient costs being nearly

twice that of Willmar and Fergus Falls. Brainerd and Faribault have had substantial decline in population over the past five years, 15% and 12% respectively. This, combined with their relatively inefficient boilers, (72% and 70%), could be a major reason for their high per resident/patient energy cost.

H. ENERGY IMPROVEMENTS

Energy use in Minnesota's state hospitals during the last five years has been marked by rapidly rising fuel prices and attempts to shift to lower price fuel sources. The average price of natural gas, the main source of energy for heating and other nonelectrical energy needs, has increased 55% in real dollars from FY '79 through FY '83 (Department of Administration, 1984). The average price of electricity has increased 37% in real dollars during the same five-year period.

Several state hospitals have moderated the price increases with reduced use of fuel oil, which is often required as a backup to interruptable natural gas service. Faribault in particular reduced its fuel oil use from 58% of nonelectrical energy needs in 1979 to no use in 1983. Cambridge converted almost entirely to coal before the 1981 heating season.

The conversions at Faribault and Cambridge were accompanied by equipment problems that lowered the combustion efficiency of their boilers significantly. Although this problem was short-lived, the energy use at these two state hospitals rose sharply. However, their conversion to cheaper fuels still helped moderate energy costs at the state hospitals.

Currently two state hospitals are making more efforts to increase their energy efficiency. St. Peter, via a legislative authorization is in the process of installing a summer boiler. This smaller boiler should reduce energy consumption and lower energy cost. Brainerd is currently negotiating a shared savings contract with Honeywell, Inc. The contract would call for the installation of a wood gas generator, an automated energy control system, and repair and replacement of steam traps and pneumatic controls.

Table 9 highlights the amount of funds expended for energy improvements at each of the hospitals (Ellerbe Associates, Inc., 1978, 1979a, 1979b); (Michaus, Cooley, Hallberg, Erickson & Associates, 1978); (Oftedahl, Locke, Broadston & Associates, 1979); (Orr-Schelen-Mayerson & Associates, 1979); (Sam Stewart & Associates and Ann Pawlak & Associates, 1979). The improvements were recommended in each of the maxi-energy audits of the state hospitals.

TABLE 9

ENERGY IMPROVEMENTS COMPLETED AT MINNESOTA STATE HOSPITALS
(1979 to 1983)

	Actual Cost (Thousands)	Estimated Savings To Date (Thousands)	$ Cost Per Sq. Ft.	$ Savings Per Sq. Ft.
Anoka	$300.1	$125.0	0.45	0.19
Brainerd	$273.4	$ 90.0	0.48	0.16
Cambridge	$ 69.8	$ 61.0	0.08	0.07
Faribault	$634.6	$340.0	0.87	0.47
Fergus Falls	$601.7	$143.0	1.28	0.30
Moose Lake	$224.5	$121.0	0.29	0.16
St. Peter	$208.9	$ 68.0	0.39	0.13
Willmar	$111.6	$ 47.0	0.11	0.05

Note: These figures include all energy improvements identified in maxi audits for each state hospital and funded by the Department of Administration. Funding was provided for all projects with a payback of less than five years.

IV. SUMMARY

- Minnesota State Hospitals, like everyone else, have faced rising energy prices for the period 1979 - 1983. Natural gas increased 55% in real dollars during the period and electricity increased 37% in real dollars.

- The overall energy use at all state hospitals declined 6% over the five year period; however, energy use per resident/patient increased 12%.

- Total energy cost for the state hospitals increased 25%, but because of declining populations and having to heat buildings where there are no or a few patient/residents, the individual cost per resident/patient increased 49%.

- Energy costs represent 3.7% of all operating cost and 36% of operating cost less personnel cost among all state hospitals.

- All state hospitals spent $4,836,338 in FY '83 for energy costs. Faribault State Hospital's expenditure was $1,109,753.

- Based upon annual energy cost per resident/patient, Willmar ($742) and Fergus Falls ($746) were the lowest among all state hospitals. The average for all state hospitals was $1,085.

- Based upon annual per resident energy use Willmar (163 MMBTU and Moose Lake (164 MMBTU) utilized the least amount of energy. The average for all state hospitals 248 MMBTU.

- The cost of electricity varied considerably from state hospital to state hospital. Fergus Falls paid the least amount, at 1.112 cents per kwh, and Moose Lake the most, at 6.22 cents per kwh. The average was 3.97 cents per kwh.

- The fuel price at each hospital varied from $1.96 per MMBTU at Fergus Falls to $4.98 per MMBTU at Moose Lake. The average was $3.85 per MMBTU.

- The average energy cost per square foot was $0.903. Fergus Falls had the lowest cost per square foot at $0.479 and Faribault the highest at $1.186.

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The 1984 Legislature mandated that a study and plan for Minnesota State Hospitals be prepared (Chapter 654, Section 19).

An Institutional Care and Economic Impact Planning Board was created composed of the following state agency heads: Sister Mary Madonna Ashton, Dept. of Health; Barbara Beerhalter, Dept. of Economic Security; Gus Donhowe, Dept. of Finance; Bill Gregg, Dept. of Veterans Affairs; Sandra Hale, Dept. of Administration; Leonard Levine, Dept. of Human Services; Orville Pung, Dept. of Corrections; David Reed, Dept. of Energy & Economic Development; Nina Rothchild, Dept. of Employee Relations; James Solem, Housing Finance Agency; and Tom Triplett, Chair, State Planning Agency.

Responsibility for the studies was given to the Developmental Disabilities Program/Council of the State Planning Agency.

Eight technical papers have been prepared to respond to the legislative requirements. This paper may be cited:

State Planning Agency. (1985, January). Policy Analysis Series Paper No. 2: Minnesota State Hospital energy use and cost. St. Paul, MN: Developmental Disabilities Program, State Planning Agency.

"Residents" refer to people with mental retardation who live in state hospitals.

"Patients" refer to people with mental illness and people with chemical dependency who receive services at the state hospitals.

Additional free copies of reports or information about this project can be received from:

Developmental Disabilities Program
State Planning Agency
201 Capitol Square Building
550 Cedar St.
St. Paul, MN 55101
612-296-4018