Submitted by: John L. Davis, Vice President of Finance and Facilities Management

CAMPUS STEAM BOILERS PROJECT

Recommendations

It is recommended that the Board of Governors authorize the President or his designee to design, solicit bids, and award contracts to construct new boiler plants that will serve 50 buildings at various locations across campus, including the Michigan Center for High Technology, for an amount not to exceed $43,000,000 plus an estimated $3,245,500 for bond issuance costs and capitalized interest. Funding for this project will be provided from the sale of 2005 Series general revenue bonds to be recommended and approved during the summer of 2005. The annual debt service on the bonds for this project will be paid from annual cost savings realized from the project in the general fund and applicable auxiliary fund accounts for utilities.

Background

The University's utility costs have increased substantially since June 2002, with the majority of the increase attributed to the cost of purchasing steam. From Fiscal Year 2002 (FY02) to Fiscal Year 2003 (FY03), the University experienced a $4.3 million increase in general fund steam costs. This represented an increase of 145 percent for this period.. Average annual steam rates have increased from $7.43 per thousand pounds of steam (Mlb) in FY02 to $18.69/Mlb in FY03 and $20.81/Mlb in FY04. For FY05, the year-to-date rate as of January 31, 2005 is $24.87/Mlb. Through a court order, the University and Detroit Thermal LLC, the current owner and operator of the district steam system, have agreed to a flat interim rate of $18.50/Mlb until the Michigan Public Service Commission (MPSC) rules on a new tariff for Detroit Thermal. This interim rate is retroactive to January 2003 when Detroit Thermal took ownership of the system from Detroit Edison. Once the new tariff is established, the difference between the interim rate and the invoiced rate will be reconciled. The new tariff will have a component to adjust for the monthly variation for more volatile costs including natural gas, electricity, and water. There are a number of factors that have had an impact on the increase in steam costs, including inefficiencies in the steam plant and related distribution system, the expiration of our 10-year contract with Detroit Edison in late 2002, and unsuccessful negotiations with the new district steam owners, Detroit Thermal LLC.

These conditions caused the University to commission an engineering study to evaluate the conversion of campus buildings currently purchasing steam from Detroit Thermal to self-generating steam production systems. The study, conducted by DiClemente Siegel Design, inc., concluded that the conversion of existing buildings on the district steam system to self-generating natural gas steam boiler plant facilities is both feasible, and the best economic solution for the university. Attached are copies of the Executive Summary and Overview of Recommended Project from the study report.

Submitted by: John L. Davis, Vice President of Finance and Facilities Management

Project Description

The proposed project will install a combination of cluster and individual boiler plants to serve 50 University owned or operated buildings for which steam is purchased from Detroit Thermal, including the Michigan Center for High Technology (MCHT) building at 2727 Second Avenue. MCHT is included in the project due to the significant research operations that the University has in this building, and our intentions to keep these programs at this location over the long-term. Cluster plants will be designed to provide steam to a group of three to five buildings in the immediately surrounding area. Individual plants will satisfy the steam loads of some single buildings. Boiler plant installations will occur in either existing mechanical rooms, newly constructed penthouse boiler rooms on existing buildings, or in newly constructed on grade boiler rooms adjacent to existing buildings. An upgrade to the MichCon gas main serving the University is also included in this project. Each plant location was evaluated based on space availability, proximity to utility services, ease of access, disruption to campus life and cost.

A 30-year, discounted cash flow economic analysis was conducted and considered several variables as listed below.

1. Total project capital cost.
2. Individual building energy consumption.
3. Utility rates (natural gas, steam, electricity, water and sewer).
4. Utility rate escalation and general inflation.
5. Current labor costs for building engineers.
6. Additional labor to operate and maintain the new boiler installations.

Future and present value costs and savings, along with simply payback period information is provided in the attached Executive Summary and Overview of Recommended Project from the study report. The values presented are based on several initial assumptions regarding future utility costs, and are tested by way of three separate sensitivity analyses. For purposes of this project recommendation, utility costs have been modified with respect to the study assumptions to reflect an improved understanding of current conditions and to introduce more conservative assumptions relative to future utility prices. The current economic analysis is summarized in the following paragraph and on the attached table titled Self Generating Cash Flow.

As shown on the attached table, using steam consumption figures from FY03, the projected costs savings to the University for this project are expected to be $75.12 million over 30 years. This represents a present value savings of approximately $22.74 million, with a simple payback achieved in 11.28 years. The projected purchased steam rates used to derive these values include the loss of the current Detroit Edison subsidy for steam to Detroit Thermal that is delivered from the Greater Detroit Resource Recovery Authority (GDRRA). As part of the purchase agreement for the steam system between Detroit Edison and Detroit Thermal, Detroit Edison purchases steam from

GDRRA at rates ranging from $12/Mlb to $13/Mlb and resells that steam to Detroit Thermal for $6.00/Mlb. This subsidy continues through 2008. It is anticipated that this subsidy will be discontinued thereafter causing the cost of GDRRA steam to Detroit Thermal to increase to market rates. Approximately 60% of DT's steam is delivered by GDRRA. After 2008, the projected savings for this project is $707,000 annually after debt service. This savings will increase each year over the life of the project. The boiler plants have an expected life of over 30 years. These values include cost projections for major maintenance of equipment every ten years.

Finally, with respect to the development of the University's future utility budgets, it is important to note that while this project will produce cost savings, expenditures for related energy will continue to increase. For the 50 buildings identified for this project, purchased steam prices for 2005 are estimated at $6,959,000. If we do not move forward with self-generation of steam, and instead continue to purchase steam for these buildings, we can expect costs to rise dramatically in 2009, after the discontinuation of the GDRRA subsidy. We estimate that the purchased steam expenditures in 2009 would rise to an estimated $8,566,000. Even with self-generation, energy costs will continue to increase. However, implementation of this project will slow or reduce the rate of increase in related energy costs.

All contracts will be awarded in compliance with University policies and procedures, including affirmative action.

Self Generating Cash Flow

Net Savings after Debt Service

Years	Purchased Steam	Self Generating (inclg. Labor, Maintenance & Utilities)			Net Period Savings
	Operating Cost Period Total	Operating Cost Period Total	Gross Period Savings	Debt Service (for Capital Costs)	
2005 - 2010	45,540,285	32,736,402	12,803,883	10,885,000	1,918,883
2011 - 2015	48,249,905	27,650,087	20,599,818	14,750,000	5,849,818
2016 - 2020	55,934,864	32,054,029	23,880,835	14,750,000	9,130,835
2021 - 2025	64,843,838	37,159,405	27,684,433	14,750,000	12,934,433
2026 -2030	75,171,780	43,077,935	32,093,845	14,750,000	17,343,845
2031 - 2036	106,167,993	60,525,966	45,642,028	17,700,000	27,942,028
Total	**395,908,665**	**233,203,823**	**162,704,842**	**87,585,000**	**75,119,842**

Future Value versus Present Value

Term 30 Years	Purchased Steam	Self Generating	Net Savings
	Operating Cost Cumulative Total	Operating Cost + Debt Service = Cumulative Total (233,203,823 + 87,585,000 = 320,788,823)	
Future Value	395,908,665	320,788,823	75,119,842
Present Value	**149,311,462**	**126,837,749**	**22,473,713**

EXECUTIVE SUMMARY & OVERVIEW OF RECOMMENDED PROJECT

EXECUTIVE SUMMARY

Wayne State University's (WSU) utility costs have increased substantially since June 2002. The majority of the cost increase can be attributed to purchased steam. From Fiscal Year 2002 (FY02) to Fiscal Year 2003 (FY03), WSU experienced a $4.3 million increase in general fund purchased steam costs. This represented an increase of 145 percent from FY02 to FY03. Average annual purchased steam rates have increased from $7.43 per thousand pounds of steam (Mlb) in FY02 to $18.69 /Mlb in FY03 and $20.81/Mlb in FY04. For FY05 the year to date rate as of January 31, 2005 is $24.87/Mlb. Through a court order, WSU and Detroit Thermal LLC, the current owner and operator of the district steam system, have agreed to an interim flat rate of $18.50/ Mlb until the Michigan Public Service Commission (MPSC) rules on a new tariff for Detroit Thermal. This interim rate is retroactive to January 2003 when Detroit Thermal took ownership of the system from Detroit Edison. Once the new tariff is established, the difference between the interim rate and the invoiced rate will be reconciled. The new tariff is likely to have a component to adjust for the monthly variation in more volatile costs including natural gas prices, electricity and water. The expiration of a 10 year contract, inefficient district steam generating and distribution systems, and unsuccessful negotiations with the new district steam owners are factors that have influenced the increase steam costs.

In June of 2004, WSU commissioned DiClemente Siegel Design Inc. (DSD) to complete an evaluation for the conversion of all campus buildings from steam purchased from Detroit Thermal to self generated steam production systems. Various energy types, delivery methods and physical plant types were investigated.

Conclusions

As a result of the study, it was concluded that the conversion of the existing buildings on the district steam system to self generating steam boiler plant facilities is the best economic solution for WSU and would require a capital investment of $42 million. This conversion could be completed in less than two years. A 30 year cash flow analysis (see Section VI), based on steam load profiles from Fiscal Year 2003 (FY03) and utility rates assumptions that were appropriate in July 2004, indicated a future savings of $122.3 million and a present value savings of $41 million (6% discount rate). See Section VI for a sensibility analysis which modify the assumptions originally developed. This analysis included the capitalized interest of $3.04 million during the construction period. The simple payback is 8.9 years. The simple payback is the point at which the cumulative savings equal the total cost of the conversion project. It is measured from the first full year all plants are projected to be on line (2007) and going forward from that point.

The projected first year steam costs after conversion to self generation would be $10.28/Mlb compared to a projected $21.00/Mlb for the district steam system, a 51 percent reduction. These costs for self generation of steam are per thousand pounds (Mlb) and include labor and maintenance costs. The first full year (2008) of self generation after capitalized interest would yield $4.17 million in projected savings before debt service and $1.41 million in savings after debt service. The annual steam consumption used in this study is 362,995 Mlb, accounts for usage reductions already implemented by the University.

The study investigated forty-nine buildings that are currently on the district steam system. Fifty-one other WSU buildings are already benefiting from lower cost self generated steam. Coal, fuel oil, solar, wind and natural gas were energy types that were evaluated. Natural gas proved to be the most economical. Various physical plant type configurations were also evaluated. These included central plant, cogeneration plant (producing electricity and utilizing waste heat to produce steam), cluster plants (one plant serving 3-5 buildings in the immediate area) and individual plants, serving single building loads.

For the purpose of this study, the main campus is defined as being bounded by Cass, Warren, Anthony Wayne and Palmer. The central plant configuration and cogeneration plant option did not prove to be economically and technically feasible. Even if the central plant was economically viable, it would only provide 134,087 Mlb to buildings on the main campus of the total 362,995 Mlb required by the conversion from the district steam system. The remainder of the buildings would have to be cluster and individual plants due to their diverse locations. Additionally, there would be a very significant disruption impact to the main campus due to the need to install an estimated four thousand (4,000) feet of steam and condensate through the pedestrian malls. The central plant was estimated to cost $5.8 million more than a combination of cluster and individual plants. The cogeneration plant was estimated to cost an additional $8 million more than the central plant. Solar and wind energy proved not to be viable. The lack of consistent sunlight, the large amount of area required for solar collectors, cost, batteries for energy storage and then the conversion of electrical energy to steam did not proved to be feasible. Wind energy did not proved to be feasible for similar reasons.

A combination of cluster and individual plants with natural gas fired boilers proved to be the most feasible. Proposed boiler plant installations would occur in either existing mechanical rooms, newly constructed penthouse boiler rooms on existing buildings or in newly constructed on grade boiler rooms adjacent to existing buildings.

The conceptual design package included in this report provides sketches, pricing, economic evaluations and construction schedules for the creation of self generating plants located on WSU's campus. Each plant location was evaluated based on space availability, proximity to utility services, ease of access, disruption to campus life and cost. These plants have a projected life of over 30 years. Specific locations for each plant are also included in this report.

An economic analysis was performed based on data received from WSU at the start of the study in July 2004, and included, individual building energy consumption, utility rates (natural gas, steam, electricity, water and sewer), utility rate escalation during the study period, general inflation rate, and WSU labor costs for building engineers. DSD also included costs associated with lead paint monitoring, asbestos abatement, and utility service upgrades (gas and electric) necessary for the implementation of the campus building steam system conversion based on input from the WSU staff and DTE Energy. Additional labor to maintain these new boiler installations was also included in the analysis.

The economic analysis of the recommended alternate indicated that WSU will expend, over the next 30 years, a projected cumulative total cost of $380.4 million for the purchased steam service provided from the district steam system. If WSU constructs its own self generating steam system, at a probable project cost of $42 million, the projected 30 year cumulative total cost for self generation with debt service is $258.0 million. Therefore the projected cumulative net cost avoidance (savings) after servicing the debt is $122.3 million.

Because utility rates used in this analysis were based on costs developed by WSU in 2004 and confirmed to DSD on July 16, 2004, and revised July 26, 2004, a sensitivity analysis (see Section VI) was performed to explore the impact of natural gas rates increasing as well as the impact if capital costs were to increase.

Sensitivity Analysis				
Criteria & Assumptions	**Original Study**	**10% Increase Capital Only**	**Increase Natural Gas Only**	**Increase Capital and Nat. Gas**
Capital Cost	$42 Million	**46.2 Million**	$42 Million	**46.2 Million**
Natural Gas Rates	NA	NA	**25%**	**25%**
Simple Payback	8.9 Years	9.7 Years	12.2 Years	13.2 Years
30 Year Future Savings	**$122,340,789**	**$114,148,090**	**$56,655,383**	**$48,462,684**
Present Value	**$41,040,926**	**$37,730,873**	**$17,514,086**	**$14,204,033**

In the first sensitivity analysis, only the capital cost was increased. A ten per cent increase was assumed. The projected future savings changed to $144.1 million, present value to $37.7 million and the simple payback to 9.7 years.

Next, only the natural gas rates were modified and increased by twenty-five percent in the first year. All other variables were kept constant. It should be noted that as natural gas rates increase, they will directly affect the Detroit Thermal's steam rates. The purchased steam rates **were not** changed in this scenario. This presents a very conservative approach. In this scenario, the projected future savings changed to $56.7 million, present value to $17.5 million and the simple payback to 12.2 years.

The last scenario changed both the capital cost and natural gas rates. This represents a combination of the first two scenarios. The projected future savings changed to $48.5 million, present value to $14.2 million and simple payback to 13.2 years.

Note that all sensitivity analysis scenarios presented positive present value savings and acceptable payback periods.

Recommendations

DSD recommends implementation of the independent steam generating plants for the WSU's buildings included in this study for an approximate project cost of $42,000,000.

This study recommends for the forty-nine buildings included in the study, the installation of natural gas fired boilers in twenty (20) individual buildings and eight (8) clusters comprised of three (3) or more buildings. Residence and science building structures have been provided with the mandatory design for redundant boilers sized to provide 100% capacity even with the failure of one (1) boiler. The remaining buildings have been provided with multiple boilers sized for a minimum of 50% total capacity if one boiler would fail. To maximize reliability, connections at the residence and science building exterior have been included for portable generators to provide electrical power to operate the heating plants during utility power outages.

DSD recommends that bid documents be prepared to allow WSU to receive bids on eight (8) groupings of boiler installations:

- four (4) groups of individual buildings, each worth approximately $4,800,000, and include the installation of boilers in 3 to 6 individual buildings per group

- four (4) groups of cluster buildings, each worth approximately $4,300,000 and include the installation of boilers for two (2) clusters per group

It is anticipated that the complete project can be operational in 500 days, which includes design and construction. However, the individual buildings will come on line prior to the clusters, in approximately 300 days, thereby reducing the district steam consumption by approximately 200,000 Mlb. at the end of the first year after the project starts.

OVERVIEW OF RECOMMENDED PROJECT

Introduction

For the purpose of this study, the main campus is defined by the area bounded by Cass, Warren, Anthony Wayne and Palmer. Wayne State University (WSU), at present, purchases steam from Detroit Thermal, LLC, for many of its buildings. Forty-nine (49) buildings on the WSU campus are included in this study. These buildings represent an annual consumption of 362,995 thousand pounds (Mlbs) of steam.

The cost of this purchased steam has increased significantly and the implementation of this proposed project will assist WSU to mitigate the impact of these increases.

The intent of this study was to provide WSU with the information needed to make an informed decision as to whether it should modify its steam procurement practices and self generate steam instead.

Energy Types Evaluated

This study investigated various energy types, including wind, solar, coal, fuel oil, and natural gas.

Wind—Wind energy conversion can produce a virtual inexhaustible source of energy. However, it is a market that has never fully emerged. Wind can only satisfy the electrical requirements and not the thermal consumption issue. The effectiveness of wind conversion is based on how much wind energy is available at the site. The US Department of Energy created a wind resource assessment of the United States, which determined that the Detroit area is a wind power class 2 source. Generally, areas designated wind power class 4 or greater are suitable for most utility-scale wind farm applications. In order to provide the necessary electrical power to light a 200,000 Sq.Ft. classroom facility, a pair of wind turbine generators approximately 13 stories high (160 ft) with three variable pitch blades, over 10 stories high, would be required. Additionally, connection to the commercial electrical utility would be required for periods when wind power is not available and would be charged at a higher standby rate.

Positive features for Wind Power:

- Wind is free if available

Negative features for Wind Power

- Limited to a few areas of the US.
- Need 3X the amount of installed generation to meet demand due to intermittent (unpredictable) operation
- Equipment is expensive to maintain
- Need expensive energy storage (batteries)
- Highly climate dependant
- Requires 10 to 80 acres of land per megawatt generated (wide spacing to avoid wake effect between towers)
- Peak demand for electricity and peak wind speeds do not always coincide
- Create considerable noise, vibration, land use, and visual impact
- Steam production is not direct. Must convert electrical energy into steam

Economics and various disadvantages caused this option to be rejected.

Solar or Photovoltaic Energy--- The sun is a renewable source of energy. Solar heating, solar water heating, photovoltaic energy, and solar thermal electric power are all systems that use the sun to create energy. However this source is intermittent needing sunlight to create this energy and is economically impractical due to the size of collection systems needed and the percentage (32%) of Detroit sunshine availability. In order to provide the necessary electrical power to **light** a 200,000 Sq.Ft. classroom facility, approximately 28,500 solar panels requiring a surface area of approximately **8.7 acres**, would be required. Battery storage space required to convert the solar power to electrical power and to support lighting during non-sunlight times would require approximately 40,000 Sq.Ft of conditioned/ventilated space. Additionally, connection to the commercial electrical utility would be required for periods when demand exceeds the available stored power and would be charged at a higher standby rate.

Positive features for Solar Power:

- Sunlight is free if available

Negative features for Solar Power

- Limited to southern areas of the US.
- Current technology requires large amounts of land for small amounts of energy
- Technology is expensive
- Requires backup power from electrical utility
- Need expensive energy storage (batteries)
- Steam production is not direct. Must convert electrical energy into steam

Economics and various disadvantages caused this option to be rejected.

Coal---- Coal is a plentiful fuel for creating energy. The United States has nearly 275 billion short tons of coal available to mine. During 2000, 1.08 billion short tons of coal were consumed by the United States. Current environmental emission regulations, negative aesthetic aspects as to location within the city and campus area, complex coal delivery and storage problems as well as coal preparation, and ash disposal eliminates this concept from further consideration. The annual energy consumption for the main campus area is approximately 134,087 Mlb of steam per year. A coal plant to meet the main campus steam demand would burn approximately 56 tons of coal per day, an amount that requires a delivery of one (1) railroad car of coal every other day.

Positive features for Coal:

- As raw material coal is inexpensive
- Available (in US, China, India, and Russia)

Negative features for Coal:

- High capital and operating cost due to the requirements of additional monitoring, testing, reporting and waste disposal
- Requires expensive air pollution controls

- Higher regulated emissions with this fuel type
- Difficulty in obtaining the necessary permits
- Significant contributor to acid rain and global warming
- During winter months requires heating to separate frozen coal
- Requires extensive transportation system
- Requires additional land for storage
- Would only be applicable to central plant configurations

Economics and various disadvantages caused this option to be rejected.

Fuel Oil – Fuel oil cost is directly dependant on the cost of crude oil. Over the last several years, the cost of crude oil has risen significantly and is currently over $50 a barrel. The supply of this commodity is increasingly dependant on foreign supplies. Domestic production is decreasing as oil wells mature. All this has produced a great deal of volatility in the market pricing of fuel oil. Each site or application would require its own fuel storage tank, typically located underground. This would require additional space as well as a permit for the underground tank. Emissions permits are also required. Emissions are higher with fuel oil and they contribute to acid rain.

Positive features for Fuel Oil:

- None

Negative features for Fuel Oil:

- Requires expensive air pollution controls
- Higher emissions with this fuel type
- Difficulty in obtaining the necessary permits
- Significant contributor to acid rain and global warming
- Requires additional underground space for storage tanks
- Permit required for underground tanks

Economics and various disadvantages caused this option to be rejected.

Natural Gas – Natural gas is currently used in approximately half of WSU buildings and is recommended as the fuel to use in support of continued self generation steam. Despite price increases experienced during the past several years, natural gas has historically been the most economic fuel type in this region of the US. Domestic natural gas production is experiencing a decline. Shortfalls are being met by imports. Liquefied natural gas (LNG) plants are being considered on both the east and west coasts to accommodate the transportation of liquefied natural gas from offshore countries. Drilling in the Artic National Wildlife Refuge (ANWR) has recently been approved. Until these measures are implemented, some volatility will remain in natural gas pricing. Even with all of these variables, natural gas is still the best option for WSU and its steam plants.

To support natural gas consumption caused by the proposed self generation steam plants, DTE has proposed an upgrade to our distribution network. Cost for this upgrade is included in the project budget.

Positive features for Natural Gas:

- Less expensive when compared to the other energy types
- Currently being used on campus
- Existing infrastructure in place, only requiring upgrading
- No onsite storage required
- Available 24 hours a day, 365 days a year
- Least amount of emissions compared to fossil fuels

Negative features for Natural Gas:

- None

DSD recommends **natural gas** as the energy type to be used for its proposed steam plants.

Physical Plant Types

For the purpose of this study, the main campus is defined by the area bounded by Cass, Warren, Anthony Wayne and Palmer. Physical plant types were also investigated for the most feasible application. They included: central plant for the main campus; cogeneration plant for the main campus; cluster plants serving three to five buildings in the immediate area; and individual plants to serve just one building.

Central Plant

A central plant location, in order to achieve economic efficiency, needs to be in the center of the main campus area. The only viable location was the courtyard by the intersection of Gullen Mall and Williams Mall. In order to "fit" with the campus master plan, a below grade structure was the only acceptable solution. The disruption impact of the construction of a below grade structure in the center of campus as well as the below grade steam or heating hot water distribution system feeding all buildings was impracticable. Four thousand (4,000) feet of insulated steam and condensate lines would have to be installed below grade, looping and encircling the main campus. The disruption and confusion to student traffic flow from barricaded construction areas would be significant and could cause a major concern to WSU. The capital cost proved to be $5.8 million more than cluster and individual plants. See Section 5 for details regarding the central plant assumptions. This option was rejected for these reasons.

On-Site Cogeneration

DSD does not recommend on-site electrical generation with heat recovery as an option to the cluster and individual plants.

A proposed system of on-site electrical generation with heat recovery sized to handle either the electrical consumption of the campus or the steam consumption of the campus or shaving peak demand operation does not provide the necessary economic, operational, maintenance, and reliability factors for consideration. The cogeneration option is $5 million more than the central plant. This is based on a proposed 2,260 KW electric and 150,000 Mlbs steam cogeneration system, which would serve only the main campus, and would result in a simple payback of between 18 to 20 years.

Cluster & Individual Plants

DSD investigated the application of each of these plant types. Potential location for the boiler plants were thoroughly analyzed for mechanical, electrical and structural requirements. The grouping and potential location were also scrutinized. Suggested clusters were recommended after DSD concluded that these were feasible applications. Cluster and individual plants for the main campus are the most economical solution. The other buildings not on the main campus are a combination of cluster and individual plants.

The forty-nine (49) buildings included in this study represented a wide geographic dispersion of building locations. Evaluating a site plan, the selection became obvious for buildings to be considered as individual or clusters to provide the best economic configuration. The following buildings were selected for **individual steam plant** design.

- 6050 Cass (203) **b**
- Engineering Building (090) **a**
- Music North Building (141) **b**
- Shapero Hall (050) **a**
- Education Building (140) **d**
- Matthaei Building (080) **c**
- Manoogian Hall (155) **a**
- Old Main (001) **c**
- Thompson Home (504) **b**
- Music Annex (041) **b**
- University Tower (507) **c**
- Bonstelle Theatre (620) **b**
- Elliman Research Building (629) **a**
- C.S. Mott (609) **a**
- 110 E. Warren (637) **b**
- Rackham Memorial Building (499) **c**
- 5057 Woodward (071) **c**
- Beecher House (064) **b**
- University Services Building (060) **a**
- Simons Building (068) **b**

a) Roof mounted boilers enclosed within fabricated penthouse.
b) Boilers located within existing mechanical room within building
c) Boilers located in new grade level mechanical room
d) Boilers located in an expanded mechanical room

The following buildings were considered ideal for grouping or **clusters** with steam service from a single plant located within the cluster.

Cluster "A" **a**
- Science Hall (005)
- Life Science (006)
- Chemistry (007)
- Science & Engineering Library (008)

Cluster "B" **b**
- State Hall (016)
- Prentis Building (022)
- Helen DeRoy Auditorium (023)

Cluster "C" **a**
- Recreation & Fitness Center (025)
- G. Flint Purdy Library (026)
- Kresge Library (027)
- Reuther Labor Library (036)

Cluster "D" **a**
- Schaver Music Building (038)
- Community Arts Building (039)
- Art Building (040)
- McGregor Conf. Center (043)
- Alumni House (042)

Cluster "E" **a**
- Richard Cohn Building (048)
- Law Library (046)
- Law School (049)
- Law Classroom Building (053)

Cluster "F" **c**
- Mortuary Science Building (065) (5439 Woodward)
- Old Woodward MHCC (066) (5435 Woodward)
- Bowen House (067) (5425 Woodward)

Cluster "G" **c**
- Knapp Building (509)
- Skillman Building (510)
- Freer House (511)

Cluster "H" **a**
- Manufacturing Engineering Building (166)
- Engineering Technology (167)
- Bio Engineering (169)

a) Roof mounted boilers enclosed within fabricated penthouse.

b) Boilers located within existing mechanical room

c) Boilers located in new grade level mechanical room

See Sections 3 and 4 for the detailed assumptions for this option.

Boiler System Design & Reliability

Residence and Research/Laboratory buildings have been designed with a standby boiler such that with a failure of any single boiler, the remaining boilers will provide 100% of the building load capacity. This provides a complete redundant system in case of a failure of any one (1) operating boiler.

Non-residence and non-research buildings, where practical, have been provided with a design of multiple boilers each sized for a minimum of 50% of the building capacity. Even if one boiler were to fail, the remaining boiler would provide heat to the building up to 50% capacity. This scenario will provide some heat and prevent the building from freezing.

As an additional reliability feature, research buildings have been provided with a manual transfer switch and power receptacle for connection to a portable generator to serve boilers and auxiliary equipment in the event of an outage of normal power.

Chiller Replacement Considerations:

Wayne State University is proceeding with a program to replace existing aged chillers. Current study buildings with chillers scheduled for or having been recently replaced include Manoogian Hall, Reuther Library, Hillberry Theatre, and Mott Center. Manoogian Hall and Mott Center have both installed new electric centrifugals chillers to replace old steam absorbers (chillers) and Reuther Library’s current design is based on an electric centrifugal located in the Purdy Library basement. The trend of replacing with electric centrifugal chiller in lieu of steam absorption should continue.

Economic Criteria

Wayne State University provided the following data on July 16, 2004 and revised on July 26, 2004 to be used in preparing the economic analysis of the heating plant options.

These rates were established prior to settlement of the rate case currently under consideration by the Michigan Public Service Commission (MPSC) for Detroit Thermal, LLC. The utility rates should be adjusted based on the final settlement. The ruling on the rate case by the MPSC is expected in early 2005. Pricing differences, based on current utility rates, will occur but the basic results of the study and underlying analysis will not change.

Study Assumptions

Building Steam Consumption –2003 steam account with total usage at 362,995 Mlbs for the forty-nine (49) buildings included in this study.

Rate of Inflation – 3%.

Electric Rate – Bundled D6 rates, increased by 4% in 2004, and then increased at the rate of inflation thereafter.

Natural Gas - $6.30/MCF flat until 2011, then increase at the rate of inflation. At the commencement of the study, natural gas futures on the New York Mercantile Exchange (NYMEX) indicated the rates to be flat for this period.

Purchased Steam - $18.00/Mlb for 2005, $19.00/Mlb for 2006, $21.00/Mlb for 2007, and then increased at the rate of inflation thereafter

Water/Sewer - $3.35/CCF, escalated 5% per year plus rate of inflation.

Operating Engineers - $37.39/hr, FY05 with fringe benefits for second class engineer, then escalated at rate of inflation.

Discount Rate – 6%

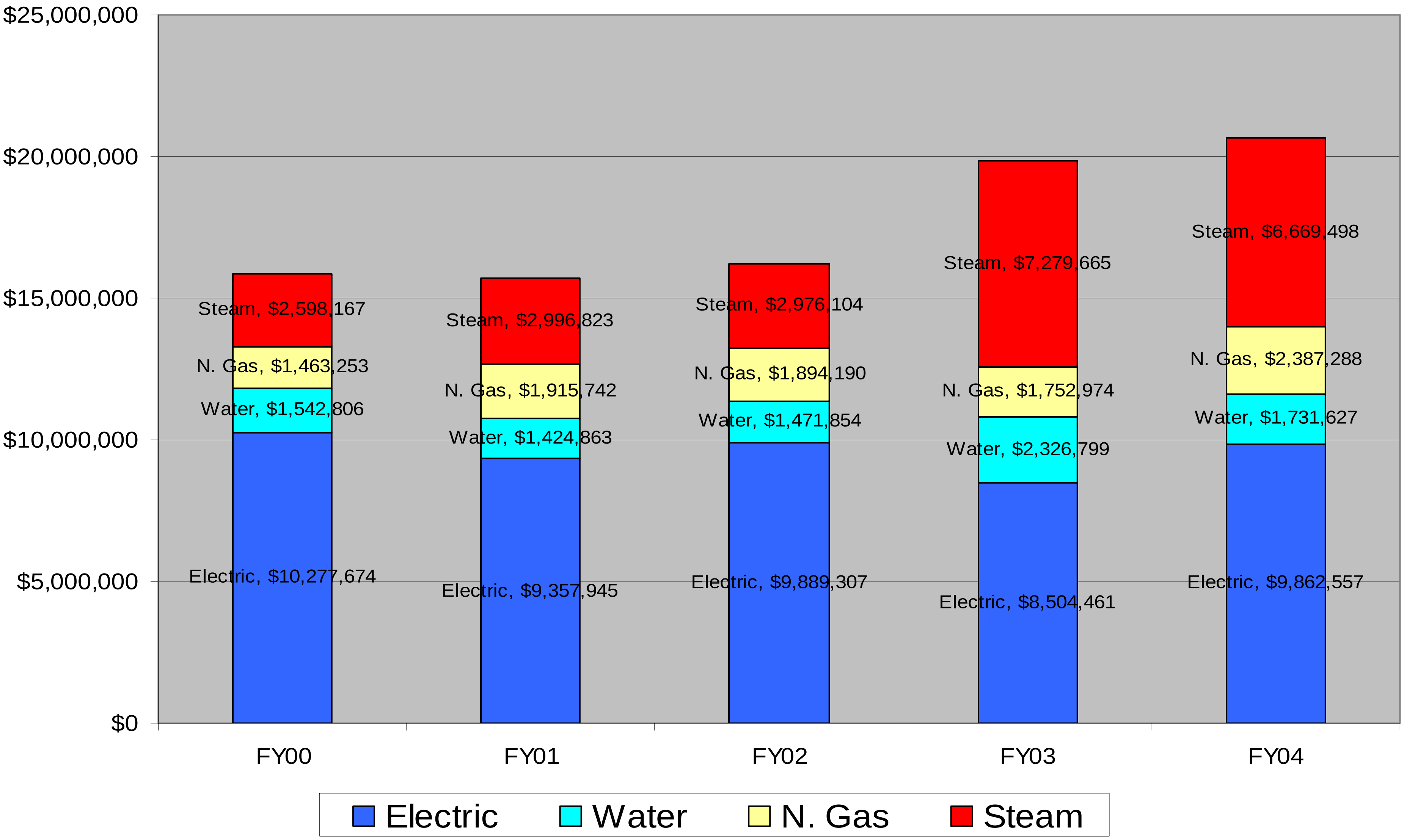
Wayne State University

Facilities Planning and Management

Energy Strategies &
Long Term Steam Options

April 20, 2005

General Fund Annual Utility Cost



Detroit Edison Steam History

- Long Term Contract Oct 92 – Oct 02
- Rates $6.80 - $8.92
- No contract renewal

Detroit Edison Steam History

- Sold business in Jan 03 to Thermal Ventures LLC (Parent of Detroit Thermal LLC)
- Does not have to resume ownership if new owner defaults

Detroit Thermal LLC

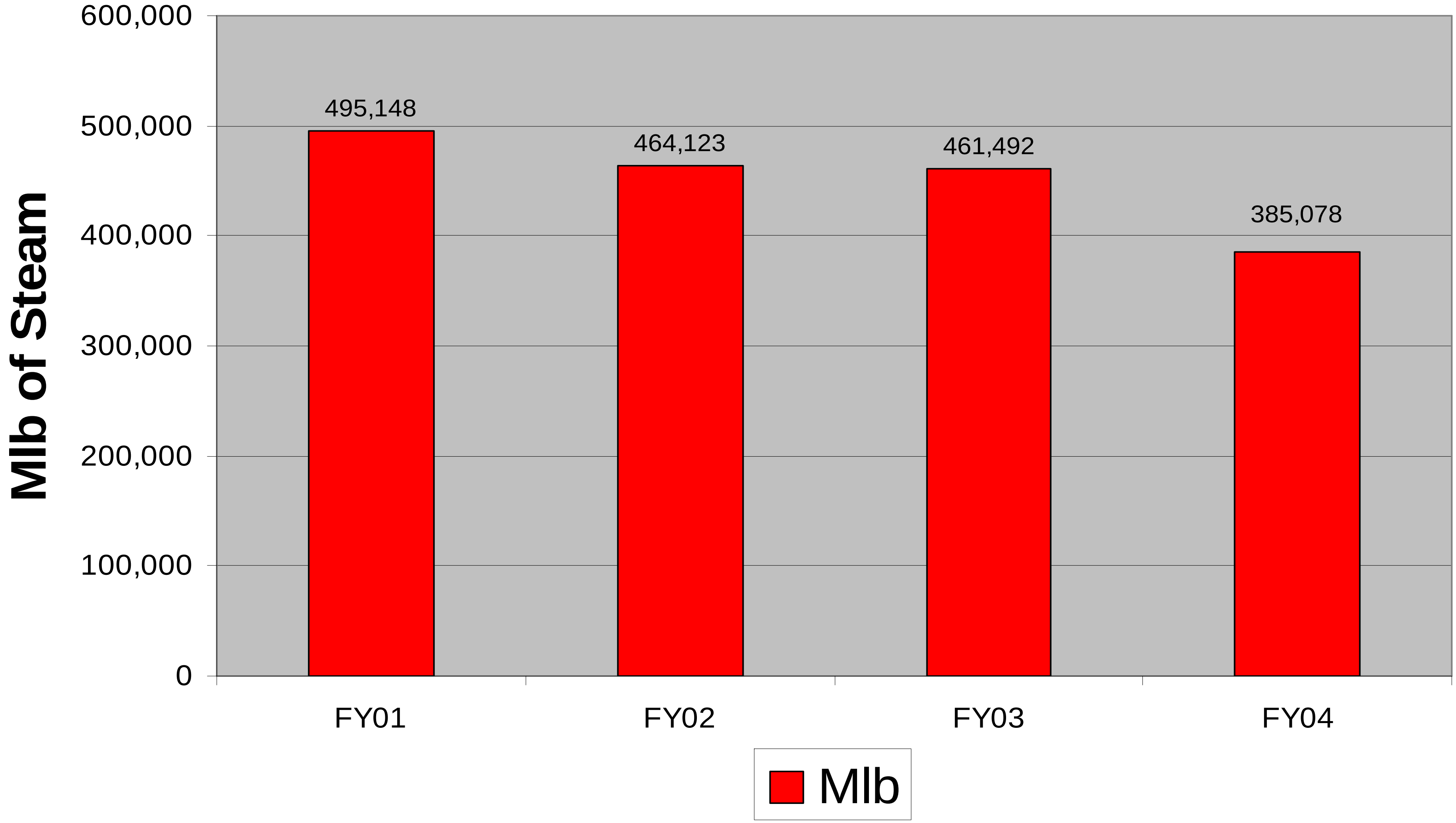
- Assumed ownership in January 2003
- Unable to negotiate contract
- Continues to invoice at variable rates

Detroit Thermal LLC

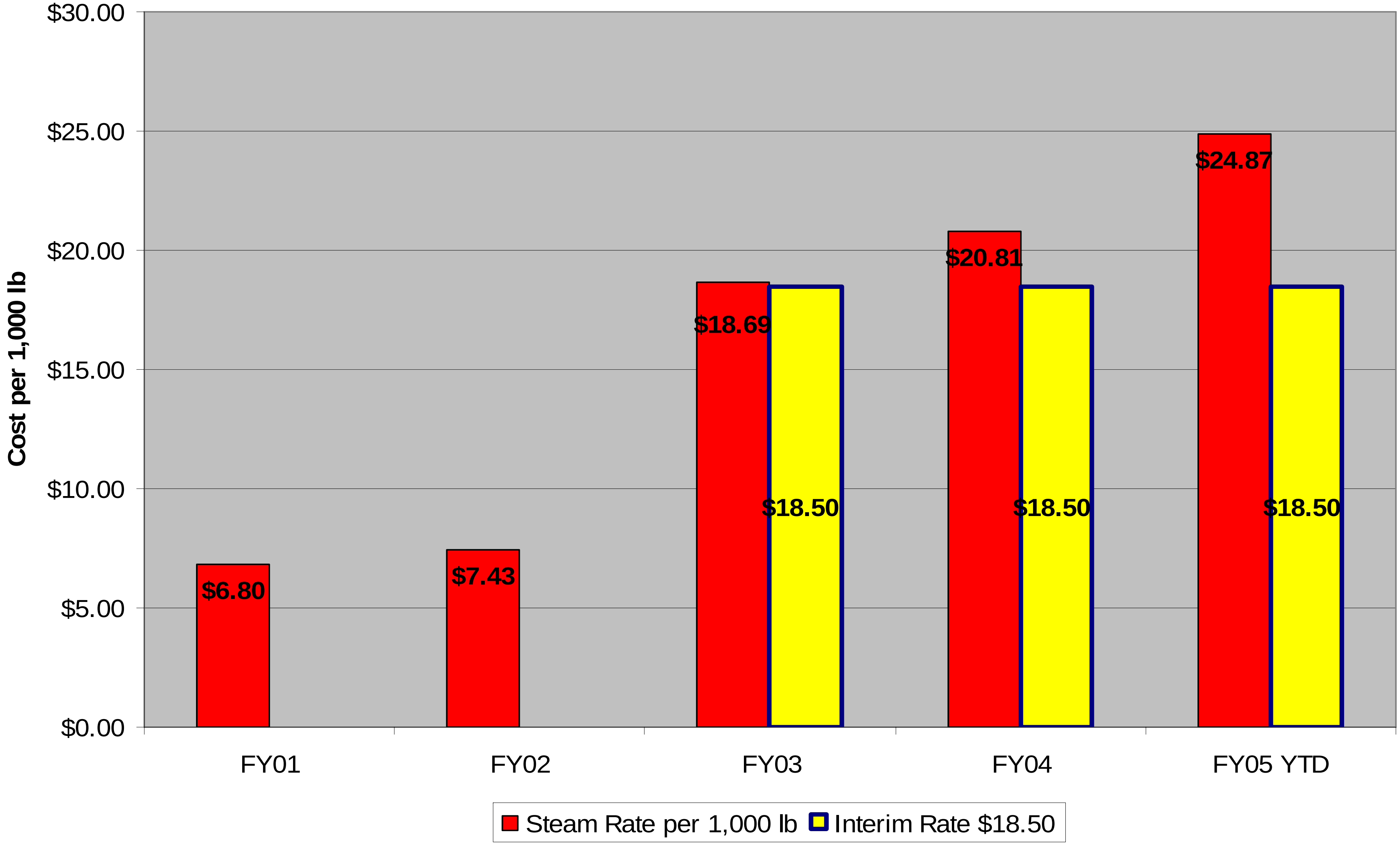
- Currently paying $18.50 per Mlb (interim rate)
- MPSC to rule on tariff in early 2005
  (could be between $18.19 - $19.75 ?)
- Retroactive adjustments up or down after MPSC ruling

Annual Steam Consumption

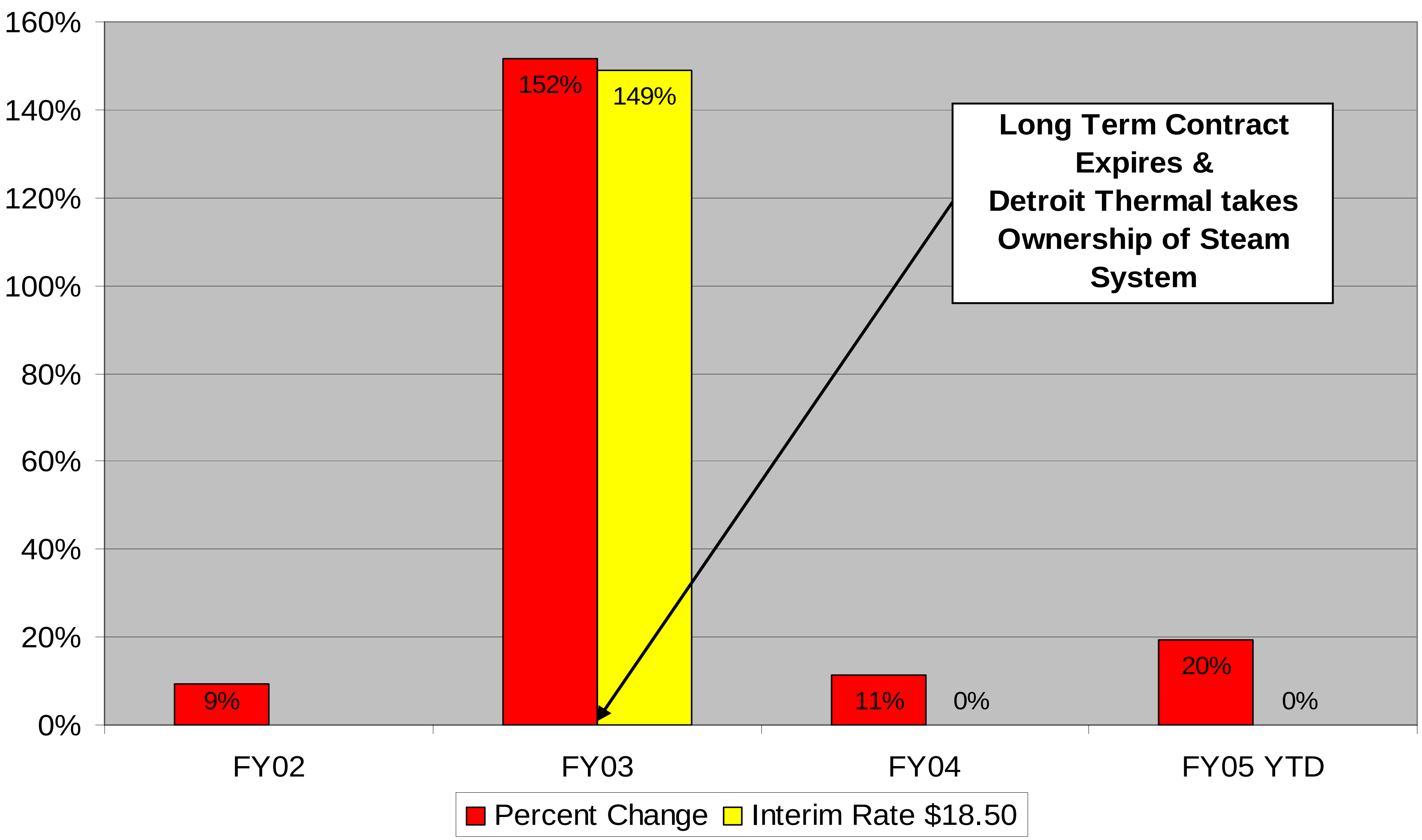
(General & Non General Fund)



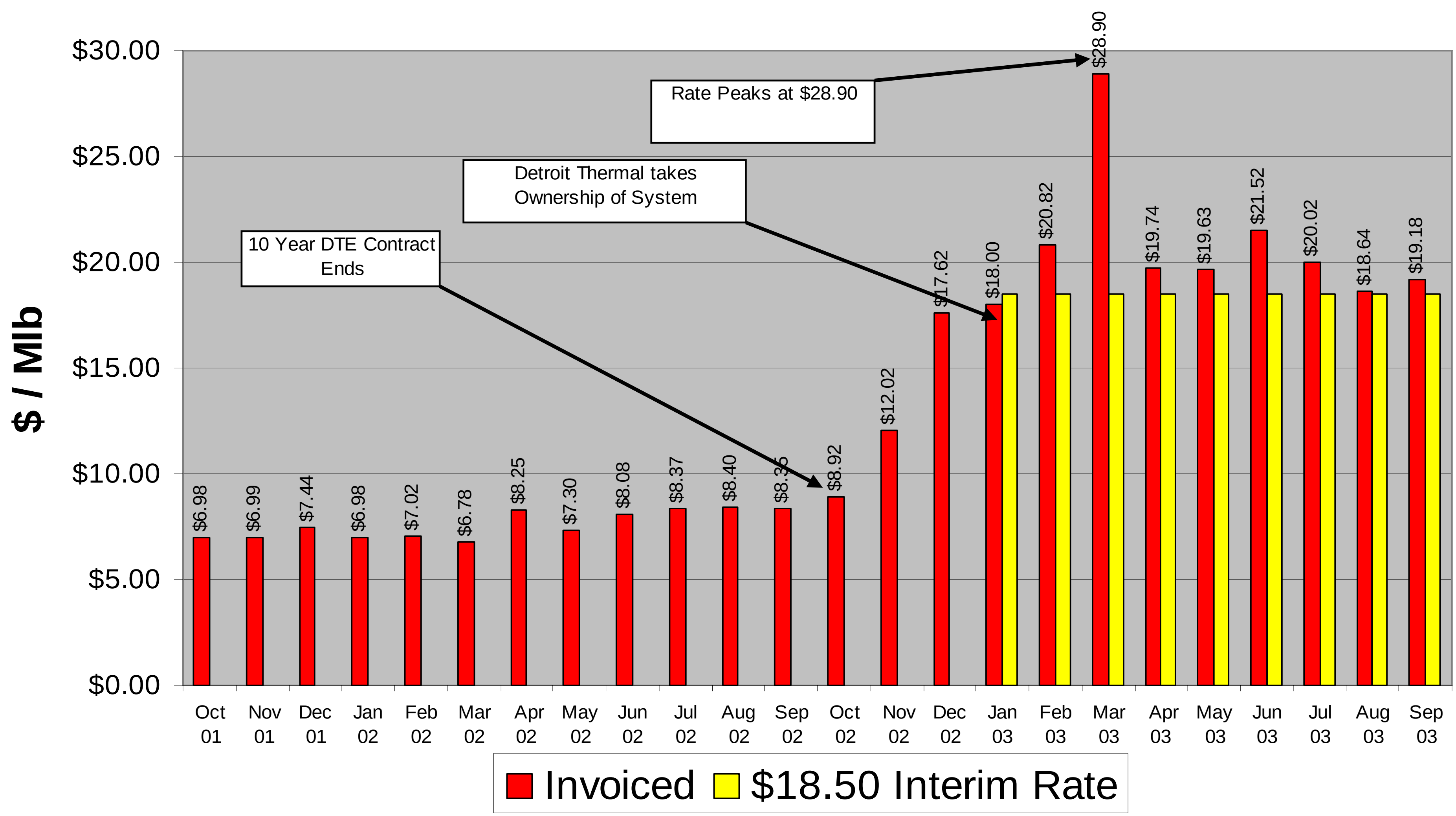
Annual Steam Rate

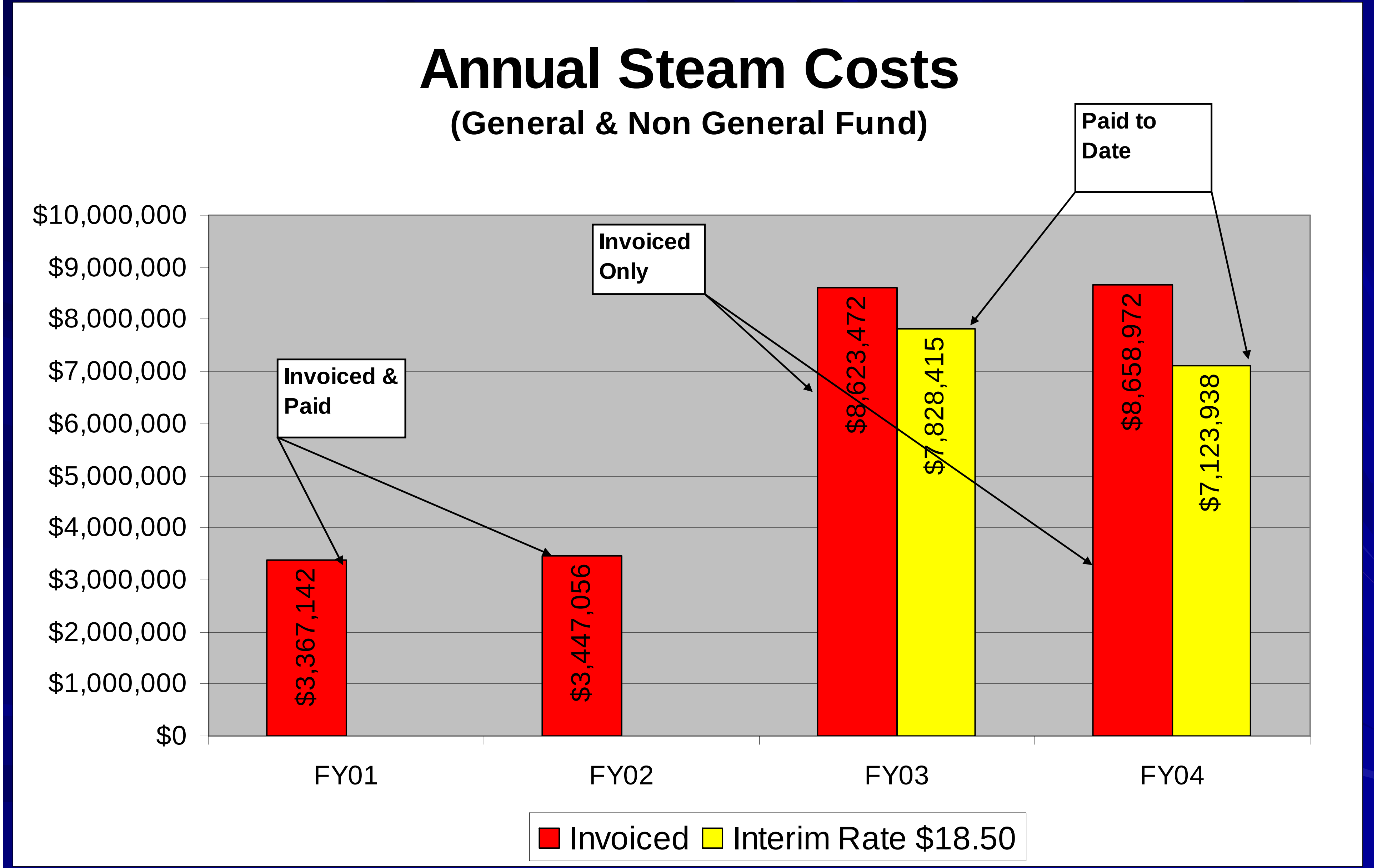


Annual Percent Change of Steam Rate



FY02 & FY03 Monthly Steam Rates





Annual Steam Costs
(General & Non General Fund)
Paid to Date
Invoiced Only
Invoiced & Paid
$10,000,000
$9,000,000
$8,000,000
$7,000,000
$6,000,000
$5,000,000
$4,000,000
$3,000,000
$2,000,000
$1,000,000
$0
$3,367,142
$3,447,056
$8,623,472
$7,828,415
$8,658,972
$7,123,938
FY01
FY02
FY03
FY04
Invoiced
Interim Rate $18.50

Current & Implemented Steam Reduction Initiatives

- New natural gas steam boiler at Pharmacy ($300K)
- New nat. gas boiler plant at Chatsworth ($350K)
- New electric chillers at Mott & Manoogian ($250K)
- New nat. gas heating plant at Tower 3 ($170K)
- Bio Sci boiler feeding UGL ($44K)

- Total savings = $1.1 million

Engineering Steam Study

- DiClemente Siegel Design commissioned steam study in summer 2004
- Long term self generating options were investigated
- Several energy options investigated including Coal, Fuel Oil, Wind, Solar & Nat. Gas

Energy Options Rejected

- Coal – emissions, permits, transportation, storage
- Fuel Oil – storage, emissions, cost
- Solar (Photovoltaic) – large area, lack of sun, batteries
- Wind – large open area, inconsistent, batteries

Physical Plant Types Investigated

- Central Plant (Main Campus)
- Cogeneration (Electricity & Steam)
- Mini Plants (Clusters)
- Individual Plants

Physical Plant Types Rejected

- Central Plant – cost & disruption to campus

- Cogeneration (Electricity & Steam) – high capital & fuel costs

Steam Study Recommendations

- University should self generate
- Natural gas as an energy type, economical, available
- Cluster plants & Individual plants, most feasible

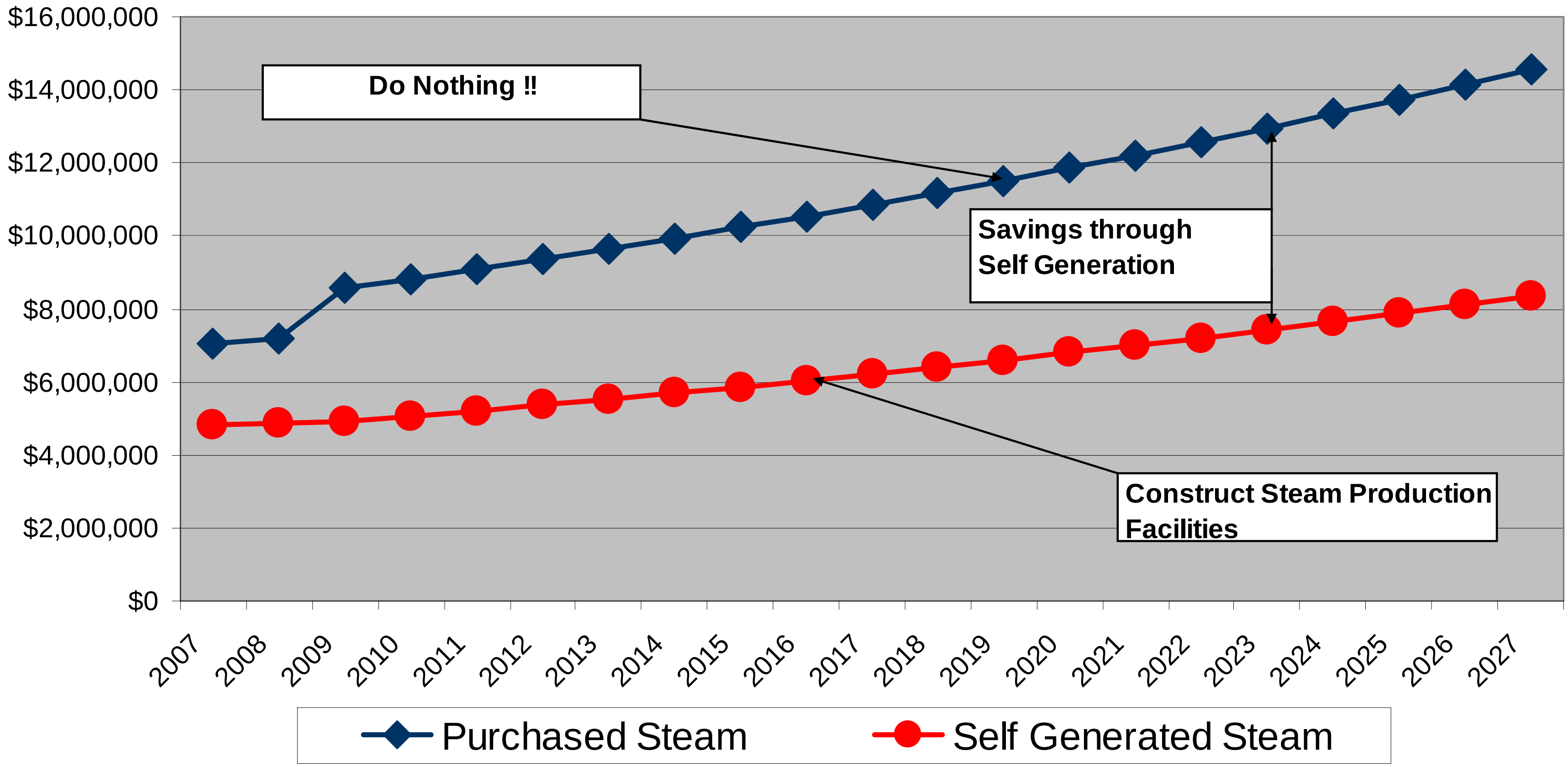
Steam Study Sensitivity Analysis

Criteria	Original Study	10% Increase Capital Only	Increase Natural Gas Only	Increase Capital and Nat. Gas
Capital Cost	$42 Million	**46.2 Million**	$42 Million	**46.2 Million**
Natural Gas Rates	NA	NA	**25%**	**25%**
Simple Payback	8.9 Years	9.7 Years	12.2 Years	13.2 Years
30 Year Future Savings	**$122,340,789**	**$114,148,090**	**$56,655,383**	**$48,462,684**
Present Value	**$41,040,926**	**$37,730,873**	**$17,514,086**	**$14,204,033**

Recommend Project including MCHT

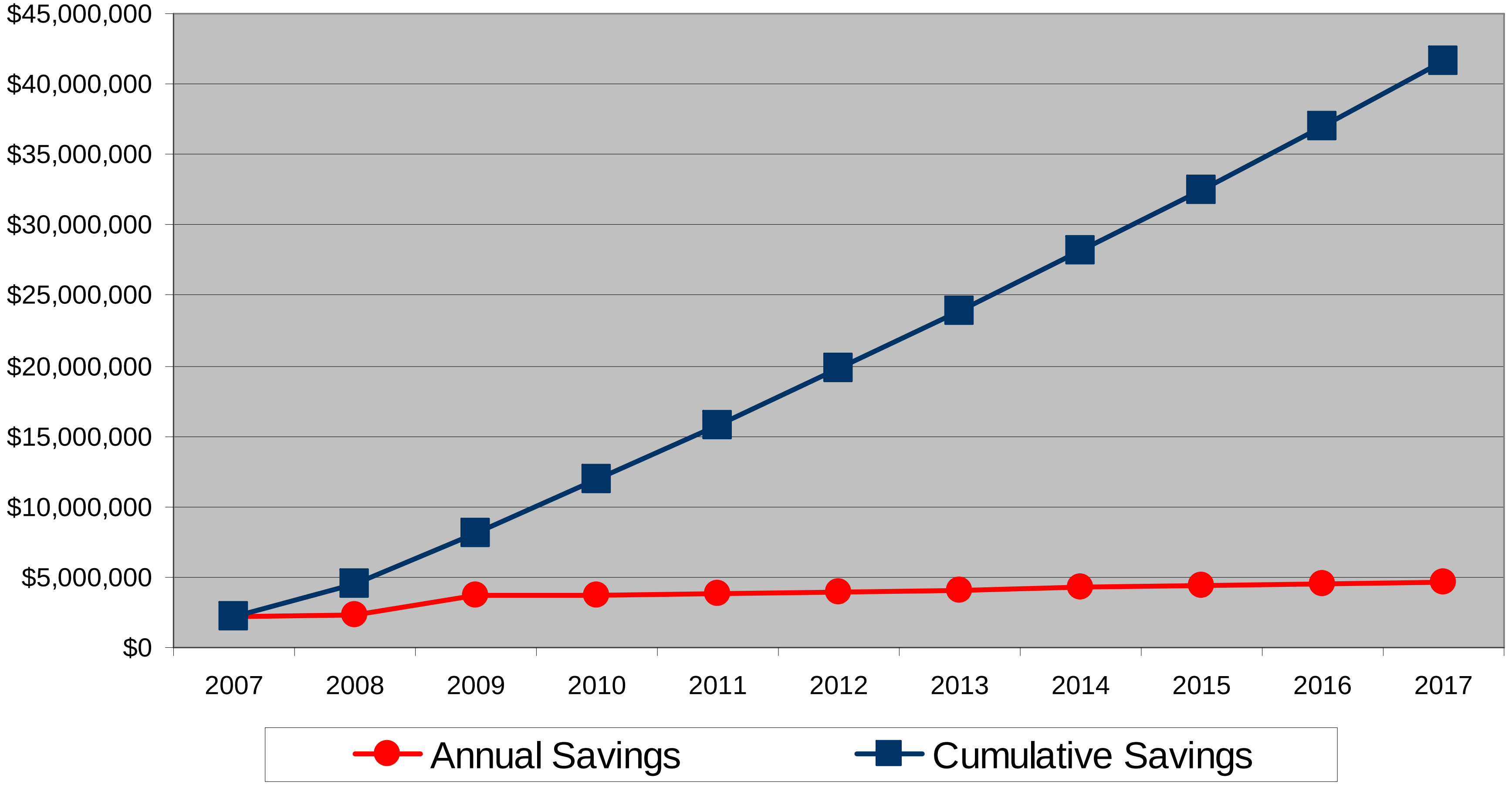
- Project cash flow based on steam study and MCHT impact
- Approximately 16,000 Mlb incremental steam load
- Additional $1 million to construct self generating facility

Projected Operating Steam Costs
Purchased Steam vs. Self Generation
(without debt service, includes MCHT and current utility prices)



Self Generating Steam Savings

(without debt service, includes MCHT and current utility prices)



Self Generation Option

- Self generation project cost is $43 million (includes MCHT)
- The cost of issuing bonds is $3.25 million (including capitalized interest during construction)
- Simple payback is 11.28 years (based on current utility prices & includes MCHT)
- Plant life is 30+ years

Self Generating Cash Flow

Net Savings after Debt Service

Years	Purchased Steam	Self Generating (inclg. Labor, Maintenance & Utilities)			Net Period Savings
	Operating Cost Period Total	Operating Cost Period Total	Gross Period Savings	Debt Service (for Capital Costs)	
2005 - 2010	45,540,285	32,736,402	12,803,883	10,885,000	1,918,883
2011 - 2015	48,249,905	27,650,087	20,599,818	14,750,000	5,849,818
2016 - 2020	55,934,864	32,054,029	23,880,835	14,750,000	9,130,835
2021 - 2025	64,843,838	37,159,405	27,684,433	14,750,000	12,934,433
2026 -2030	75,171,780	43,077,935	32,093,845	14,750,000	17,343,845
2031 - 2036	106,167,993	60,525,966	45,642,028	17,700,000	27,942,028
Total	**395,908,665**	**233,203,823**	**162,704,842**	**87,585,000**	**75,119,842**

Future Value versus Present Value

Term 30 Years	Purchased Steam	Self Generating	Net Savings
	Operating Cost Cumulative Total	Operating Cost + Debt Service = Cumulative Total (233,203,823 + 87,585,000 = 320,788,823)	
Future Value	395,908,665	320,788,823	75,119,842
Present Value	**149,311,462**	**126,837,749**	**22,473,713**

Self Generation Option

- 50 of 108 buildings (excludes parking decks) to convert from district steam
- Conversion represents 8 cluster plants & 21 individual plants

Building List

Cluster A

- Science Hall (005)
- Life Science (006)
- Chemistry (007)
- Science & Engineering Library (008)

Cluster B

- State Hall (016)
- Prentis Building (022)
- Helen DeRoy Auditorium (023)

Building List

Cluster C

- Rec. & Fitness Center (025)
- Purdy Library (026)
- Kresge Library (027)
- Reuther Library (036)

Cluster D

- Music Building (038)
- Community Arts Bldg (039)
- Art Building (040)
- Alumni House (042)
- McGregor Conf. Center (043)

Building List

Cluster E

- Cohn Building (048)
- Law Library (046)
- Law School (049)
- Law Classroom (053)

Cluster F

- 5439 Woodward (065)
- 5435 Woodward (066)
- 5425 Woodward (067)

Building List

Cluster G

- Knapp Building (509)
- Skillman Building (510)
- Freer House (511)

Cluster H

- Manufacturing Engineering (166)
- Eng. Technology (167)
- Bio Engineering (169)

Building List (individual)

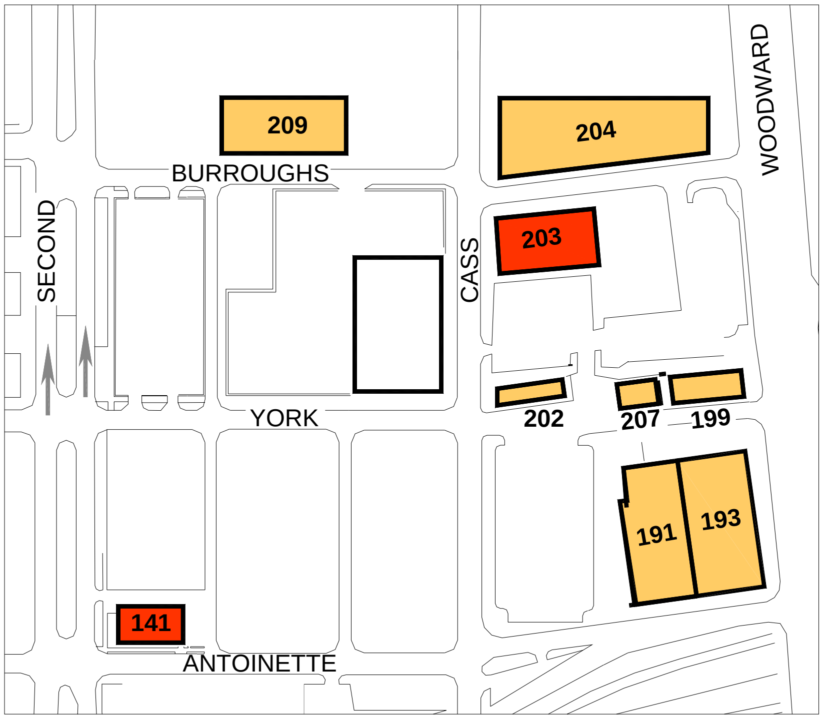
- 6050 Cass (203)
- Music Building (141)
- Shapero Hall (050)
- Education Building (140)
- Matthaei Bldg. (080)
- Manoogian Hall (155)
- Engineering Bldg. (090)
- University Tower (507)
- Bonstelle Theatre (620)
- Elliman Bldg. (629)
- C.S. Mott (609)
- Old Main (001)

Building List (individual)

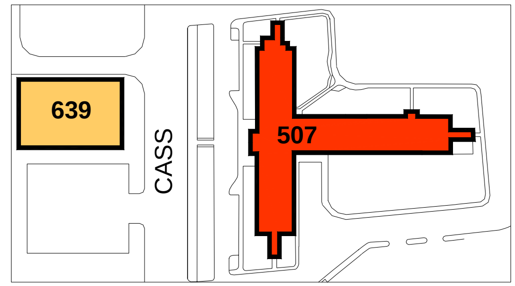
- University Services Bldg (060)
- Simons Bldg. (068)
- Music Annex (041)
- Thompson House (504)
- Karmanos Cancer (637)
- Rackham Bldg. (499)
- 5057 Woodward (071)
- Beecher House (064)
- MCHT

INDIVIDUAL CLUSTER NON DISTRICT STEAM

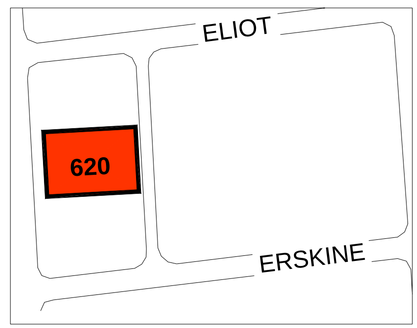
TECH TOWN



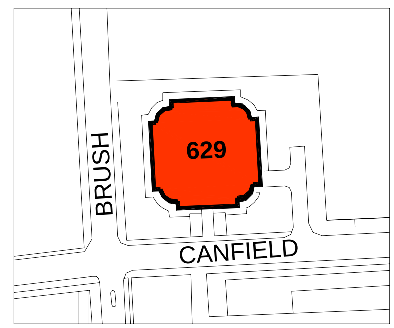
UNIVERSITY TOWER



BONSTELLE



ELLIMAN RESEARCH BUILDING



INDIVIDUAL

NON DISTRICT STEAM

Boiler Plant Locations

- Roof mounted in penthouses (5 clusters & 6 individual)
- In existing mechanical rooms (1 cluster & 9 individual)
- New grade level mechanical room, next to existing building (2 clusters & 6 individual)

Self Generation

- 100% redundant boilers for residence and research buildings
- Approximately 500 days to complete project
- Some buildings on line in approximately 300 days

Current Status of Detroit Thermal

- LLC for profit company
- Non traditional utility – no large parent for backup (parent is LLC)
- Limited financial investment – $2 Million to purchase

Current Status of Detroit Thermal

- Aging inefficient infrastructure
- Inadequate investment to upgrade infrastructure
- WSU is second largest customer
- 16% of D. T. annual load

Self Generating Impact on Detroit Thermal

- Other customers considering leaving the system
- DMC currently looking at options, contract expires in 2007

Self Generating Impact on Detroit Thermal

- If University's annual load of approx. 378,749 Mlb (includes MCHT) is removed from system, it will increase steam costs by $2.50 / Mlb
- Same holds true if other customers leave the system

Risks to the University Status Quo

- No protection against bankruptcy or closure (LLC)
- No traditional large parent utility as backup (parent also LLC)
- DTE does not have to resume ownership if Detroit Thermal defaults
- No price protection – unable to sign long term contract

Risks to the University Status Quo

- Fixed steam unit costs will rise as customers leave system
- Doubtful DT will make large investments to upgrade system
- Any investment will increase cost of steam (fixed unit steam price increase)

Risks to the University
Self Generation

- Operating cost projections may vary with actual future costs
- Project cost could be more than preliminary estimate
- Project timetable may take longer than estimated

Recommendation

- University control its steam risk
- Construct its own self generating facilities

Questions ?