South Loop District Energy
Preliminary Assessment

City of Bloomington
Bloomington, Minnesota

Final
September 3, 2010

Stanley Consultants INC.
A Stanley Group Company
Engineering, Environmental and Construction Services - Worldwide

In Association With

EVER-GREEN ENERGY™
Service Provider to
District Energy St. Paul

RMF Engineering, Inc. Professional Engineers

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I hereby certify that this plan, specification, or report was prepared by me or under my direct personal supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Signature: ______________________ Typed or Printed Name: Patrick J. Hirl

Date: September 3, 2010 Reg. No.: 26772

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Executive Summary

Sixty-five percent of the growth potential for the City of Bloomington has been projected to occur within the area defined as the South Loop District. There are three major property stakeholders and several smaller, but prominent, owners that are located within or adjacent to the South Loop District. The three major entities are listed below:

- Mall of America (MOA).
- Bloomington Central Station (BCS).
- Metropolitan Airport Commission (MAC).

The smaller owners consist of national hotel chains, technology and manufacturing as well as office park complexes. The existing facilities total roughly 12 million gross square feet (gsf). The City of Bloomington's development plan for this South Loop has identified a potential increase of approximately 17 million gsf divided into four 10-year growth stages.

These growth projections were used to estimate the growth in energy use in the South Loop. The South Loop energy use is predominantly building heating and cooling. By 2020, the South Loop is estimated to require 247,000 MWhr of electricity, 263,000 mmBTU of heating, and 26.2 million ton-hours of cooling annually. These loads are expected to develop predominantly around two current load centers centered at the MOA and the BCS. Heating and cooling loads at MAC's Terminal 1 building have been reduced through energy conservation efforts over the last few years. Therefore no additional capacity is anticipated. At Terminal 2, some additional capacity is expected but it remains small in comparison to the MOA and BCS. MAC however is interested in purchasing electricity from a combined heat and power (CHP) facility and could take up to 20 MW.

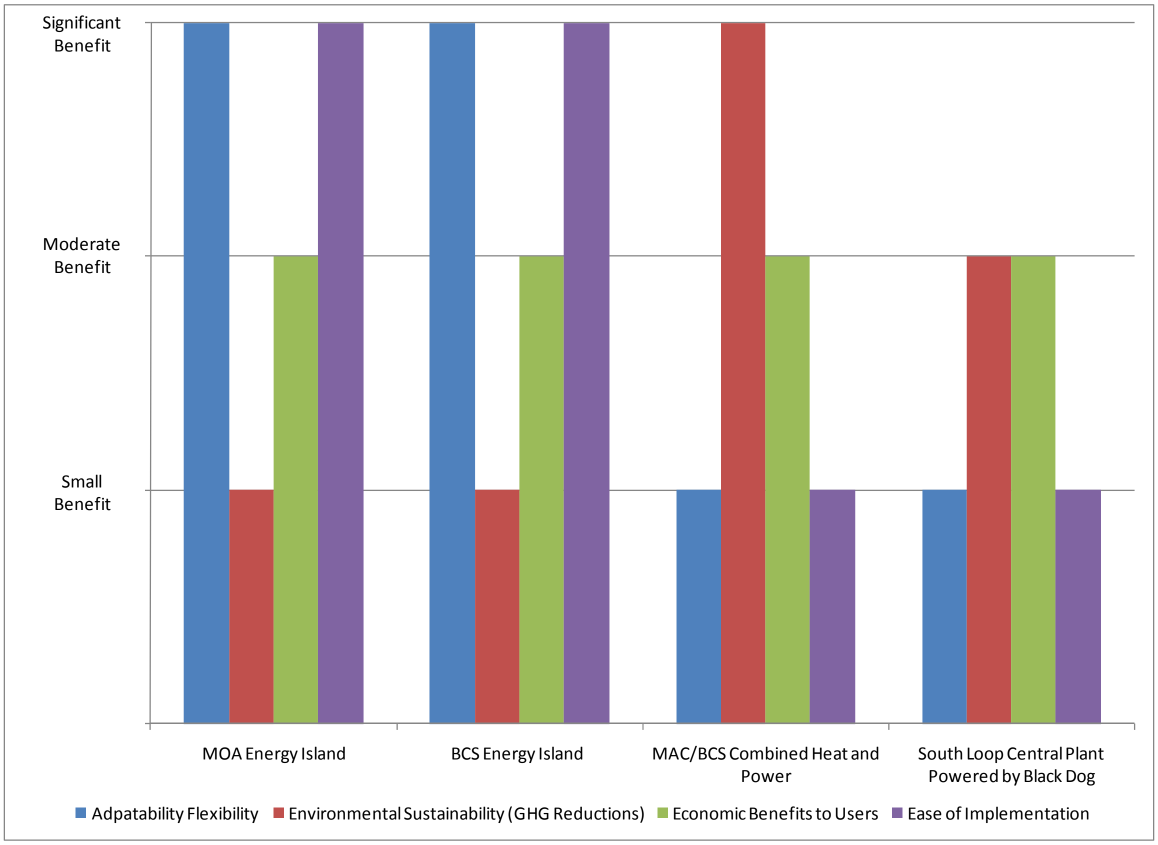
The City recognizes the potential impact on the energy use for a development of this magnitude and is therefore committed to minimizing energy use in the South Loop as part of its long-term plan of creating and maintaining a sustainable community. As a component of the overall plan, this study will assess the feasibility of implementing a District Energy System to reduce the environmental impact, while providing affordable utility service for the various entities located within and potentially near the South Loop District.

A concept was developed for the implementation of a district energy system in the South Loop. This concept identifies three energy islands (i.e., areas of concentrated energy use): MOA, BCS, and the MAC. These energy islands could include some or all of central heating, central cooling, and/or electricity production. Electricity and natural gas were identified as the initial energy sources. Central cooling plants significantly reduce the net carbon emissions of the South Loop. Cogeneration (i.e., electricity production coupled with central heating and/or cooling) and/or off-site biogas generation are possible variations to further reduce the carbon dioxide emissions of the South Loop.

The district energy concept allows for development of any or all the energy islands either separately or in parallel. These individual sites would be developed as the local load centers develop and choose to take advantage of the district energy system. Distribution would expand as new loads come on line. The goal would be to expand the distribution systems of the individual energy islands towards each other seeking to create a single integrated district energy system. This approach allows for construction of the energy islands and distribution system to grow as South Loop development grows. Therefore, this energy island concept presented above provides for system flexibility and adaptation to actual South Loop development.

Chiller plants would provide a significant reduction in carbon dioxide emissions from individual building direct expansion cooling used today. A cogeneration plant proposed provides even greater carbon dioxide emission reductions because of the greatly increased thermal efficiency of the facility. Black Dog Power Station could provide steam or high temperature hot water as the prime energy source for heating and cooling (e.g., absorption chilling or steam driven chillers) in any or all of the energy islands. This approach increases the efficiency of Black Dog leading to carbon dioxide emission reductions similar to the South Loop cogeneration option. Therefore, the energy islands proposed can play a role in reducing the environmental impact of the City of Bloomington and specifically South Loop activities.

All the energy island concepts were shown to provide payback time periods of less than 15 years. These projects have financial paybacks that are consistent with financial requirements of municipalities and non-profit public-private partnerships. These economic evaluations assumed current energy rates so that South Loop businesses could transition to the district energy system without changing their energy costs. Conversion to district energy would likely occur when current equipment needs replacement. At this time, customer conversion to district energy would have a lower capital cost than equipment replacement. New development would see a capital cost savings by hooking up to the district energy system as part of facility construction. Therefore, district energy provides a capital cost savings and market competitive energy rates. These benefits provide economic incentives for businesses to stay in or relocate to the South Loop.



Comparison of the Four District Energy Options
Figure 1

The graph above presents a comparison of the four district energy options identified for the South Loop. All four options are deemed viable based on the key guiding principles identified by the City. Each option, though, may provide more or less benefit in each of in each of the categories. Thus, an energy island approach to implementing district energy in the South Loop is economically sustainable, environmentally sustainable, and would be socially acceptable because it would fit with the City of Bloomington's commitment to creating a sustainable community.

It is recommended that the City of Bloomington proceed to the District Energy Feasibility study to further develop this concept into an implementable plan that current South Loop tenants can embrace and that provides incentives for development with the South Loop.

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Section 1

Introduction

Sixty-five percent of the growth potential for the City of Bloomington has been projected to occur within the area defined as the South Loop District. This region includes the land parcels bounded by Route 77 on the west, Interstate 494 to the north and Long Meadow Lake to the south and east as indicated in Figure 1-1.

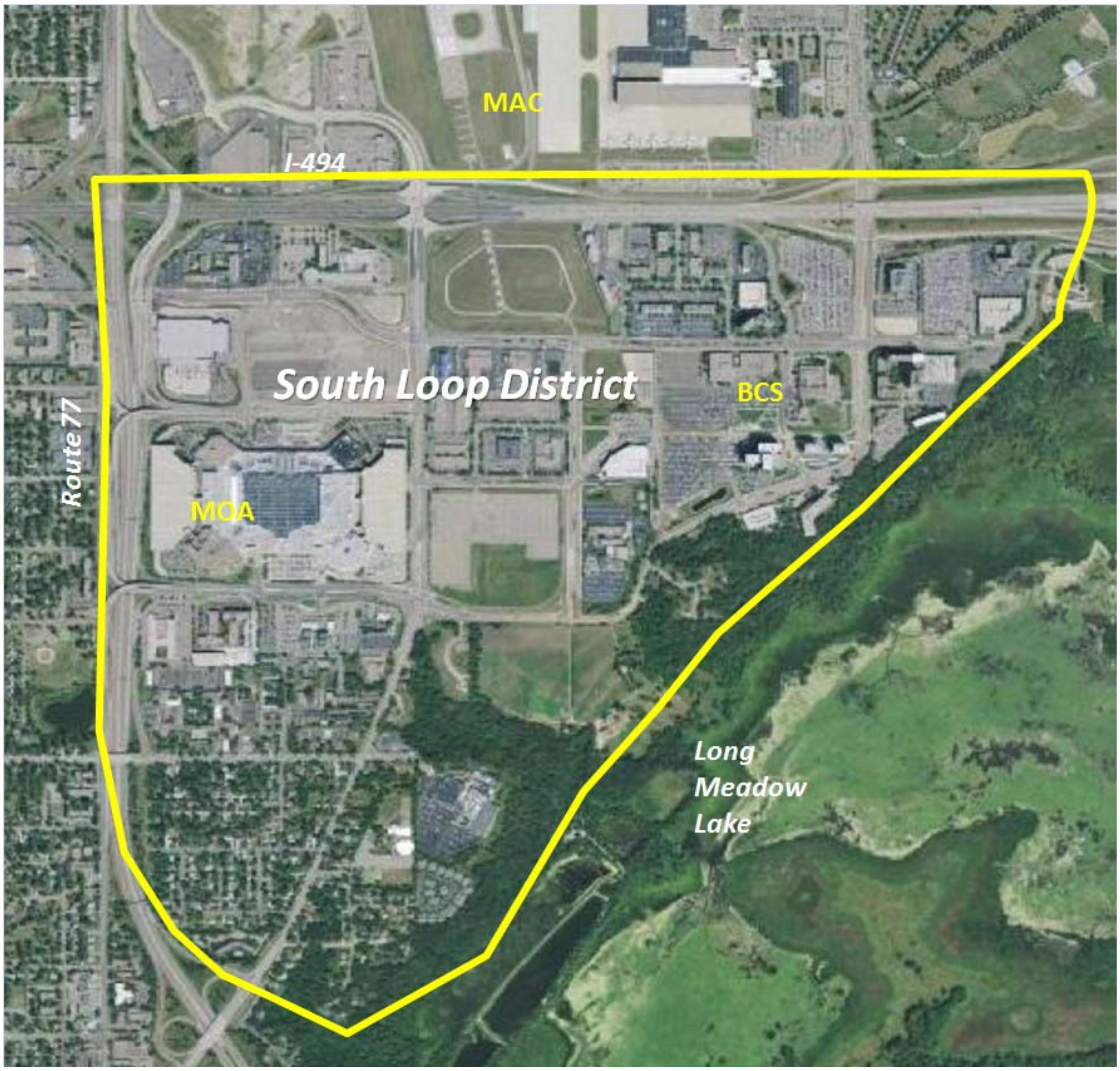
The City recognizes the potential impact on the energy use for a development of this magnitude and is therefore committed to minimizing energy use in the South Loop. As a component of the overall plan this study will assess the feasibility of implementing a District Energy System to provide affordable utility service for the various entities located within and potentially near the South Loop District. Some of the potential benefits of a District Energy System include:

- Maximization of energy efficiency.
- Less equipment resulting in lower maintenance cost.
- Reduction of building mechanical space requirements allowing for an increase in program space.
- Shared benefits of implementing energy saving and sustainability utility concepts as new technologies emerge.

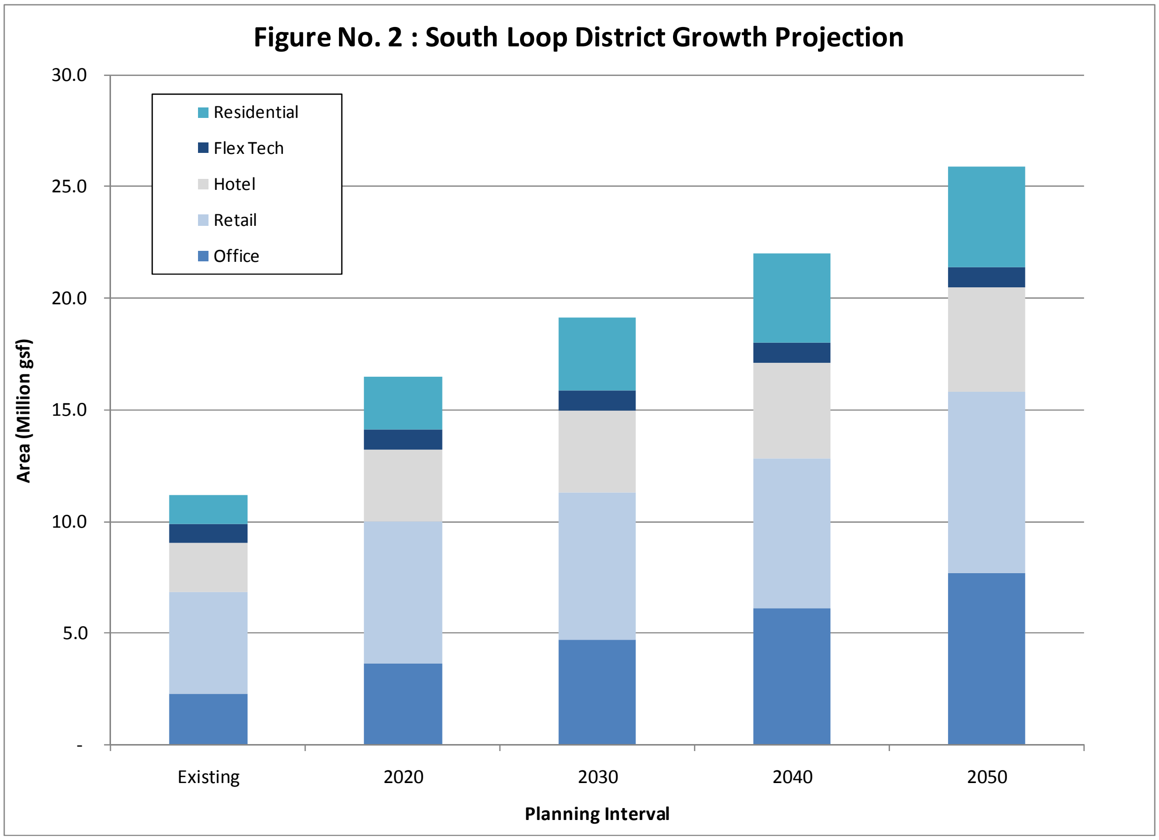
There are three major property stakeholders and several smaller, but prominent, owners that are located within or adjacent to the South Loop District. The three major entities are listed below:

- Mall of America (MOA).
- Bloomington Central Station (BCS).
- Metropolitan Airport Commission (MAC).

The smaller owners consist of national hotel chains, technology and manufacturing as well as office park complexes. The existing facilities total roughly 11 million gross square feet (gsf). The City of Bloomington's development plan for this South Loop has identified a potential increase of approximately 15 million gsf divided into four 10-year growth stages. A graph indicating the growth potential of the area is presented in Figure 1-2.



South Loop District
Figure 1-1



South Loop District Growth Projection
Figure 1-2

Stakeholder Inputs

The initial phase of the Preliminary Assessment consisted of gathering current and future projected load data (i.e., electrical, heating, and cooling) from the Mall of America, Bloomington Central Station, Metropolitan Airports Commission, PolarFab, and IKEA. In addition, discussions were held with Xcel Energy and CenterPoint Energy who supply electricity and natural gas, respectively, to the South Loop. Below are summaries of the information gathered through face-to-face meetings and phone conversations.

Mall of America (MOA)

The current MOA facility (Phase I) consists of approximately 4.2 million gross square feet of the core mall including four anchor stores (i.e., Bloomingdale's, Macy's, Sears, and Nordstrom's). The utilities for the core mall are operated and maintained by MOA. Each of the anchor stores operates and maintains its own utilities. MOA provided utility information and energy usage for the core mall. The anchor stores were not able to provide utility information during the limited duration of the Preliminary Assessment.

The mall core consumes 123,000 MWhr of electricity and 660,000 mmBTU of natural gas annually. A majority of the electricity is used for cooling using 33 direct expansion cooling units mounted on the roof of the facility. These cooling units provide 13,000 tons of cooling capacity. The natural gas is used almost exclusively by the restaurants in the mall core for cooking.

MOA performs routine maintenance on these cooling units and expects them to last another 10 to 15 years before needing replacement. Therefore, MOA did not express an interest in converting these 33 cooling units over to a more efficient district cooling system at this time.

MOA indicated that, in their opinion, the best opportunities for a district energy system would come from the Phase II expansion projects. These include the South Pad Hotel (2011), Mayo Clinic facility (2012), Bass Pro Shop (2014), and Great Wolf Water Park (2016). MOA recommended that as these developments progress District Energy should be promoted as an option.

Bloomington Central Station (BCS)

McGough Construction Development is the developer of the BCS complex. This area currently includes the HealthPartners building and the Reflections Condominiums. HealthPartners is heated and cooled using the former Control Data central plant across the street from the HealthPartners building. The Control Data central plant has more heating and cooling capacity than is needed by HealthPartners. Therefore, as equipment in the aging facility fails, it is not being replaced. McGough expects to spend $3–$4 million in the next 10 years to replace the Control Data central plant.

McGough has a plan for further developing the BCS complex adding hotels, residential high-rise buildings, and five office buildings. When these facilities are constructed, their size will be driven by the local market, which is currently depressed. McGough is interested in connecting to a district energy system if it can reduce their cost of construction and operation. District energy would have to make them more competitive in the local market. District energy's ability to improve efficiency of a building would only be interesting to McGough if we can demonstrate to the tenants the advantages of District Energy including being more environmentally conscious.

McGough Development expressed concern that new buildings at BCS would be relying on a third party district energy management company to make budget and pricing decisions as opposed to relying on the electricity and natural gas providers that the rest of the market (their competition) will rely upon. The long-term success of BCS's commercial development would be contingent upon district energy's ability to deliver economical heating and cooling at or below market rates.

It should be noted that district energy can provide reductions in capital, operations and maintenance costs. The combination of these cost reductions combined with actual energy rates for heating and cooling can make district energy economically attractive on a life cycle cost basis.

Metropolitan Airports Commission (MAC)

The MAC operates two terminals and various other buildings at the Minneapolis/St. Paul International Airport. They currently consume approximately 500,000 mmBTU of natural gas and 147,317 MWhr of electricity annually. The natural gas is used for building heat, airport restaurant cooking, and snow melting. These systems use a combination of steam, hot water, and hot glycol to distribute the heat. The electricity is used for lighting, building equipment and cooling. The cooling plants (one at each terminal) are a combination of steam turbine driven and electric motor drive chillers for a total of 13,000 tons of cooling capacity.

MAC expects the current plant at Terminal 1 to be sufficient for the final expansion phases of this terminal due to energy conservation measures that have significantly reduced the demand on the Terminal 1 cooling system. Terminal 2 is planned to double in size in the next 5 years and triple in size in the next 20 years. The current heating and cooling plant will need to double in size to meet the full expansion of Terminal 2.

There are other tenants on the airport property that have heating and cooling needs. These include Delta, FEDEX, and UPS. The heating and cooling needs of these tenants were not quantified as part of the Preliminary Assessment. These potential loads will be evaluated as part of the Feasibility Study.

Though MAC has significant heating and cooling loads, their focus in discussions was on electricity production on the airport property. MAC expressed interest in hosting a co-generation facility (i.e., electricity generation with heating and/or cooling) in order to have an alternative source of electricity. The hot and chilled water from the co-generation facility could be supplied to clients within the South Loop.

PolarFab

PolarFab operates an electronics manufacturing facility in the South Loop. PolarFab has four 7 mmBTU/hr boilers and 3,400 tons of cooling capacity. All of the chillers are air-cooled. They consume approximately 24,000 mmBTU of natural gas and 48,000 MWhr of electricity annually. PolarFab currently uses one boiler for base load and one boiler for peak winter loads. Base load cooling requirements are typically met with two chillers and peak cooling conditions with five chillers. In addition, PolarFab has a cryogenic nitrogen purification plant on-site that rejects about 1 mmBTU/hr of waste heat. PolarFab expects to replace 1,000 tons of chiller capacity in the near future with a water cooled centrifugal chiller.

Xcel Energy

Xcel Energy provides electricity to the entire South Loop. Two of Xcel's top electricity customers (i.e., MOA and MAC) are part of or adjacent to the South Loop. Xcel has worked with MAC, MOA, and the City of Bloomington on energy conservation projects. They expressed interest in the energy conservation opportunity of a district heating and cooling system in the South Loop. Xcel also expressed an interest in evaluating sale of steam from the Black Dog Power Plant for district heating in the South Loop. The City of Bloomington is communicating directly with Xcel in parallel with the Preliminary Assessment.

CenterPoint Energy

CenterPoint Energy provides natural gas to customers within the South Loop and the airport. They are interested in the opportunity to provide natural gas for a district heating or co-generation facility in the South Loop.

Building Load Projections

In order to develop a preliminary estimate of the energy requirements for the South Loop District, the gross floor areas of existing and future facilities were multiplied by unitary load factors for heating, cooling, and electricity. Various types of space utilization have different ventilation and energy use requirements and therefore unitary load factors were established for each space type. The majority of the South Loop existing and future building spaces were categorized into the following five general groups for this preliminary assessment:

- Office.
- Retail.
- Hotel.
- Flex Tech (research/manufacturing).
- Residential.

The unitary load factors for the five general types of space utilization were developed based upon load data and operating experience for the buildings connected to the district energy system that serves the city of St. Paul. By multiplying these load factors by the floor area of each facility a generalized estimate of the building utility demand was developed. For a few of the larger facilities the owners provided estimates for their peak energy demand and this data was used in lieu of the loads calculated from the unitary factors.

The optimum approach to implementing a district energy system is based upon establishing an initial system that can cost effectively support the existing buildings and the first stage of future buildings identified for the 2020 timeframe. If this initial system is proven cost effective, then it would serve as the foundation for future expansion to supply buildings beyond the 2020 timeframe. Therefore, the initial system capacity and associated cost analysis were based upon connecting a district energy system to suitable, existing buildings and future facilities identified within the first stage of development.

A comprehensive list of all existing buildings and future development planned to occur between 2010 and 2020 is presented in Table 1-1. Included in this table are the estimated heating, cooling and electric loads for each building.

A site plan identifying the buildings listed in the previous table is presented as Figure 1-3. One of the key factors in establishing a district energy system is a high load density. A high load density[1] for a district energy system results in less distribution piping and associated capital costs. From the site plan it is evident that the highest load density occurs in two primary locations which include the MOA site and the BCS region. These two areas have the greatest opportunity for successfully initiating a district energy system. Therefore, the existing and future facilities located within the MOA site and the BCS were considered as the primary candidates for district energy.

[1] Load Density refers to the energy use per square foot of a region. Typically a high load density results from energy consumers being within close proximity of one another.

Table 1-1 Building Load Summary (2020) - All Buildings

SUB-TAZ NUMBER	BUILDING	BUILDING TYPE	AREA SUMMARY: EXISTING AREA (GSF)	AREA SUMMARY: 2020 ADDITION (GSF)	AREA SUMMARY: TOTAL AREA (GSF)	2020 LOAD ESTIMATES: HEATING UNITARY (B/hr/gsf)	HEATING LOAD (MBH)	COOLING UNITARY (gsf/ton)	COOLING LOAD (Tons)	ELECTRIC UNITARY (W/gsf)	ELECTRIC LOAD (KW)
471B	CYPRESS	FLEX TECH	219,000	---	219,000	40	8,760	350	630	5.0	1,100
471D	CERIDIAN	OFFICE	195,000	---	195,000	20	3,900	600	330	4.0	780
471E	APPLETREE	OFFICE/HOTEL/RES	846,750	300,000	1,146,750	23	26,800	635	1,810	3.7	4,200
471F	EMBASSY SUITES	HOTEL	457,500	---	457,500	30	13,730	500	920	4.0	1,830
472B	METRO OFFICE PARK	OFFICE/HOTEL	663,250	---	663,250	25	16,600	550	1,210	4.0	2,650
472C	HYATT HOTEL	HOTEL	96,000	---	96,000	30	2,880	500	190	4.0	380
	INTERNATIONAL PLAZA	OFFICE	298,000	---	298,000	20	5,960	600	500	4.0	1,190
472D	HEALTH PARTNERS	OFFICE	471,000	---	471,000	20	9,420	600	790	4.0	1,880
[BCS]	RETAIL	RETAIL	---	65,000	65,000	30	1,950	450	140	5.0	330
	CONNECTOR	OFFICE	---	4,500	4,500	20	90	600	10	4.0	20
	HOTEL (350 beds)	HOTEL	---	280,000	280,000	30	8,400	500	560	4.0	1,120
	RESIDENTIAL (263 units)	RESIDENTIAL	236,700	---	236,700	20	4,730	800	300	3.0	710
	RESIDENTIAL (840 units)	RESIDENTIAL	---	756,000	756,000	20	15,120	800	950	3.0	2,270
	OFFICE A	OFFICE	---	359,500	359,500	20	7,190	600	600	4.0	1,440
	OFFICE C	OFFICE	---	306,400	306,400	20	6,130	600	510	4.0	1,230
	OFFICE	OFFICE	---	145,000	145,000	20	2,900	600	240	4.0	580
472E	POLAR FAB	FLEX TECH	220,000	220,000	440,000	32	14,080	110	4,000	5.0	2,200
472G	FAIRFIELD INN	HOTEL	110,000	(110,000)	---	---	---	---	---	---	---
473A	MARRIOTT HOTEL	HOTEL	300,000	---	300,000	30	9,000	500	600	4.0	1,200
	RAMADA INN	HOTEL	250,000	---	250,000	30	7,500	500	500	4.0	1,000
473B	MOA (COMMON AREA0	RETAIL	3,341,000	---	3,341,000	30	100,230	216	15,500	5.0	16,710
[MOA]	ANCHOR STORES	RETAIL	884,000	---	884,000	30	26,520	450	1,960	5.0	4,420
	BLOOMINGDALE'S	RETAIL	incl.	---	---	---	---	---	---	---	---
	MACY'S	RETAIL	incl.	---	---	---	---	---	---	---	---
	NORDSTROM	RETAIL	incl.	---	---	---	---	---	---	---	---
	SEARS	RETAIL	incl.	---	---	---	---	---	---	---	---
	RETAIL IKEA	RETAIL	330,000	---	330,000	22	7,100	550	600	3.1	1,009
	RENAISSANCE HOTEL	HOTEL	---	345,000	345,000	30	10,350	500	690	4.0	1,380
	MAYO GATEWAY	OFFICE	---	250,000	250,000	20	5,000	600	420	4.0	1,000
	BASS PRO	RETAIL	---	230,000	230,000	30	6,900	450	510	5.0	1,150
	WATER PARK HOTEL	HOTEL	---	550,000	550,000	30	16,500	500	1,100	4.0	2,200
	HOTEL/OFFICE	HOTEL	---	175,000	175,000	30	5,250	500	350	4.0	700
473C	BLN OFFICE PARK	OFFICE	450,000	---	450,000	20	9,000	600	750	4.0	1,800
	DAYS INN	HOTEL	438,750	---	438,750	30	13,160	500	880	4.0	1,760
	COUNTRY INN	HOTEL									
	HOMEWOOD SUITES	HOTEL									
473D	RESIDENTIAL	RESIDENTIAL	950,000	---	950,000	20	19,000	800	1,190	3.0	2,850
MAC	TERMINAL 2	FLEX TECH	N/A	N/A	N/A	---	---	---	---	---	1,850
	DELTA BUILDING	FLEX TECH	N/A	N/A	N/A	---	---	---	---	---	---
WEST	RADISSON HOTEL	HOTEL	355,500	---	355,500	30	10,670	500	710	4.0	1,420
TOTALS	---	---	11,112,450	3,876,400	14,988,850	26	394,820	380	39,450	4.3	64,359

NOTES:
1. NEGATIVE AREAS REPRESENTS BUILDINGS TO BE DEMOLISHED IN THE FUTURE.
2. DATA WAS NOT AVAILABLE FOR MAC, EXCEPT ELECTRIC LOADS FOR TERMINAL 2
3. HEATING, COOLING, AND ELECTRIC LOADS BASED UPON THE FOLLOWING UNITARY FACTORS:

	OFFICE	RETAIL	HOTEL	FLEX TECH	RESIDENTIAL
HEATING (Btu/hr/gsf)	20	30	30	40	20
COOLING (gsf/Ton)	600	450	500	350	800
ELECTRIC (W/gsf)	4	5	4	5	3

[shaded box] Data based upon existing loads

2020 Buildings
Figure 1-3

The MAC Terminal 2 currently utilizes a dedicated district heating and cooling plant to support the loads of that facility and was not included as an initial load candidate, because of the distance from the other load centers. Both Terminal 2 and the Delta facility have potential for integration into the district energy system, but have been deferred until a more detailed evaluation of those facilities can occur.

Several of the existing hotel sites have been deferred as well, because the associated building systems are not easily convertible to receive district energy and would require expensive system modifications. When these building are in need of renovation, then district energy would provide a cost effective alternative.

In addition, the future connection of the PolarFab facility to a district energy system may also result in mutual system benefits, by providing utility supply to the site as well as a potential opportunity to capture waste heat from the current manufacturing processes. Because of the distance from the BCS load center, the incorporation of the PolarFab facility was deferred until further evaluation can be performed.

District Energy Loads for Initial Stage (2020)

The utility loads established for the initial phase of a possible district energy system are listed in Table 1-2. To determine the coincident peak load of the buildings initially considered for connection to a district energy system, the individual peak demands of each building were totaled and a system diversity factor was applied. This diversity factor accounts for buildings experiencing peak demand occurrences at different times throughout day based upon variations in solar gain, occupancy, process load schedules, etc. Every district energy system experiences a load diversity. For the South Loop District a 0.80 diversity factor was applied to the sum of the building peak demands to estimate a coincident peak load. This factor is consistent with the diversity experienced by the St. Paul district energy system. The diversified load[2] allows a district energy system to utilize less capacity compared to the sum of the individual buildings. This is one of major benefits associated with district energy systems.

In addition to the diversified load, the total energy required over a typical year was estimated as well. This total load was calculated using a "load factor" also based upon the historical operation of the St. Paul district energy system. The "load factor" equals the total system energy load divided by the total possible load (peak demand times 8,760 hours per year). The load factor and peak demand were used to estimate the total annual load for each utility (ie. heating and cooling). The total energy use was noted in the previously referenced Table 1-2.

The data was further developed into a monthly load profile for the South Loop energy requirements. This load profile identified the peak monthly demand and total energy need for each utility, again based upon data from the District Energy St. Paul system. A summary of the estimated load profile is presented in Table 1-3. The peak demand and total energy requirements are utilized to establish the initial capacity requirements of a South Loop District Energy System.

[2] The diversified load is the coincident peak load of a system.

Table 1-2 Buildings to be Initially Included in a District Energy System

SUB-TAZ NUMBER	BUILDING	BUILDING TYPE	AREA SUMMARY: EXISTING AREA (GSF)	AREA SUMMARY: 2020 ADDITION (GSF)	AREA SUMMARY: TOTAL AREA (GSF)	2020 LOAD ESTIMATES: HEATING UNITARY (B/hr/gsf)	HEATING LOAD (MBH)	COOLING UNITARY (gsf/ton)	COOLING LOAD (Tons)	ELECTRIC UNITARY (W/gsf)	ELECTRIC LOAD (KW)
471B	CYPRESS	FLEX TECH									
471D	CERIDIAN	OFFICE									
471E	APPLETREE	OFFICE/HOTEL/RES									
471F	EMBASSY SUITES	HOTEL									
472B	METRO OFFICE PARK	OFFICE/HOTEL									
472C	HYATT HOTEL	HOTEL									
	INTERNATIONAL PLAZA	OFFICE									
472D	HEALTH PARTNERS	OFFICE	471,000	---	471,000	20	9,420	600	790	4.0	1,880
[BCS]	RETAIL	RETAIL	---	65,000	65,000	30	1,950	450	140	5.0	330
	CONNECTOR	OFFICE	---	4,500	4,500	20	90	600	10	4.0	20
	HOTEL (350 beds)	HOTEL	---	280,000	280,000	30	8,400	500	560	4.0	1,120
	RESIDENTIAL (263 units)	RESIDENTIAL									
	RESIDENTIAL (840 units)	RESIDENTIAL	---	756,000	756,000	20	15,120	800	950	3.0	2,270
	OFFICE A	OFFICE	---	359,500	359,500	20	7,190	600	600	4.0	1,440
	OFFICE C	OFFICE	---	306,400	306,400	20	6,130	600	510	4.0	1,230
	OFFICE	OFFICE	---	145,000	145,000	20	2,900	600	240	4.0	580
472E	POLAR FAB	FLEX TECH									
472G	FAIRFIELD INN	HOTEL									
473A	MARRIOTT HOTEL	HOTEL									
	RAMADA INN	HOTEL									
473B	MOA CORE	RETAIL	3,341,000	---	3,341,000	[ex. Elect. Heat]		216	15,500	5.0	16,710
[MOA]	ANCHOR STORES	RETAIL	884,000	---	884,000	30	26,520	450	1,960	5.0	4,420
	BLOOMINGDALE'S	RETAIL	incl.	---	---	---	---	---	---	---	---
	MACY'S	RETAIL	incl.	---	---	---	---	---	---	---	---
	NORDSTROM	RETAIL	incl.	---	---	---	---	---	---	---	---
	SEARS	RETAIL	incl.	---	---	---	---	---	---	---	---
	RETAIL IKEA	RETAIL	330,000	---	330,000	22	7,100	550	600	3.1	1,009
	RENAISSANCE HOTEL	HOTEL	---	345,000	345,000	30	10,350	500	690	4.0	1,380
	MAYO GATEWAY	OFFICE	---	250,000	250,000	20	5,000	600	420	4.0	1,000
	BASS PRO	RETAIL	---	230,000	230,000	30	6,900	450	510	5.0	1,150
	WATER PARK HOTEL	HOTEL	---	550,000	550,000	30	16,500	500	1,100	4.0	2,200
	HOTEL/OFFICE	HOTEL	---	175,000	175,000	30	5,250	500	350	4.0	700
473C	BLN OFFICE PARK	OFFICE									
	DAYS INN	HOTEL									
	COUNTRY INN	HOTEL									
	HOMEWOOD SUITES	HOTEL									
473D	RESIDENTIAL	RESIDENTIAL									
MAC	TERMINAL 2	FLEX TECH									
	DELTA BUILDING	FLEX TECH									
WEST	RADISSON HOTEL	HOTEL									
TOTAL CONNECTED LOAD			5,026,000	3,466,400	8,492,400	---	128,820	---	24,930	---	37,439
ESTIMATED LOAD DIVERSITY FACTOR							0.80		0.80		0.80
PEAK LOAD OF DISTRICT SYSTEM			5,026,000	3,466,400	8,492,400	---	103,000	---	20,000	---	30,000
ESTIMATED LOAD FACTOR (APPLIED TO THE CONNECTED LOAD							20%		15%		60%
TOTAL ANNUAL LOAD (PER YEAR)						226,000 MMB/YR		26,180,000 T-HRS		197,000 MWH/YR	

NOTE: HEATING, COOLING, AND ELECTRIC LOADS BASED UPON THE FOLLOWING UNITARY FACTORS (CONSISTENT WITH CURRENT DESIGN TECHNOLOGY):

	OFFICE	RETAIL	HOTEL	FLEX TECH	RESIDENTIAL
HEATING (BTU/HR/GSF)	20	30	30	40	20
COOLING (GSF/TON)	600	450	500	350	800
ELECTRIC (W/GSF)	4	5	4	5	3

Table 1-3 2020 District Energy Load Profile

Month	Electric		Heating		Cooling	
	%	(MWH)	%	(MMBtu)	%	(ton-hrs)
Jan	7.1%	13,900	16.7%	37,700	1.3%	350,000
Feb	7.1%	14,000	16.0%	36,300	1.3%	350,000
Mar	7.5%	14,700	12.6%	28,400	1.3%	350,000
Apr	7.1%	13,900	5.9%	13,400	2.3%	600,000
May	8.7%	17,100	4.9%	11,000	11.5%	3,000,000
June	9.7%	19,100	2.1%	4,800	17.6%	4,600,000
July	10.0%	19,700	2.5%	5,600	28.3%	7,400,000
Aug	10.7%	21,200	3.2%	7,300	20.2%	5,300,000
Sep	9.2%	18,100	3.2%	7,200	11.5%	3,000,000
Oct	6.9%	13,600	6.9%	15,600	2.0%	530,000
Nov	7.6%	15,000	12.0%	27,200	1.3%	350,000
Dec	8.5%	16,800	14.0%	31,500	1.3%	350,000
Totals	---	197,000	---	226,000	---	26,180,000

Notes:
1. Heating required in the summer months for domestic hot water.
2. Winter cooling based upon internal heat gain in spaces without air-side economizers.

Section 2

Technology Evaluation

Heating Plants

Heating plants normally produce steam in the United States. Hot water, at a variety of supply temperatures, is an alternative more commonly used in Europe but also in use in the United States. The district heating system in use in downtown Minneapolis is a steam system while the St. Paul district system is hot water.

Hot water systems have several advantages over steam systems: reduced system losses, reduce maintenance costs, less expensive piping costs with low temperature systems, and ease of routing. Steam has the advantage of increased flexibility within the utility powerhouse. Steam can be used to generate electricity or as a prime mover for mechanical equipment. The Preliminary Assessment will assume hot water for the distribution system while either steam or hot water will be used for generation. The final selection of the generation system will be done as part of the Feasibility Study.

Hot water distribution systems can be divided into high temperature systems typically with supply temperatures in the 350–400°F range or medium temperature systems with supply temperatures between 180 and 250°F. The amount of hot water that must be pumped is directly proportional to the temperature difference between the supply temperature and the return temperature.

In high temperature hot water distribution systems the design temperature difference is normally around 150°F. For medium temperature systems the temperature difference is normally in the 50–90°F range. Medium temperature systems therefore may require up to three times the amount of pumped hot water to achieve the same amount of heat transfer. The higher flow rates directly impact the pumping costs for the system and require larger pipe sizes. Higher temperatures however also require more expensive pipe materials, insulation, and pipe expansion equipment. Typical costs will be used for the distribution system during the Preliminary Assessment and a final recommendation made during the Feasibility Study.

Chilled Water Plants

Central chilled water plants typically produce water at between 42–45°F. Return temperatures usually run 10 to 20°F higher resulting in system "Delta T's" of 10 to 20°F. As with hot water systems, the Delta T directly affects the pumping costs and the pipe sizes. Increasing the system design Delta T can therefore significantly reduce system costs. These do come however at some cost to the building design. As chilled water Delta T increases the costs for the building cooling coils also increases. Therefore, the design Delta T must be selected based on current building designs that will be served or the increase building cost for improving the Delta T, as well as evaluating the costs to supply the chilled water. A 15°F Delta T will be used for the Preliminary Assessment.

Chilled water can be produced with a variety of equipment. Mechanical compression units are by far the most common. They use a variety of compressor types to produce chilled water. Compressors, centrifugal, screw, or reciprocating, compress a hydrocarbon refrigerant which is then cooled either with air coolers or with a water cooling tower. Most often the compressor is motor driven however, steam or gas turbine drives are found along with reciprocating engine drives.

Other options to the mechanical compressor are absorption chillers that use either steam or high temperature hot water as the prime mover, and adsorption chillers that use desiccants to adsorb moisture from the air and regenerate the system using hot air.

A motor drive centrifugal chiller has been selected as the basis for the Preliminary Assessment. These units usually have the lowest first cost in the size range required for a central chilled water plant and often are the lowest cost to operate. Other options will be compared against this selection during the Feasibility Study phase of this project. Other options may have some advantages in utilizing waste heat from cogeneration options.

Factory assembled chillers in the 1,000 to 2,000 ton size will be the basis of analysis. These units typically have the lowest first cost per ton and there are several suppliers in this size range. Smaller units are more costly because of their size while larger units require either multiple compressors or they must be field erected. In either case the first costs are typically higher. These units come motor driven in most cases; however, steam or gas driven units as well as reciprocating engine driven units are all available. It is common for central chilled water facilities to have a mixture of chiller types or drives to allow flexibility and to respond to market prices for electricity and fuel.

The use of thermal storage is also a consideration for chilled water. Large tanks can be used to store chilled water for use during peak chilled water periods. These tanks operate liquid filled at all times with supply temperature chilled water on the bottom of the tank and return temperature warmer on the top.

The thermal storage tank is normally charged at night during off-peak chilled water periods and is used during the daytime high usage periods. This can reduce the chiller capacity required to meet short term peak loads and can utilize potentially lower cost nighttime electric rates for the production of peak period chilled water. The use of chilled water thermal storage will be investigated during the Feasibility Study phase of this project. These tanks are large and will require available land. Typical tanks are 50-70 feet in diameter and equal in height.

An alternate to water thermal storage is ice storage. The concept is the same except that special chillers operating below 32°F are required to make the ice. These chillers cost more to operate because of the lower operating temperatures however the space required for the ice storage system is significantly reduced. In areas where available space is limited or very costly, ice thermal storage may be a viable option. These systems require about on fifth the acreage of water storage.

Electric Generation

A central utility plant may also provide electricity in addition to steam or hot water and chilled water. The electrical interconnections to the utility must be addressed for each user (customer) of electricity. It is most common for this electricity to be provided to supplement the power purchased from the local utility. Therefore, each user (customer) will be connected to both the local utility and to the central utility plant. This operation in parallel can get costly and complicated. For this Preliminary Assessment we have only considered one user for purchased electricity, the Metropolitan Airports Commission (MAC). They are a single large electric user that may benefit from a central electric generating facility.

Use of steam or gas turbines or reciprocating engines for the production of electricity has been initially screened during this Preliminary Assessment. The results of that screening will be presented later in this report. This initial examination deals with the export of power to MAC. Cogeneration for on-site use at the central facility will be explored further during the Feasibility Study phase.

Fuels

Introduction

Central utility plants can operate on a wide variety of fuels. These can include solid fuels such as coal, wood, and refuse derived fuel (RDF), liquid fuels such as fuel oils and gasoline’s, or gaseous fuels including natural gas and biogas as examples.

Liquid Fuels

Liquid fuels are the most flexible fuels. They can be easily transported, stored, and they can be supplied to almost any location. Liquid fuels however are the most expensive per unit of energy and are therefore only rarely used for central utility systems. The exception is No. 6 fuel oil. This fuel is cost competitive however the environmental issue with permitting a facility are significant and make this fuel unattractive. Liquid fuels can either be derived from crude oil or they can be produced from renewable sources such as corn. In either case the cost of the liquid fuel is higher than other alternatives. Liquid fuels are primarily used only when other fuels are not readily available. For all the locations investigated here, alternates are available and therefore liquid fuels will only be used as emergency back-up fuel.

Solid Fuels

Solid fuels were also considered. Solid fuels generally have a lower price than any other fuel however they require expensive boiler designs to allow for combustion. This includes baghouses or electrostatic precipitators for particulate control and possibly other systems for the control of sulfur and NOx emissions. Space is also an issue with solid fuels. The boilers and environmental support equipment consume much more space than alternate boiler options using gaseous fuels. They also require space for the storage of fuel on-site. This will require large ground storage areas or silos. Truck traffic to deliver the fuel can also become an issue. For these reasons, solid fuel is not considered a viable option for any of the initial Bloomington sites but could be an option in the future when the systems are tied together.

Gaseous Fuels

Gaseous fuels such as natural gas or biogas are the initially most likely fuels for the central facility. Natural gas lines are available in the immediate area. Gas line capacities will need to be confirmed with the suppliers once use requirements have been determined. Gas pipeline pressure may also be an issue for gas turbine cogeneration systems. Natural gas and biogas are clean burning fuels with relatively low carbon footprints. It can be burned in boilers, reciprocating engines, or gas turbines. Biogas can either be produced on-site for immediate use or it can be produced at an alternate location, cleaned up to natural gas specifications, pressurized to gas pipeline pressures, and transported through the existing natural gas pipeline system to the district energy plant location.

Sources of Energy

Black Dog Power Plant

The Black Dog Power Plant is approximately three miles southwest of the South Loop. This power plant produces 260 MW of electrical power from natural gas using a gas turbine combined cycle plant. Combined cycle plants have historically not been based loaded plants but are normally brought on-line as required to meet expected loads. Black Dog also produces 278 MW of electrical power from traditional coal fired boilers and steam turbines. Xcel Energy expects to repower the coal-fired portion of Black Dog to gas turbine combined cycle in the next 6 to 10 years. Either the existing combined cycle plant could be modified, or the new combined cycle plant be designed for cogeneration. In either case, steam could be extracted from the power cycle for export to the south loop. Two options are available, steam and condensate lines could be run or the extracted steam could be converted to high temperature hot water and the hot water transported to the south loop area. In either case, the pipelines from Black Dog to the South Loop would be 3.7 miles long and cost $15 to $20 million. If extracted steam was transported to the district energy plant it could also be converted at the district energy plant to hot water for distribution with in the South Loop. This would require 120,000–180,000 lb of steam per hour in 2020. The steam or hot water could also be used for chilled water production. The maximum steam demand for a central chiller plant running solely on 150-psi steam would be 190,000 lbs of steam per hour. The Black Dog Power Plant could provide the energy necessary for a district heating and cooling plant in the South Loop

There are other advantages to this approach. First, the South Loop district energy plant would not have any combustion equipment with this alternative. This would make the permitting issues for the district energy plant much simpler. The air emission in the south loop area would also not be impacted by new combustion equipment. This will minimize the effect of a district energy plant on the south loop air quality. It would also reduce the size of the district energy facility smaller as well. The largest equipment normally included in a district energy plant is the boilers. This option would eliminate the need for the space consuming units.

Renewable Energy Sources

Natural gas is the most likely initial fuel for any of South Loop district energy scenarios because it is the most clean burning fossil fuel; it is a lower cost fuel today, but pricing can be volatile. Natural gas can be used in boilers or combustion turbines, and natural gas burning equipment is lower cost than solid fuel equipment. Natural gas prices have a history of volatility justifying the consideration of other fuels. In order to look to the future, there are two renewable fuels that could be used for the South Loop solid fuel biomass and biogas produced outside the South Loop.

Solid Fuel Biomass. "Biomass" can take many forms, including plant material and other sources such as solid waste or refuse derived fuel (RDF) which includes plant material. For this study biomass is considered to be woody biomass from plant material such as agricultural, forestry and urban wood residues such as is used at St. Paul Cogeneration, which provides heat to the District Energy St. Paul system.

There have been several studies performed in recent years to examine the use of woody biomass for boiler fuel in the Twin Cities metro area. For example, studies have shown that there are significant quantities of agricultural residues in close proximity to the Twin Cities. However, since there is currently a limited market for this material, the infrastructure required to gather and transport the material into the metro area has not been developed. Likewise, depending upon the quantities required, there are significant quantities of forest residue near the metro area. Again, the economics of processing and transporting the material into the metro area generally do not result in sufficient savings to offset the additional capital required to use the fuel vs. using natural gas. Urban wood waste generated in the metro area is successfully being used at St. Paul Cogeneration to meet approximately 70 percent of the energy needs of District Energy St. Paul. However, quantities are limited and increasing competition for this material would put pressure on the price for the material. According to a 2007 study performed by the Green Institute on biomass fuel, investors often require biomass fired energy plants to have access to fuel supplies two to four times greater than what the plant requires. This strategy typically requires the plant be able to use a mixture of fuels. Given the South Loop urban location, there are no readily available woody biomass fuel sources nearby.

Biogas. Several agricultural processing facilities in Minnesota produce sufficient quantities of biodegradable waste products or co-products to meet the natural gas requirements of the South Loop energy using anaerobic digestion to produce biogas. The approach would be to construct an anaerobic digester adjacent to the processing facility. The processing facility is likely to be in a rural environment. This could be in Minnesota or an adjacent state. The biogas would then be purified to pipeline quality natural gas (i.e., remove the carbon dioxide) and put into the local natural gas pipeline. CenterPoint Energy would then transport the gas, for a fee, via pipeline to the South Loop district energy islands. Corn based fuel ethanol plants, potato process plants, and wet mill corn processing plants are some of the likely candidates for biogas generation.

The proposed district energy plants would require 125,000 mmBTU/yr for the BCS heating plant, 210,000 mmBTU for the MOA heating plant, and 900,000 mmBTU/yr for the MAC co-generation facility. As an example, the thin stillage from a 40 million gallon per year corn ethanol plant would be sufficient feedstock for an anaerobic digester to produce 900,000 mmBTU per year. There are 15 plants in the state of Minnesota that would be candidates to produce the energy needed for the co-generation plant. There are 21 plants in Minnesota that could provide enough feedstock for anaerobic digestion to produce biogas for either the east or west heating plants. It should be noted the feedstock does have a market value. The cost of the biogas would likely be in the range of $2.50 to $3.00 per mmBTU higher than the market natural gas price. Natural gas prices at Henry Hub have typically ranged from $2 to $6 per million Btu. Transportation charges typically add $1-1.50 per million to that price.

Section 3

District Energy System

Plant Locations

Preliminary plant locations for evaluation purposes were established based upon the following basic parameters:

- A plant site within a future building is preferred to a standalone facility within the South Loop District, because of the expense associated with procuring each land parcel .
- Land is considered to be more readily available and at a lower cost north of Interstate 494.
- Ideally, a plant site should be in close proximity to the load centers to minimize the distribution requirements.
- Airport compatibility.

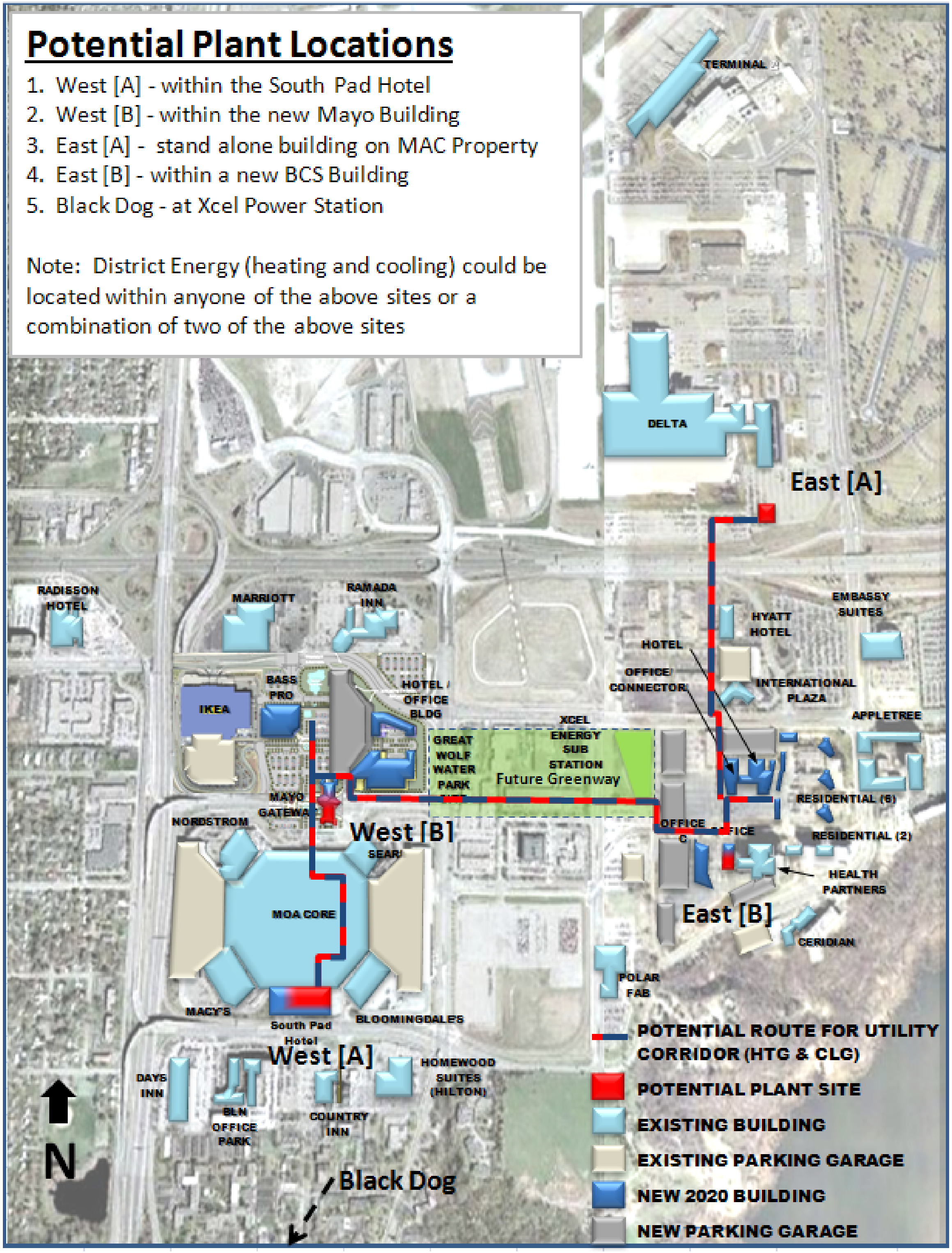
Based upon these parameters, four potential plant sites were identified and are noted in Figure 3-1. The blue and red dashed lines represent preliminary utility corridors that would consist of direct buried heating and cooling distribution pipes and possibly electrical ductbanks. The plant sites identified are potential locations established for this preliminary evaluation. Two of the plant sites are located on the east side of the South Loop, near the BCS load center and the other two sites are on the west side within the MOA load center. Each of the sites included challenges in regards to boiler stacks, cooling tower plumes and coordination with various stakeholders. The four sites and associated unique challenges are summarized below:

- **West [A]:** The district energy plant would be located at the ground level of the South Pad Hotel within the planned parking structure. This site provides significant advantages to serving the existing Mall of America and associated anchor stores, all of which are approaching a utility equipment renewal cycle within the next 5 to 10 years. The primary challenge with this site is the timing associated with the design of the South Pad Hotel that is currently in progress. It may be too late to incorporate a utility plant into this ongoing project.

- **West [B]:** A district energy plant may be located in the basement area of the proposed new Mayo Clinic facility.
- **East [A]:** A district energy plant may be sited within a standalone facility on the MAC property north of Route 494. The obvious issues with this site are the distance for distribution to the BCS and MOA as well as the procurement of the property.
- **East [B]:** A district energy plant would be located within a future building constructed as part of the BCS site development. The major challenge with this site option is the coordination required between the BCS developer and the operator of the district energy system, which would not be established until a later stage of development.

The district energy system could ultimately consist of one or more of these plant sites. The final selection of the optimum site will be based upon project timing, refined distribution costs, potential customers, and the life cycle economics. However, there is adequate potential to warrant further investigation to the utilization of one or more of these sites.

For this preliminary assessment analysis it was assumed that the generation capacity and plant space would remain relatively constant for each site alternative. Therefore, the capital cost for generation equipment and plant space, included in the economic analysis, would be representative of any of the plant locations.



Potential District Energy Plant Sites
Figure 3-1

Financial Evaluation

For this preliminary assessment a unitary operating cost for a typical facility within the South Loop District was estimated and compared to the approximate cost to purchase utilities from a district energy system. This comparison was performed for both heating and cooling systems. A subsequent analysis was developed to evaluate the potential of on-site electric generation in a combined heat and power arrangement.

Cooling

Based upon initial surveys and discussions with facility operators, the majority of the existing buildings utilize an air-cooled air conditioning system. Most of the systems are direct-expansion (DX) type where the refrigerant is circulated through the coils as well as the cooling unit. A district energy cooling system is comprised of large industrial refrigeration machines (chillers) that utilize a water-cooled condenser system to reject the heat through atmospheric cooling towers. The water-cooled systems require 30% less energy and last nearly twice as long as the typical DX cooling unit. However, the water-cooled systems, which are available in much larger capacity increments, cost about twice as much as the DX systems and require interior mechanical space for chillers and pumps. These cost and space requirements are typically mitigated when water-cooled systems serve loads greater than 500 tons. The energy advantages of district cooling are maximized when air-cooled equipment is replaced by a water-cooled centralized cooling system.

To estimate the annual operating costs for a typical air-cooled system several basic assumptions were established. These assumptions are noted in Table 3-1. This table also develops the unitary cost of operation based upon energy use, electric rates, maintenance costs, and debt service for capital expense. To estimate the debt service the approximate capital cost was converted to an annualized loan payment at 6% interest with a term equivalent to the average equipment life which varies depending upon equipment type. For comparison a separate cost was also estimated for a water-cooled system installed to serve a single building. The maximum annual savings for a building similar to HealthPartners (i.e., 471,000 gsf) is estimated at $25,000 (i.e., shifting from DX cooling to district cooling).

One of the key assumptions and the greatest risk associated with a District Energy Cooling System is the unitary capital cost of $3,000 per ton of installed refrigeration. This is an average cost which varies from site-to-site based upon the required plant architecture, distribution costs, etc. Therefore, if the a District Cooling System can be implemented to serve the South Loop District at a cost equal to or less than $3,000 per ton, then there could be a distinct economic advantage to district cooling. If the capital costs exceed the $3,000 per ton then the economic advantage of the District Energy System may be in jeopardy. Therefore, further refinement of the capital cost and evaluation are recommended to minimize risk and contingencies.

In addition, most district cooling systems utilize additional system components such as thermal energy storage, water-side economizers, alternative condenser water cooling systems, etc. to further improve the energy cost component. More detailed study and evaluation of the potential system enhancements are recommended as well.

Table 3-1 Generalized Comparison of Air Conditioning Systems

	AIR-COOLED BUILDING CHILLER		WATER COOLED BUILDING CHILLER		DISTRICT ENERGY COOLING SYSTEM	
	Assumptions	Unitary Rate	Assumptions	Unitary Rate	Assumptions	Unitary Rate
Unitary Electric Use	1.20 kw/ton		0.80 kw/ton		0.80 kw/ton	
Average Electric Cost (Note 2)	$ 0.105 / kwh		$ 0.105 / kwh		$ 0.073 / kwh	
Unitary Energy Cost	---	$ 0.126 / ton-hr	---	$ 0.084 / ton-hr	---	$ 0.058 / ton-hr
Maintenance Cost (Note 3)	$ 50 / ton /yr		$ 30 / ton /yr		$ 25 / ton /yr	
Capacity to Load Ratio (Note 4)	150%		150%		120%	
Load Diversity Factor	1.00		1.00		0.80	
Load Factor (Note 5)	13%		13%		13%	
Unitary Maintenance cost	---	$ 0.066 / ton-hr	---	$ 0.040 / ton-hr	---	$ 0.021 / ton-hr
Unit Capital Cost	$ 800 / ton		$ 1,500 / ton		$ 3,000 / ton	
Capacity to Load Ratio (Note 4)	150%		150%		120%	
Load Diversity Factor	1.00		1.00		0.80	
Replacement Period (Note 6)	15 years		23 years		30 years	
Annualized Capital Cost	$ 120 / ton / yr		$ 180 / ton / yr		$ 210 / ton / yr	
Load Factor (Note 5)	13%		13%		13%	
Unitary Capital Cost	---	$ 0.109 / ton-hr	---	$ 0.164 / ton-hr	---	$ 0.191 / ton-hr
Total Estimated Operating Cost		$ 0.301 / ton-hr		$ 0.287 / ton-hr		$ 0.270 / ton-hr

Notes:

1. The following formulas were used in the above calculations
   Unitary Energy Cost = Unitary Electric Use x Average Electric Cost
   Unitary Maintenance Cost = [Maintenance Cost x Capacity to Load Ratio x Load Diversity Factor] / [8,760 hours per year x Load Factor]
   Unitary Capital Cost = Annualized Capital Cost / [8,750 hours per year x Load Factor]
   Annualized Capital Cost = Annual Load Payment on Capital Cost with a term = replacement period and an interest rate of 6%
   Capital Cost = Unit Capital Cost x Capacity to Load Ratio x Load Diversity Factor
2. Average Electric Cost is based upon the average 2009 summer rate for Minnesota as published by the Department of Energy (DOE) and
   For the Building Systems the "Commercial" electric rate was used.
   For the District Energy System the "Industrial" electric rate was used.
3. Unitary Maintenance Costs were based upon data published by Electric Power Research Institute (EPRI).
4. Capacity to Load Ratio includes additional capacity for standby and non-diversified loads.
5. Load Factor = Total Annual Load / [peak demand x 8,760 hours per year]
6. Replacement Period based upon data published by American Society of Heating, Refrigeration and Air condition Engineers (ASHRAE).
7. Capital Costs include plant system and distribution piping.

Heating

Similar to the cooling system, a unitary cost comparison was developed for a generalized analysis to determine if a district energy heating system warranted further analysis. Typically individual buildings could utilize natural gas fired rooftop units or a building boiler system that circulates hot water to various terminal units throughout the facility. A comparison of typical building heating systems to district energy is presented in Table 3-2. In some cases, such as the MOA, electrical heating is also utilized. These electric heating systems were not initially included in the service area of the district energy heating system. The following is a comparison of the generalized unitary costs for each system type based on current natural gas prices. The maximum annual saving for a building similar to HealthPartners (i.e., 471,000 gsf) is estimated at $65,000 (i.e., building boiler to central heating).

The most significant cost difference in this general comparison is the savings associated with a district energy purchasing gas at an industrial rate under an interruptible tariff where the owner agrees to switch from using natural gas during high demand periods in exchange for a lower gas rate. The owner is required to have a secondary fuel source on-site to switch to when the natural gas supply is interrupted. . Most building systems, especially rooftop units, will be designed for one specific fuel source and therefore could not tolerate an interruption to the supply of natural gas. This will require the owner to purchase natural gas at the more expensive non-interruptible rate tariff. District energy systems are designed for multiple fuel sources and can purchase natural gas based upon an interruptible rate schedule at a much cheaper cost. When the supply of natural gas is temporarily interruptible, due to high localized demand, the district energy system will typically burn fuel oil which is stored on site.

The capital cost component of the District Energy Heating System was estimated based upon a unit cost of $60/mbh (1,000 Btu's/hr). Similar to the cooling system, the capital cost represents the greatest risk and potential disadvantage of a District Energy System. Based upon the initial capital cost assumptions, there appears to adequate economic support to warrant further investigation and refinement of a district heating application for the South Loop District.

There are also additional advantages associated with a district heating system that are not included in the previous general comparison. The district heating system will facilitate the potential use of renewable or alternative fuel source such as waste stream products, heat from manufacturing process, geothermal, etc. Further evaluation of these alternatives is recommended as well.

Table 3-2 Generalized Comparison of Heating Systems

	NATURAL GAS FIRED ROOFTOP UNITS		BUILDING BOILER SYSTEM		DISTRICT ENERGY HEATING SYSTEM	
	Assumptions	Unitary Rate	Assumptions	Unitary Rate	Assumptions	Unitary Rate
Fuel Efficiency	80%		80%		80%	
Fuel Cost (average from '07-'09)	$ 11.00 / mmbtu		$ 11.00 / mmbtu		$ 7.50 / mmbtu	
Unitary Energy Cost	---	$ 13.75 / mmbtu	---	$ 13.75 / mmbtu	---	$ 9.38 / mmbtu
Maintenance Cost (Note 3)	$ 3 / mbh		$ 6 / mbh		$ 10 / mbh	
Capacity to Load Ratio (Note 4)	150%		150%		120%	
Load Diversity Factor	1.00		1.00		0.80	
Load Factor (Note 5)	20%		20%		20%	
Unitary Maintenance cost	---	2.57 / mmbtu	---	5.14 / mmbtu	---	5.48 / mmbtu
Unit Capital Cost	$ 15 / mbh		$ 30 / mbh		$ 60 / mbh	
Capacity to Load Ratio (Note 4)	150%		150%		120%	
Load Diversity Factor	1.00		1.00		0.80	
Replacement Period (Note 6)	15 years		25 years		30 years	
Annualized Capital Cost	$ 2,320 / mbh / yr		$ 3,520 / mbh / yr		$ 4,180 / mbh / yr	
Load Factor (Note 5)	20%		20%		20%	
Unitary Capital Cost	---	$ 1.32 / mmbtu	---	$ 2.01 / mmbtu	---	$ 2.39 / mmbtu
Total Estimated Operating Cost		$ 17.64 / mmbtu		$ 20.90 / mmbtu		$ 17.24 / mmbtu

Notes:

1. The following formulas were used in the above calculations
   - Unitary Energy Cost = Fuel Cost / Fuel Efficiency
   - Unitary Maintenance Cost = [Maintenance Cost x Capacity to Load Ratio x Load Diversity Factor] / [8,760 hours per year x Load Factor]
   - Unitary Capital Cost = Annualized Capital Cost / [8,750 hours per year x Load Factor]
   - Annualized Capital Cost = Annual Load Payment on Capital Cost with a term = replacement period and an interest rate of 6%
   - Capital Cost = Unit Capital Cost x Capacity to Load Ratio x Load Diversity Factor
2. Fuel Cost is based upon the annual natural gas cost averaged for 2007, 2008 and 2009 for Minnesota as published by the Department of Energy (DOE) and
   - For the Building Systems the "Commercial" rate was utilized
   - For the District Energy System the "Industrial" rate was utilized
3. Unitary Maintenance Costs were based upon industry estimates
4. Capacity to Load Ratio includes additional capacity for standby and non-diversified loads.
5. Load Factor = Total Annual Load / [peak demand x 8,760 hours per year]
6. Replacement Period based upon data published by American Society of Heating, Refrigeration and Air condition Engineers (ASHRAE).
7. Capital Costs include plant system and distribution piping.

Combined Heat and Power (Cogeneration)

A combined heat and power system is based upon utilizing a waste heat stream from an electric generation system for a useful heating application to increase the overall fuel efficiency from 35% to 70%. If electric power can be generated from a system having a total cycle efficiency of 70%, then it may be cheaper than the power that is purchased from the local utility supplier depending on the costs for fuel. The following is an estimate of the cost to generate electric power for a new, stand alone cogeneration plant based upon the DOE energy rates previously used for the cooling and heating analyses (i.e., natural gas price of $7.50/mmbtu and 70% cycle efficiency) at a price of $0.048/kWhr.

The unit cost of $0.048/kWh is significantly less than the average electric cost of $0.075/kWh. For this initial analysis an average, regional electric rate was utilized. As more details are developed a comprehensive review of the specific rate tariff applicable is necessary. Possibly included in this tariff will the application of standby charges which are typically applied to power generation facilities that require the utility to provide standby power to the site in the invent that the power generation equipment is out of service. These charges can be significant and could possibly eliminate any economical advantages associated with the CHP system.

In addition to an efficient, cost effective approach to power generation, a combined heat and power system can also reduce the heating and cooling costs of a district energy system. Most combustion turbine applications include a supplemental duct-burner within the waste heat stream to further increase the boiler output. The net increase in heat generation is at an efficiency that is approximately 10% higher than a traditional boiler system. Therefore in addition to the heat generated from the waste stream of the power cycle, supplemental heating can be produced using 10% less fuel, thereby reducing the district energy steam or hot water rate.

To fully comprehend the economic savings associated with a combined heat and power system a more detailed analysis is necessary. However, in general, a $0.027 per kwh reduction in unitary cost would result in approximately $270,000 per year for a building similar in size to HealthPartners. This estimate is based upon a unitary electric load of 4 watts per sf and an annual load factor of 60%. The calculation is summarized below:

Annual electric load = 4 watts/sf x 471,000 sf x 60% x 8,760 hours /yr = 10 million kwh

Electric savings = 10 million kwh x $0.027 / kwh = $270,000

Additional heating savings: 16,250 mmbtu x $17.00 / mmbtu x 10% = $27,700

The heating load and unitary heating costs are based upon the example previously presented under the District Energy Heating System section.

Also, heat driven cooling can be added to the system to utilize the cogeneration waste heat flow during the summer period, when the district heating load is minimal. The heat driven cooling can be in the form of absorption cooling or steam turbine driven centrifugal chillers. The equipment selection will depend upon a detailed analysis of the optimum heat generation type for the district energy system. The cost to generate chilled water in a combined heat power cycle can be less than the cost to operate electric driven water-cooled chillers in a district system. The savings vary depending upon the heat source whether it is high pressure steam or low temperature hot water. A further detailed analysis will optimize the system selection.

There are several challenges that must be overcome to effectively implement a stand-alone CHP system. These challenges include: regulatory requirements and permits, power reliability, configuration of electrical gear, coordination with the local utility and a consistent load requirement. To fully realize the potential savings the waste heat must be fully utilized, which requires a continuous heat load throughout the year. Any one of the challenges, if unmet, could result in the elimination of the potential CHP system. Therefore a thorough and comprehensive evaluation is necessary to mitigate the potential risk associated with a combined heat and power system. The evaluation of CHP system follows the analysis for district energy heating. As the district heating system is evaluated in further detail, the potential for a CHP system should be considered as well.

Energy Islands

As mentioned above, the concept for the South Loop District Energy system is to develop small energy islands adjacent to the initial heating and cooling load centers at the Mall of America (MOA) and Bloomington Central Station (BCS). The BCS energy island could also be a combined heat and power facility with electricity production for the Metropolitan Airports Commission with heating and cooling provided initially to BCS. Electricity produced from the CHP system must be sold only to the MAC and the CHP facility must be located on MAC property. Therefore, there are three possible energy islands which are described below.

MOA

This facility would be a 16,000-ton electric driven chiller plant and a 75 mmBTU/hr natural gas or bio-gas hot water plant. As described previously, this plant would be constructed in either the parking garage below the Renaissance Hotel planned for the south side of the MOA Phase I complex or in the basement of the Mayo Clinic being considered for property immediately north of the MOA Phase I complex. This facility is estimated to cost $36 million to construct. The annual revenue was estimated at $7 million with a profit of $3 million. This gives a simple payback of approximately 12 years.

BCS

This facility would be a 3,000-ton electric driven chiller system and a 45 mmBTU/hr natural gas fired hot water plant. As described above, this facility could be constructed in a parking ramp adjacent to the HealthPartners building, in another BCS parking structure, or in the MAC parking lot in the northwest corner of 34 Street and Highway 494. The constructed cost of this facility is estimated at $8.7 million. The annual revenue is estimate at $2.5 million with a profit of $850,000. This generates a simple payback of approximately 10 years.

MAC/BCS Combined Heat and Power

This facility would be a 19,000-ton chiller plant (i.e., 2,000 tons steam driven and 17,000-ton electric driven), a 120 mmBTU/hr hot water plant, and an 8.5 MW gas turbine with a heat recovery steam generator. This facility would be constructed in the MAC parking lot northwest of the intersection of 34th Street and Highway 494. The constructed cost is estimated at $42 million. The annual revenue is estimated of $25 million with a profit of $5.3 million. This generates a simple payback of approximately 8 years.

South Loop Central Plant Powered BY Black Dog

Following repowering of Units 3 and 4, Black Dog could provide 150-psi steam or high temperature hot water to drive a hot water and chiller plant in the South Loop. This plant would be a 19,000-ton steam driven chiller plant and a 120 mmBTU/hr hot water plant. The steam and condensate pipelines are estimated to cost $17.5 million. The chiller plant would cost $38 million. The heating plant would cost approximately $2 million. The total project constructed cost is estimated at $57.5 million. The annual revenue is estimated at 10.6 million. The annual profit and payback will be dependent on the price of steam.

Environmental Impacts

The load projections show that the energy usage in the South Loop in 2020 will include 247,000 MWhr of electricity and 263,000 mmBTU of natural gas annually assuming continued use of individual building heating and cooling systems. The projected carbon emissions from the South Loop development can be calculated. The average emission of carbon dioxide for electricity generation in the state of Minnesota is 1.587 lb CO_2/kWhr. The carbon dioxide emission from combustion of natural gas is 116.36 lb CO_2/mmBTU. The carbon emission in 2020 of the South Loop is estimated to be 211,000 tons CO_2/yr.

As presented above, district energy systems increase the efficiency of energy use which reduces the overall carbon dioxide emissions. The carbon dioxide emission reductions for the systems presented in this report are calculated below.

Central Heating

Rooftop direct-fired building heating units, building boiler using hot water heating, and central heating plants with hot water distribution all have a similar efficiency. Assuming that natural gas is used for all building heating application in the South Loop, there is no increased efficiency from conversion to district heating. Therefore, a district heating system based on natural gas does not to any extent reduce carbon emissions.

Central Cooling

The majority of the building cooling in the South Loop uses electric DX (direct expansion) cooling systems that use 1.2 kW/ton. A centralized chilling plant that is electrically driven and water-cooled can increase the efficiency by 30%. This reduces the energy consumption to 0.8 kW/ton. Steam turbine driven chillers are an alternative to electric driven chillers for the central plant. Production of steam from natural gas increases the carbon emissions for chilled water production and it is also more expensive. Only in a combined heat and power scenario, as presented below, can the use of steam turbine driven chillers reduce net carbon emissions. This is due to the use of waste heat for steam generation.

The cooling load in the South Loop for 2020 is projected to be 26,184,000 ton-hr/yr. Converting these DX units to a central chilled water plant would save 10,473 MWhr of electricity annually. This could reduce the carbon dioxide emissions of the South Loop by 8,310 tons/yr. This is a 4% reduction in greenhouse gas emissions.

Combined Heat and Power

Cogeneration is the option to produce electricity and se the waste heat for producing hot water or steam to drive a steam turbine driven chiller. In this way, a cogeneration plant would produce electricity and hot water in the winter and electricity and chilled water in the summer. A 8.54 MW gas turbine generator was sized to drive a 2,000-ton chiller plant (i.e., 20% of chilled water load) in the summer and meet the average hot water demand in the winter. The systems can auxiliary fire using addition natural gas to meet peak water hot water demand. This plant would also have 17,000 tons of electric drive chillers in order to meet the entire South Loop chilled water demand.

This plant would use 900,000 mmBTU/yr of natural gas to produce 69,648 MWhr of electricity, 263,000 mmBTU/yr of hot water and 8,474,200 ton-hr/yr of chilled water. This plant would have a thermal efficiency of 67% and would reduce the carbon dioxide emissions of the South Loop by approximately 35,000 tons/yr. This represents a 16% reduction in the carbon dioxide emissions from the South Loop.

South Loop Central Plant Powered by Black Dog

Xcel Energy operates a power generating station approximately 3.7 miles from the South Loop. Currently, the power plant uses natural gas and coal to generate electricity. Xcel expects to repower the older coal fire units in the next 6 to 10 years. These units would be converted to gas turbine combined cycle operation fire with natural gas. Steam or high temperature hot water would be used as the sole energy source for a district heating and cooling (i.e., steam driven chillers) system. The extracted steam, used directly or converted to high temperature hot water, is estimated to have an associated carbon emission of 25,000 tons/yr. The central heating and cooling system would save 44,000 tons/yr of carbon emissions. The net emissions reduction for the South Loop is estimated at 19,000 tons/yr. This represents a 9% reduction in carbon dioxide emissions from the South Loop.

Section 4

Implementation Issues

Regulations and Legislation

There are a variety of regulations relevant to the development and operation of a district energy system. Similar to any infrastructure project, depending upon the technologies used, and plant design and configuration, there are a variety of federal, state and local codes and regulations concerning plant/system design, safety, emissions, etc., that must be considered and complied with. However, unlike the natural gas industry or electricity generation and distribution, which are highly regulated, the district energy industry is basically unregulated. The Minnesota Public Utilities Commission (PUC) regulates the sale and distribution of both electricity and natural gas, but not the control the distribution and sale of steam, hot or chilled water. There are PUC regulations that intersect with district energy systems when it comes to the use of public right-of-way for distribution systems, and for those district energy systems that have electricity generation and distribution included in the system. An example would be a system that uses a combined heat and power plant to co-generate heat for the district energy system and electricity that is sold to the electric grid.

There are regulations concerning the use of public right-of-way that must be considered. Minnesota Statues on Cities, Chapter 410 indicates that a city charter may be used to regulate the use of public street or right-of-way for utility infrastructure such as district energy systems. This is an area that needs to be examined further to determine what if any regulations or ordinances would be required to allow a system in the South Loop to use the public right-of-way for distribution piping. Another area that needs further exploration is the Suburban Rate Authority (SRA). The SRA is a joint powers organization of Twin Cities metropolitan area suburbs totaling over 850,000 in population. The SRA intervenes in electric, gas, and telecommunications matters before the Minnesota Public Utilities Commission and actively reviews developments in right-of-way use, utility franchise, and other utility matters affecting cities and their residents. Based upon information available on the SRA it is unclear as to what interest or involvement the SRA would have in a district energy system in the South Loop.

On the legislative front, district energy and combined heat and power are receiving more attention, due its ability to improve energy efficiency and reduce carbon emissions. The Energy Independence and Security Act of 2007 (EISA) includes a variety of programs and incentives to encourage the use of district energy systems and combined heat and power. Until the American Recovery and Reinvestment Act (ARRA) those programs and incentives went largely unfunded. The Department of Energy and members of Congress have recognized the need to fund projects through EISA and there are a number of bills being considered. The International District Energy Association (IDEA) is working with a number of senators and representatives on new legislation and funding of programs created by EISA. In addition, climate and energy legislation under consideration have provisions that pertain to district energy and combined heat and power. In the Minnesota delegation, Congresswoman McCollum and Senator Franken have been strong supporters for funding the programs in EISA that specifically target the increased use of district energy and combined heat and power.

There is also a growing recognition in Washington that the creation of sustainable communities requires there be collaboration across the agencies. HUD, EPA, and DOT are now working together under a new program called Sustainable Communities. The Met Council, MHFA, Hennepin and Ramsey Counties, and the cities of Minneapolis and Saint Paul are actively engaged in conversations with representatives of this program.

At the State level, the Minnesota Office of Energy Security is very supportive of the use of district energy and combined heat and power, and in changing state statute to further encourage its use.

Liability and Risk

There are a variety of risks and liabilities that must be managed during the development and operation of a district energy system. The risks to the City are dependent upon its involvement, project ownership structure, financing model, and how it is constructed, operated, regulated, and governed.

Like many infrastructure assets, the development process for a significant district energy system project is both lengthy and costly. The design and construction risks for district energy projects are similar to that of other infrastructure projects. The project must be properly contracted and managed during design and construction to mitigate the liability and risks inherent in an infrastructure type project. The project must also be financed and the debt secured. A South Loop project could be financed with the City of Bloomington backing a portion or all of the debt. The degree to which the City is involved in the financing of a project and the terms of the agreements would establish risk for the City.

The financing of district energy projects are unique in that the security for project financing regularly use long-term customer contracts as security. Contract lengths are typically the same for the term of debt financing, 15–25 years. Use of customer contracts as security would require completing contracts with a sufficient number of customers/buildings prior to closing on the project financing. This can be a lengthy process. In addition to being important for the financing of a project, the terms and conditions of customer contracts are important for managing risk for the owner/operator of the district energy system. Customer contracts establish the terms under which the system will interconnect, deliver, meter, and invoice customers for heating and/or cooling services. Customer contracts also establish other important terms such as service dates, building capacity needs, contract extension and termination, etc., which determine the operational risks for the owner/operator.

There are also regulatory risks that must be managed during operation. The main risk is the environmental regulatory risk which is dependent upon the technologies used, energy sources, system size, plant design, etc. For example, the development of a combined heat and power plant would require obtaining an air emissions permit from the Minnesota Pollution Control Agency, and operating the plant within the limits of that permit. Environmental regulations are regularly being updated, which in turn change the limits under which a system must operate and comply. Updates in environmental regulations may require the system to change how it operates, or require the investment of additional capital to enable the system to comply with a change in emissions limits.

While there are many liabilities and risks that must be considered and managed as in all businesses, there are several district energy systems in operation in Minnesota and many throughout the U.S. The City's exposure resulting from the development of a South Loop system can be managed and risks mitigated or eliminated depending upon how the ownership and management of the project is structured and level of involvement of the City in the project. Development owned and operated by the City would have more exposure than a development owned by a private entity.

City Involvement

The level of city involvement in a district energy system located within a city is dependent upon factors including state statutes, city ordinances, and company ownership and governance structure. District energy systems (heating and cooling) in the United States have a wide variety of city involvement, from little to no involvement to ownership and complete oversight.

District energy systems can typically be in classified into one of the following categories,

- Municipal or Public Utility.
- Private Utility.
- College and University.
- Private District Energy System (hospitals, company campuses, etc.).

A district energy system that serves a college, university, hospital or company campus typically have little to no city involvement, except for those instances where distribution piping for the system needs to be routed in a public street or right-of-way. Such routings may require a permit or other approval by the city. District energy systems serving cities and business districts, such as is being considered for the South Loop, typically have an increased level of involvement, and the level of involvement varies greatly.

One of the factors is system ownership. The system being considered in the South Loop could be developed either by a private utility, the City, a developer, or a combination thereof. Recently developed systems in the United States, such as the district cooling system serving downtown Phoenix, have typically been developed by the local public or private utility. This is driven in large part to the capital requirements of district energy projects. Similar to other utility systems, district energy plants and distribution systems are capital intensive, with long development times, and paybacks on investments that occur over several years. The degree of involvement of the City varies greatly depending upon how the project is developed and owned. There are district energy systems in Minnesota owned and operated by the municipal utility. Among them are New Ulm, Virginia, Hibbing, Willmar, and Duluth. There are also examples of a district energy system owned by a county. Hennepin County owns the heating and cooling system serving Hennepin County Medical Center as well as a number of private buildings in close vicinity. Hennepin County is currently considering the development of a new district heating and cooling system in the North Loop that would emanate from the Hennepin Energy Recovery Center (HERC).

Another factor that determines the level of City involvement is the use of public lands and right-of-ways (streets, sidewalks, etc.). District energy systems that serve business districts typically use public lands and right-of-ways for distribution piping systems. The authority, permission or license to access and use public land and right-of-ways for the distribution system can be granted in many forms (charter, franchise agreement, etc.), and too depends in part on the ownership of the system. In Minnesota, permission to use the public right-of-way in cities is managed by the cities. The City of Bloomington can expect to be involved allowing a new district energy system to access and use the public right-of-way for its distribution systems.

Another area that the City could become involved in is in rate regulation. The Minnesota Public Utilities Commission (PUC) does not regulate district energy systems, and thus the regulation of rates in Minnesota varies by the system and its ownership. Systems owned by municipalities typically have a rate regulation process. It is mixed for the private utilities. For example, District Energy St. Paul's rates are reviewed and approved by the City of Saint Paul in accordance with its franchise agreement with the City. Conversely, NRG Thermal Minneapolis' rates are not regulated. How rates are regulated for a system in Bloomington will be determined in part by the ownership structure of the district energy system.

Section 5

Conclusions

Presented above is a Preliminary Assessment of implementing a district energy system in the South Loop. This concept identifies three energy islands: Mall of America, Bloomington Central Station, and the Metropolitan Airports Commission. These energy islands could include central heating, central cooling, and electricity production or a combination thereof. Electricity, natural gas, and steam from Black Dog Power Station were identified as the initial energy sources. Central cooling plants significantly reduce the net carbon emissions of the South Loop. Combined Heat and Power and/or off-site biogas generation are possible variations to further reduce the carbon dioxide emissions of the South Loop. The use of steam from Black Dog electricity generation also provides a reduction in carbon dioxide emissions.

The concept presented allows for development of any or all the energy islands either separately or in parallel. These individual sites would be developed as the local load centers develop and choose to take advantage of the district energy system. Distribution would expand as new loads come on line. The goal would be to expand the distribution systems of the individual energy islands towards each other seeking to create a single integrated district energy system. This approach allows for construction of the energy islands and distribution system to grow as South Loop development grows. Therefore, this energy island concept presented above provides for system flexibility and adaptability to actual South Loop development.

As presented above, the central chiller plants provide a significant reduction in carbon dioxide emissions from individual building direct expansion cooling used today. The combined heat and power plant proposed provides even greater carbon dioxide emission reductions because of the greatly increased thermal efficiency of the proposed facility. Steam produced from cogeneration at Black Dog Power Station can provide additional reductions in carbon dioxide emissions. Therefore, the energy islands proposed can play a role in reducing the environmental impact of the City of Bloomington and specifically South Loop activities.

All of the energy island concepts were shown to provide payback time periods of less than 15 years. These projects have financial paybacks that are consistent with financial requirements of municipalities and non-profit public-private partnerships. These economic evaluations assumed current energy rates so that South Loop businesses could transition to the district energy system without changing their energy costs. Conversion to district would likely occur when current equipment needed replacement. At this time the conversion to district energy would have a lower capital cost than equipment replacement. New development would see a capital cost savings by hooking up to the district energy system as part of facility construction. Therefore, district energy provides a capital cost savings and market competitive energy rates. These benefits provide economic incentives for businesses to stay in or relocate to the South Loop.

Thus, an energy island approach to implementing district energy in the South Loop is economically sustainable, environmentally sustainable, and would be socially acceptable because it would fit with the City of Bloomington's commitment to creating a sustainable community.

It is recommended that the City of Bloomington proceed to the District Energy Feasibility study to further develop the energy island concept into an implementable plan that current South Loop tenants can embrace and that provides incentives for development with the South Loop.

Appendix A

Charrette Meeting Notes

Stanley Consultants INC.

MEETING NOTES

No. 1

Date: April 14–15,2010

Place: City of Bloomington, MN

Project/Purpose: South Loop District Energy Study

Attendees: City of Bloomington: S. Rudlang, B. Sharlin, K. Keel, D. Johnson, S. Pederson
MAC: D. Kowalke, S. Wareham, G. Warren, F. Hartrauft (Machaud Cooley)
Ever-Green energy: K. Smith, A. Rydaker
RMF Engineering: S. McAdams
Stanley Consultants: P. Hirl, R. Darnell, B. Liegois

Notes By: Rob Darnell

The following meeting notes set forth our understanding of the discussions and decisions made at this meeting. If no objections, questions, additions, or comments are received within 5 working days from issuance of the meeting notes, we will assume that our understandings are correct. We are proceeding based on the contents of these meeting notes.

Wednesday, April 14, 2010

1. STAKEHOLDER REVIEW

A. Mall of America (MOA)

Phase 1 (core mall excluding 4 anchor stores)

- There is minimal to opportunity to supply heating to the MOA (phase 1) because of heat from lighting and patrons. The MOA currently utilizes 3-4 MW of electrical heat at entrances and loading docks and to promote snow melt on sky light windows. The 4 anchor stores maintain their own HVAC heating and cooling systems. Sears utilizes direct-expansion (DX) cooling units; while, Bloomingdales, Macy's, and Nordstrom's have water-cooled systems which utilized exterior mounted cooling towers. There may be an opportunity to supply chilled water to the MOA as an alternative to the existing 33 Rooftop Units that have a total cooling capacity of 13,000 tons. These units utilize evaporative cooling condensers and are generally less efficient than District Energy cooling.
- The MOA (phase 1) had 123,000 MWH of electrical consumption in 2009. The MOA has 10 years of historical electric data available. The total electric use has been reduced by ~10% by the implementation energy efficiency initiatives, but electric costs have increased 5%. The MOA has a committed focus on energy reduction.
- The consultant team needs to contact the utility manager for each of the 4 anchor stores – SCI. The MOA will provide the contact information.
- All Domestic hot water heating is accomplished through electrical point-of–use equipment.
- The MOA restaurants consume 660,000 mmBTU of natural gas annually for cooking (95%)
- The restaurants each have their own, separate exhaust systems.
- The restaurants also dispose of 2,000 gallons of waste oil per month and approximately 1,600 tons of food waste per year. The food waste is currently be utilized by a local pig farm.
- The MOA is in the process of conducting a baseline carbon footprint survey.
- The MOA is also implementing LED lighting tests for parking lot areas.

Phase II

- The Renaissance Hotel is planned for completion next summer (2011) on the south end of the MOA. The hotel is planned for 345,000 sq ft with 500 rooms. (using Build American Bonds).
.
- MOA is developing Phase II in multiple stages. Overall the MOA Phase II includes approximately 33 acres available for building sites.
    - Phase IIA – Mayo Clinic Facility: the size range potential is from a kiosk to a 250,000 sq ft building. More information may be available in July 2010 and an announcement by the Mayo Clinic is anticipated in November 2010.
    - Phase IIB – Bass Pro Shop and parking lot.
    - Phase IIC – Great Wolf Water Park and Hotel Site.
    - Phase IID – Central mall complex (2017 start).
- There is a meeting at City Council on April 22, 2010 to discuss phasing and financing of the proposed 3.5 million sq ft MOA expansion.
- Depending upon the location of possible Mayo Clinic Facility the lowering of Lindau Lane –may be required at a cost of $17 million. The MOA would like the City to pay this cost; however, more planning and discussion is required in regards to the building location and road changes. Lindau Lane was just rebuilt by the City in 2004.
- For the MOA the timing of a district energy (DE) system will determine the viability for incorporating the various MOA facilities. If buildings are not initially connected, they won't be for 20-30 years. The MOA and Mayo Clinic likely have a positive interest in DE, if available.
- Expansion of DE to supply the MOA Phase I would be possible. MOA has previously considered a combined heat and power (CHP) plant, but several future phases of expansion are needed before cogen is feasible. The MOA is not interested in owning or operating the CHP Plant, if possible
- The goal of LEED certification is tenant dependent.
- The existing MOA (phase I) roof is 18 years old and has a 20-year warranty. Therefore a new roof may be needed within the next 5-10 years. The new roof may provide an opportunity to replace the existing cooling system with DE.

B. Bloomington Central Station – McGough

- The existing central plant the serves the Health Partners building. The plant has more capacity than required today, but needs to be replaced. The capital cost for replacement is estimated to be $3-4 million. The new location for plant is planned for the basement of Health Partners Building.
- There is a 150,000 sq ft addition on Health Partners planned.
- The future site development of hotels, residential, and five office buildings are all market driven. The use of District Energy is tenant dependent, The energy supplied by DE must be at or cheaper than what they pay today. There is a concern that if BCS commits to District Energy they may not be as competitive in attracting tenants.
- LEED certification is considered a positive, but only if tenants want it.
- The Ceridian site is a McGough 1998 development south of the current BCS development. The site was originally Control Data which later downsized and renamed the site Ceridian.

C. MAC

- The commitment for reduction of Greenhouse Gases (GHG) is not yet defined, but is anticipated to be established within the next 5 years.
- On-site emissions reduction by Federal Aviation Administration (FAA).
    - VALE (Voluntary Airport Lower Emissions) program.
    - MPCA – Administers VALE program.
    - VALE program is a potential funding source.
    - VALE looks at existing systems.
- Terminal 1 (Lindbergh)

    - steam (125 psig) with Jet A as back-up fuel
    - Chilled water plant (11,000 ton capacity including 2,000 tons of standby).
    - 4 MW of on-site emergency power generation
- Terminal 2 (Humphrey)
  - Hot water (185 F) generated for heating
  - Heating plant purchases firm gas
  - Plant was designed to double in size
  - An expansion of Terminal 2 is planned in the near future (existing 10 gates are to expand to 27 gates in the next 5 years and then ultimately 36 gates total within 20 years)
  - 80% of the facility has outside air economizer capability
- Plume abatement for cooling towers is a big issue/requirement to get FAA approval. Existing systems have plume abatement capabilities, but are rarely used due the use of dry-coolers for the minimal winter cooling load.
- New construction requires shadow studies for control tower to ensure the tower is not obscured from seeing aircraft on approach (shadowing).
- RPZ (Runway Protection Zone) and Safety Zones A and B have noted clearance requirements that extend outward from the runway edge and rise at a rate of 1 foot per 50 feet. No open water is allowed within the RPZ or under the Safety Zones.
- Any new project near the airport and RPZ with require 7460 FAA review.
- Snow storage moved to snowmelt.
- Mn/DOT also doing snow storage around airport property.
- Snow storage can be below RPZ zones, but the structure needs to be designed to support emergency response vehicles.
- Left and right stormwater ponds belong to MAC.
- Middle stormwater pond belongs to Mn/DOT.
- 110 ft drop from upper pond down to river. Possible low head electric/hydro.
- 8-12 ft deep stormwater ponds.
- Box culvert from RW 17/35 for storm water collection.
- Thermal Storage Opportunity (south of FEDEX building)
    - 7 million gallons of glycol storage (3 tanks) (15 ft deep).
    - Tanks segregate recovered glycol solution based on concentration.
    - The tanks are drained during the summer for annual inspections.
    - Pumps and valves are installed to facilitate switching between tanks.
- Delta – Building F and C complex – Chillers were just replaced. Recently added $10 million upgrade to old Republic building

D. Utilities

A. Xcel

- Likely to want to retain customers.
- Receptive of ideas around energy conservation.
- Xcel has expressed interest in providing heat from Black Dog Power Plant.
- There are quarterly meetings scheduled between the City and Xcel to provide updates on the progress of the District Energy Study.
- Conservation and sustainability goals of Xcel could provide an advantage for a District Energy System.
- The City has been open with Xcel and has no hidden agenda.
- Xcel appears supportive of energy conservation/reduction programs.
- Based upon previous experiences, it is anticipated that Xcel Energy will be opposed to on-site power generation, when that evaluation occurs.
- MAC is evaluating locally available renewable energy options.
- Xcel has invested in South Loop area with infrastructure (duct banks and substation). The original substation was relocated out of the RPZ.

- The Franchise agreement between City and Xcel expired 2-3 years ago.

B. CenterPoint Energy

- Appears neutral thus far about South Loop DE.

C. Metro Transit

- The Metro Transit is currently converting from 2 to 3 car trains and expanding station platforms to accommodate the larger trains. This program will result in more power requirements and thus the need to renovate substations and a new substation at end of line at MOA.
- Metro Transit would like to utilize renewable energy.

2. OUTSIDE SOUTH LOOP CORE OPPORTUNITIES

- Polar Fab (flex tech) – just expanded.
- Cypress Semiconductor
- Fish and Wildlife Service – property owner along river and will require coordination for access rights across property.
- Metro Council (in Eagan) –
  - Transit (LRT)
  - sanitary sewer,
  - storm sewer,
  - planning-land use – energy use us on their radar screen.
- Black Dog Power Plant is located in Burnsville and there is a power line corridor extending north from the plant.
- Sanitary sewer mains that transverse the site
  - 48" gravity line is installed along 86th Street south to MOA and along Route 77
  - The 48" line connects to three 36" lines that cross the Minnesota River terminating at the waste water treatment plant.
  - This sewer collection service supports Richfield, Edina and Bloomington
  - The average load is estimated to be 10 to 12 million gallons per day.
- IKEA (Philadelphia HQ) – 320,000 sq ft
- Radisson Hotel and Water Park – 65,000-75,000 sq ft.
- The City is purchasing 5 buildings east of MOA that they will demo within 3 years and make a greenway (road with bike and pedestrian trail and green path) which could be used as a utility corridor between MOA and BCS for District Energy.
  .
- The parcels owned by MAC that are located on southern half of the South Loop.
- Existing Kelly Farm property is currently involved in a lawsuit with MAC and the City.
- Potential for Personal Rapid Transit (Elevated personal/computerized pods).
  - Heathrow Airport (London) – parking lot to terminal.
  - West Virginia – Morgantown – hybrid.
  - Minnesota has PRT Czar.
  - J-PODS – There is a possibility for a test track to run from MOA to IKEA
  - The track may be a potential to support utility distribution.
- 66% of the future growth for the City of Bloomington is planned for the South Loop.
- CenterPoint – Peak shaving natural gas plant south of the Minnesota River in Burnsville may be a heat recovery opportunity
- Existing buildings along American Boulevard west of Route 77(property becomes less expensive)
  - Water park, hotel, office/warehouse
  - Potential loads to add to the District Energy System in the future.

- Mn/DOT
    - Apple Valley to MOA – along 77 – Mn/DOT is doing a traffic study, which will disturb traffic lanes and shoulders which may present an opportunity to install distribution pipes.
    - Old Cedar Bridge – existing steel truss bridge that is not being replaced, but will be renovated. This could be used to support pipes.

3. PROJECT DEVELOPMENT BRAINSTORM SESSION

A. "2020" Loads (Phases have been divided into 10 year increments; the 2020 interval represents the first phase)

- MOA Phase I – The consulting team needs information on the 4 anchors
- MOA Phase II – Mayo, Bass Pro Shop, Renaissance Hotel, Water Park and Hotel Site, office building, parking structure
- IKEA - consulting team will request energy use data
- BCS – residential on east, 2 offices, hotel, Health Partners (150,000-200,000 sq ft expansion)
- Hotels and Restaurants – south and west of MOA (built same time as MOA or 1990s)
- Water park/hotels/office – west of MOA (American Boulevard)
- PolarFab - consulting team will request energy use data (waste to energy source supplier)
- Cypress - consulting team will request energy use data (waste to energy source supplier)
- Marriott/Thunderbird (Ramada now) Hotels (1960s)

B. MAC – Airport

- No expansion plans in Building C area.
- Potential load for Building C – Dennis to look at.
- MAC leases the facility to Delta.
- Building loads separate from MAC.
- Terminal 2 (Humphrey) Expansion – five-year window (2010-2015 Humphrey buildout)
- QTA (quick turnaround) car rental facility parking expansion.
- Terminal 1 (Lindbergh) Expansion
    - Terminal 1 will support Delta and Sky Partners
    - All non-Delta flights go to Terminal 2.
    - The MAC has shaved 12% load already for Lindbergh since 1989.

C. Other Loads

- International Plaza (1984) (south of airport in loop) 300,000 sq ft office building.
- Hotel just north of Health Partners (1996)
- Apple Tree Square Area (1973) – Holiday Inn, office building (east of Health Partners)
- Hilton Hotel
- Embassy Suites (1985)

*34th Avenue Bridge/494 Interchange will be redone in next 20-30 years. This could be an opportunity to get DE piping across 494. Terminal 2 expansion may drive this opportunity.

4. DISTRICT ENERGY CONCEPTS

A. District plants –Energy islands – 3 locations

- BCS, Terminal 2 (Humphrey), MOA
- Interconnect District Plants (over multiple phases)

B. Two plant sites

- Terminal 2 (Humphrey)
- South Plant to serve MOA and BCS areas

C. **Centralized Energy System**
  - Central Energy Plant to serve the entire site
  - The MAC wants forecastable electric rates which represents their priority interest in District Energy.
- CHP at MAC
  - Loads in MAC/South Loop
    - MAC – 23 MW
    - MOA – 27 MW
    - Delta – 21 MW

(CenterPoint and Xcel feeder drawing – Dennis still owes us this.)

<u>Thursday, April 15, 2010</u>

1. **BOB'S CONCERNS FOR PLANNING:**
   - Politics
   - 2025 mandates
   - 60% of energy needs today
   - RPS (Renewable Portfolio Standard) of 10% for State
   - Now, 2030, 2050

2. **POTENTIAL ENERGY SOURCES**

A. **Black Dog**
  - 140°F HW
  - 150-psig steam
  - 200°F or 400°F

B. **Seneca Wastewater Treatment Plant**
  - Fluidized bed incinerator for sludge disposal
  - Potential waste heat recovery from incinerator

C. **Waste heat recovery from MOA cooling system heat rejection.**

D. **Sewage line along Highway 77 going to Seneca, Waste heat recovery from 10-12 MGD**

E. **Hennepin County Waste Transfer Station (River and 35W)**

F. **Other stakeholders – Cypress, Polar Fab**

G. **Biomass Energy Production in South Loop**
  - Wood SPDE:
    - Importing 50% from outside Twin Cities.
    - Dependent on storms and construction.
  - Wood:
    - Emerald ash borer will generate more feedstock in future.
    - Enough wood is available locally for heating plant, but not for a cogen plant.
  - Others:
    - Corn stover has logistic issues.
    - Wood study from RockTenn– doesn't address ash borer issue.
    - C&D wood waste (construction debris) – Ramsey and Anoka's going to landfill now; need waste burner to use it (SWIM club).
    - Wheat mill feed.

  - Energy crop – incentives to grow trees.

H. Biogas sources – MAC/MOA/Bloomington restaurant and kitchen waste.

I. Gasification politically more acceptable then incineration.

J. Geothermal (ground source):
  - High water table (20 ft) and permeable soil (sand).

K. Solar thermal for HW:

L. Thermal storage.
  - Snow collection/melt – snow based cooling.
    - MAC glycol tanks – thermal storage during summer. Delta controls with contractor for summer maintenance of glycol tanks.
    - MAC snowmelt – melt water drains to ponds.

M. Biogas production out-state (AD – wheel credit to South Loop):
  - Ethanol plant.
  - Potato processor.
  - Sugar beet processors.

N. KL cellulosic ethanol – high density/high energy lignim pellet.

3. FEDERAL AND STATE LEGISLATIVE INITIATIVES

A. Legislation
- Federal:
  - Energy Independence and Security Act (EISA) – 2007.
    - 471 – Institutional Energy Efficiency.
    - 451 – Industrial Energy Efficiency.
- State:
  - RPS – focused on electrical; not thermal.
  - Vary by states.
  - Office of Energy may have legislation next year.
- Local.

- Franken and McCollum – CHP, DE.
- Klobuchar – less interested.

B. Utility
- GRE supports renewable CHP.
- Xcel not as much.

C. Grants
- Production tax credits
- Waste heat recovery.

D. Sustainable Community Program
- Federal - LaHood (DOT).
- $140 million – grants and/or loans.
- HUD.
- EPA.
- Housing and Transportation and Economic Development.
- DOE (in future).
- USDA (in future).
- Distribution of piping – tax exempt financing.
- Plant – can get percentage if serving government entities.
- CenterPoint may support DE/CHP. CHP increases gas usages.
- Mostly residential load. Difficult to achieve 1 to 1-1/2% per year for RPS.

E. Fuel Cells

- Hydrogen – Need renewable energy to make hydrogen. Also, energy recovery is possible, if doing power.
  - NG
  - Biogas
- Bloom Box – Electrical Production
  - Off NG
  - Off methane

4. REVIEW AND SUMMARIZE DEVELOPMENT CONCEPTS

A. Closing Issues

- MAC land is important.
- Free Trade Zone – north of 494.
- BCS – District heating and cooling plant integrated into parking structure.
- MAC is open to CHP on the airport property.

B. Summary

- Energy islands developed around load centers. They can be developed separately.
  - o BCS
  - o MAC
  - o MOA/American Boulevard
- Pick up initial loads and minimize initial distribution piping
- Expand distribution systems as loads are built
- Take advantage of greenway and 34th Ave renovation to connect energy islands

C. City Filters

- Sustainable (renewable).
- Economic (beneficial) for development into the Loop.
- Flexibility.
- Timing.

D. Next Steps

- Meeting:
  - o Met Council.
  - o 4 anchors.
  - o Polar Fab.
  - o Cypress.
- Estimate Load Profiles.

Distribution:
Attendees