Utility Master Plan

FM - Energy Management Department

University of Minnesota

Agenda

- Scope of Energy Management
- Sustainable & Alternate Energy Options
- Scope and Approach to Master Plan
- Energy Statistics and Costs
- Recommended Upgrades (Long & Short Term)

Energy Management's Core Principles

- **SUSTAINABILITY**
- **RELIABILITY**
- **COST CONTROL**

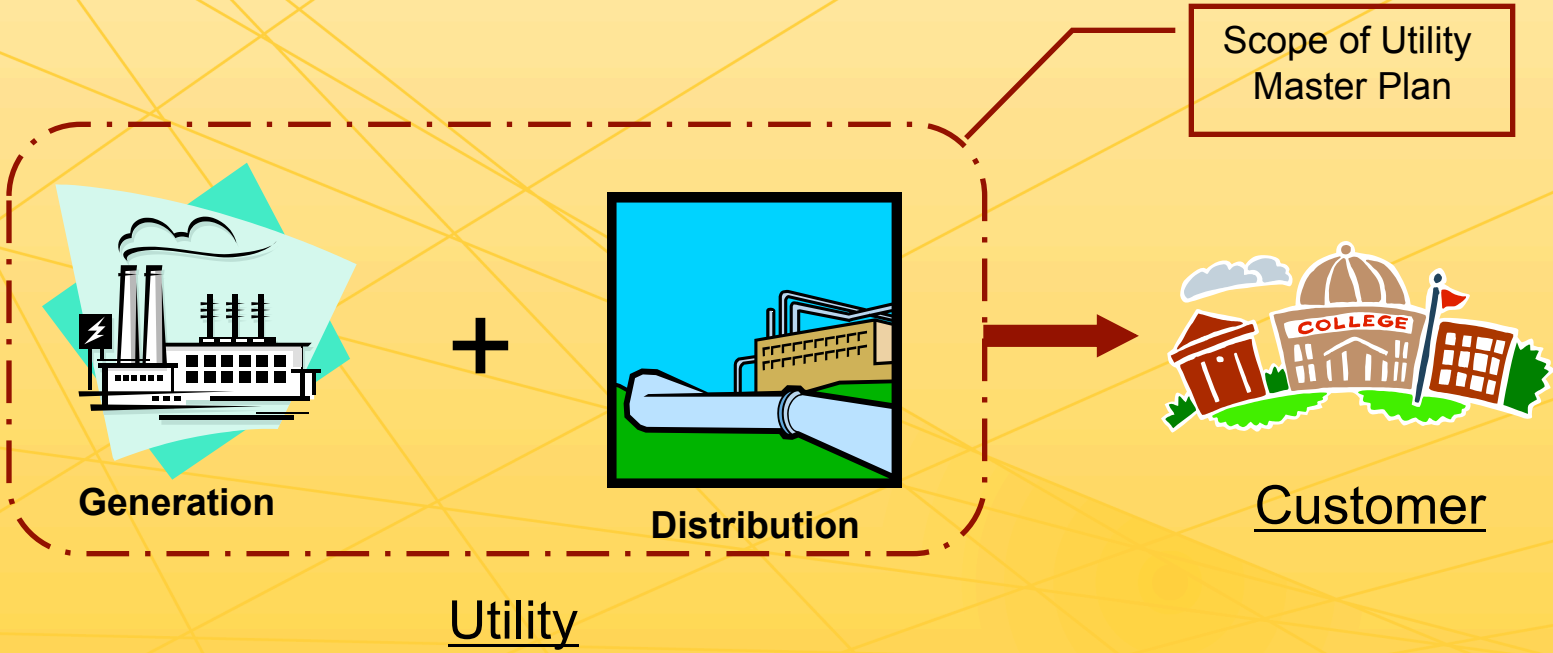
Energy Management Initiatives and Their Impact on Principles

	Utility Master Plan	Facility Standards	Commission/ Recommission Buildings	Behaviors/ Scheduling
Reliability	Highest	High	Medium	High
Sustainability	Medium	High	Highest	Highest
Cost Control	High	High	Highest	High

How Is Utility Infrastructure Design Traditionally Approached?....

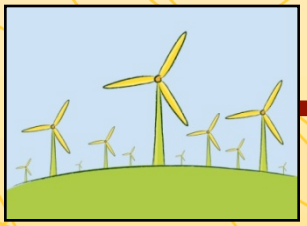
With Generation and Distribution of Utilities.

(i.e. Build Enough Generation and Distribution To Meet The Present and Future Demands Of The Customers)



Electric System Has Opportunities For Sustainable Solutions

* Requires New Legislation On Wheeling Power

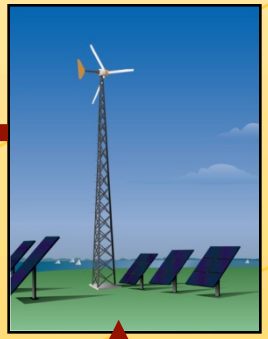


OPTION
Purchase Remote Wind Generation

Xcel Energy
Transmission Grid

OPTION
Combined Heat & Power Bio-Fuel Plant

Build A New Electrical Switch Station



OPTION
On-Campus Wind or Solar Generation

OPTION
Plug-In Vehicles

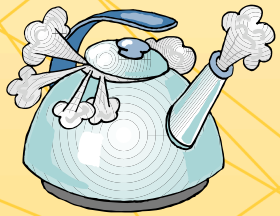
Existing Campus Electrical System

OPTION
N.E. Chiller Cluster

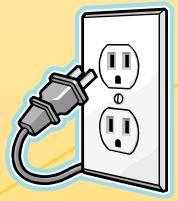
OPTION
Battery Storage

Utilities In Master Plan …..

- **Steam**



- **Electricity**



- **Chilled Water**

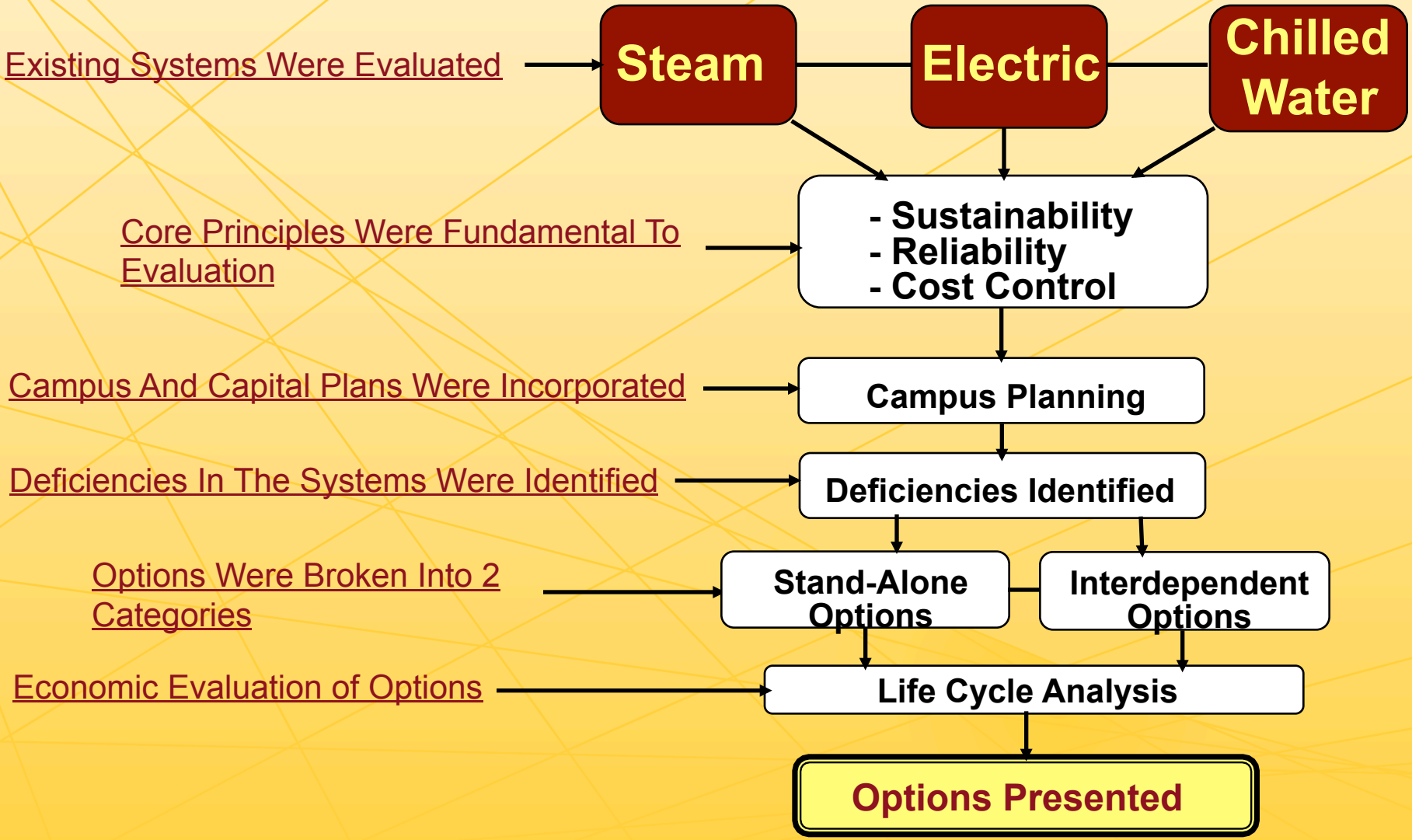
- **Storm Sewer**

- **Sanitary Sewer**

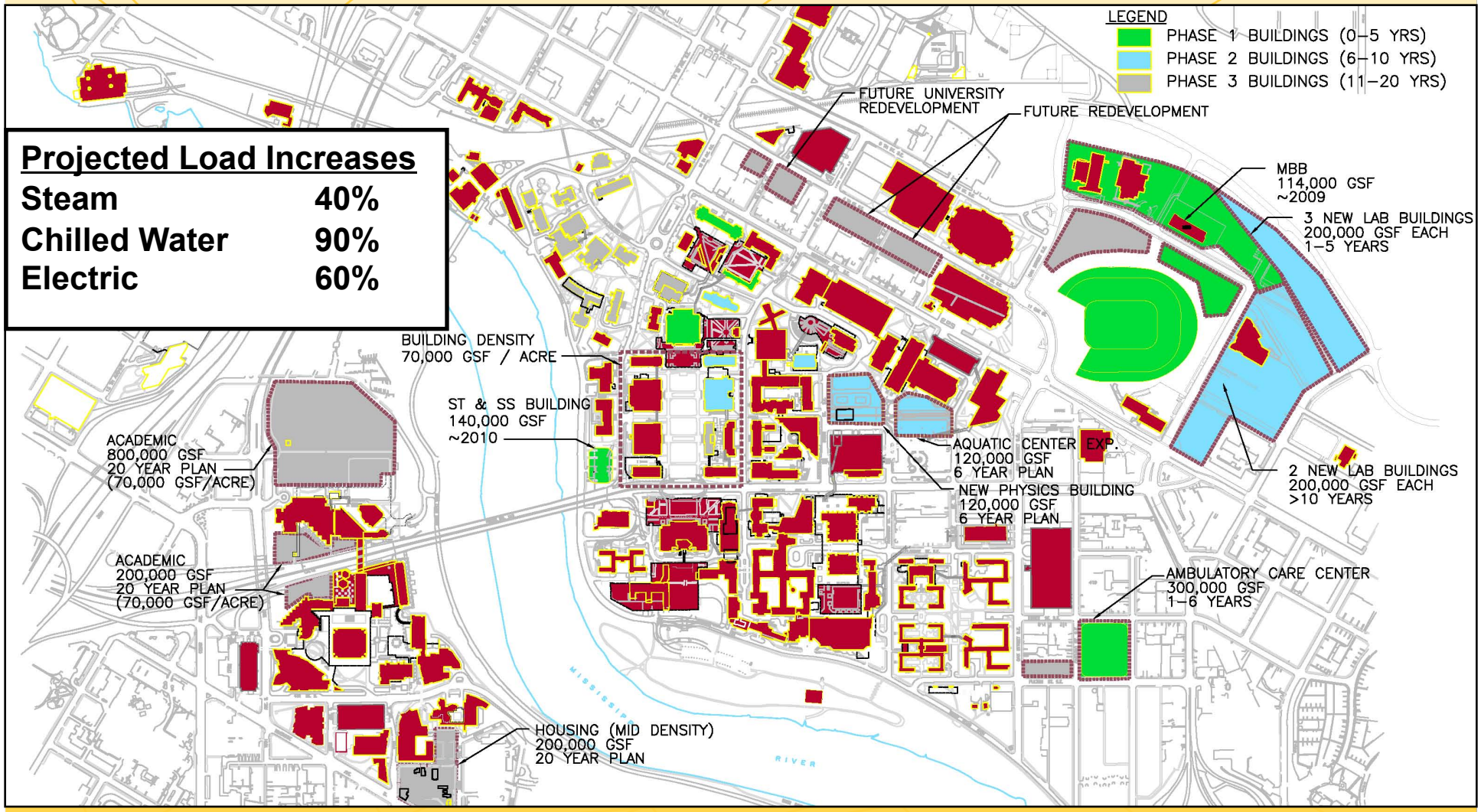
- **Domestic Water**

Focus Of This Presentation

Development of a Utility Master Plan



CAMPUS PLANNING (Minneapolis)



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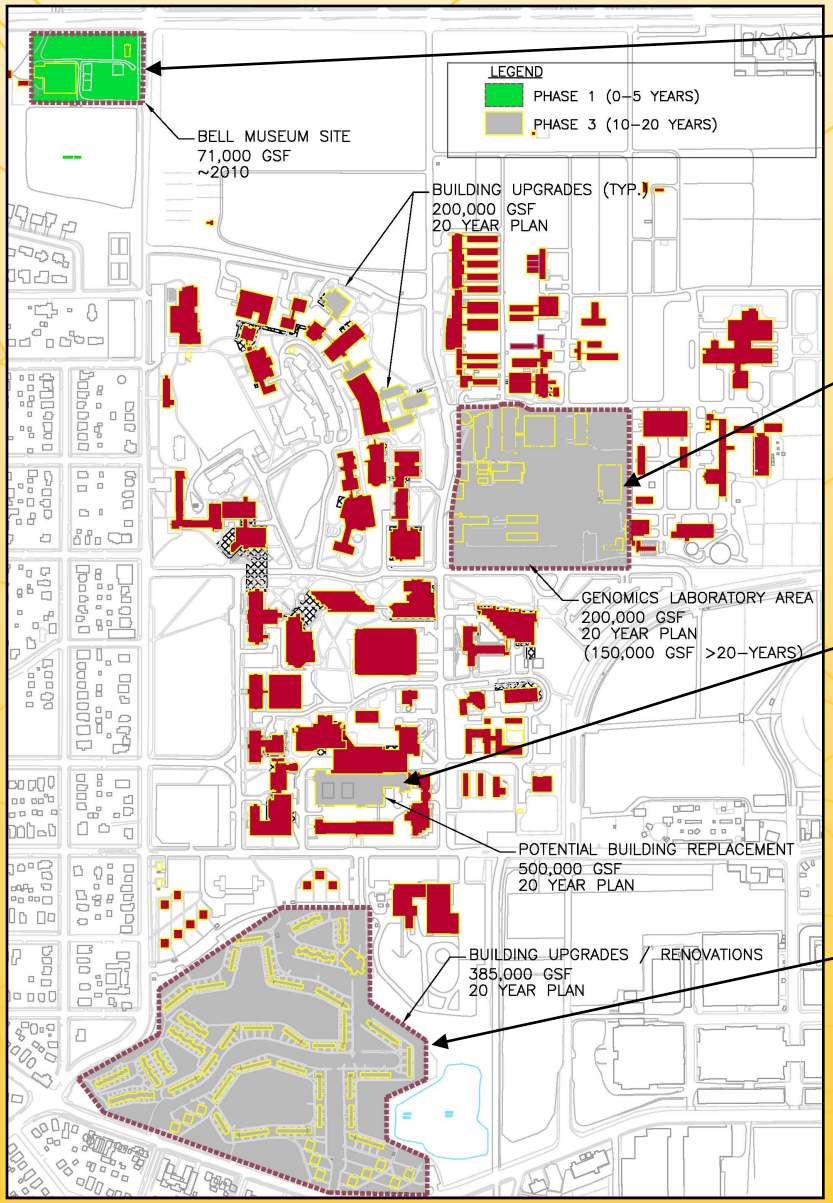
CAMPUS PLANNING (St. Paul)



Bell Museum Site

(71,000 gsf ~2010)

Genomics Laboratory Area

(200,000 within 20 yrs)

(+150,00 gsf >20 yrs)

Possible Building Replacement

(500,000 gsf within 20 yrs)

Building Upgrades / Renovations

(typical)

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Energy Statistics

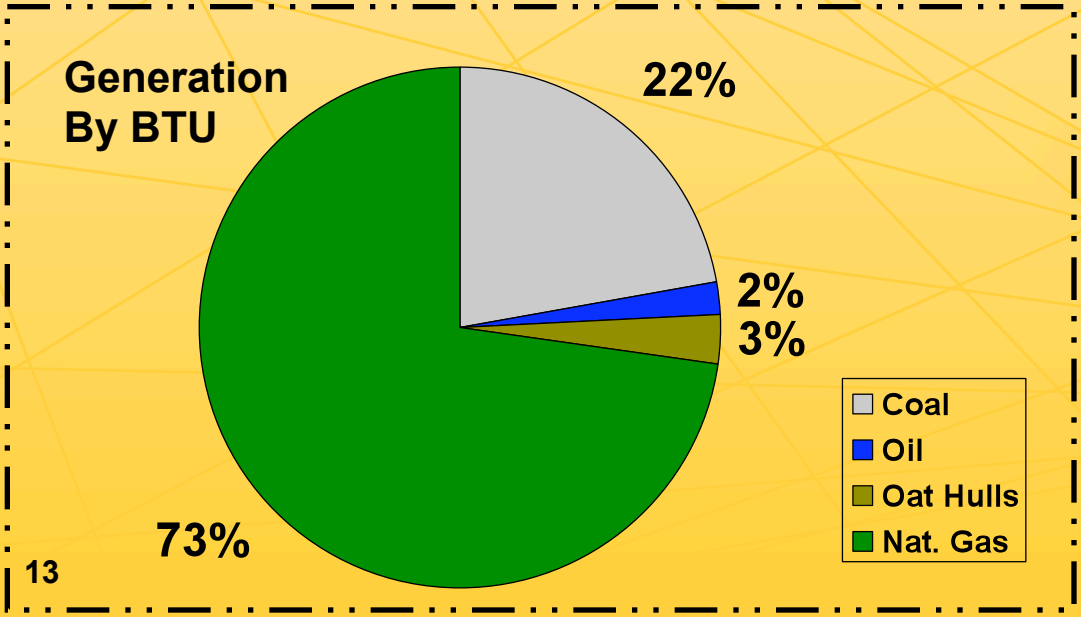
Electrical Energy Consumption & Costs (Twin Cities Campus)

- Present Peak Demand = 70 MW
- Total Consumption = 364,006,000 kWh
- Purchased Electric Cost = $28,488,000

Boiler Fuel Consumption & Costs (Twin Cities Campus)

- Natural Gas = 202,700 M Cubic Feet
- Fuel Oil = 667,000 Gallons
- Coal = 36,000 Tons
- Oat Hulls = 7,600 Tons
- Wood = 0 Tons

Total Purchased Fuel Cost = $16.3M



Steam + Electricity = $45M Total Purchased

Recommended Options & Upgrades

Long Term Strategic Vision

PROJECT	BENEFITS	BARRIERS
Combined Heat & Power Plant (CHP)	• Sustainable/Efficient/Reliable • Reduces Peak Load	• High Capital Cost • Xcel Rates Are Presently Cheaper • Stranded Costs At SE Plant • Permitting/Politics
Chilled Water Thermal Storage	• Reduces Peak Load • Reduces Energy Costs	• Requires A Lot of Physical Space • Very Long Term Payback
Wind or Hydro Powered Generator	• Sustainable • Shared Reliability • Reduced Carbon Footprint	• Lack of Wind in Metro • Wheeling Power • Need To Own Substation • Permitting
District Cooling For All Buildings	• Highest Efficiency/Reliability • Reduces Peak Loads/Energy Costs	• Very High Capital Cost • Feasibility
Increase Distribution Voltage To 35 kV	• Increased Capacity • Increased Reliability	• Placement of Large Transformers • Feasibility

20+ Year Planning - Energy Infrastructure Upgrades …

PROJECT	TRIGGER EVENT
Addition of Alternative Energy Solutions	➢ Financial and Technical Opportunity
Expansion of Steam Distribution System	➢ Building Additions On The East Side of Mpls Campus
New Energy Facility For Mpls. Campus	➢ Retirement of SE Plant
Knoll Area Chilled Water Cluster	➢ Building Remodels
Stand-by Power System Cluster	➢ Need To Back-up Research
St. Paul Boiler Plant Renovation	➢ Age/Condition of Boilers

Energy Infrastructure Upgrades In Progress…

St. Paul Switching Station Replacement	$20M Funded
4th St. To Fulton Electric Interconnect	$ 8M (In Design)
Fulton To ACC Primary Service Duct Bank	$ 2M (In Design)
Northrop Chilled Water Expansion	$ 3M Funded
New Deep Steam Tunnel To ACC	$10M (In Design)
TSB Deep Tunnel Repair	$400K Funded

6 Year Infrastructure Upgrade Plan

Program & Design Natural Gas Peaking Boiler for Mpls. Campus

Steam Distribution Piping Improvements On East Bank

N.E. Gateway District Chiller Plant & Dist

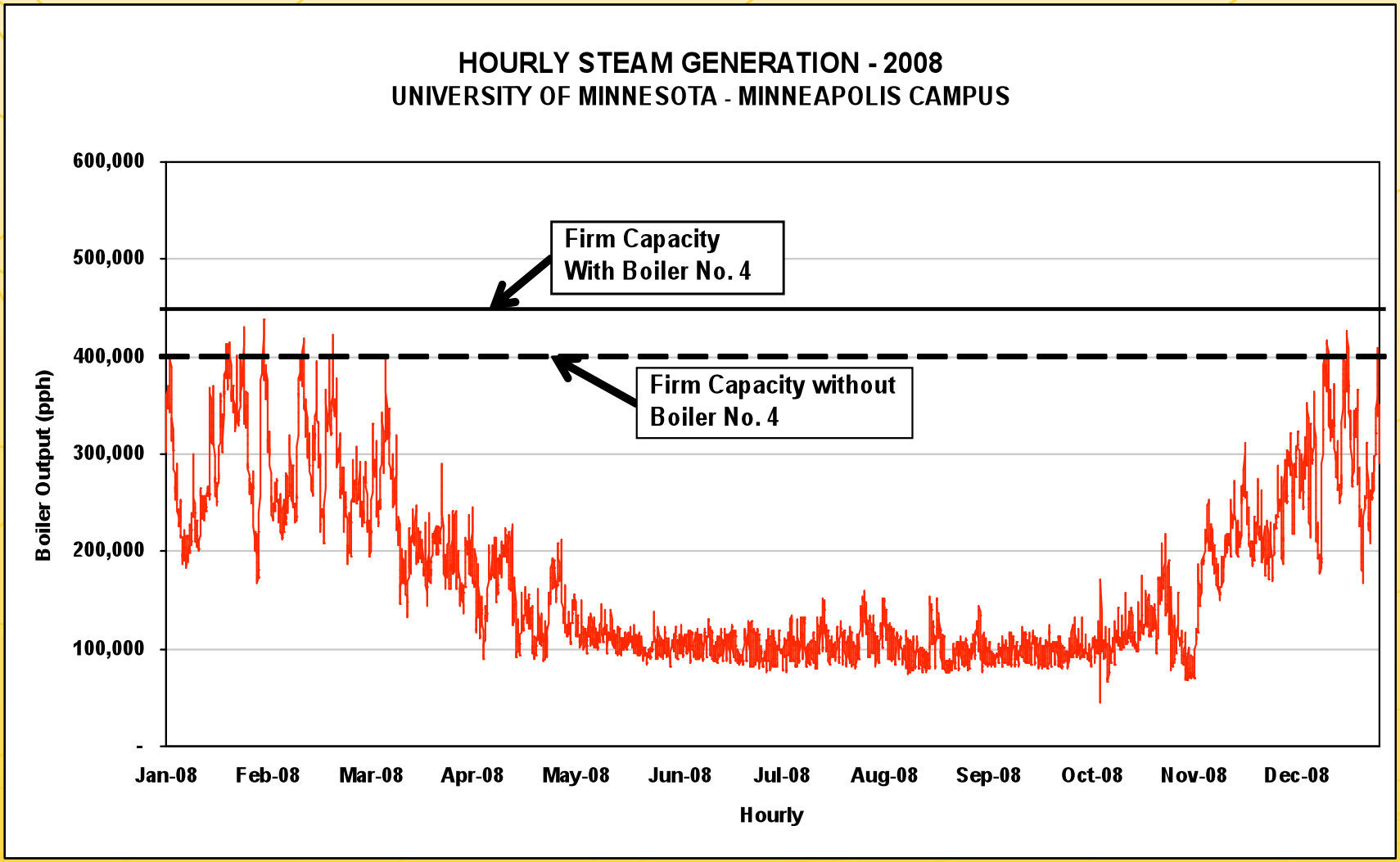
N.E. Electrical Duct Bank and/or New 13.8 kV Switch Station

St. Paul Phase 2 Chilled Water Plant

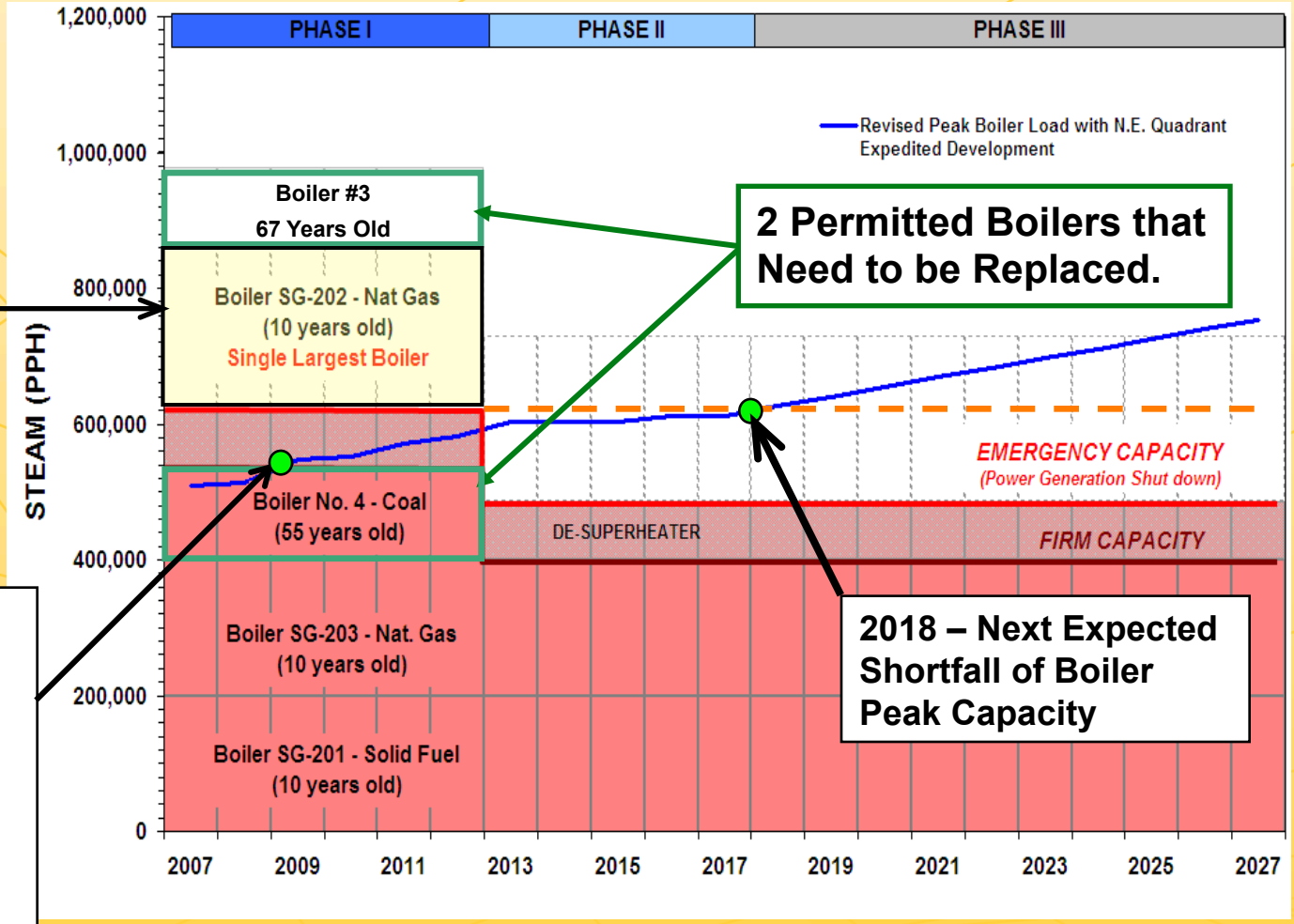
Expansion of I.T. Chilled Water Cluster On East Bank

Natural Gas Peaking Boiler Replacement

Daily Steam Peak Load Profile



Steam Demand VS. Reliable Generation



Largest Boiler

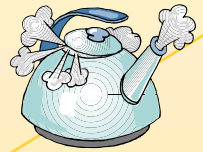
2 Permitted Boilers that Need to be Replaced.

2018 – Next Expected Shortfall of Boiler Peak Capacity

Problem

By 2008/2009 – The Peak Demand On Campus Has Exceeded The Reliable Capacity With The Loss of 2 of The 4 Boilers.

New Natural Gas Peaking Boiler



Deficiency

- Due to Recent and Upcoming Load Growth, We Will No Longer Have The Means To Provide Peak Steam Demand In The Event of The Loss of Our Largest Boiler.

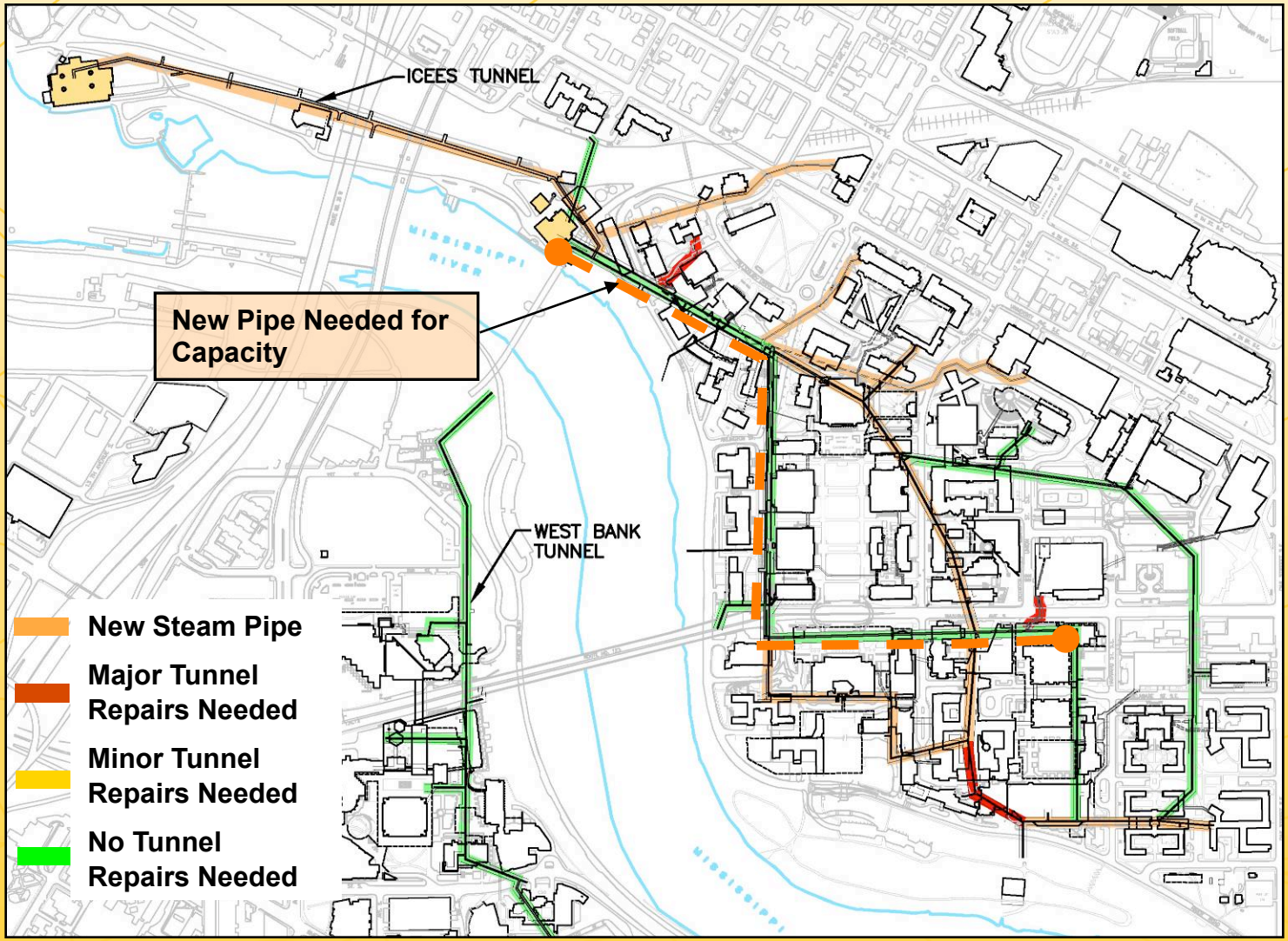
Recommended Solution

- Add a New Natural Gas Fired Boiler To The System
- The Recommended Location For This New Boiler Is In The Old Main Heating Plant (Bldg. 034).
  - Alternate Locations are The S.E. Heating Plant and a New Energy Plant in the N.E. Gateway District.
- Cost = $15M for Boiler + $15M for Building Renovations and Stack.
- Timeline = 2 Years For Permitting + 3 Years For Construction

Additional Near Term Projects

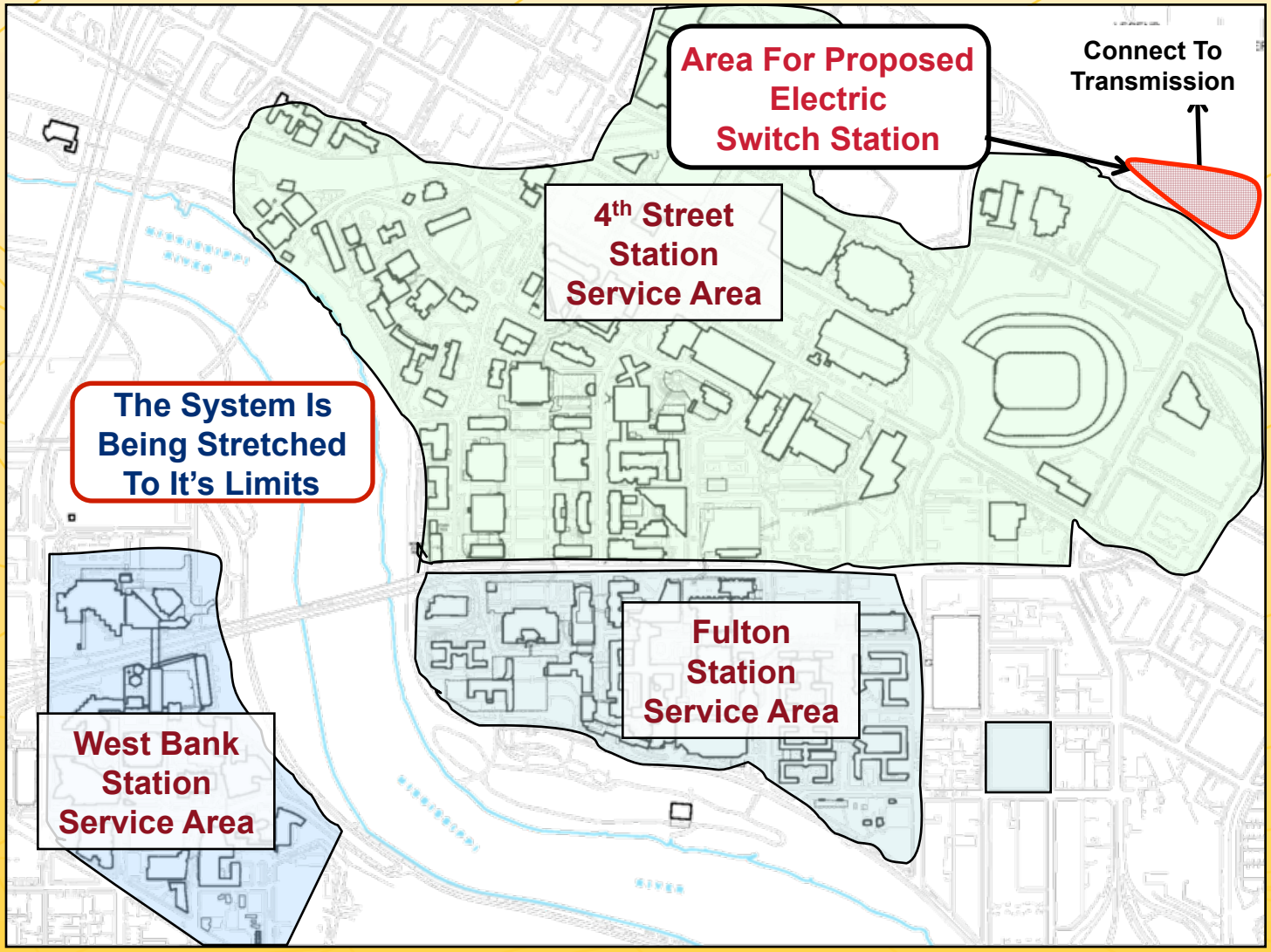
Steam Distribution System (Minneapolis)

- Growing Steam Demand On East Side of Campus Requires A New Pipe Line To Serve The Load.
- Portions of The Steam Tunnels Need Minor to Major Repair.



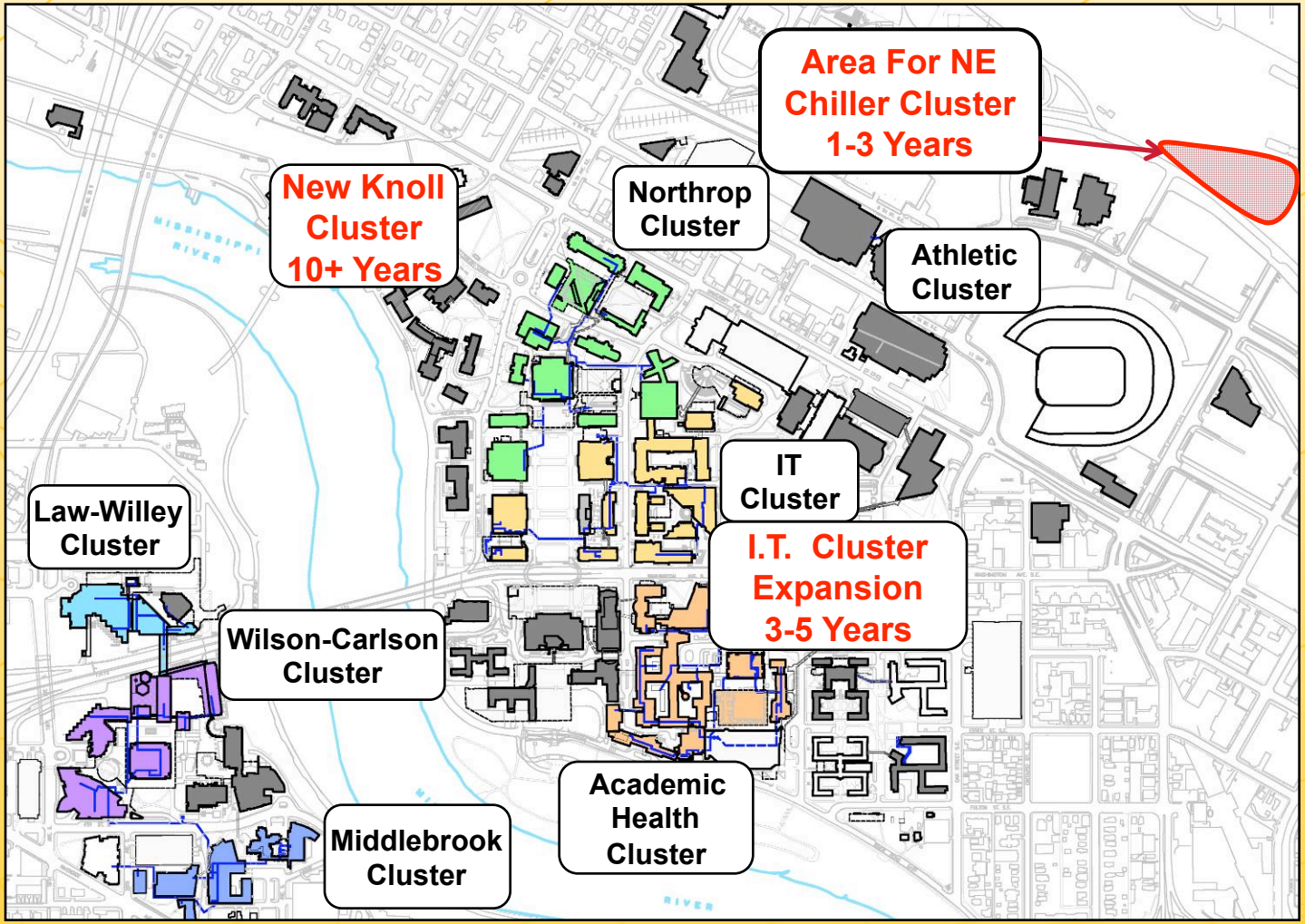
Existing Electrical System (Minneapolis)

- Xcel Reliability Is Not "Research Level".
- We Need To Prepare To Serve A 100 MW Load.
- At Present, Electricity Cost = 2X Natural Gas and 4X Solid Fuel Costs.



Chilled Water (Minneapolis)

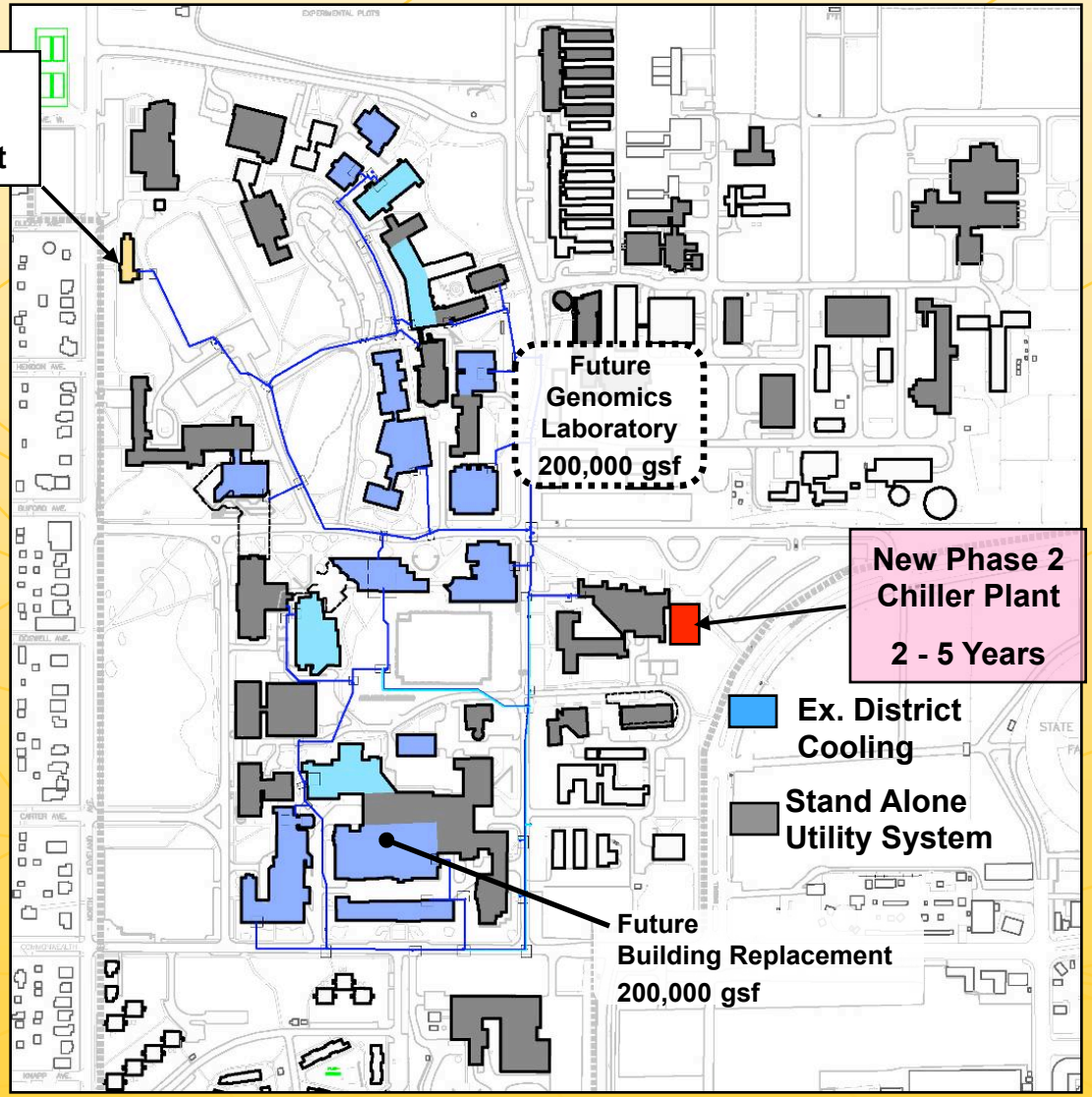
- There Are Numerous Stand-Alone Chiller Units In Buildings Which Reduces Overall Efficiency.
- Stand-alone Units Have High Energy Costs And Create A Larger Carbon Footprint.
- Back-up Cooling For Critical Research Is Inadequate.
- Need A New Cluster In NE Gateway District



Chilled Water (St. Paul)

- **Existing Stand Alone Chillers Are Quickly Reaching The End of Their Life Cycle.**

- **Implementation of Phase 2 Chiller Plant Will Reduce Energy, Operation and Maintenance Costs**



6 Year Infrastructure Upgrade Plan

Project	Prelim $ Estimate
Program & Design Natural Gas Peaking Boiler for Mpls. Campus	$ 30M
Steam Distribution Piping Improvements On East Bank	$ 10M
NE Gateway District Chiller Plant & Dist	$ 30 M
NE Gateway District Electrical Duct Bank Expansion and/or New 13.8 kV Switch Hub	$ 4 M (D.B.) $35 M (Station)
St. Paul Phase 2 Chilled Water Plant	$ 12 M
Expansion of I.T. Chilled Water Cluster On East Bank	$ 2 M

So How Do We Proceed?

Demand Side?

Supply Side?

Answer Is Both.

In The Short Term…

We need to meet our Reliability requirements (peak demand) by adding to the utility infrastructure to meet our program requirements.

In The Long Term…

We continue our efforts to reduce our energy footprint and find ways to incorporate renewable and more efficient technologies.

End Of Presentation

Reference Slides

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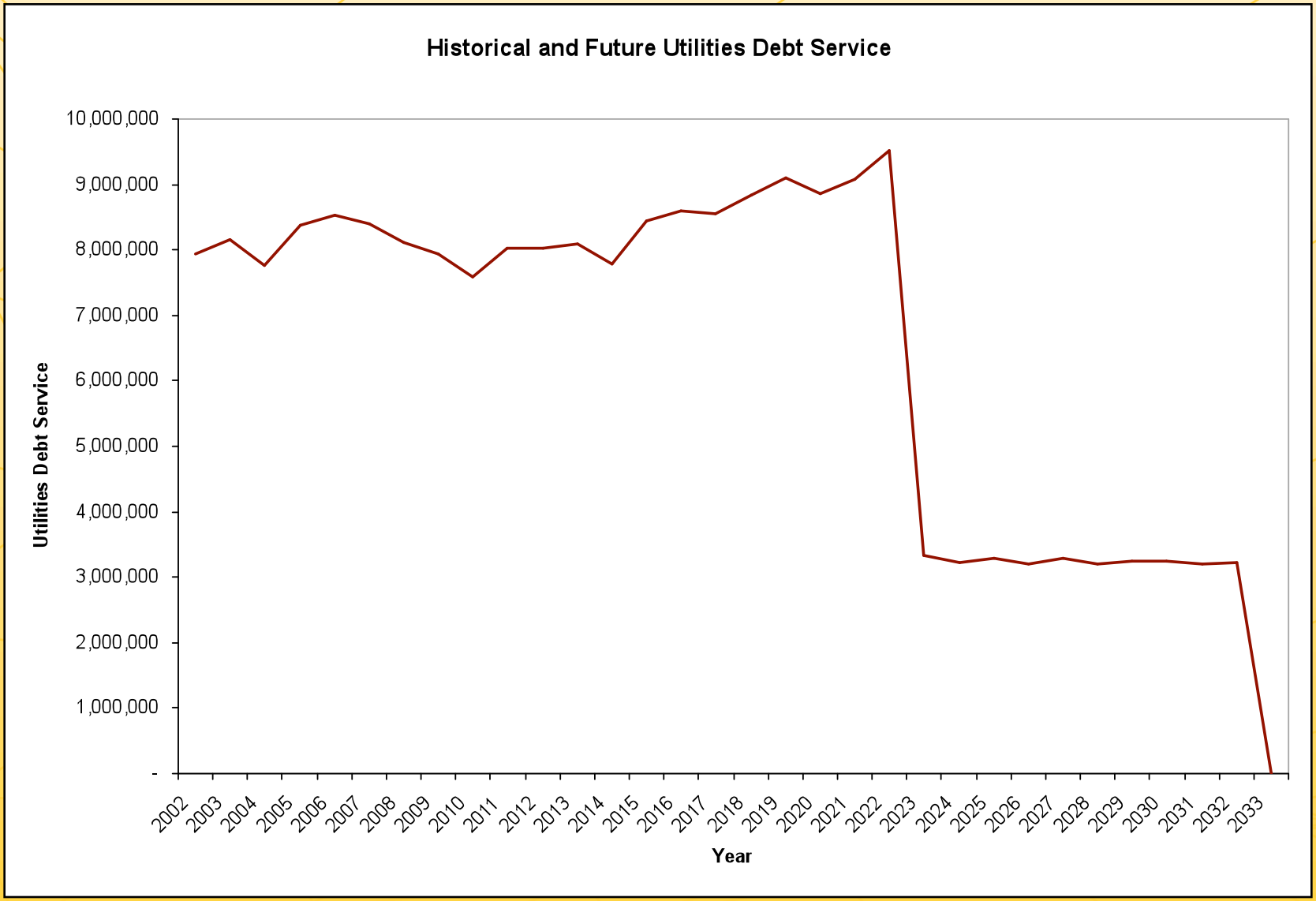
Utility Historical and Future Debt Service



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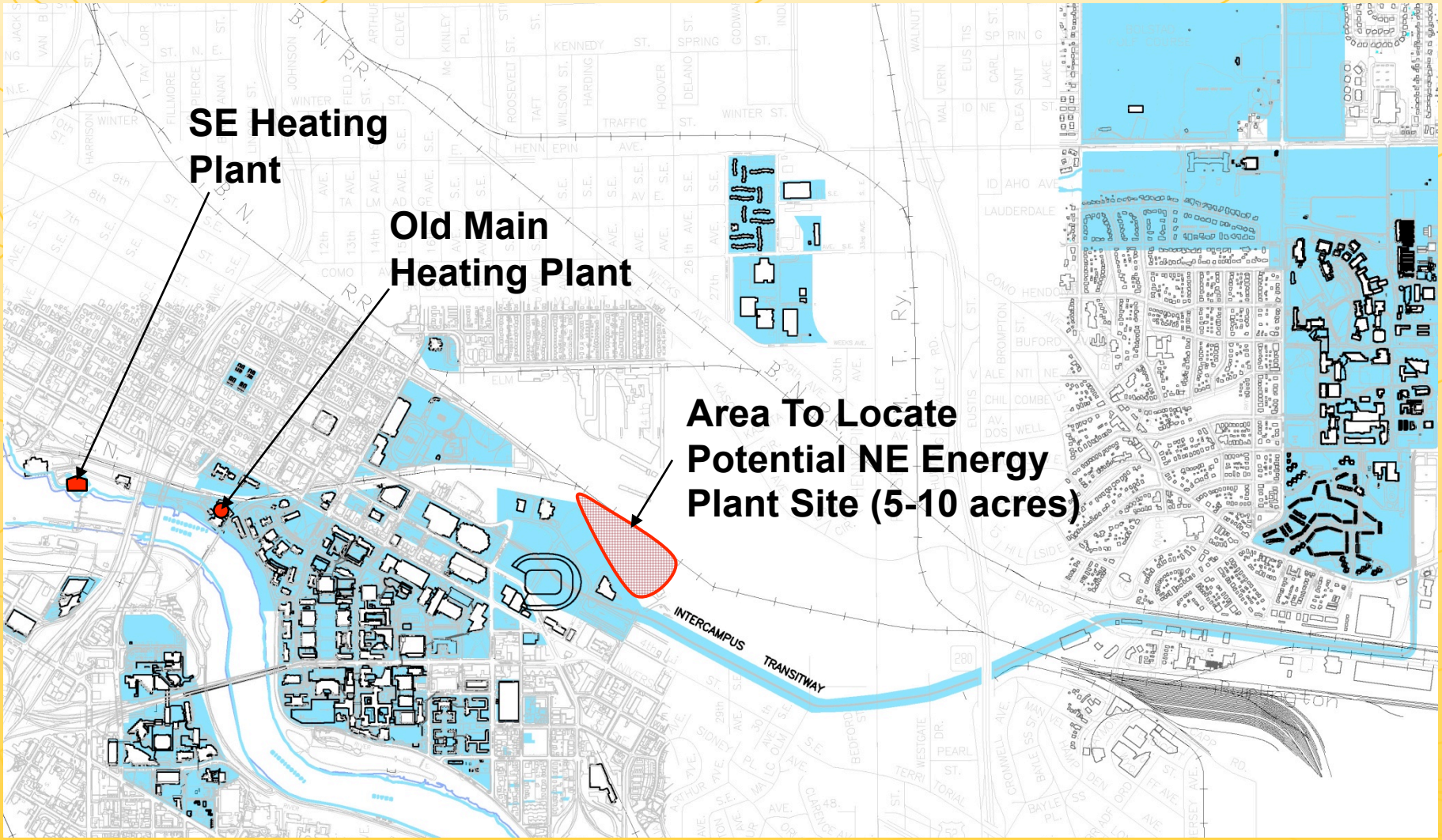
Location Options For New Boiler



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