



Maximizing the Usefulness of Existing Assets

*University of Nebraska-Lincoln
20-Year Utility Master Plan*

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IDEA 2019: The Energy for
More Resilient Cities

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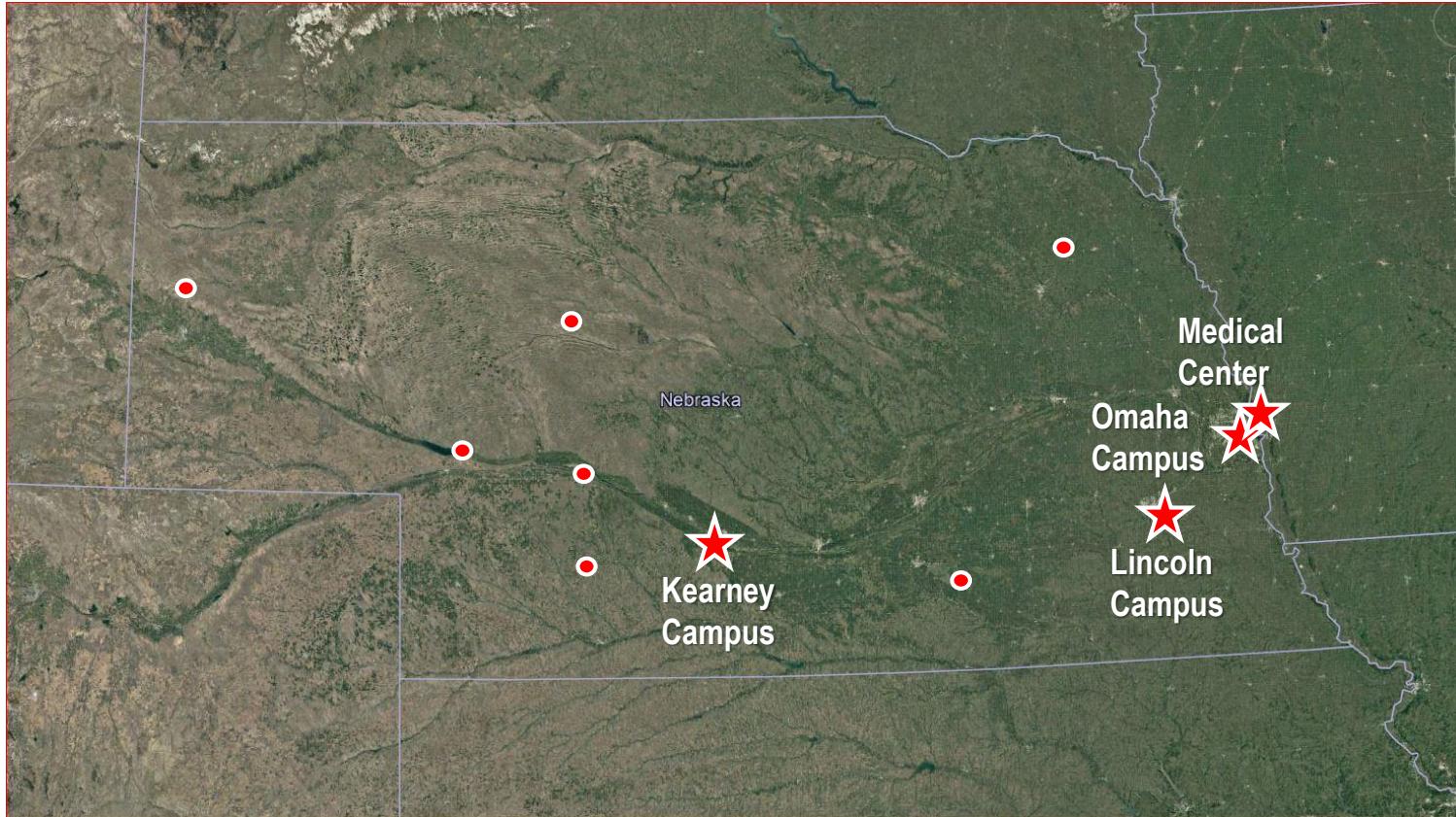
Agenda

- ▶ UNL Utility Infrastructure
- ▶ NUCorp
- ▶ Unique Nature of Master Plan
- ▶ Master Plan Details
- ▶ Results



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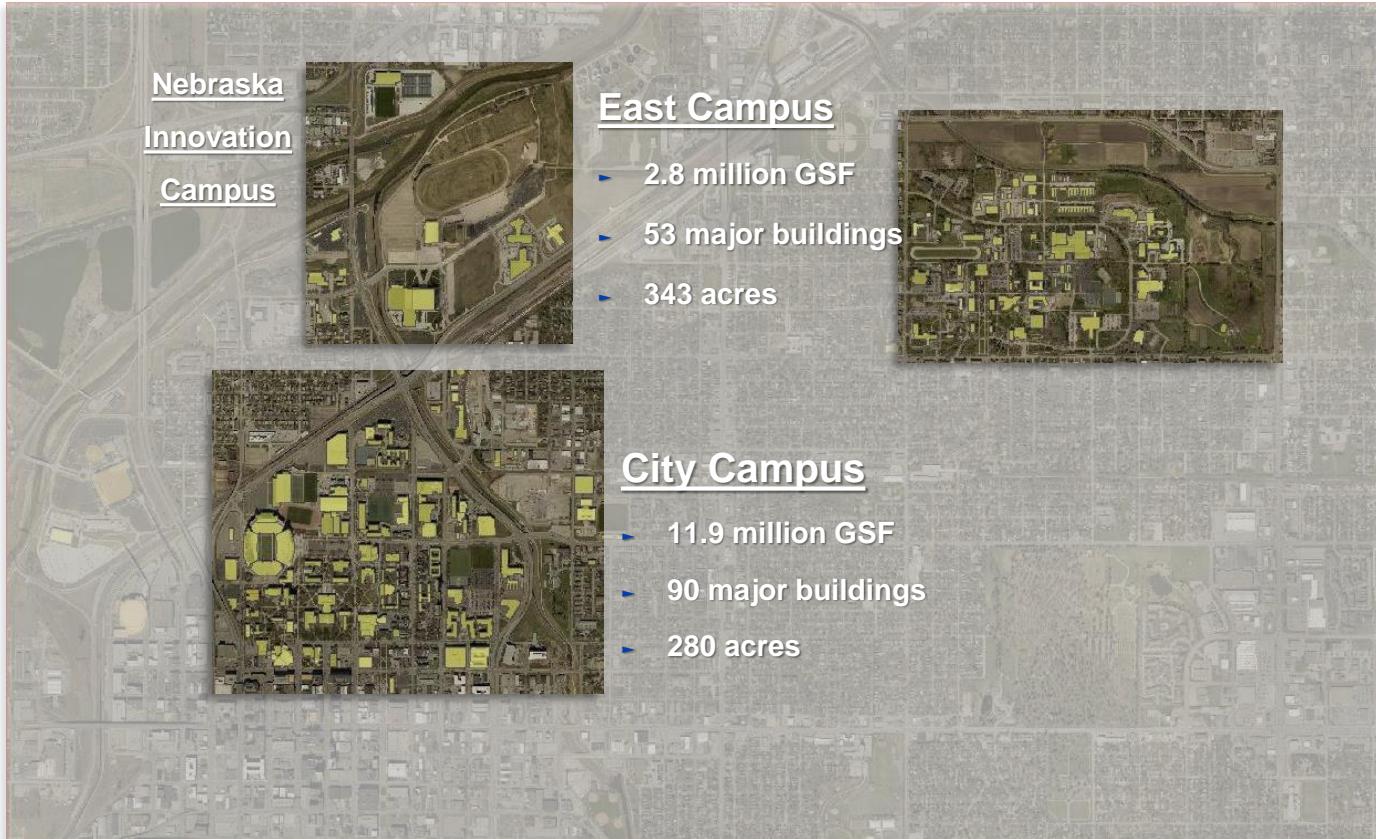
University of Nebraska-Lincoln



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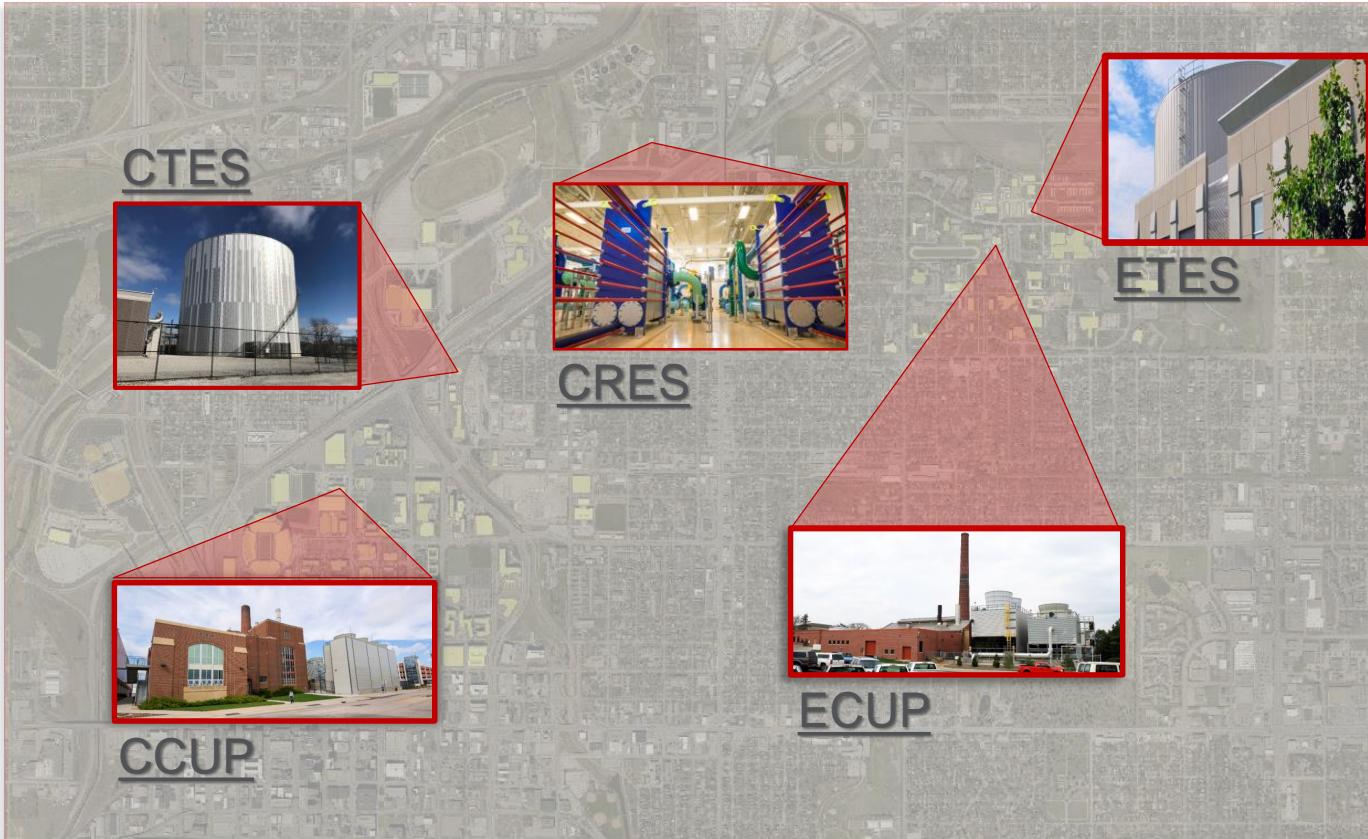
Campus Populations

- 26,079 students
 - 20,954 undergraduate
 - 4606 graduate
 - 519 professional
- 1,891 faculty
- 4,060 staff



Utility Plants

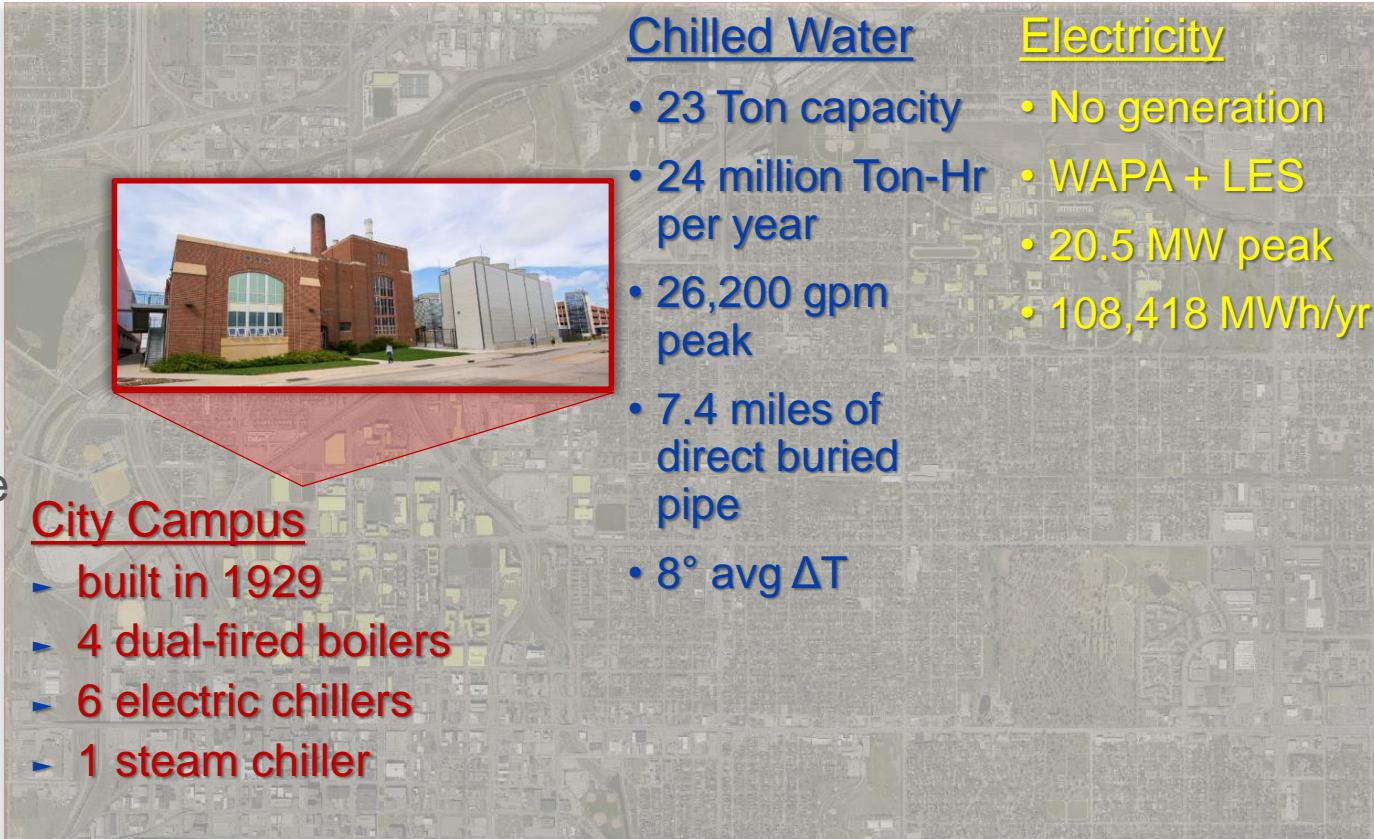
- ▶ 5 Facilities
- ▶ 33,000 Tons Cooling
- ▶ 68,000 Ton-hrs TES
- ▶ 460 KPPH Steam
- ▶ ~11 Miles Thermal Distribution
- ▶ 4,875 Tons WSHP



City Campus Utility Plant (CCUP)

Steam

- 3 dual-fired boilers
- 600 & 250 psi
- 240,000 lb/hr cap.
- 298 million lb/yr
- 6 miles of tunnels and direct buried pipe
- 35 psi, superheated
- Converted to hot water for use in buildings



East Campus Utility Plant (ECUP)

Steam

- 3 dual-fired boilers
- 65 psi, saturated
- 220,000 lb/hr cap.
- 142 million lb/yr
- 4.7 miles of tunnels and direct buried pipe
- Converted to hot water for use in buildings

Chilled Water

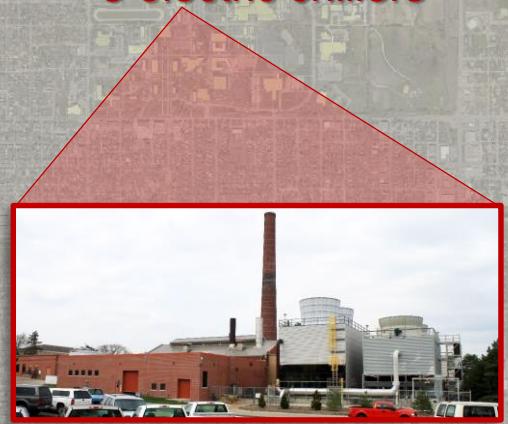
- 7.5 Ton capacity
- variable secondary
- 10.5 million TonHr per year
- 12,500 gpm peak
- 4.7 miles of direct buried pipe
- 7° avg ΔT

Electricity

- No generation
- Lincoln Elec System
- 9.1 MW peak
- 39,584 MWh/yr

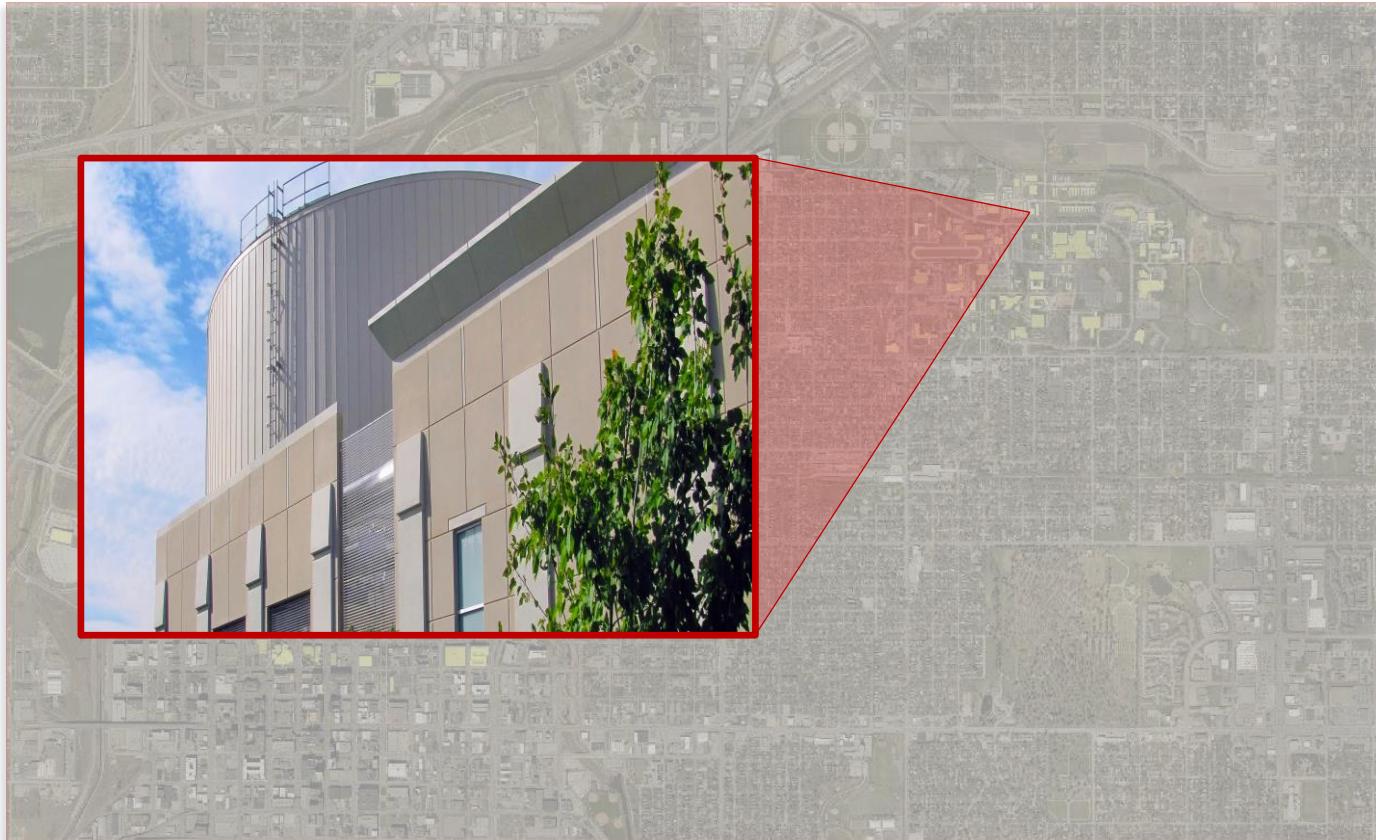
East Campus

- built in 1915
- 3 dual-fired boilers
- 3 electric chillers



East Campus Thermal Energy Storage (ETES)

- ▶ Online in 2013
- ▶ 2.8 million gallons
- ▶ 16,300 Ton-hr capacity
- ▶ 2500 Ton variable-speed chiller
- ▶ Free-cooling capacity in winter
- ▶ 2 MW demand reduction (15%)

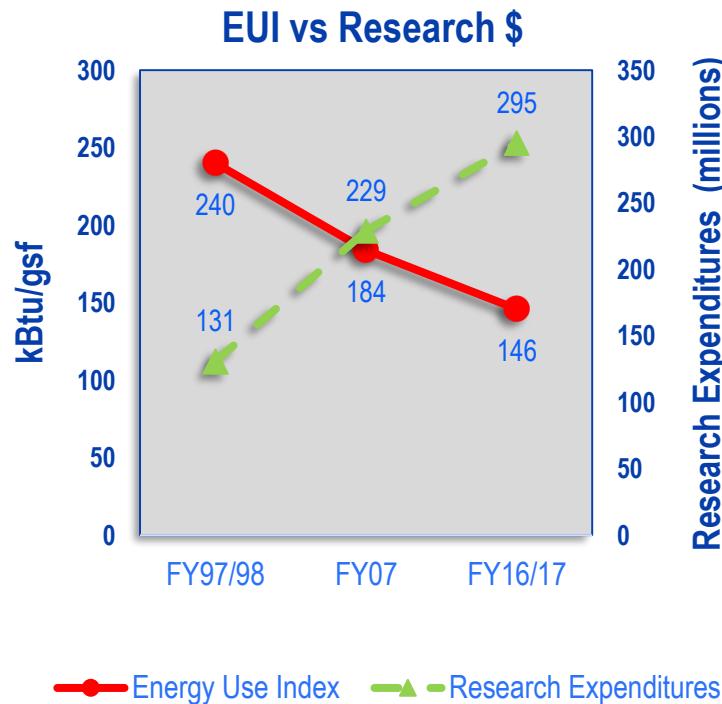
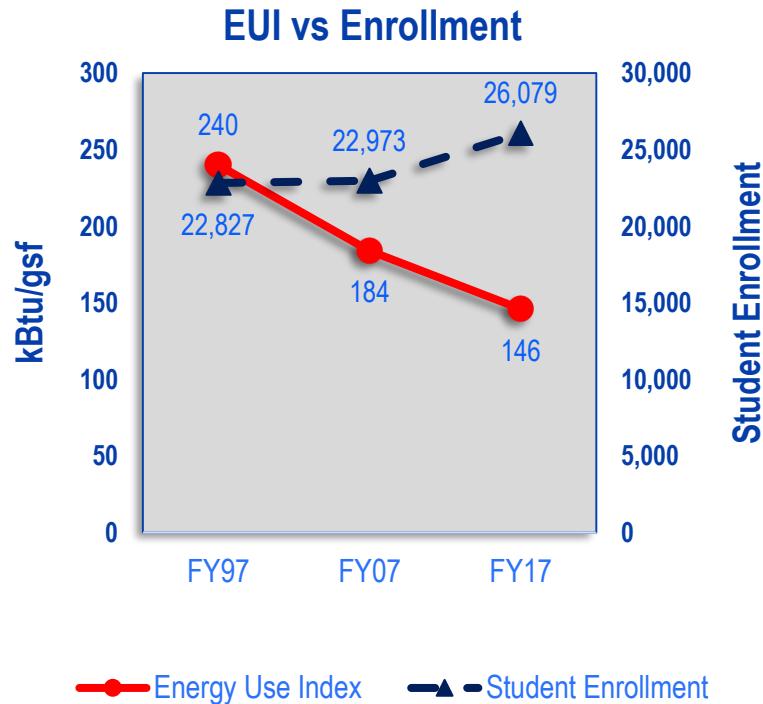


City Campus Thermal Energy Storage (CTES)

- ▶ Online in May 2018
- ▶ 8.2 million gallons
- ▶ 52,000 Ton-Hr capacity
- ▶ 5-6 MW demand reduction (20%) in first year of operation



Long-Term Energy Trends



NUCORP

► **Mission**

“Develop, maintain, monitor, control and coordinate energy requirements, utility infrastructure facilities and all related energy, utility and infrastructure.”

► **Partnership**

- Raise Capital by Issuing Bonds
- Accounting Management
- Financial Projections
- Rate Development
- Energy Procurement

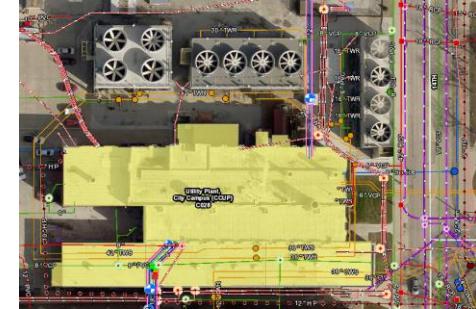
UTILITY MASTER PLAN

Prioritize Safety,

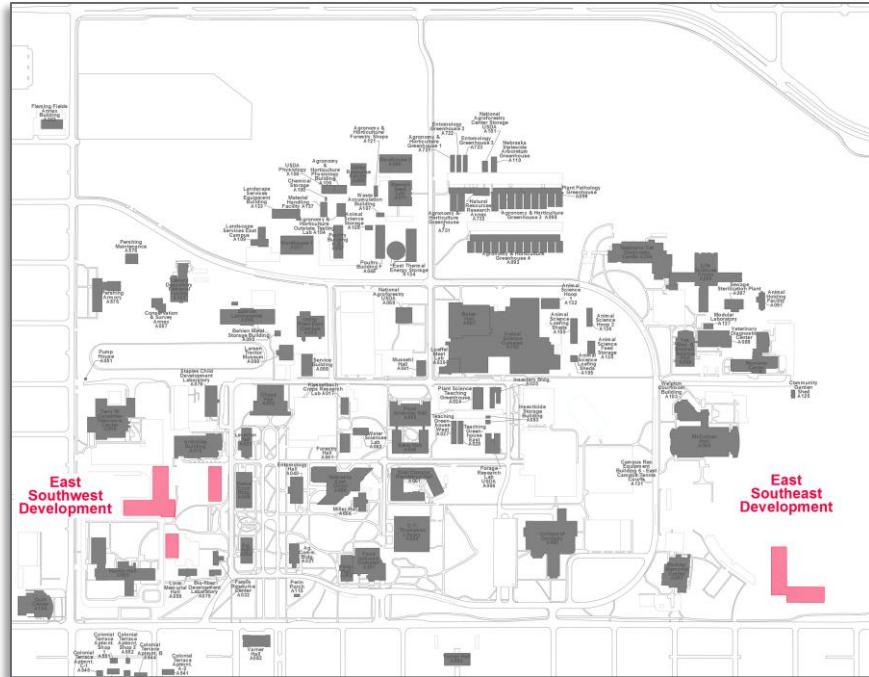
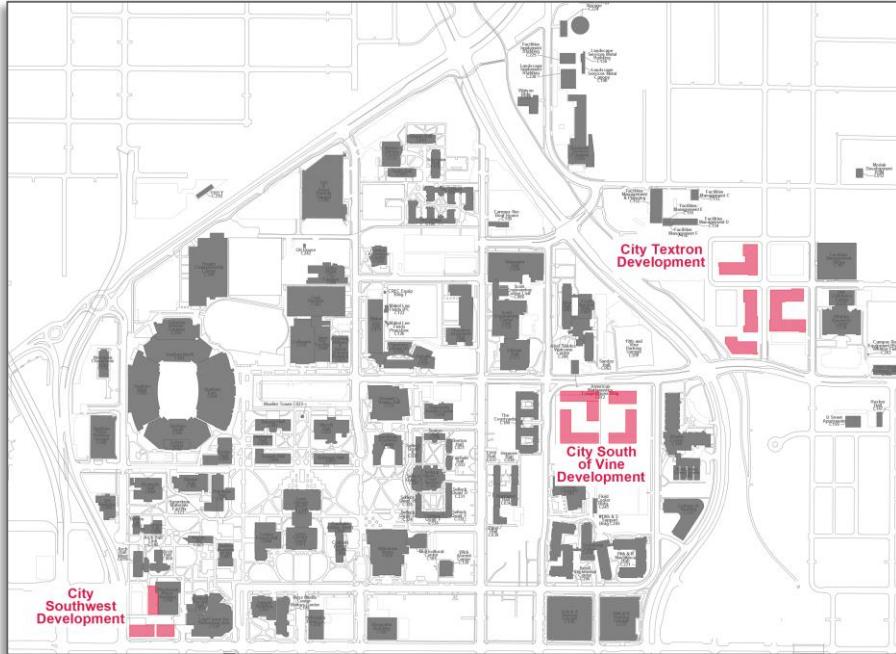
Increase Reliability, Maximize Efficiency

Utility Master Plan

- Optimization of existing assets
 - Chiller/Boiler Retrofits
 - TES Dispatch Optimization
- Condition Assessment of Distribution System
- Traditional Utility Master Planning
 - Load Projections (data availability through in-house BAS)
 - Distribution Modeling (mature GIS system)
 - Viability of CHP, Renewables etc.



Campus Development



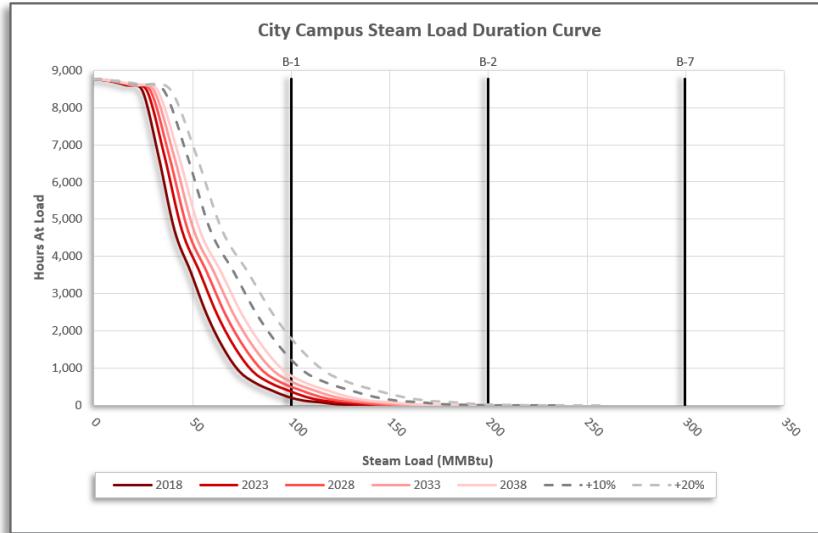
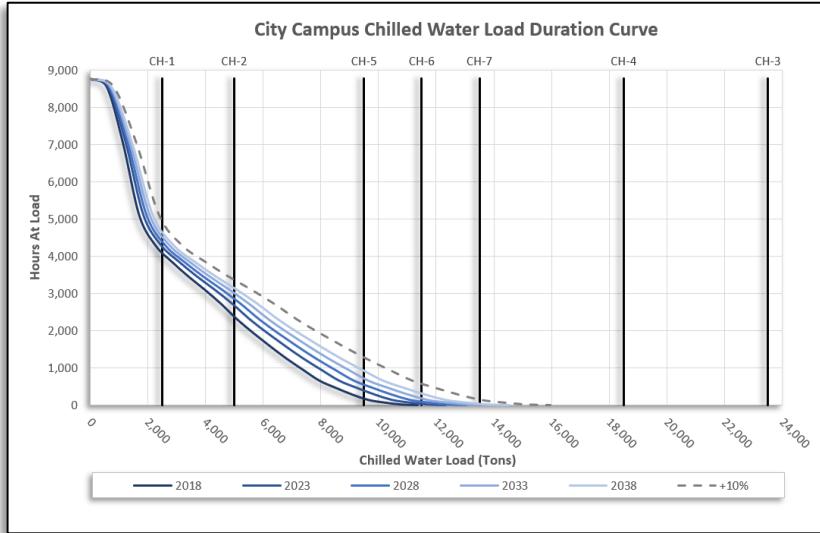
Campus Development: Load Growth Summary

	2019	YEAR 5	YEAR 20	AVG GROWTH/YR
AREA (MGSF)	15.6	16 (3%)	16.8 (8%)	0.5%
CHW (ktons)	16.3	17.5 (7%)	20 (22%)	1.1%
STM (MMBtu)	241	259 (7%)	298 (23%)	1.2%
ELE (MW)	32	35 (8.0%)	40 (25%)	1.2%

- Modest Campus Development
- Focus on Existing Assets
- Target Improved Efficiency, Reliability

Capacity Management

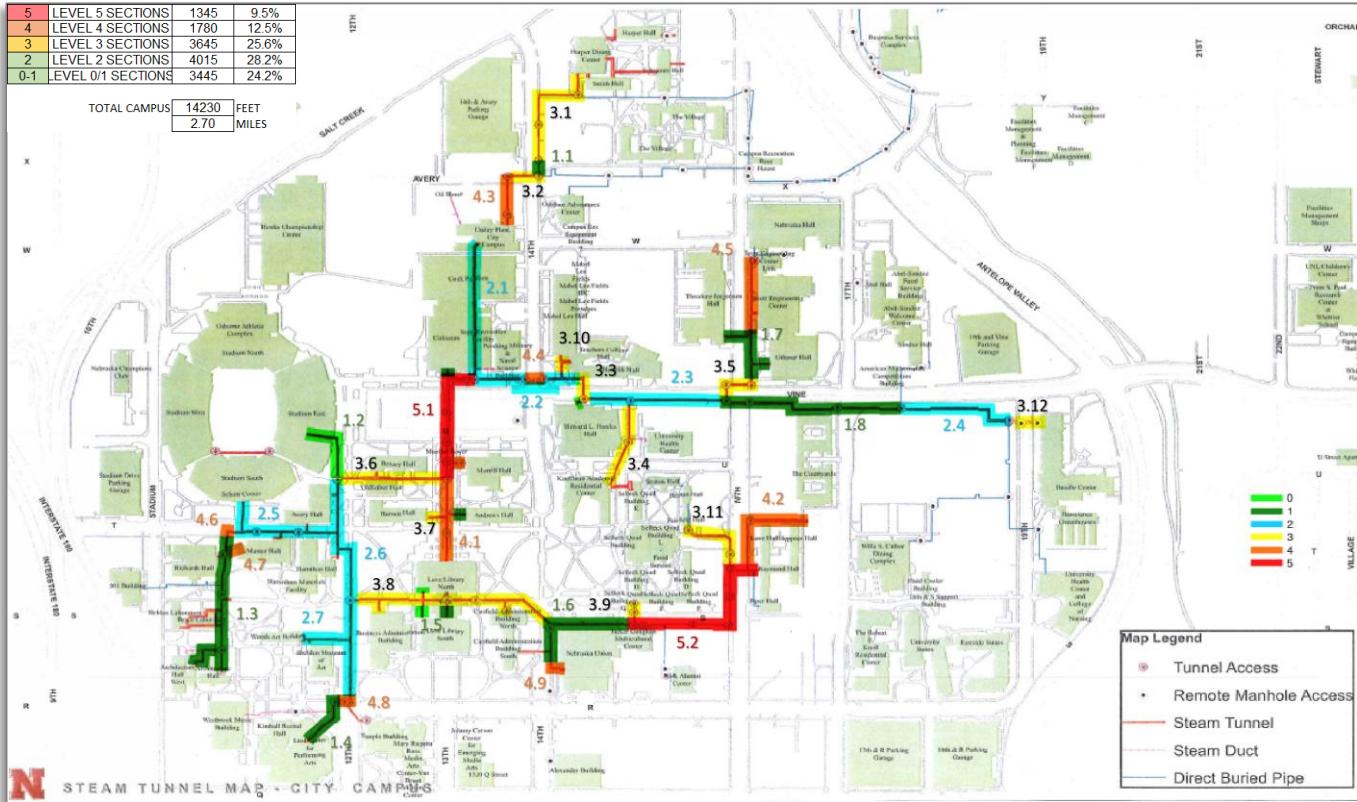
- ▶ Increase Reliability
- ▶ Improve Efficiency
- ▶ Manage Retirement



- ▶ Capacity Renewal
- ▶ Overhaul/Replace Existing Chillers
- ▶ Optimize Equipment Dispatch

Steam Tunnel Evaluation: City Campus

#	FROM	TO	LENGTH	%
C5.1	CREC	D15-T3	575	4.0%
C5.2	GAUN	RAYH	770	5.4%
C4.1	D15-T3	LLN	375	2.6%
C4.2	RAYH	HEPP	485	3.4%
C4.3	CCUP	E20-T1	220	1.5%
C4.4	E16-T1	E16-T2	75	0.5%
C4.5	MS	SLNK	360	2.5%
C4.6	SHOR	RH	25	0.2%
C4.7	MS	MANT	50	0.4%
C4.8	C12-T3	C12-T4	50	0.4%
C4.9	ADMS	NU	140	1.0%
C3.1	E20-T2	HDC	550	3.9%
C3.2	E20-T1	E20-T2	140	1.0%
C3.3	HENZ	HLH	100	0.7%
C3.4	E16-T4	KAUF	410	2.9%
C3.5	F16-T3	F16-T1	170	1.2%
C3.6	D15-T3	C15-T1	460	3.2%
C3.7	MS	BURN	75	0.5%
C3.8	C13-T3	NU	1090	7.7%
C3.9	GAUN	SELG	100	0.7%
C3.10	MS	MABL	145	1.0%
C3.11	F14-T3	FAIR	330	2.3%
C3.12	BEAD	BEAD	75	0.5%
C2.1	CCUP	CREC	650	4.6%
C2.2	CREC	HENZ	480	3.4%
C2.3	HILH	F16-T3	590	4.1%
C2.4	1740	BEAD	510	3.6%
C2.5	MS	SHOR	550	3.9%
C2.6	MS	C12-T3	1035	7.3%
C2.7	MS	WAB	200	1.4%
C1.1	E20-T2	MH	70	0.5%
C1.2	C15-T1	STE	310	2.2%
C1.3	RH	ARCH	800	5.6%
C1.4	C12-T4	LIED	230	1.6%
C1.5	LLN	LLS	380	2.7%
C1.6	ADMS	GAUN	470	3.3%
C1.7	F16-T1	JH	400	2.8%
C1.8	F16-T3	1740	785	5.5%

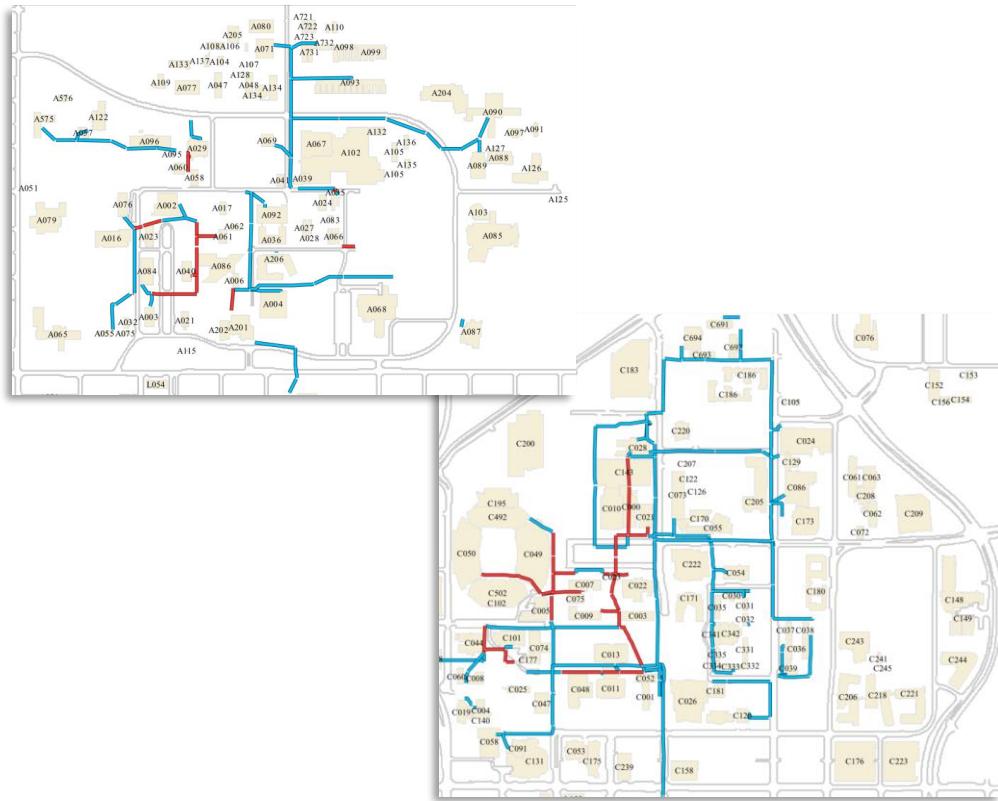


Electrical Feeder & Ductbank Analysis

- Load Growth/Capacity

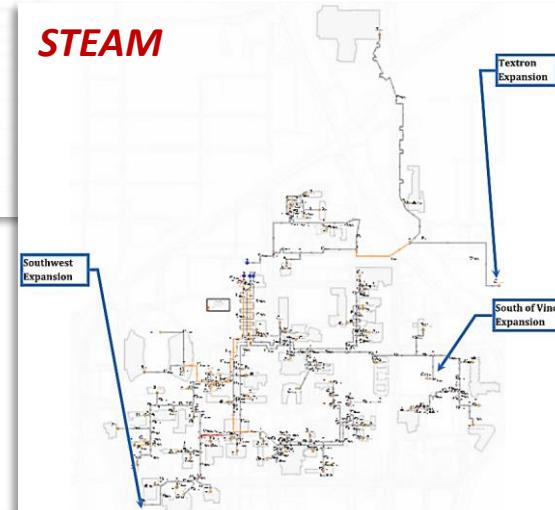
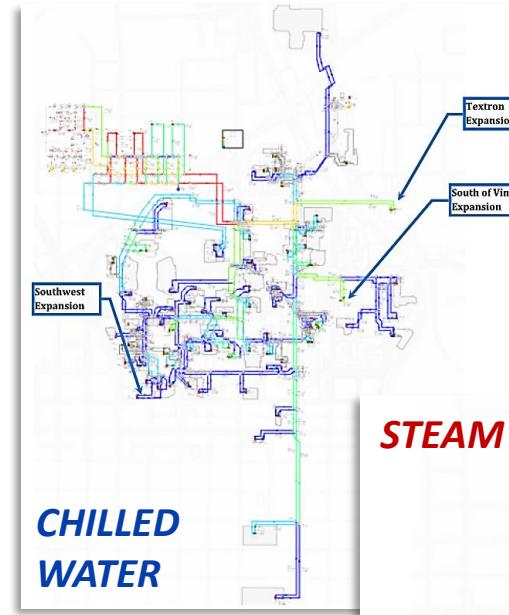
- Reliability/Resiliency

- Paper Insulated Lead Cable (PILC)
- Clay Tile Ductbank
- Transite Ductbank
- Phased Replacement



Distribution Modeling

- Visualize District Energy Systems
- Identify & Troubleshoot Existing Issues
- Evaluate Impact of Future Changes



Chilled Water Systems: Chiller #3 Analysis

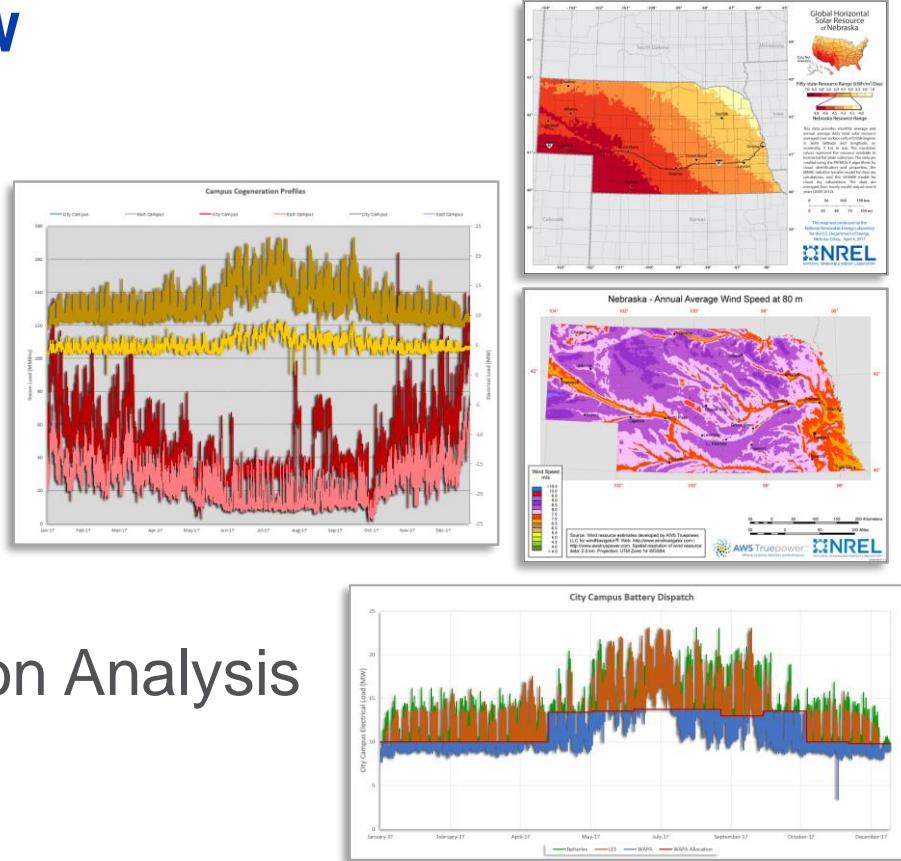
- CH-3 Advantages
 - Can Shed 3.5-5MW at Peak
 - High Tons/Sqft in Plant
- Recommendation (Near-Term)
 - Enhanced Startup
- Recommendation (Long-Term)
 - Rerate to 250# Steam

CH-3 Financial Analysis				
Option	Description	First Cost	Potential Annual Savings	Simple Payback
1	Enhanced Startup	\$25,000	\$40,000	0.63
2	Push-Button Startup	\$512,467	\$80,000	6.41
3A	Partial Rerate - 250#	\$1,191,154	\$216,000	5.51
3B	Full Rerate - 250#	\$2,955,629	\$205,000	14.42
3C	New Turbine - 250#	\$1,849,100	\$205,000	9.02
4	Extraction Turbine	\$4,800,000	\$230,000	20.87
5	Tube Replacement	\$881,945	\$14,000	63

Mutually Exclusive

Additional Technologies Review

- Cogeneration Analysis
- Solar Analysis
- Wind Analysis
- Battery Storage Analysis
- HHW/Geoexchange Conversion Analysis

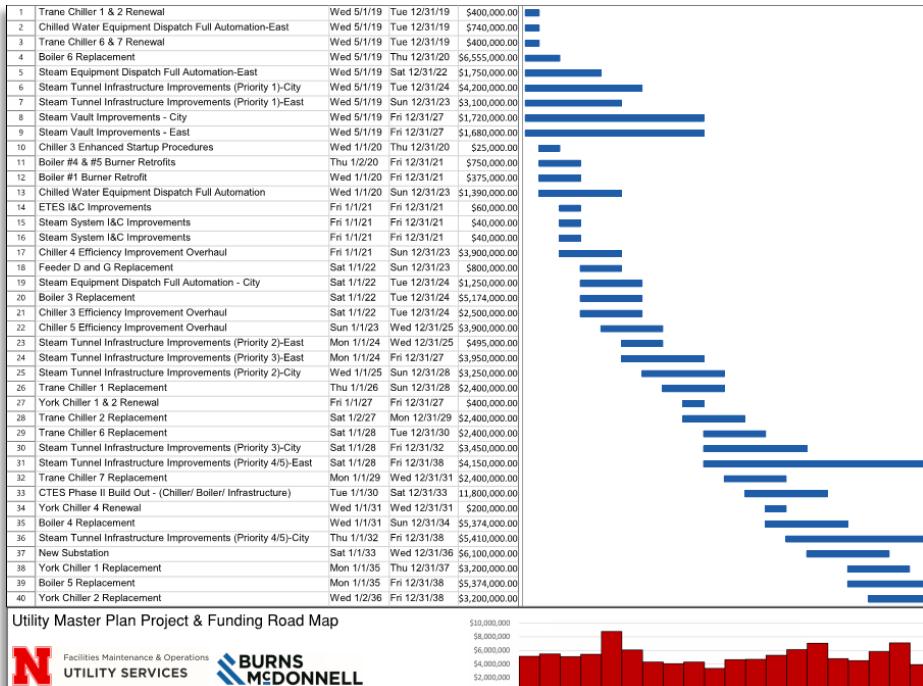


Results

- \$127M in recommended projects

► Near-Term Project Highlights

- Steam Tunnel Phasing
- Burner Retrofits
- Boiler Replacements
- Chiller Renewals



Use Master Planning Effectively!

- Document Existing Assets – “Go-To” Reference
- Identify & Plan for Load Growth – Proactive not Reactive
- Maximize Usefulness of Existing Assets – Efficiency!
- Explore New Technologies/Strategies – High Level Look

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THANK
YOU!

