



Making the Most of Your Assets

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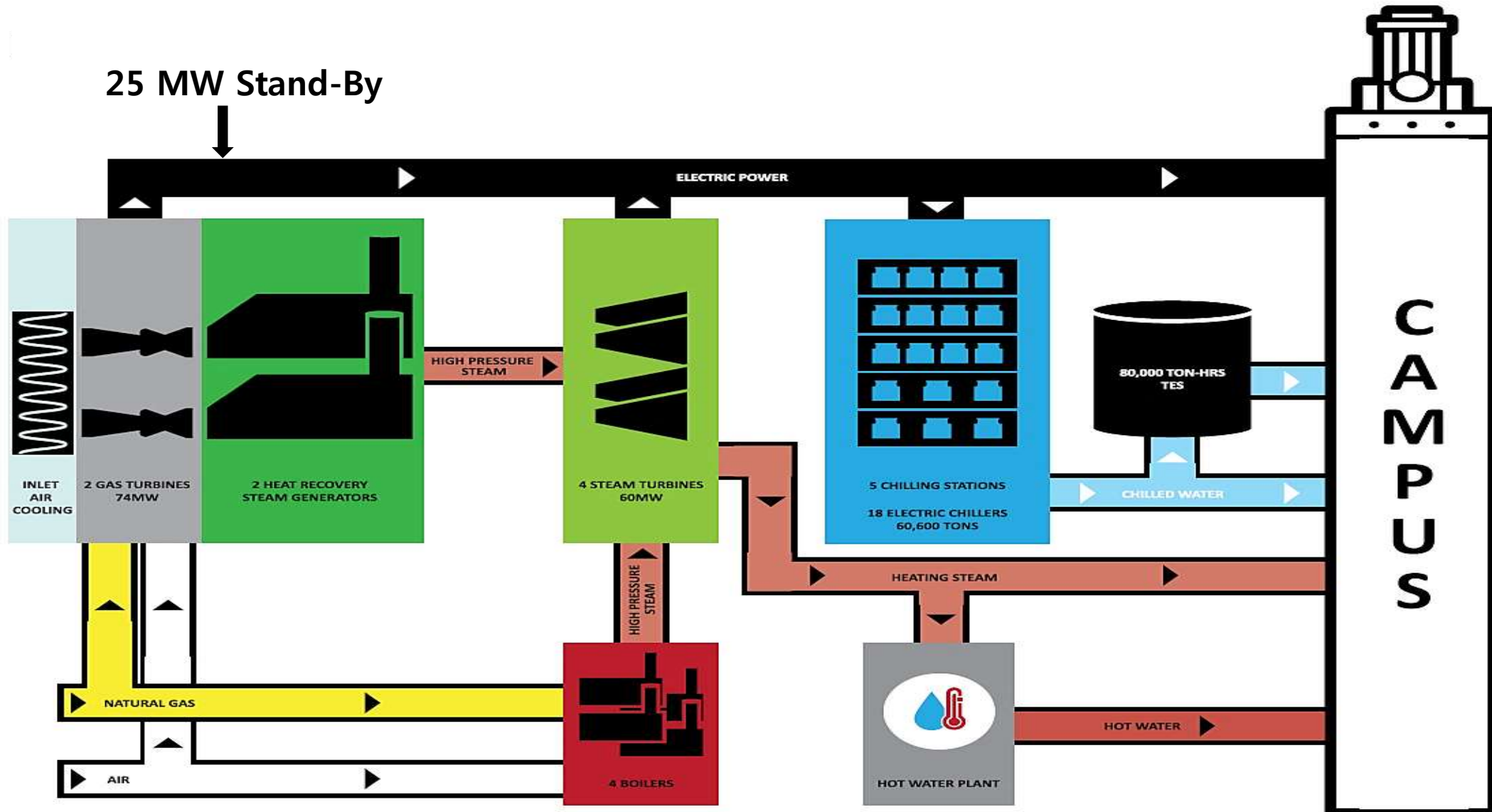
The University of Texas at Austin

Overview

- Use a holistic approach
- Master Plan – involve experts
- Involve all of the players that may be affected
- Use off-the-shelf applications
- Changing systems - improving systems involves smart risk taking
- Be methodical
- Be determined



Energy Generation and Distribution



Central Gathering of Data

Central Cog to Make Data
Available to Applications

Root Cause
Analysis

Historical Memory of
Past Issues

Perform Complex
Analysis

What Makes a Good Historian?

HanPrism



Energy System Focus

Campus-wide Efficiency

	2014	2015	2016	2017
Btu of Electricity Produced per Btu of Gas Consumed	35.7%	35.9%	36.3%	36.8%
Btu of Chilled Water Produced per Btu of Gas Consumed	192.7%	186.6%	179.0%	207.6%
kW/Ton for Chilling Stations	0.672	0.669	0.689	0.690
COP of Chilling Stations	5.234	5.257	5.104	5.097
Overall Efficiency to Campus	85.71%	84.08%	82.72%	83.20%

Availability and Reliability

Year	Utility	Total Hours of Forced Outages	Availability	Hours of Unplanned & Interrupted Services	Reliability
2016	Steam	0	100%	0	100%
	Electric	0	100%	0.01667	99.99999%
	Chilled Water	0	100%	0	100%
	Deionized Water	0	100%	0	100%
2017	Steam	0	100%	0	100%
	Electric	0	100%	38.167	99.99374%
	Chilled Water	0	100%	0	100%
	Deionized Water	0	100%	0	100%

BEHIND THE NUMBERS

The values in FIGURE 2.1 were derived using the following formulae:

kW/Ton for Chilling Stations

$$Eff_{kW/ton} = \frac{\text{Total Power Consumed by Chilling Stations}}{\text{Total Chilling Station Output in Tons}} = 0.672$$

COP of Chilling Stations

$$Eff_{COP} = \frac{\text{Ton}}{0.714 \text{ kW}} \times \frac{\text{kW}}{3412 \text{ Btu}} \times \frac{12,000 \text{ Btu}}{\text{Ton}} = 5.234$$

Overall Efficiency to Campus

$$Eff_{overall} = \frac{\text{Total Thermal Energy Delivered to Campus}}{\text{Total Natural Gas Energy Consumed}} = 0.8571$$

End of Year Report

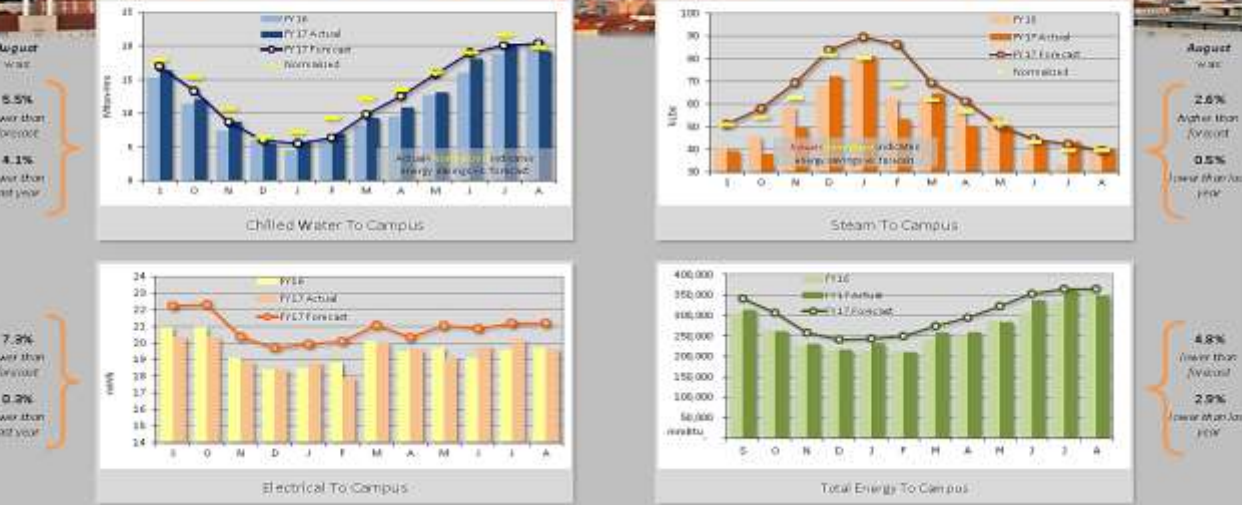
FY 2017 Energy Worksheet

Forecasted Campus Use													
Forecasted Campus Use	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Annual
Forecasted Electrical MWh	22,224	22,288	20,341	19,676	19,917	20,076	21,044	20,317	21,022	20,850	21,156	21,162	250,076
Forecasted Steam k-lbs	51,072	57,962	69,235	83,808	89,425	86,038	69,210	61,145	50,244	44,523	42,248	39,509	744,419
Forecasted Chilled Water 1,000 - ton hrs	16,891	13,301	8,631	5,971	5,498	6,330	9,802	12,534	15,785	18,953	20,046	20,343	154,084
Forecasted Electrical mmbtu	75,850	76,070	69,425	67,156	67,978	68,521	71,824	69,341	71,749	71,161	72,207	72,227	853,508
Forecasted Steam mmbtu	62,104	70,481	84,189	101,911	108,741	104,622	84,159	74,353	61,097	54,140	51,374	48,043	905,214
Forecasted Chilled Water mmbtu	202,687	159,610	103,571	71,657	65,978	75,955	117,629	150,412	189,422	227,433	240,547	244,112	1,849,013
Total Campus Energy Consumption	340,641	306,162	257,186	240,723	242,697	249,097	273,612	294,106	322,268	352,734	364,128	364,382	3,607,735
Estimated Gas Consumption mmbtu	397,294	382,317	380,387	324,847	313,088	317,635	306,989	321,482	377,553	391,108	392,709	399,631	4,254,640
Estimated Efficiency	85.7%	80.1%	77.8%	74.1%	77.5%	78.4%	89.2%	91.5%	85.4%	90.2%	92.7%	91.2%	84.8%
HDD	0	16	130	332	359	268	111	22	3	-	-	-	1,241
CDD	954	728	417	216	194	249	456	640	832	1,028	1,079	1,119	7,911
Actual Campus Use													
Electrical MWh	20,348	20,343	18,900	18,400	18,800	17,900	20,000	19,600	19,100	19,800	20,160	19,623	232,974
Steam k-lbs	39,400	38,100	48,600	72,200	80,900	53,500	64,800	50,400	50,300	43,600	43,570	40,536	626,906
Chilled Water 1,000 - ton hrs	16,400	12,100	8,800	5,500	5,800	7,000	9,300	10,900	13,100	18,100	20,320	19,227	146,547
Electrical mmbtu	69,448	69,430	64,506	62,799	64,164	61,093	68,260	66,895	65,188	67,577	68,806	66,972	795,139
Steam mmbtu	47,910	46,330	60,314	87,795	98,374	65,056	78,797	61,286	61,165	53,018	52,981	49,292	762,318
Chilled Water mmbtu	196,800	145,200	105,600	66,000	69,600	84,000	111,600	130,800	157,200	217,200	243,840	230,719	1,758,559
Total Campus Energy Consumption	314,158	260,960	230,419	216,594	232,139	210,149	258,657	258,981	283,553	337,795	365,627	346,983	3,316,016
Gas Consumption mmbtu	332,182	334,383	307,923	291,235	315,986	291,795	297,887	306,419	326,695	352,485	394,253	392,443	3,943,686
Efficiency	94.6%	78.0%	74.8%	74.4%	73.5%	72.0%	86.8%	84.5%	86.8%	95.8%	92.7%	88.4%	84.1%
HDD	-	-	36	302	241	92	37	-	-	-	-	-	708
CDD	977	818	522	258	305	440	619	702	862	1,046	1,211	1,094	8,852
FY2016 Actual Campus Use													
Electrical MWh	20,961	20,983	19,100	18,400	18,500	18,800	20,100	19,500	19,700	19,100	19,580	19,678	234,401
Steam k-lbs	40,700	45,500	58,600	68,000	79,700	62,500	62,500	57,300	54,600	39,400	33,430	40,734	642,964
Chilled Water 1,000 - ton hrs	15,300	11,400	7,400	5,900	4,500	6,000	8,200	9,500	12,700	16,000	18,810	20,055	135,765
Electrical mmbtu	71,539	71,615	65,188	62,799	63,141	64,164	68,601	66,554	67,236	65,188	66,827	67,159	800,012
Steam mmbtu	49,491	55,328	71,258	82,688	96,915	76,000	76,000	69,677	66,394	47,910	40,651	49,532	781,844
Chilled Water mmbtu	183,600	136,800	88,800	70,800	54,000	72,000	98,400	114,000	152,400	192,000	225,720	240,663	1,629,183
Total Campus Energy Consumption	304,630	263,743	225,246	216,287	214,056	212,164	243,001	250,230	286,030	305,099	338,197	357,355	3,211,039
Gas Consumption mmbtu	333,040	324,434	301,964	298,721	300,415	277,896	284,559	288,354	313,098	339,197	359,703	368,845	3,790,226
Efficiency	91.5%	81.3%	74.6%	72.4%	71.3%	76.3%	85.4%	86.8%	91.4%	89.9%	92.6%	96.9%	84.7%
HDD	-	3	121	221	357	128	42	10	0	-	-	-	882
CDD	993	804	410	300	145	345	543	636	784	1,021	1,159	1,058	8,198

Vital Signs

August, 2017

Campus Energy Use



Vital Signs

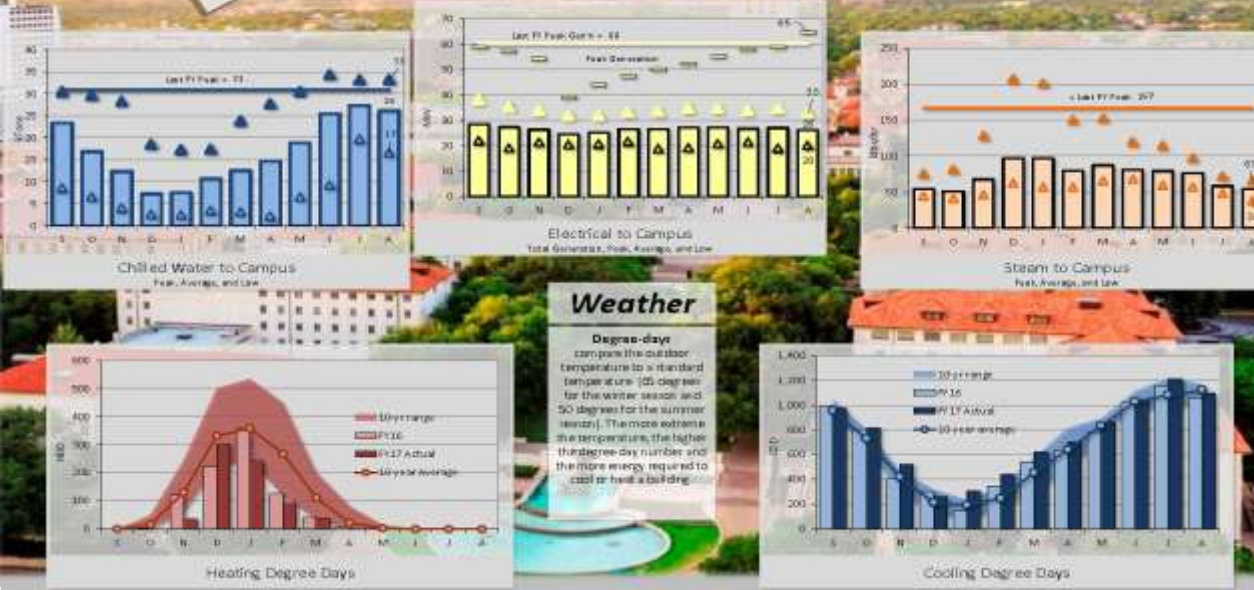
August, 2017

Vital Signs

August, 2017

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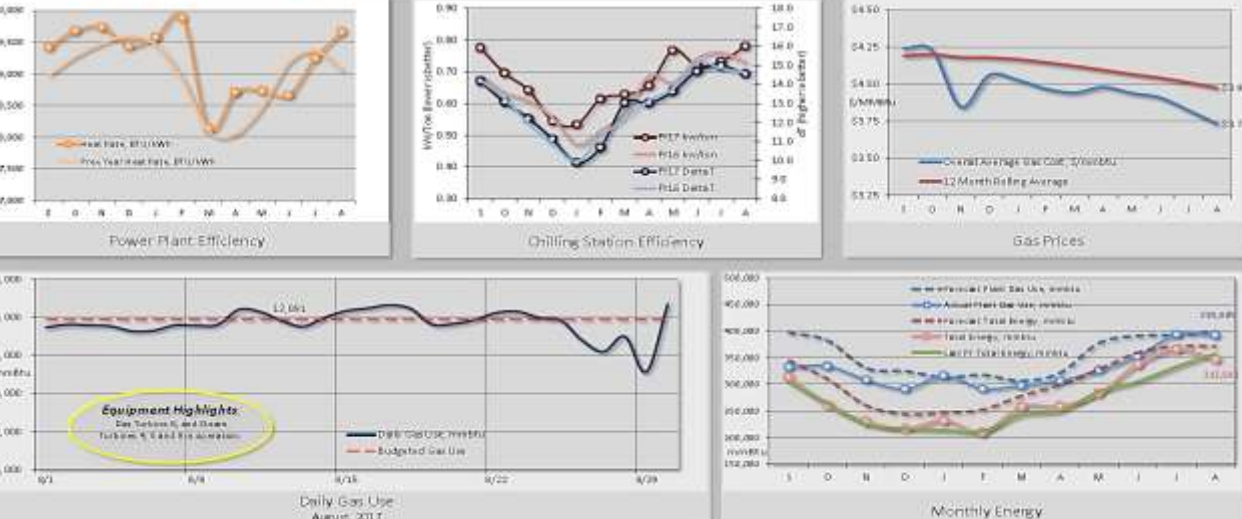
August, 2017



Vital Signs

August, 2017

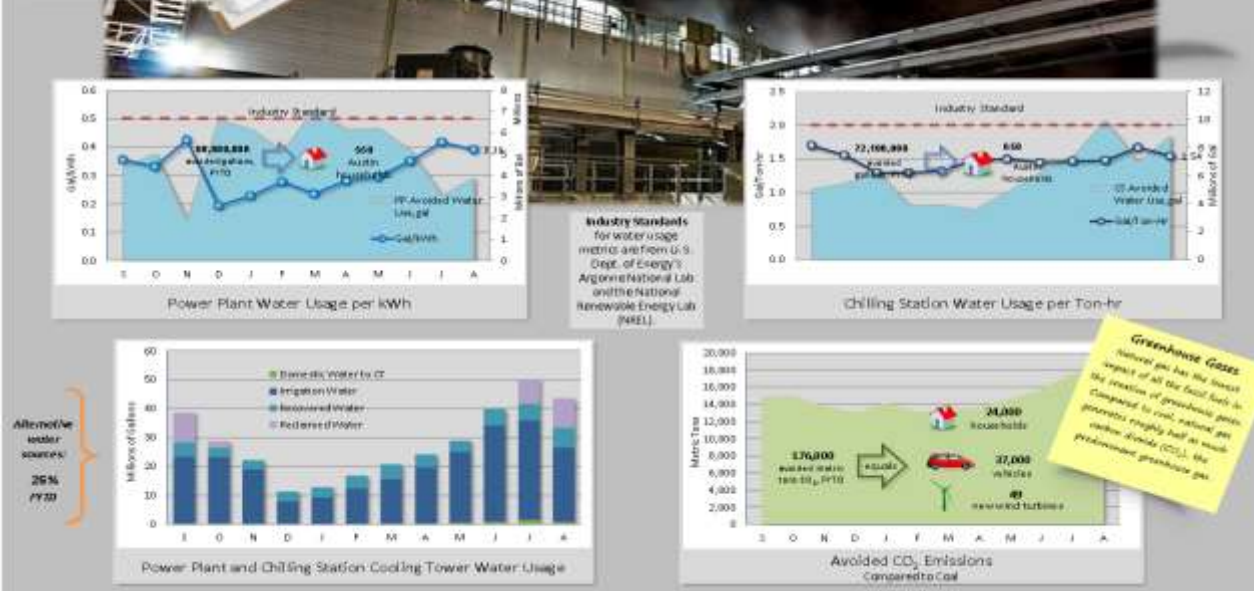
Plant Metrics



Vital Signs

August, 2017

Sustainability



HanPrism

Collects, archives, analyzes, and visualizes historical and real-time operational plant data.

HanPHI

Identifies impending equipment failure days, weeks, or months in advance.



Improved
Efficiency

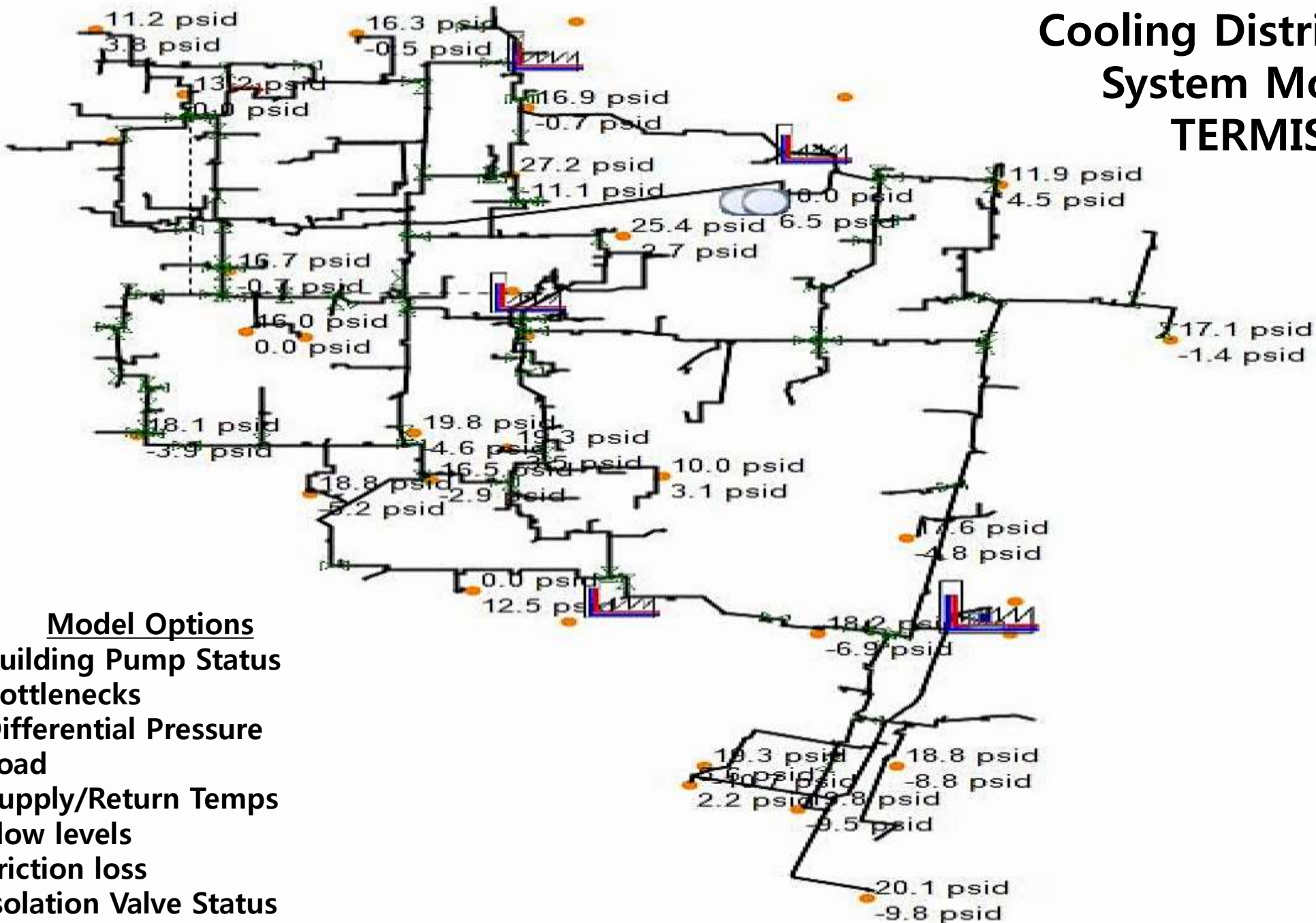
Reduced
Operating Costs

Optimized
Reliability

Increased
Availability

Increased
Safety

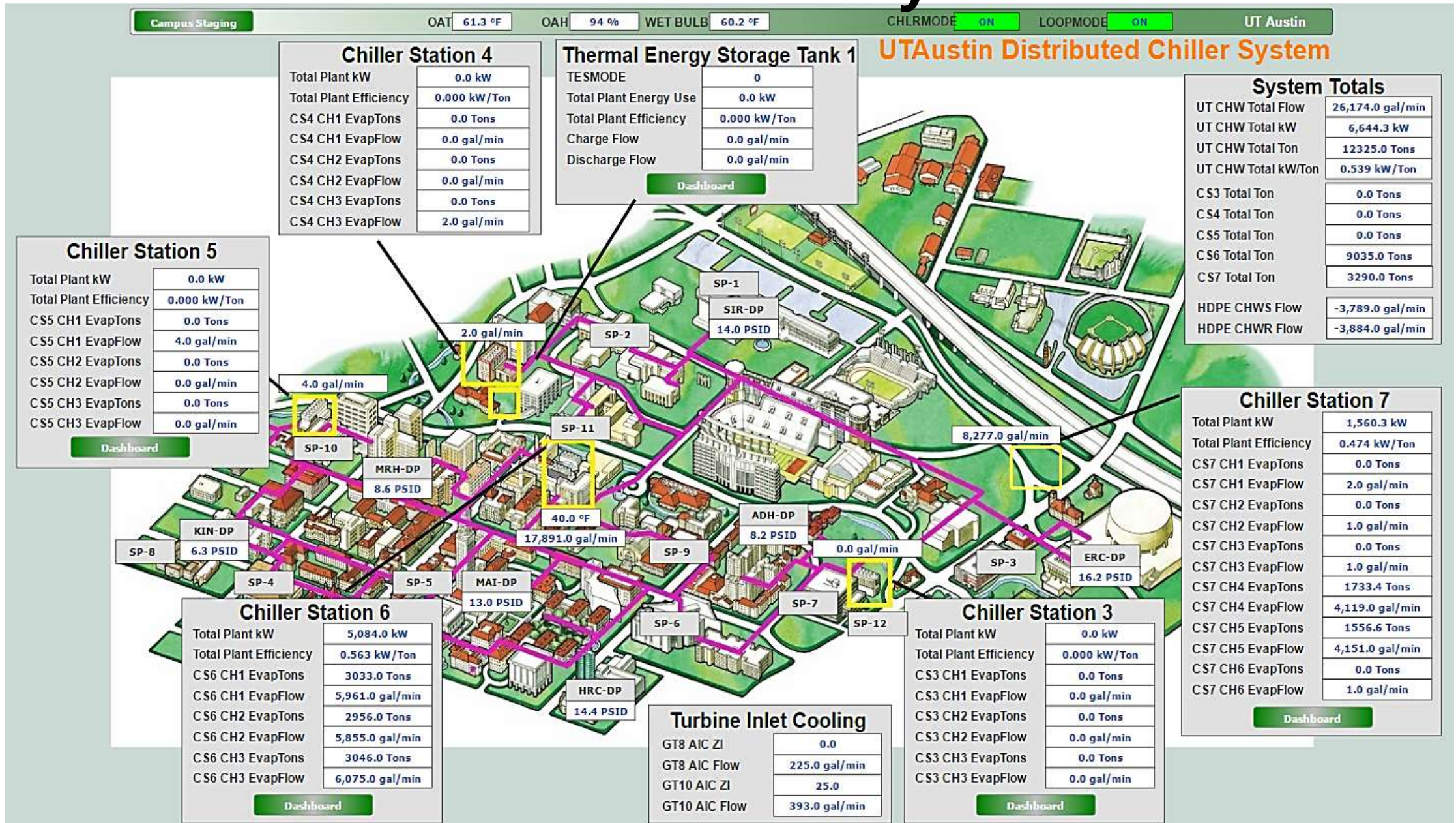
Cooling Distribution System Model TERMIS



Model Options

- Building Pump Status
- Bottlenecks
- Differential Pressure
- Load
- Supply/Return Temps
- Flow levels
- Friction loss
- Isolation Valve Status

Distributed Chiller System

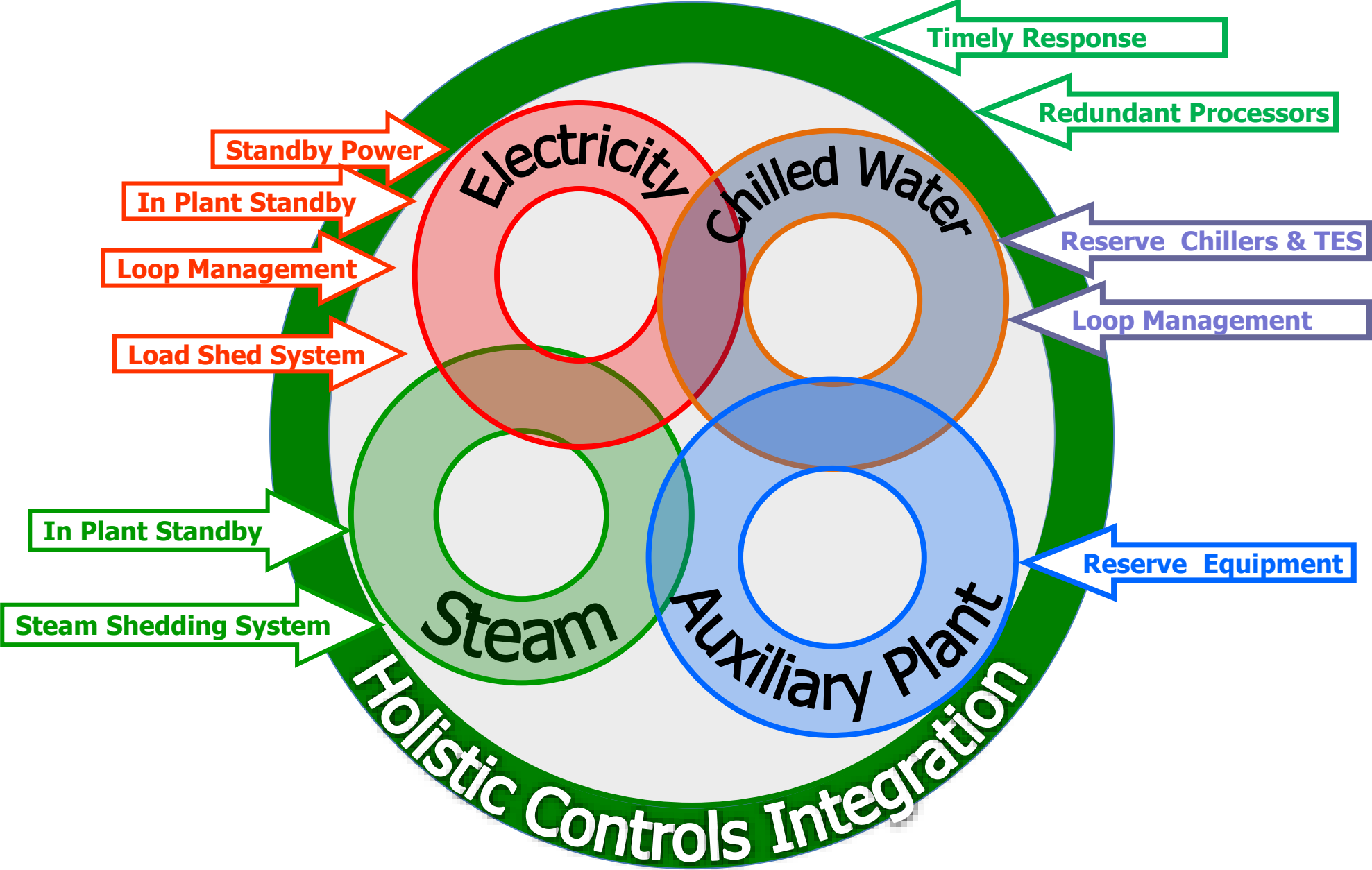


The Foundation of UT's Optimization

Campus Optimization



Reliability/Load Control Philosophy



Improvements

