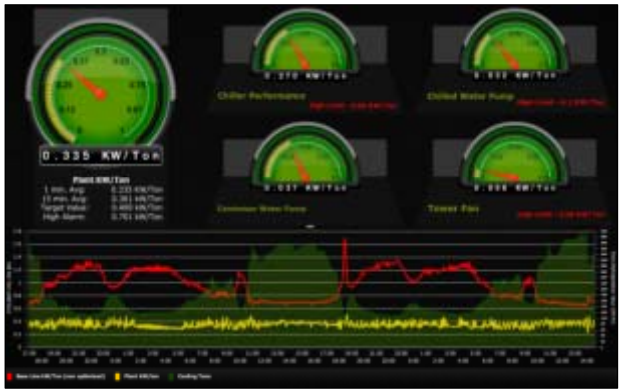
KILTECH

Central Plant Energy Control Systems (CPECS)

Empowering Automated & Dynamic Decision Making



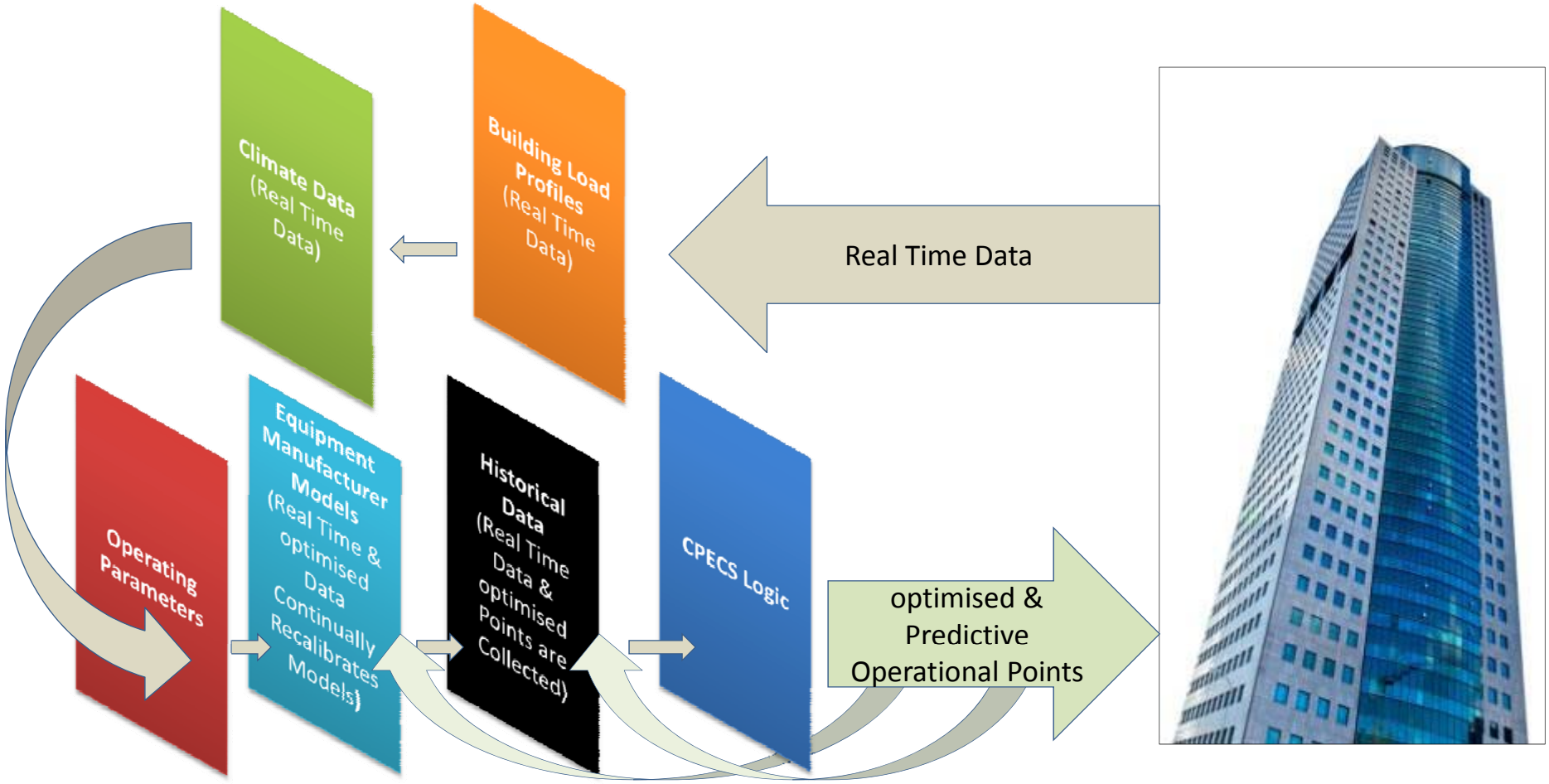
Agenda

- ✓ Background information: Common Challenges in Energy and Plant Performance
- ✓ How Central Plant Energy Control Systems assists in overcoming challenges: CPECS Overview & Benefits
- ✓ Questions & Discussion

Central Plant Energy Control System

Automated optimised Variable Speed Solutions For
New & Existing Chilled Water Plants

Continual Data Feedback Loops / Self Calibrating & Self Learning Logic



Energy and Plant Performance: Common Challenges

Understanding How Individual Equipment Performance Targets and Variables Impacts Overall Chiller Plant Performance:

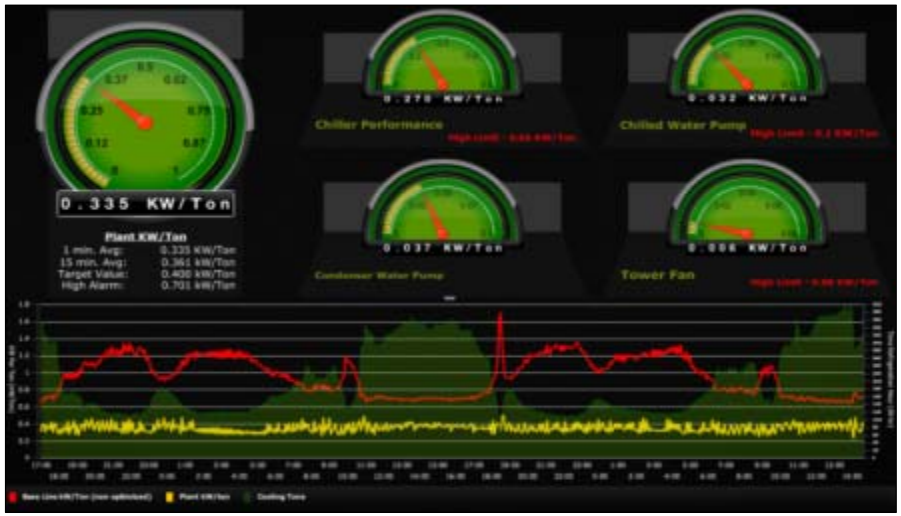
- The energy and performance implications of current operations → Data correlations
- Gathering and generating high level and granular data to make informed decisions → Implementing solutions from data on a consistent basis.
- Condition Monitoring → Tracking and accounting for performance degradation and M&V visibility.

Achieving optimal chiller plant energy performance (COP) while maintaining cooling needs and respecting equipment parameters:

- Optimised chiller sequencing based on actual loading and performance models of chillers.
- Optimised chilled water pump sequencing
- Optimised condenser water pump sequencing
- Variable tower water temperature control developed that includes optimised tower cell sequencing and spray density optimization.
- Variable speed condenser water pumping control to match flow rate against actual demand, flow boundaries of chillers and cooling towers and optimal heat exchanger flux.
- Chilled water set point reset designed specifically to operate with variable primary flow & variable primary/ variable secondary configurations.
- Variable chilled water loop pressure control in correspondence with building AHU conditions.

Central Plant Energy Control Systems

- Evaluating causal relationships → How changes to equipment performance affects overall plant performance.
- Automatic modulation of control levels to all VSD's to provide the maximum level of system performance while respecting the following limitations:
    - Chiller
    - Tower
    - Building Flow
    - Temperature
- Historical, real time and predictive performance of plant and equipment.



Dynamic Decision Making

Chiller Sequencing

- Optimised chiller sequencing based on real time adaptive control.
- Algorithms determine the combination of chillers that result in LOWEST power and pumping per 15 minute load window based on real time data available over the chiller communication links and empirical part load performance models that are adjusted with vessel fouling.
- Should predict chiller capacity and performance under variable condenser water and chiller water flow conditions.
- CPECS **DOES NOT USE** simple four point IPLV or NPLV models that fail to account for altered water flows or temperatures.

Condenser Water Control

- Optimising Tower Supply Water Temperature, Tower Approach and Condenser Pump Speed based on Chiller Load and Tower Approach Data.
- Tower fan speed control via VFD's.
- Variable speed condenser pump control via VFD's.

Real time analytics to determine optimal operating points to minimize the COP for OVERALL CHILLER PLANT.

Dynamic Decision Making

Chilled Water Control

- Optimised Chilled Water Setpoint based on Outside Air Conditions, AHU Power Input (fans), Lowest Average Air Handler Outside Aircoil Leaving Air Temperature Setpoint and Chilled Water Flow Rate.
- Chilled water decoupling valve control via 0-10V output and chiller ΔP set point.

Chilled Water Pump Control

- Utilize manufactures data in form of bi-quadratic curve fits where coefficients are input into CPECS as part of algorithm → Software always knows where devices are operating.
- Variable primary chilled water distribution pump control via VFD's and sequencing of pumps based on loop pressure, flow limits and head requirement.
- Modulate flow based on differential pressure sensors across chilled water supply and return.
- Monitoring of critical zone differential pressures.
- Variable pressure set point based on zone valve positions → moving the system curve.

CPECS provides plant protective sequences such as low temperature limits, high condenser water temperature limits and equipment failure detection.

Real time analytics to determine optimal operating points to minimize the kW/ton for OVERALL CHILLER PLANT.

Measurement, Verification, Reporting , 24/7 Condition Monitoring & ALL Onsite Data

Real Time M&V

Each CPECS system comes with NIST certified BTU (kWr cooling) and temperature metering equipment.

Reporting

CPECS allows for reports to be generated that summarizes performance and savings using trend charts and summary data.

24/7 Monitoring

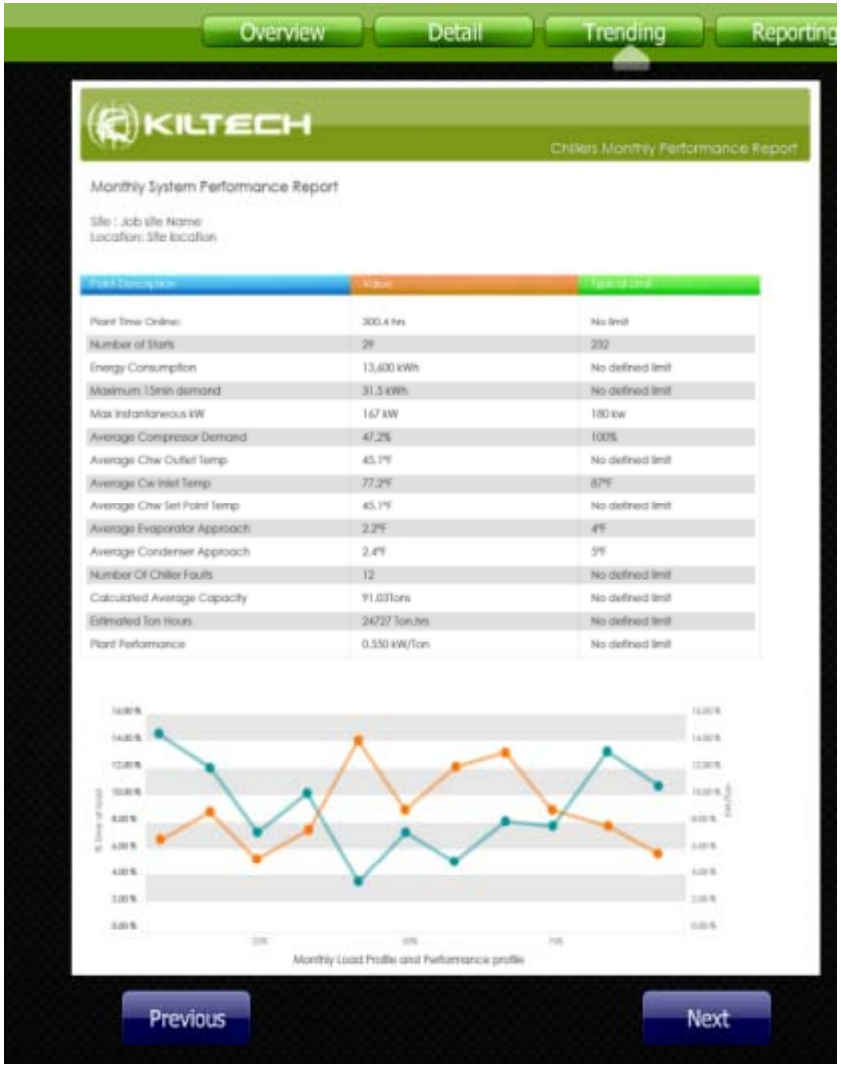
All CPECS control systems have the ability to remotely warn of equipment failure, poor efficiency or when performance exceeds and/or drops below pre-established parameters via an email, SMS or BAS alarm.

Onsite Data Storage of ALL Data / Customer Owns ALL Data

All data is stored onsite via a secure SQL Database which allows for ease of access to historical data without an internet connection.

All data is backed up once a week to a secure server off site

THIS IS ALL PROVIDED AT NO ADDITIONAL COST.



Revealing the Need for Central Plant Energy Control Systems

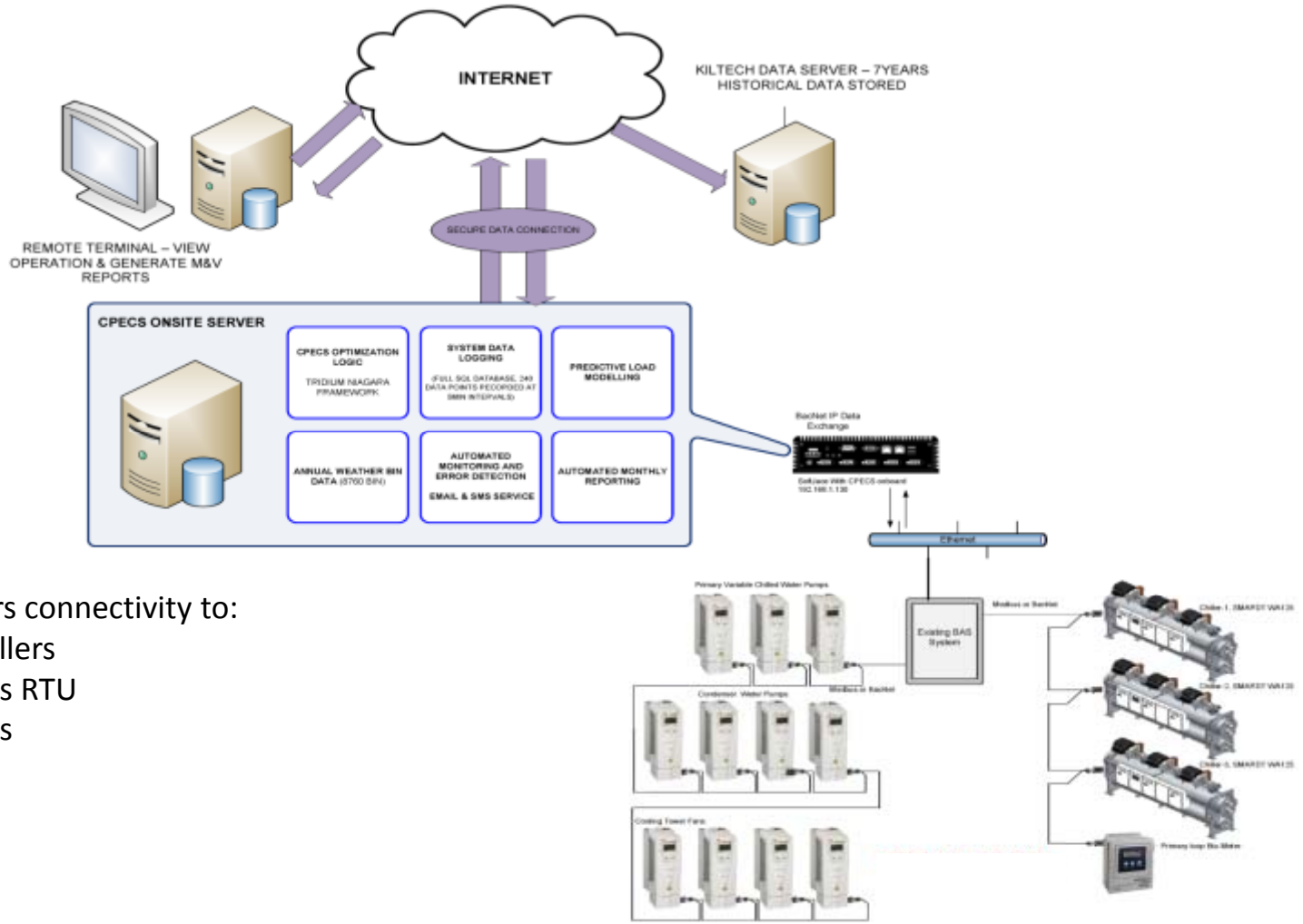
User Interface Trending for Measurement and Verification

Source: Goodyear, AZ. Above data gathered on October 18, 2011. Plant contains 3x 550 ton Smardt Chillers.

Revealing the Need for Central Plant Energy Control Systems

Product Hardware – and Panel Option Deployment

Flexible System Architecture: BAS Controls Overlay or Stand Alone Product Offering



CPECS offers connectivity to:

- ALL Chillers
- Modbus RTU
- Modbus
- TCP/IP
- BacNet
- Lon
- N2

Services Offered

Proposal Development – 8,760 Energy Bin Analysis
As part of every proposal, we utilizes an 8,760 bin analysis that analyses the installed load at 2% intervals to develop the baseline and the post-CPECS deployment levels to generate the cost-value proposition . The analysis takes into account the equipment, building's load profile, DOE TMY3 data (actual weather data or closest available to the project site), building occupancy schedules, plant operations, plant operational hours, energy costs and building use.

Engineering Consultation
Kiltech will provide design, energy, chiller VFD retrofit and controls consolation as required for projects.

Performance Guarantee, Performance Contracts and/or Project Financing
Kiltech offers performance guarantees, performance contracts and project financing where anticipated cost savings can be used to pay down the project costs.

Financial Rebate Facilitation
As part of every project (where applicable) Kiltech will facilitate federal, state and/or LSE incentives and generate the technical information required for project review.

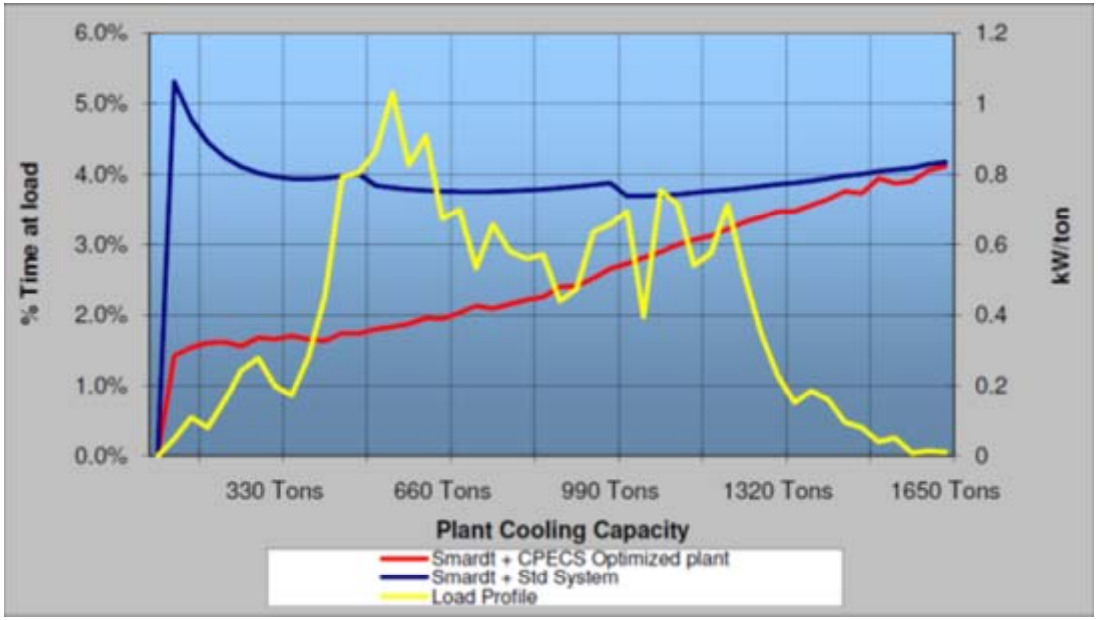
System Start-Up and Commissioning / CPECS Operational Training for all Necessary Personnel / CPECS Report Generation Data Access and M&V training
Kiltech will provide the above as part of every project.

Continual Support and Troubleshooting <u>For Life of Product</u>
As part of every project, Kiltech will provide ongoing technical support, troubleshooting and updates as needed for the life of the CPECS product.

Revealing the Need for Central Plant Energy Control Systems

Energy Sales Report - Undertaking the Energy Audit, 8760 Analysis, Load Profiling and Weather Data

Technical - Chiller Details	Smardt + CPECS Optimized plant		Smardt + Std System	
variable cooling capacity	1650.0 Tons		1650.0 Tons	
core cooling capacity	0.0 Tons		0.0 Tons	
Technical - Plant Details				
Chilled water pump power	3x 43.9 HP, Sequenced	VFD	2x 115.1 HP, Duty Standby	VFD
Primary loop pumps	-	Const	3x 11.1 HP, Sequenced	Const
Condenser water pump power	3x 33.5 HP, Sequenced	VFD	3x 33.5 HP, Sequenced	Const
Tower Fan motor power	3x 25 HP, Sequenced	VFD	3x 25 HP	VFD



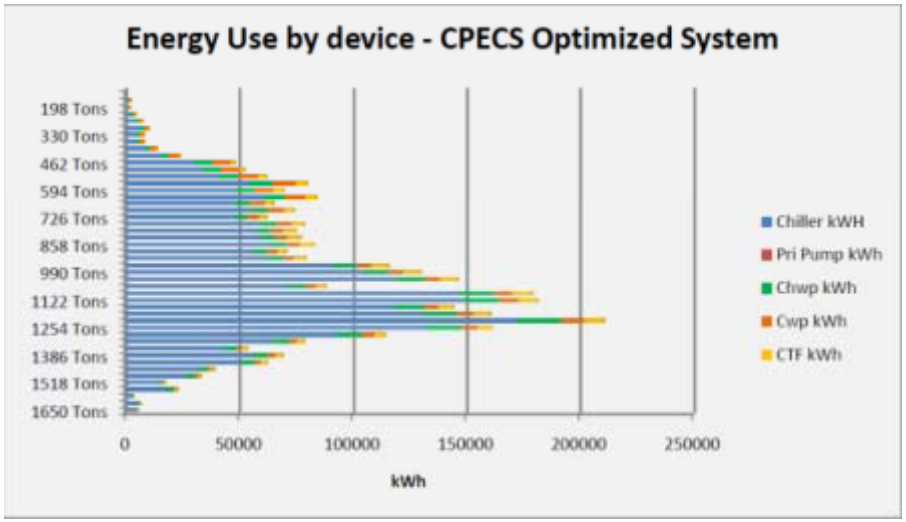
Energy Sales Report – Detailed Analysis of Existing Plant 'Baseline' vs. CPECS

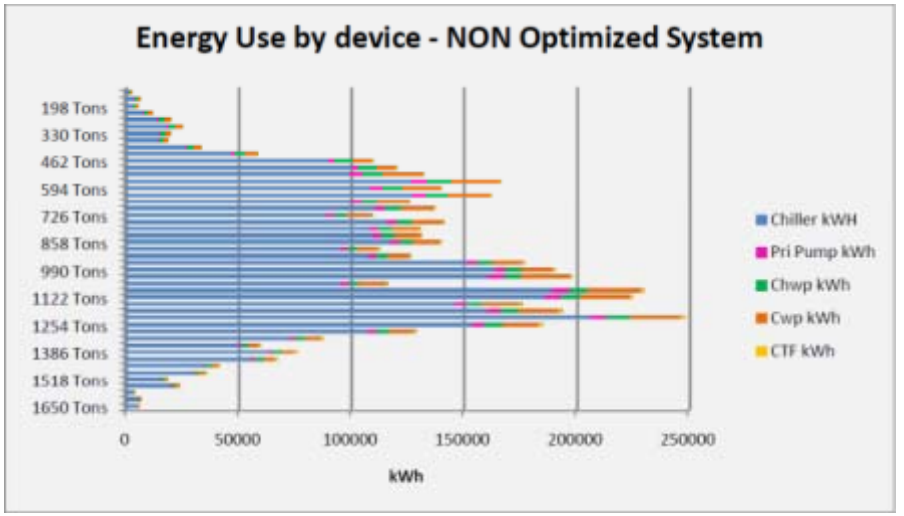
CHILLER DETAILS				
Number Chillers	3x Equal Sized		3x Equal Sized	
Manufacturer/ Model	Smardt, WA190		Smardt, WA190	
Design Tons	550 Tons		550 Tons	
Design kW/Ton (Full Load)	0.59 kW/Ton		0.59 kW/Ton	
Full Load Power Input	324.5 kW		324.5 kW	
Design ChwST	44.0°F		44.0°F	
Design ChwRT	56.0°F		56.0°F	
Design CwST	85.0°F		85.0°F	
Design CwRT	94.3°F		94.3°F	
Design Evap GPM	1100.0GPM		1100.0GPM	
Design Cond GPM	1657.5GPM		1657.5GPM	
Evaporator DP@ design Flow	20ft H2O		20ft H2O	
Condenser DP@ design Flow	19ft H2O		19ft H2O	
Evaporator Minimum GPM	605.0GPM		605.0GPM	
Condenser Minimum GPM	1077.3GPM		1077.3GPM	
Chiller Sequencing Mode	Optimized Sequencing		Percent Chiller Amps	
CONDENSER PUMPING DETAILS				
Number cond water pumps	3x Equal sized		3x Equal sized	
Design GPM & Head per pump	1657 GPM, 60 FT, each		1657 GPM, 60 FT, each	
Cond pump drive type	Variable Speed		Constant Speed	
Flow isolated through off chillers	Yes		Yes	
Cond pump sequencing mode	Sequenced with Chiller(s)		Sequenced with Chiller(s)	
BUILDING SCHEDULE DETAILS				
ASE trigger temp	Chillers off below - 50°F OAT		Chillers off below - 50°F OAT	
First Schedule Hour 1	0 hr of day	setpt -1	0 hr of day	setpt -1
First Schedule Hour 2	24 hr of day	setpt -2	24 hr of day	setpt -2
First Schedule Hour 3	24 hr of day	setpt -3	24 hr of day	setpt -3
Occupancy Details				
Monday	100%, zones occupied		100%, zones occupied	
Tuesday-Friday	90%, zones occupied		90%, zones occupied	
Saturday	80%, zones occupied		80%, zones occupied	
Sunday	50%, zones occupied		50%, zones occupied	

Revealing the Need for CPECS

Energy Sales Report – Detailed Analysis of Existing Plant 'Baseline' vs. CPECS

Operation Data		
Annual Hrs	7,548 hr/yr	7,548 hr/yr
Annual Clg Ton Hrs	6,147,009	6,147,009
Energy Consumption	3,169,583 kWh/yr	4,682,138 kWh/yr
Annual Efficiency	0.516 kW/ton	0.762 kW/ton
Percentage Saving	32%	
kWh Annual Saving	1,512,555	





Thank you.
Questions?

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