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Niagara Case Studies

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General Manger
Conserve It

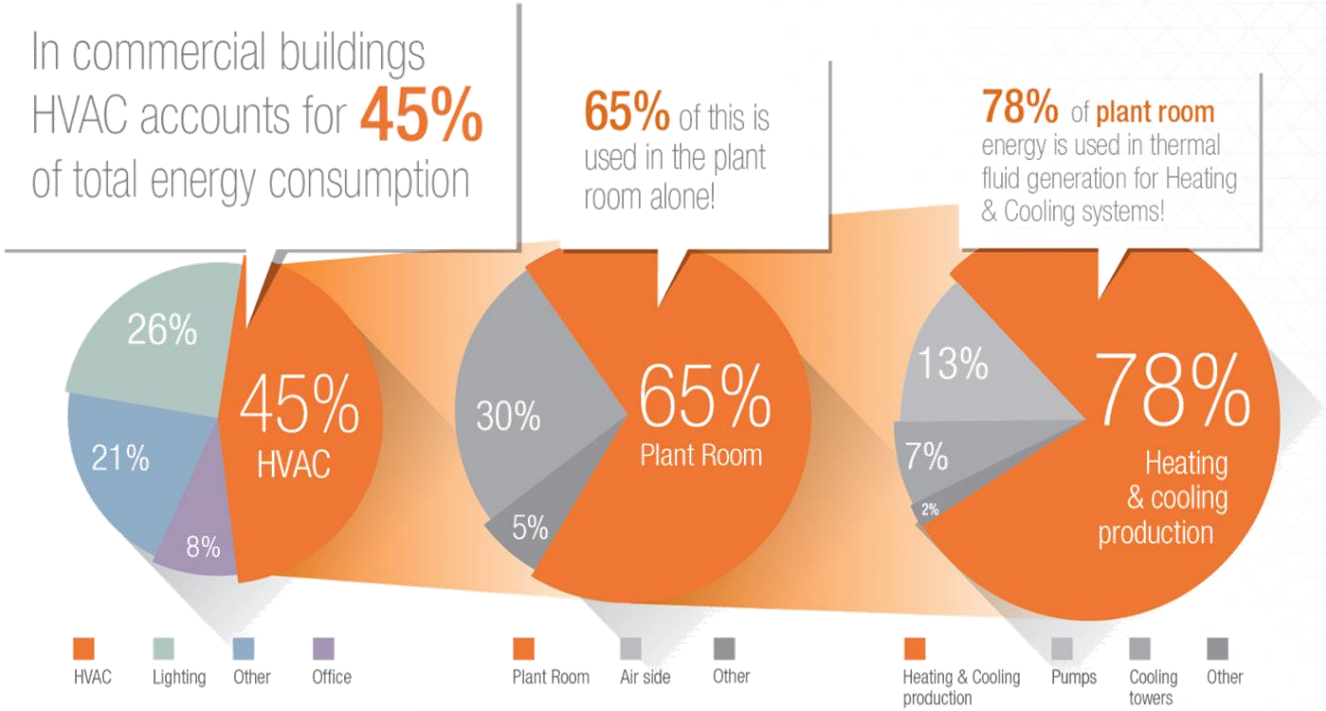
Advanced CPCOS

Chiller Plant Control and Optimisation as an Appliance

Overview

- Why do we need a Central Plant Control and Optimization System (CPCOS)
- What does a Central Plant Control and Optimization System need to do
- What doesn't a Central Plant Control and Optimization System need to do
- What are the key features of a Central Plant and Optimization System
- Why does a Chiller Manufacturer want their own Central Plant and Optimization System
- What does a Central Plant Control and Optimization System mean for
  - Property Management companies
  - Facility Managers
  - Energy Managers
  - Mechanical contractors
  - Controls technicians and contractors

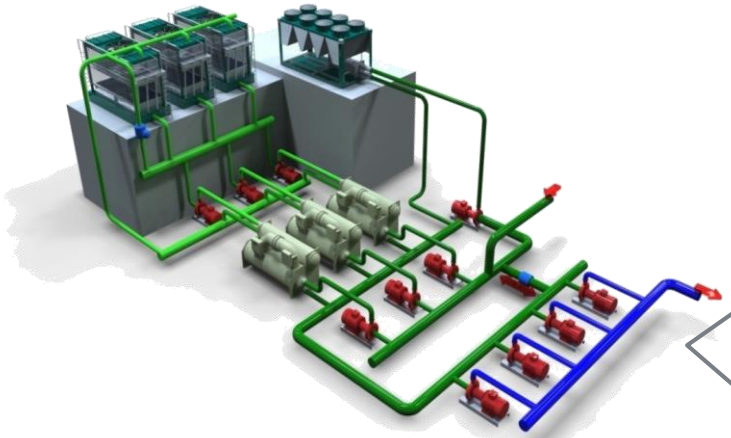
Why do we need a Central Plant Control and Optimization System



Source US Department Of Energy (DOE).
Office building environment, DHW minimal requirement provided by the main boilers through a heat exchanger. Boiler plant and pumping assumed to be a separate system, In some instances heating and cooling may be required simultaneously.

Why do we need a Central Plant Control and Optimization System

- The Plant Room is energy intensive and hides a huge savings potential



Heating & Cooling production represents up to 30% of the total building consumption

- And it all starts with the Chillers

What does a Central Plant Control and Optimization System need to do

- Efficient components can only take building efficiency so far, a system approach is needed to maximize efficiency.
- Plant Optimization recognises that the whole is greater than the sum of the parts and allows us to reach and sustain a high-performance, high-efficiency output

*Or put in a **simple** way*

- Lowest cost of production of each and every ton of chilled water

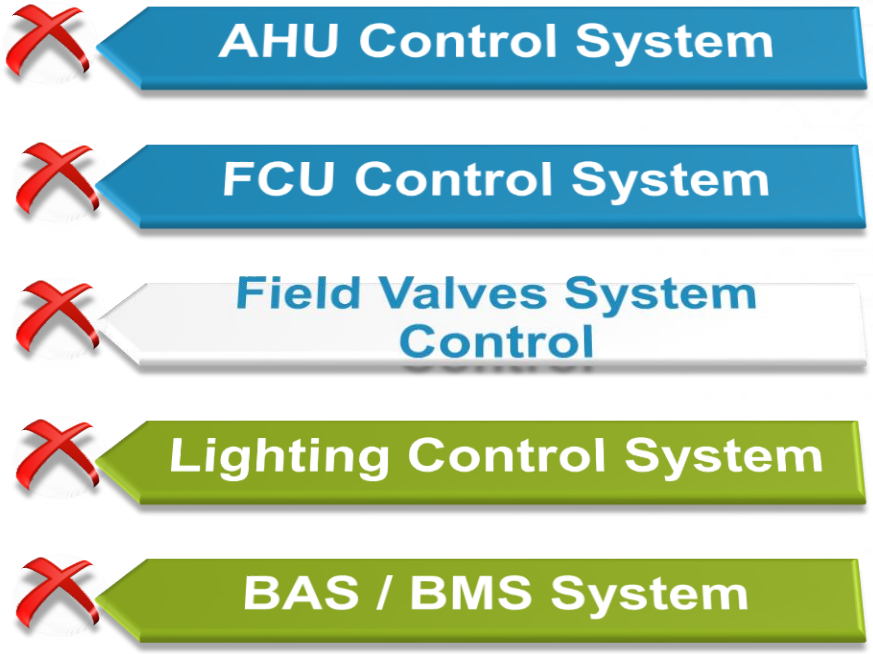
What does a Central Plant Control and Optimization System need to do

And its not easy to do

- Its not just switching on the chillers and the supporting pumps and tower fans
- Its more than staging chillers up and down to maintain a chilled water setpoint
- Its more than just driving down the condenser water temperature
- And its only now possible because of the data that is available and the power of modern software platforms

Central Plant Control and Optimization System

What doesn't a Central Plant Control and Optimization System need to do



What are the key features of a Central Plant and Optimization System

- PERFORMANCE
- RELIABILITY
- OPTIMIZATION

Plant Performance Monitoring

Plant Diagnostics and Reporting

Plant Optimization

Advanced Self Learning Algorithms based on ASHRAE Study

Plant Measurement and Verification

Plant Control and Automation

Plant Continuous Commissioning and Tuning

What are the key features of a Central Plant and Optimization System

- **The PlantPRO / MultiPRO Optimization Model**

Measure

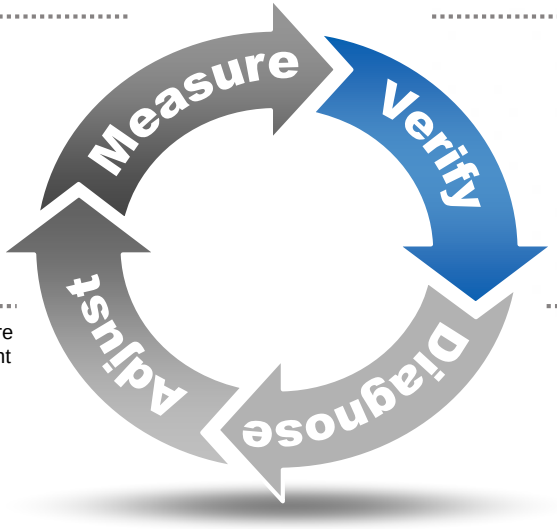
Measure the key data points and calculate the efficiency of each chiller and ancillary devices.

Report the results via HMI and through on demand and scheduled reporting

Verify

Check the instantaneous efficiency against the manufacturers design data and best case efficiency modeling.

Determine Total Plant Efficiency



Adjust

Adjust the plant through automation where possible to correct back to optimized plant efficiency.

Dispatch service personel to attend to adjustments and repairs that cannot be rectified through automation.

Diagnose

Analyse the data and run in a diagnostics engine to determine the cause of any gaps between actual, design and best case chiller and plant efficiency

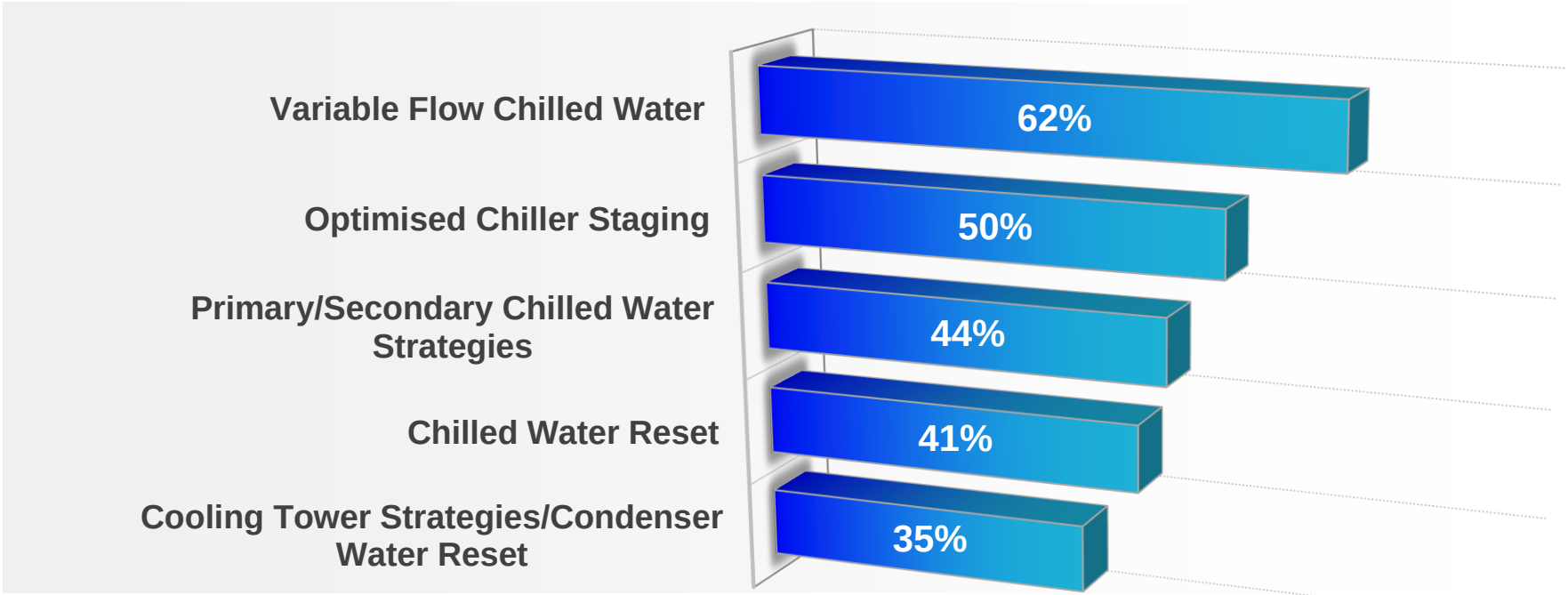
In 2012 a Worldwide “Automation to Optimization” Survey was conducted

There were two key questions

Do you prefer CPO/CPA by a Chiller Specialist or BMS Supplier?

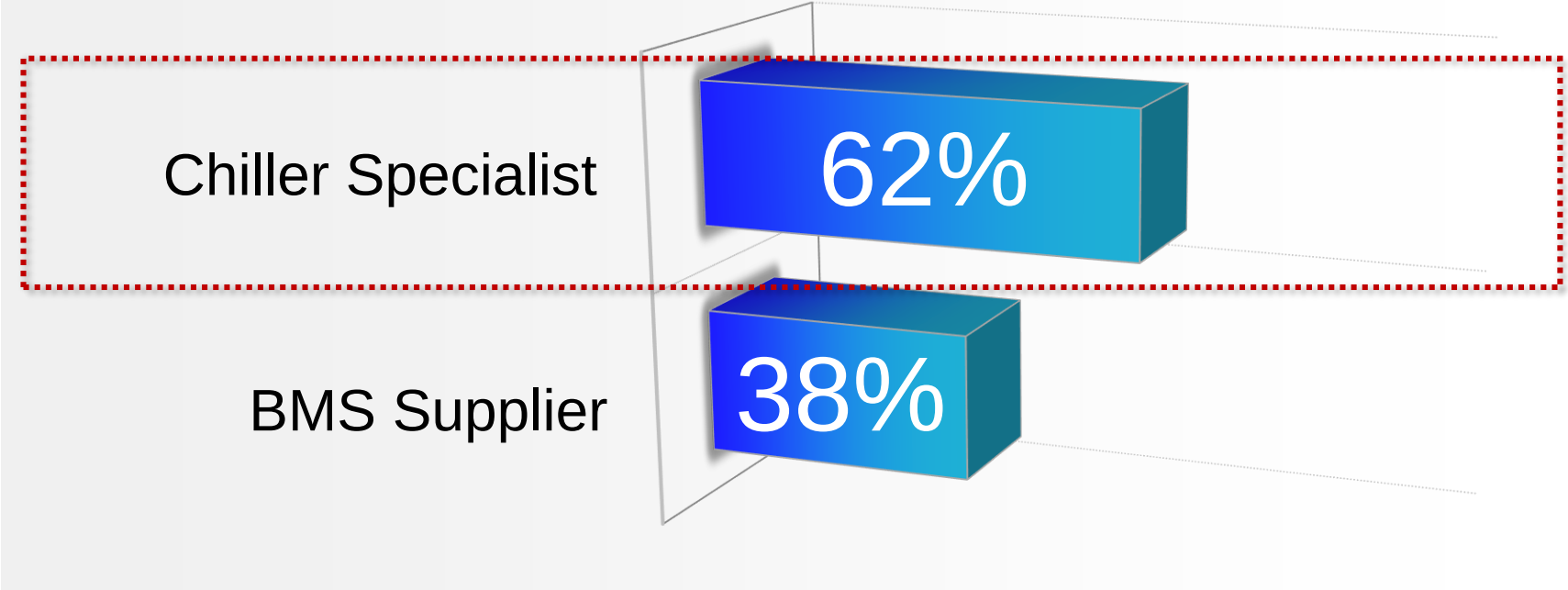
What are the most Important Optimization Strategies?

Important Optimization Strategies



Source: JCI/Airah Feb 2013

Consultants Prefer CPA/CPO by

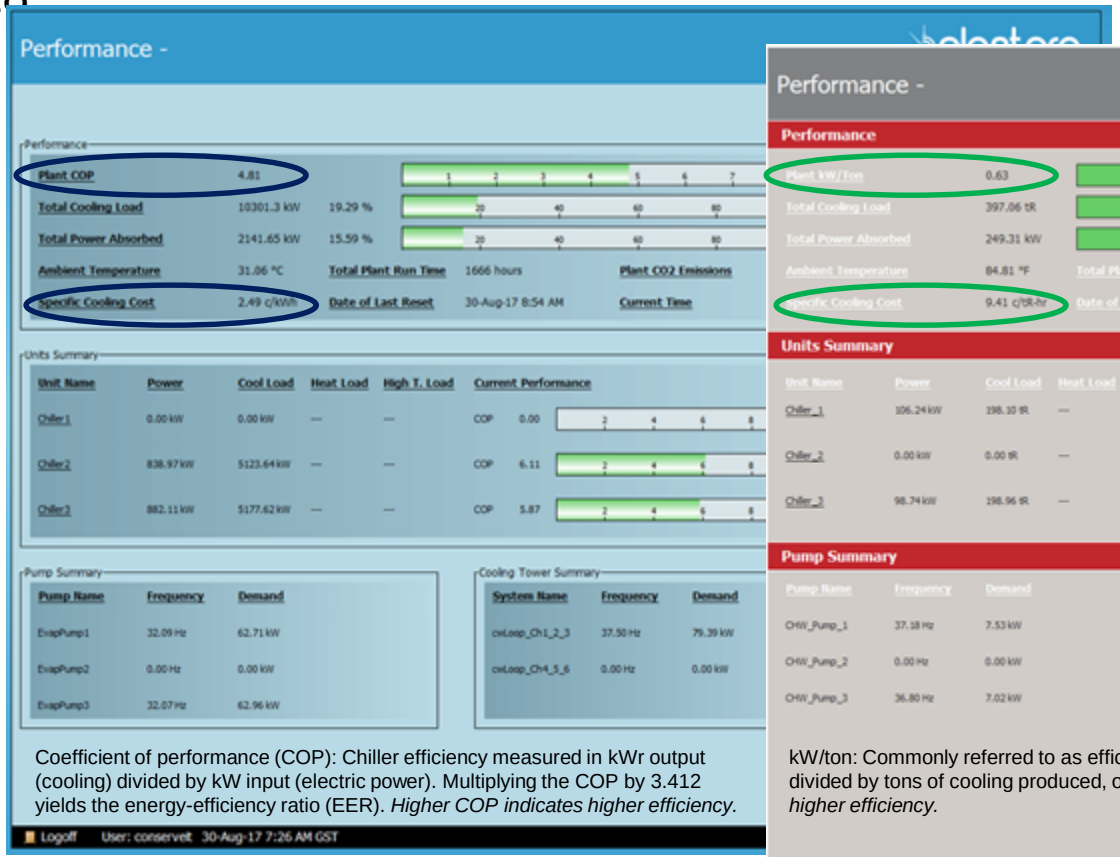


Why does a Chiller Manufacturer want their own Central Plant Control and Optimization System

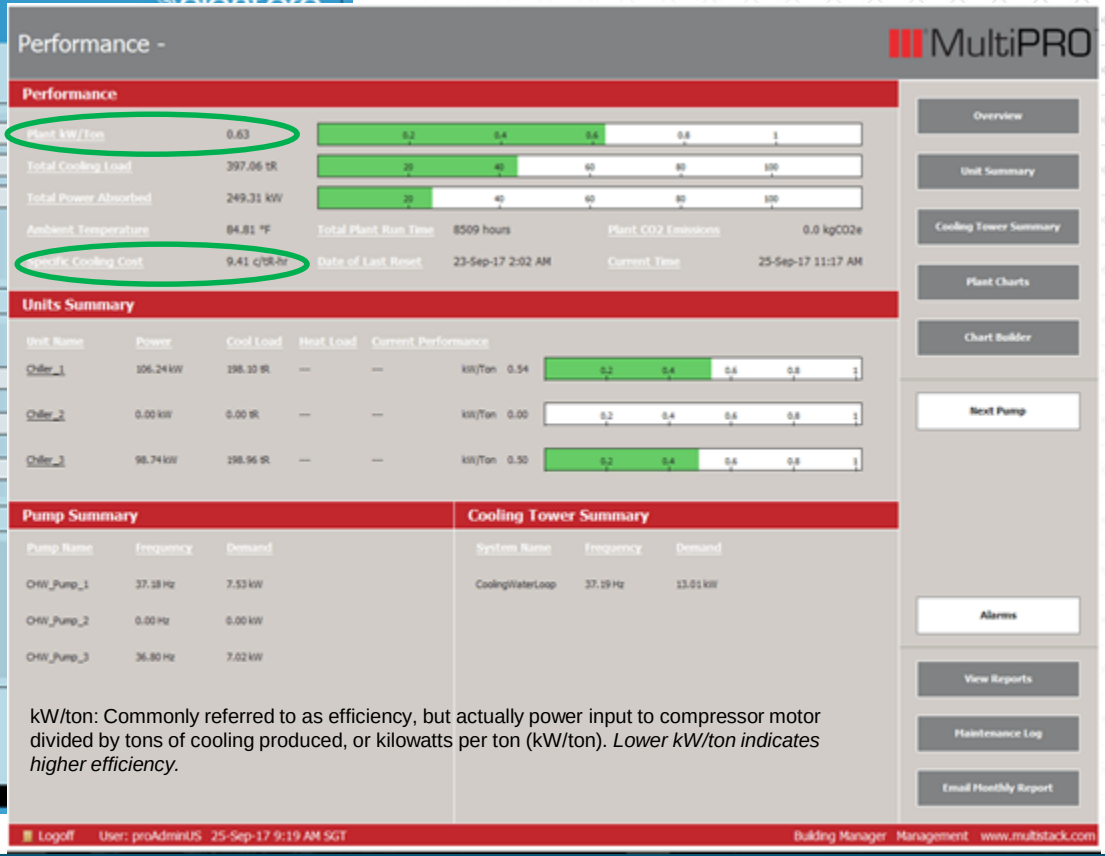
- Manufacturers know their Chillers best, so they know how to control them best
- Helps them monitor the performance of their Chillers real-time and make sure they run within operational limits
- Helps Manufactures' Reps with DLP and Warranty Claims
- Proves to consultants their machines provide efficiencies as advertised
- PRO kW/Ton Shows in Real Time Where Your System is Capable of Operating in kW/Ton and $ Vs. Where it is Actually Operating

What does a Central Plant Control and Optimization System mean for

- Property Management Companies :
  - Generally manage a portfolio of properties containing a number of large buildings that have large chiller plants.
  - Looking for a standardized way to manage their energy consumption in the HVAC systems
  - They want to benchmark their properties energy consumption against one another
  - PlantPRO / MultiPRO allows these organizations to deploy a standard product with the same look and feel across all of their assets and also compare their buildings energy consumption
  - If they need to rotate Facility Managers through their portfolio of buildings that they will be comfortable working with PlantPRO / MultiPRO due to the same functionality and look and feel across all installations.



Coefficient of performance (COP): Chiller efficiency measured in kWr output (cooling) divided by kW input (electric power). Multiplying the COP by 3.412 yields the energy-efficiency ratio (EER). *Higher COP indicates higher efficiency.*

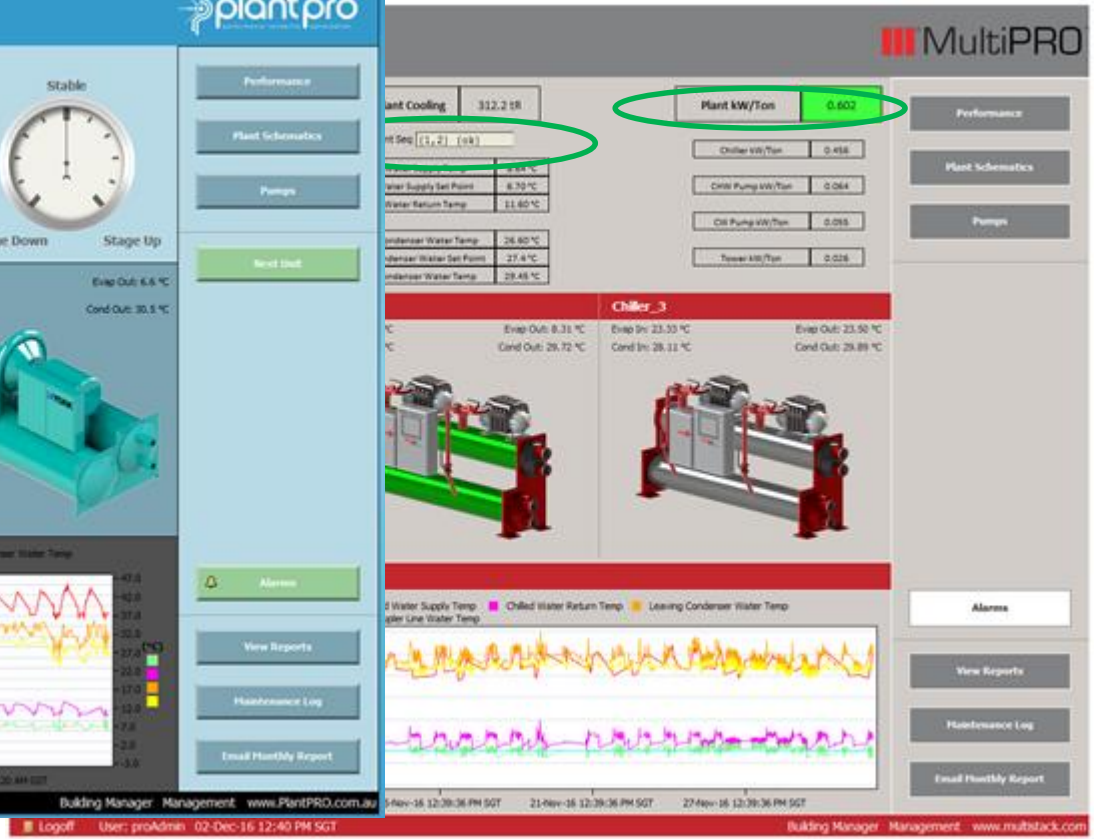


kW/ton: Commonly referred to as efficiency, but actually power input to compressor motor divided by tons of cooling produced, or kilowatts per ton (kW/ton). *Lower kW/ton indicates higher efficiency.*

What does a Central Plant Control and Optimization System mean for

- Facility Managers :
  - Are set tough KPIs while managing their buildings.
  - They want to know that their chiller plant is being constantly optimized and running at peak performance.
  - They also want to be able to do basic operations themselves without having to be versed in extensive technical details of chiller plant control and optimization can be enough to challenge even the most experienced plant engineers.
  - PlantPRO / MultiPRO delivers for Facility Managers by doing all of this as a suite of standard features, right ‘out-of-the-box’.


Overview -
plantpro
Current Plant Conditions
Chilled Water Supply 6.7 °C
Chilled Water Return 10.2 °C
Condenser Water Leaving 30.1 °C
Condenser Water Entering 26.0 °C
Active Cool. Seq {2,3}
Next Cool. Seq {2,3,5}
Total Units 6
Running Units 2
Cooling Cap. 17800 / 53400 kW
Loop Diff. Press. 0.00 kPa
IO Cosmos Status ERR
Stable
Stage Down
Stage Up
Performance
Plant Schematics
Pumps
Next Unit
Alarms
View Reports
Maintenance Log
Email Monthly Report
Chiller1
Chiller2
Chiller3
Logoff
User: conservet 30-Aug-17 7:33 AM GST
Building Manager Management www.PlantPRO.com.au


MultiPRO
Plant kW/Ton 0.602
Performance
Plant Schematics
Pumps
Chiller_3
Alarms
View Reports
Maintenance Log
Email Monthly Report
Logoff
User: proAdmin 02-Dec-16 12:40 PM SGT
Building Manager Management www.multistack.com

What does a Central Plant Control and Optimization System mean for

- Energy Managers :
  - Need to be able to track, monitor in real time and report on energy consumption and the changes in those consumption patterns.
  - Ability for a user to construct custom charts out of any data point we log and then download this data in its raw form as CSV data or export the chart to a PDF.
  - Energy Report to provide a comprehensive breakdown and analysis of energy consumption for all equipment in a chiller plant, month on month, year on year.

1. Plant Report		Month To Date Current	Previous	Variation
Total Cooling Produced	[kWh]	14,745,485	15,395,480	-4%
Total Capacity Produced	[kWh]	14,745,485	15,395,480	-4%
Total Electricity Consumed	[kW-hr]	3,302,940	3,467,722	-5%
Total Electricity Cost	[Dollar]	396,260	418,262	-5%
Average Plant Efficiency		4.4	4.4	1%
Specific Energy Cost	[c/kWh]	2.7	2.7	-1.1%
CO2	[kgCO2e]	214,473	214,812	-0%
Min/Max Outside Ambient Temp	[°C]	28 / 48	-40 / 46	

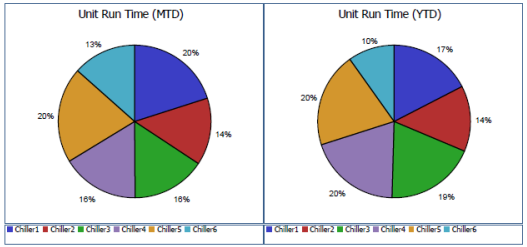
Total Electricity Cost	[Dollar]	310,213	326,704	-5%	789,064	0	0%
Run Time	[Hours]	2,197	2,050	7%	4,916	0	0%

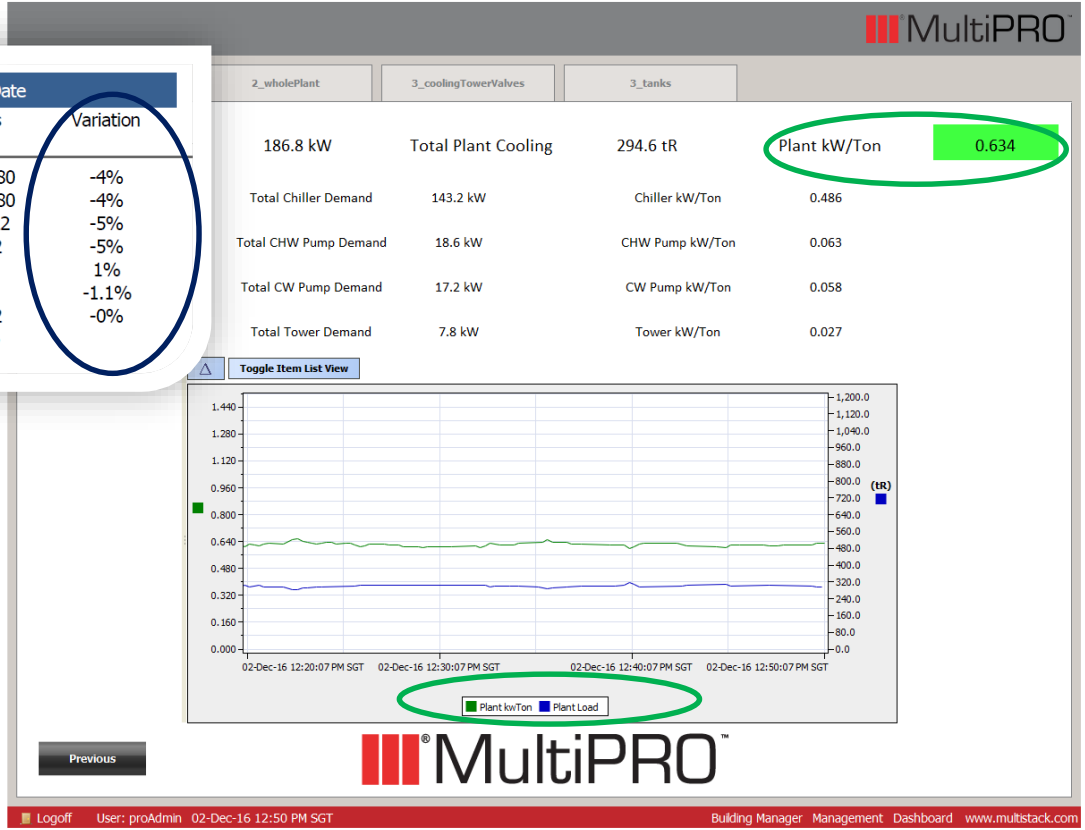
3. Pump Report

Total Electricity Consumed	[kW-hr]	518,041	552,071	-6%	1,242,547	0	0%
Total Electricity Cost	[Dollar]	62,161	66,564	-7%	154,589	0	0%
Electricity Consumed (primary)	[kW-hr]	390,782	352,673	11%	867,188	0	0%
Electricity Cost (primary)	[Dollar]	46,891	42,502	10%	107,923	0	0%
Electricity Consumed (secondary)	[kW-hr]	127,259	199,198	-36%	375,359	0	0%
Electricity Cost (secondary)	[Dollar]	15,270	24,061	-37%	46,666	0	0%

4. Source Equipments Report

Total Electricity Consumed	[kW-hr]	199,790	208,597	-4%	469,740	0	0%
Total Electricity Cost	[Dollar]	23,886	24,994	-4%	66,713	0	0%





What does a Central Plant Control and Optimization System mean for

- Mechanical Contractors :
  - Are looking for a vendor independent product that allows them to demonstrate the valuable service they can offer to their clients.
  - PlantPRO / MultiPRO is “vendor independent”. They work with machines and equipment from any manufacturer and do so seamlessly and in a standardised way.
  - It opens a wider selection of plant rooms that they can work on
  - Choose the best piece of equipment for the project rather than having to match the software and equipment.


Chiller Summary - Water Cooled -
plantpro
Performance
Cooling Tower Summary
Next Unit
Alarms
View Reports
Maintenance Log
Email Monthly Report
Logoff
User: conserveit 30-Aug-17 7:28 AM GST
Building Manager Management www.PlantPRO.com.au
MultiPRO
Chiller_2
Chiller_3
Performance
Cooling Tower Summary
Alarms
View Reports
Maintenance Log
Email Monthly Report
Logoff
User: proAdminUS 25-Sep-17 9:24 AM SGT
Building Manager Management www.multistack.com

Diagnostic Summary

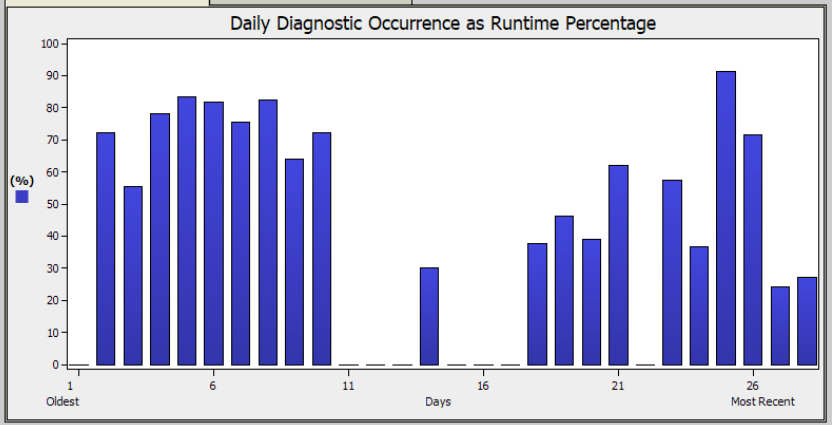
Diagnostics	Yesterday (%)	Last 7 Days (%)	Last 28 Days (%)
Sensor Imbalance Evaporator Circuit 1	0.00	49.97	66.23
Sensor Imbalance Condenser Circuit 1	0.00	24.58	24.06

Current Alarms

Timestamp	Name	State	Value
25-Nov-16 4:26 PM AEDT	Chiller_1_chwHuntingDiag	Unacked	7.21
25-Nov-16 4:39 PM AEDT	Chiller_1_calcDischargeAppTemp1	Unacked	3.96
25-Nov-16 4:42 PM AEDT	Chiller_1_sensorImbCondDiag1	Unacked	34.38
25-Nov-16 4:42 PM AEDT	Chiller_1_chwHuntingDiag	Unacked	7.40
25-Nov-16 4:56 PM AEDT	Chiller_1_chwHuntingDiag	Unacked	8.31
25-Nov-16 4:58 PM AEDT	Chiller_1_chwHuntingDiag	Unacked	7.03
25-Nov-16 5:12 PM AEDT	Chiller_1_calcDischargeAppTemp1	Unacked	3.92
25-Nov-16 5:17 PM AEDT	Chiller_1_sensorImbCondDiag1	Unacked	34.40
25-Nov-16 5:17 PM AEDT	Chiller_1_chwHuntingDiag	Unacked	7.51
25-Nov-16 5:27 PM AEDT	Chiller_1_chwHuntingDiag	Unacked	8.46

Diagnostic Analysis

Sensor Imbalance Evaporator Circuit 1 | Sensor Imbalance Condenser Circuit 1



Unit Info

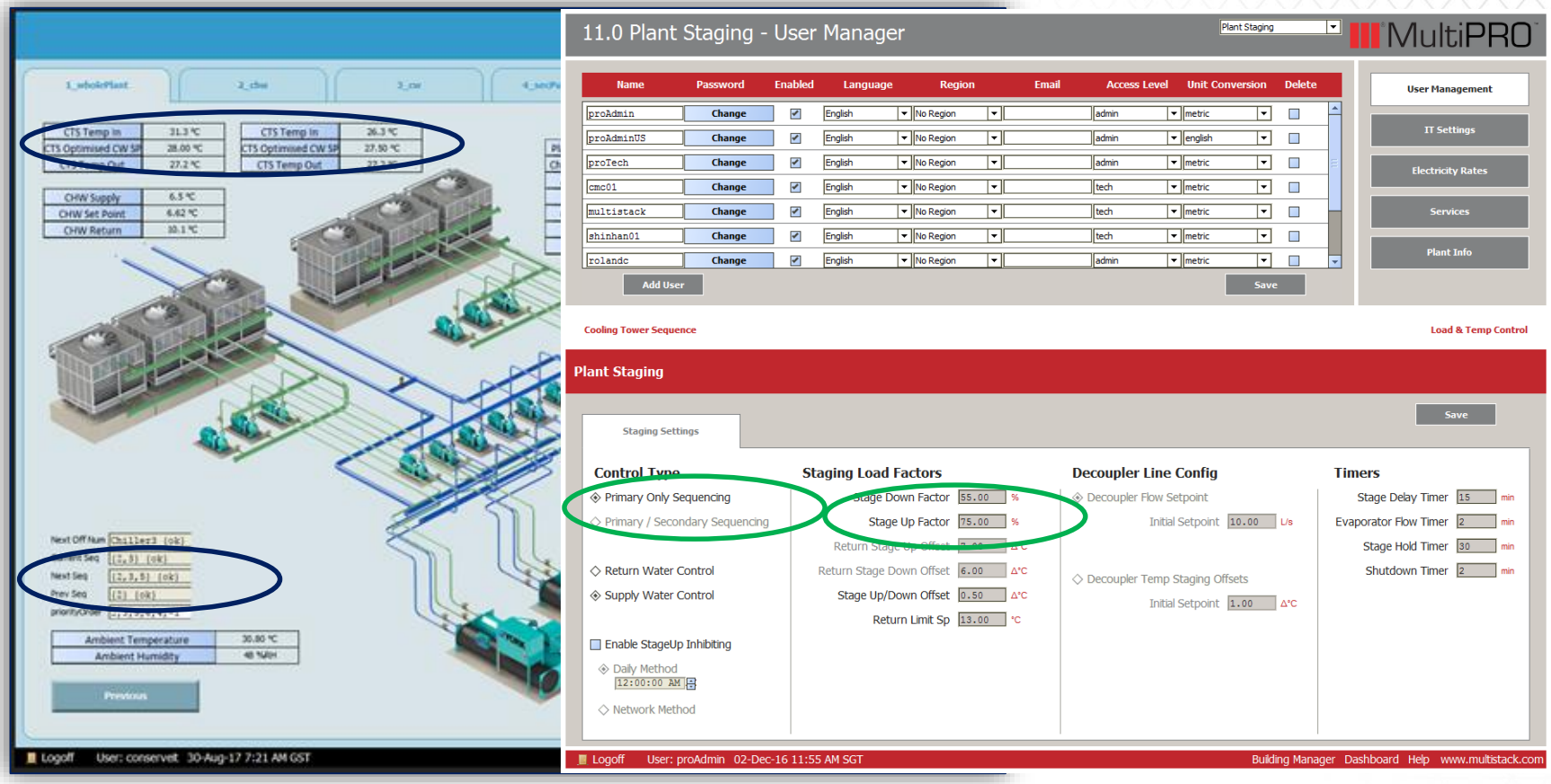
Performance | Units Summary | Alarms

Type:	MpWaterCooledChiller
Manufactured:	2016
Capacity:	1,055.06 kW
Power:	294.62 kW
Condenser Cooling Fluid:	Water
Evaporator Cooling Fluid:	Water
Chiller Type:	High Pressure
Refrigerant:	r134a
Compressor Type:	Variable
Compressor Count:	2
Circuit Count:	1

Logoff

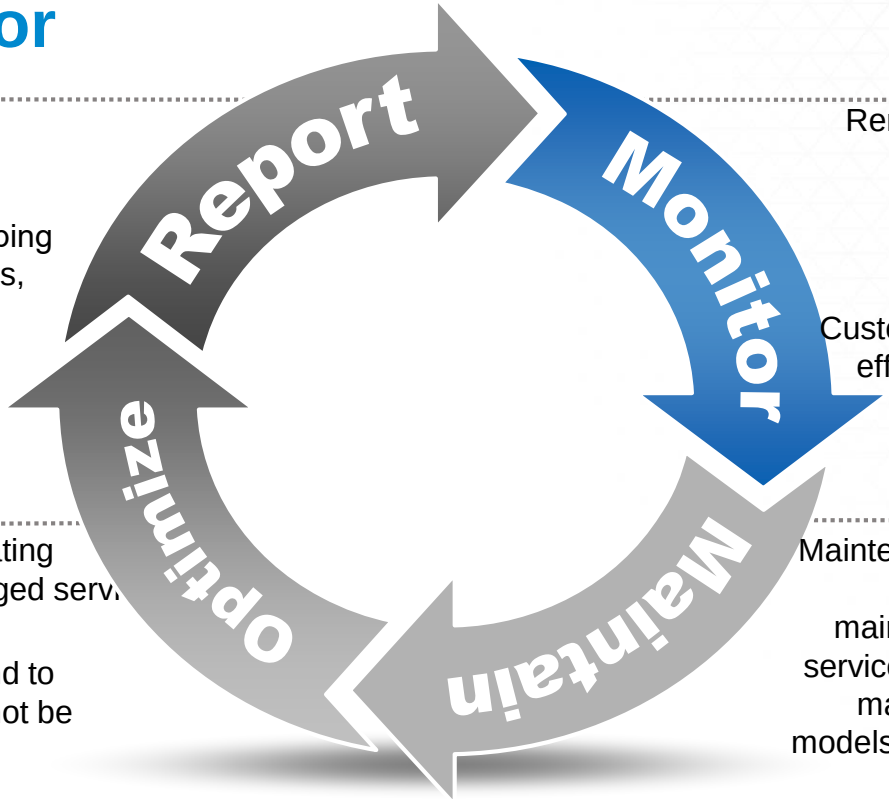
What does a Central Plant Control and Optimization System mean for

- Controls Technicians and Contractors :
  - Have to deal with increased complexities in chiller plant controls & optimization installations.
  - They are looking for a way to deliver on all of this without the increased labor costs blowing out their project pricing and making them less competitive.
  - System that can take care of all of these new situations and give the Controls Contractor the confidence that they can take on these projects and deliver them successfully.


11.0 Plant Staging - User Manager
Plant Staging
MultiPRO
Name
Password
Enabled
Language
Region
Email
Access Level
Unit Conversion
Delete
proAdmin
proAdminUS
proTech
cmc01
multistack
shinhan01
rolandc
Change
English
No Region
admin
tech
metric
english
Add User
Save
User Management
IT Settings
Electricity Rates
Services
Plant Info
Cooling Tower Sequence
Load & Temp Control
Plant Staging
Staging Settings
Save
Control Type
Primary Only Sequencing
Primary / Secondary Sequencing
Return Water Control
Supply Water Control
Enable StageUp Inhibiting
Daily Method
12:00:00 AM
Network Method
Staging Load Factors
Stage Down Factor
Stage Up Factor
Return Stage Down Offset
Stage Up/Down Offset
Return Limit Sp
Decoupler Line Config
Decoupler Flow Setpoint
Initial Setpoint
Decoupler Temp Staging Offsets
Timers
Stage Delay Timer
Evaporator Flow Timer
Stage Hold Timer
Shutdown Timer
Logoff
User: proAdmin 02-Dec-16 11:55 AM SGT
Building Manager
Dashboard
Help
www.multistack.com
Logoff
User: conserver 30-Aug-17 7:21 AM GST
Previous

What does a Central Plant Control and Optimization System mean for

Regular analysis and reporting on efficiency allows for continuous improvement recommendations driving opportunities for VSD's, piping modifications, equipment upgrades, controls enhancements, BMS replacements and drive into the remainder of the building



Remote monitoring facilities provide recurring revenue streams

Fully managed options including intervention enhances revenue potential

Customers will always listen when we efficiency and cost of operation are the drivers

Remote adjustment of plant operating parameters linked to a fully managed servi model

Dispatch service personel to attend to adjustments and repairs that cannot be rectified through automation.

Maintenance Services tailored to each site to include programmed maintenance activities, recalibration services, database support, predictive maintenance, fully comprehensive models that remove the customers risk

Advanced Chiller Plant Control and Optimisation

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