Delivering Results in Utility Management

University of the Sunshine Coast

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History of USC

- Planning began for the Sunshine Coast University College in 1994
- The University opened in 1996, becoming the first **greenfield university** to open in Australia since 1971
- Former **cane farm** on 100 hectares
- **Full university status** granted in 1998 - officially became the University of the Sunshine Coast on 1 January 1999

- Since planning commenced in 1994, the physical development has been guided by the **Campus Master Plan**
- Principles of **environmentally sustainable design (ESD)** are central to the Campus Master Plan

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USC Sippy Downs | 1995

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Campuses and study nodes

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USC today

- 11,600 students
- 900FTE staff
- 90,000sqm GFA

- New Strategic Plan
  - 6 key imperatives, including
    - Increasing enrolments (20000 by 2020)
    - Expanding campuses and study nodes
    - Institutional effectiveness
    - Leadership in sustainability

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USC Sippy Downs | 2016

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Sippy Downs campus

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- The Sunshine Coast has a **sub-tropical climate** with the buildings designed to suit
- There 2 central energy plants; the Northern plant consists of 3 **chillers** and 2 **cooling towers** (supplied with treated lake water), the Southern plant consists of 2 chillers and 2 cooling towers.
- Water, power and waste are connected to the **Building Management System (BMS)** through individual meters in various buildings
- The campus sits along a **tributary** to the Mooloolah River and all water travelling over the campus passes directly into the National Park

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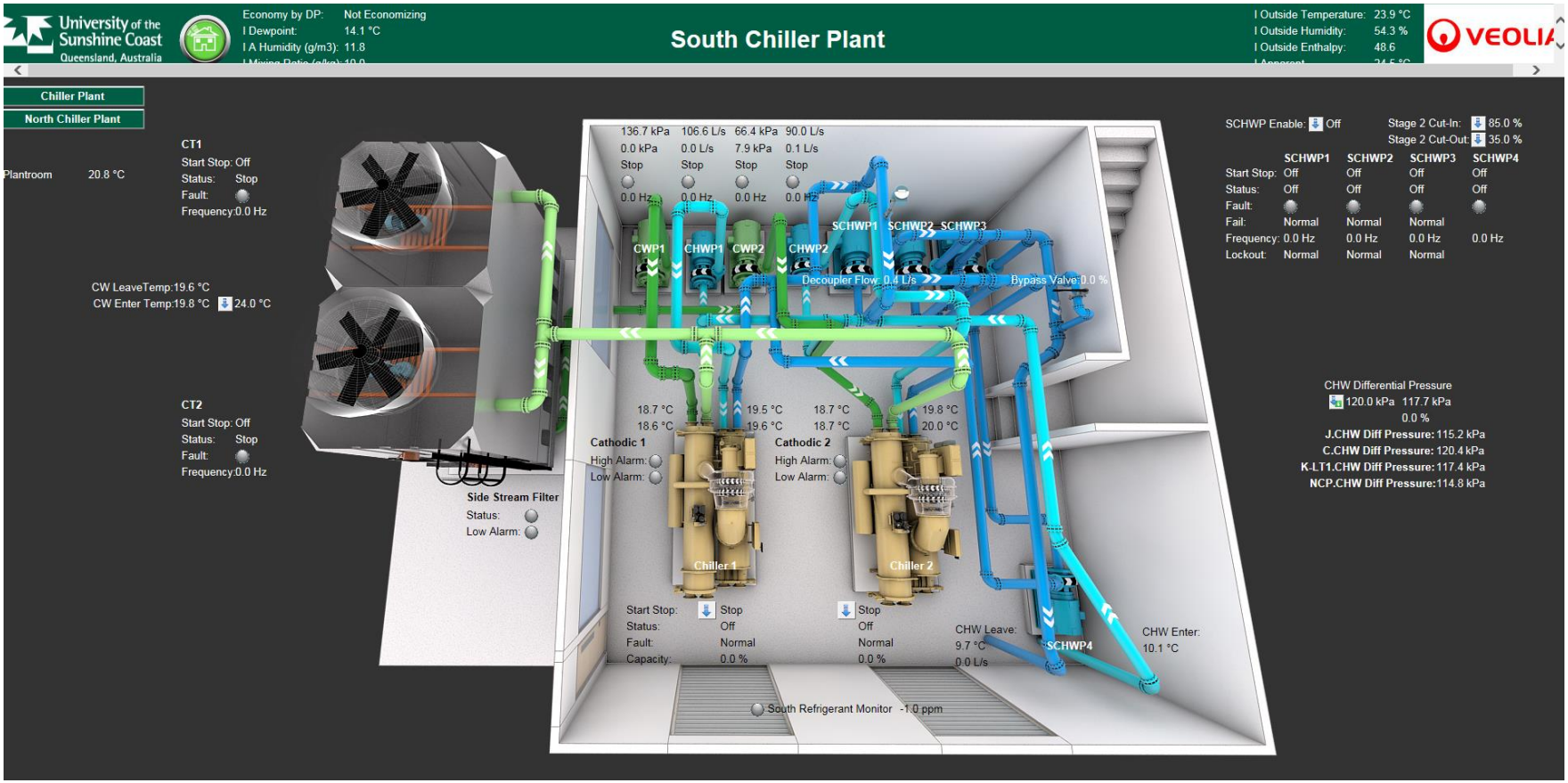
Chiller Plant



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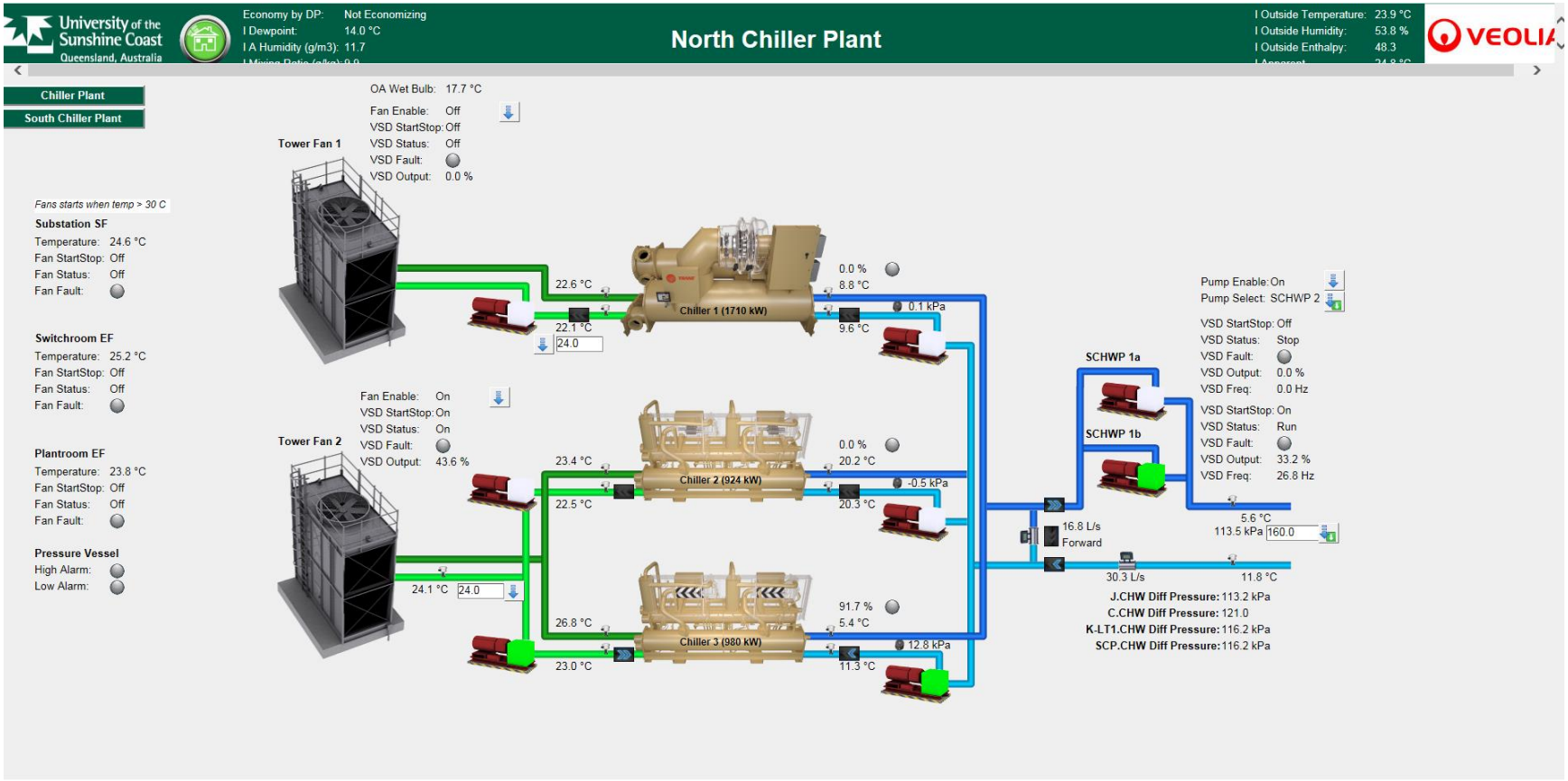
Chiller Plant



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Chilled Water use per building

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Queensland, Australia

Economy by DP: Not Economizing
I Dewpoint: 14.3 °C
I A Humidity (g/m3): 11.9
I Mixing Ratio (g/kg): 10.1

Energy Overview

I Outside Temperature: 23.9 °C
I Outside Humidity: 54.8 %
I Outside Enthalpy: 48.8
I Apparent: 24.8 °C

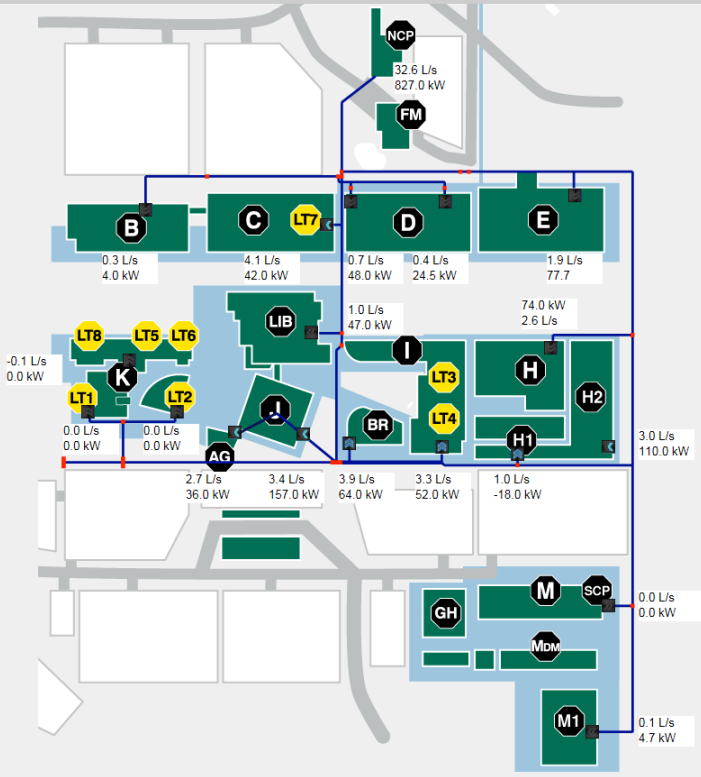
VEOLIA

Energy Building B
Energy Building C
Energy Building D
Energy Building E
Energy Building H
Energy Building H1
Energy Building H2
Energy Building I
Energy Building J
Energy Building K
Energy Building L
Energy Building M
Energy Building M1
Energy Building R
Energy Building T

Energy Art Gallery
Energy Brasserie
Energy Carpark 7
Energy Facilities Mgmt
Energy Innovation Centre
Energy Stadium
Energy Uni Club

Energy N.Chiller Plant
Energy S.Chiller Plant

	Energy kW/m2	Energy kWe
Building B	0.012	18.0 kW
Building C	0.022	78.0 kW
Building D	0.028	57.0 kW
Building E	0.034	109.0 kW
Building H	0.049	84.0 kW
Building H1 + H2	0.023	164.0 kW
Building I	0.031	83.0 kW
Building J	0.046	235.0 kW
Building K	0.015	28.0 kW
Building M	0.071	31.0 kW
Building M1	0.033	11.0 kW
Building R	0.033	32.0 kW
Building T	0.091	182.0 kW
Art Gallery	0.144	38.0 kW
Brasserie	0.129	78.0 kW
Carpark 7	0.001	8.0 kW
Facilities Mgmt	0.470	171.0 kW
Innovation Centre	0.027	96.0 kW
Library	0.022	68.0 kW
Stadium	0.048	119.0 kW
Uni Club	0.011	3.0 kW
Energy Average	0.104	67.0 kW
Energy Total	1.330	1,689.0 kW



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Utilities at USC

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What do we mean by utilities?

- Utilities = electricity, mains water and chilled water

Cost of utilities is large % of University's budget

- In 2012, USC's electricity bill was over $1.6 million, or 3.13% of non-salary expenditure
- That's a cost of about $4,500 per day

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Importance of utility management

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Why manage utilities?

- The less we spend on utilities, the more we can spend on teaching, learning and research
- Since 2012, USC has taken a proactive approach to management of utilities
- With new buildings and campuses, electricity use has increased by 24% since 2012
- But expenditure on electricity has decreased by 11% in same period
- Proactive utility management since 2012 has saved over $1.25 million
- It has also addressed key imperatives of Strategic Plan

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Understanding electricity charges

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Electricity charging is different in commercial environment

- Usage charges
  - Cost for total amount of electricity used – charged in cents per kilowatt hour (kWh)
- Demand charges
  - calculated according to the *maximum rate* that electricity is used in a specified period
  - demand charges are about 25% of the total account
  - demand management is critical
- Other network and ancillary charges
  - a variety of charges, including fixed charges, metering charges and mandated renewable energy charges

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Electricity usage 2013 – 2015

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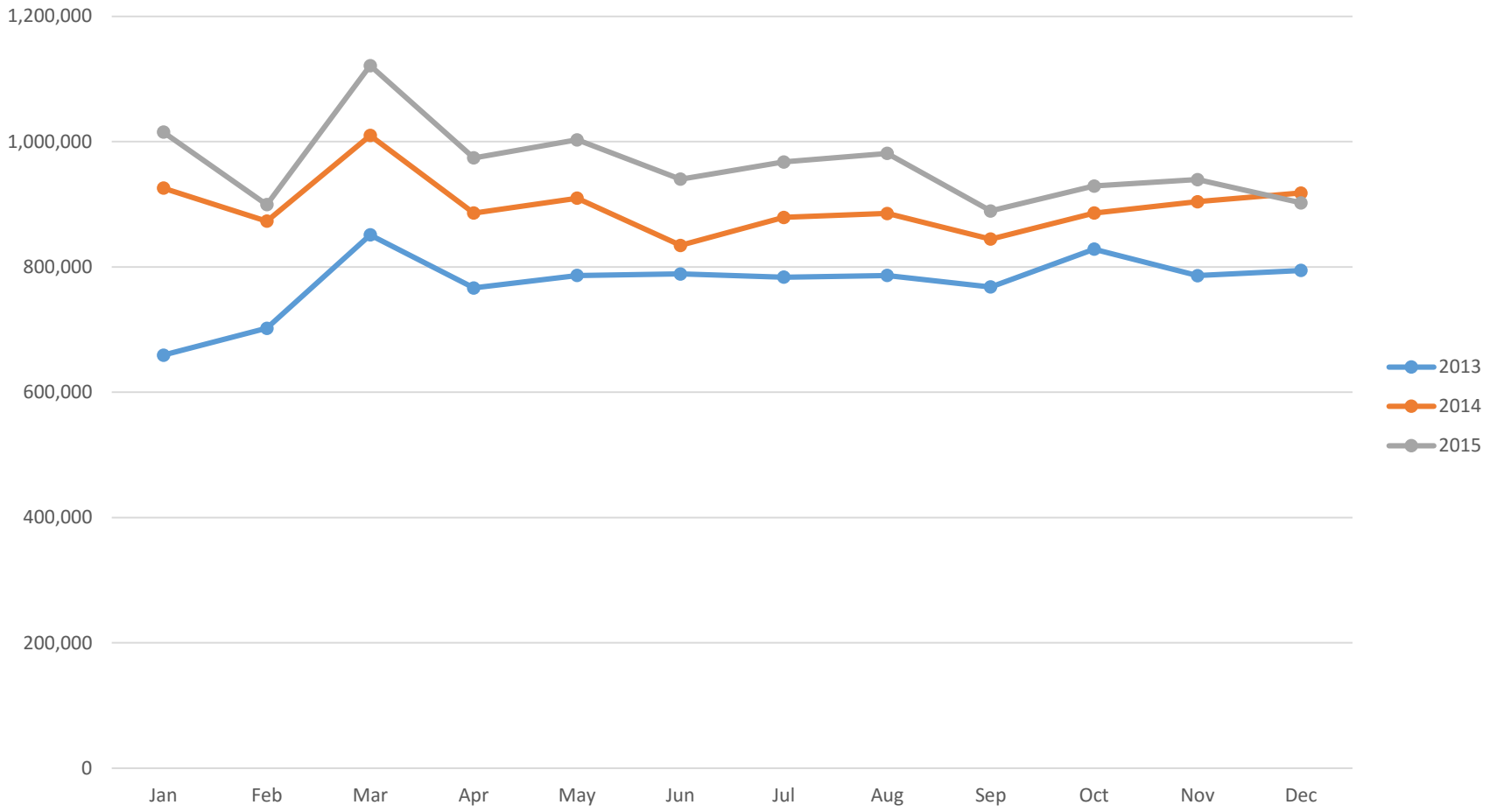

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Utility initiatives

- Managing utilities involves:
  - Financial initiatives
  - Engineering initiatives
- Financial initiatives can be complex - the billing process has become much more complex in recent years
- Need to be proactive in relation to both financial and engineering initiatives to manage costs

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Electricity initiatives – financial

Financial initiatives to reduce electricity costs include:

- Entry into Contestable Energy Market
- Virtualisation of electricity meters
- Negotiated reductions to charges

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Electricity initiatives – financial

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Entry into Contestable Energy Market

- Prior to 2012, USC, by default, used Energex as electricity retailer
- In 2012, undertook negotiations with different electricity retailers and entered Contestable Market
- Led to large reduction in costs paid per kilowatt hour
- Savings for 2015 are over $300,000 (when compared with ‘business as usual’ cost)

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Electricity initiatives – financial

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Virtualisation of electricity meters

- Sippy Downs campus has 11 electricity meters
- These meters report USC's electricity use to electricity retailer through 5 separate interfaces known as National Meter Identifiers (NMI's)
- In 2015, AMS proactively engaged with Energex to combine the meters, in a virtual sense, and also negotiated lower demand charge
- Saved over $50,000 per year
- Very complex process – understanding and implementing changes required was very challenging for AGL (electricity retailer)
- Took 4 months of discussion between AMS, AGL and Energex to get first month's account correct

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Electricity initiatives – engineering

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Upgrade of Building Management System (BMS)

- BMS is campus-wide system which monitors and controls the use of electricity, mains water and chilled water (for air-conditioning)
- Since 2012, BMS has been upgraded with smart controls and migrated onto special LAN
- BMS now provides real-time data on the utilities use for individual buildings, enabling remote, real-time diagnostic capabilities
- Chilled water accounts for 50% of electricity used
- Upgraded BMS led to significant savings in chilled water usage

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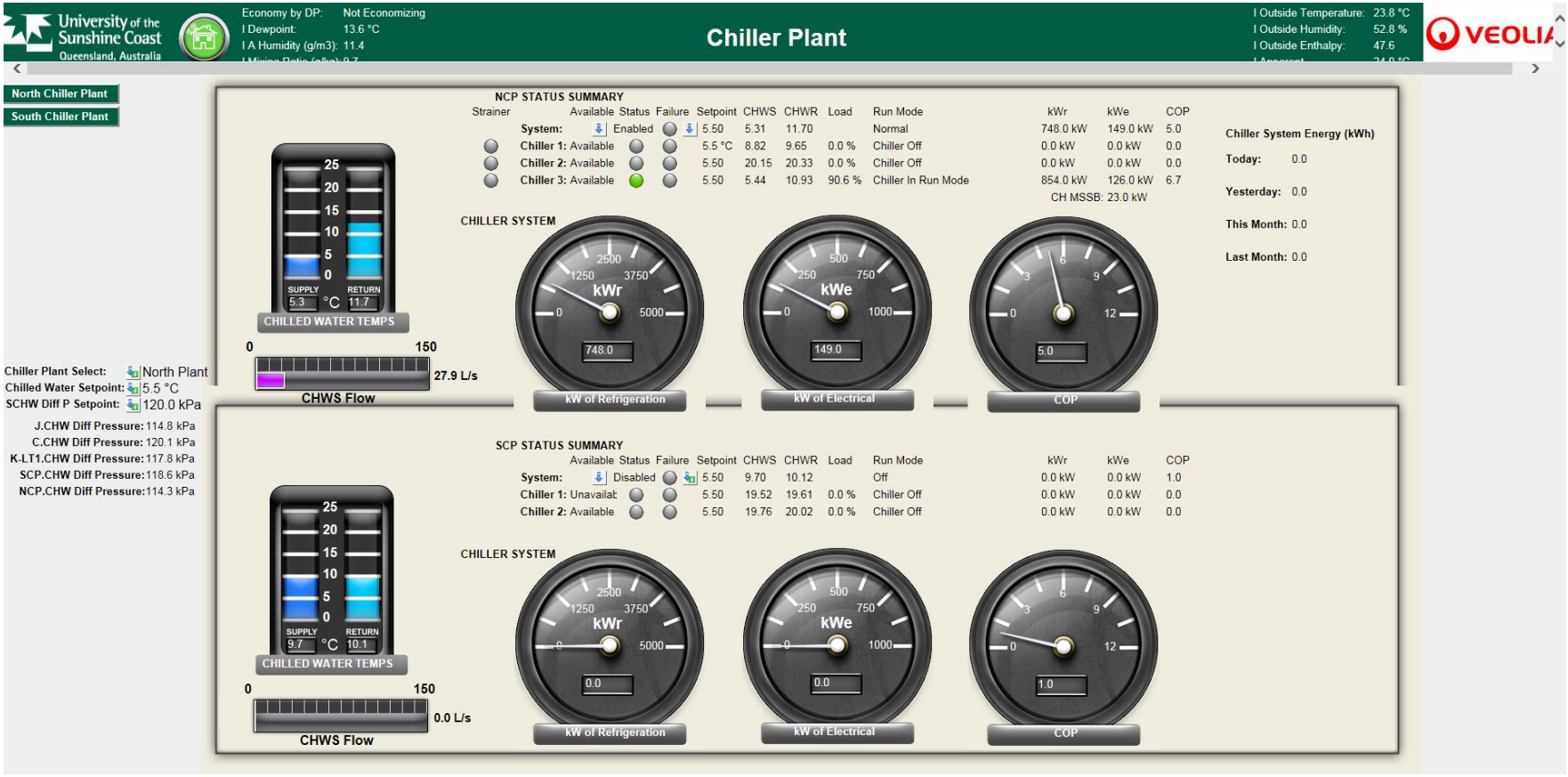
Dashboard for both Chiller Plants



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Electricity initiatives – engineering

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Energy saving initiatives

- Air-conditioning
  - Smart controls added to Building J and Library (saved 49% electricity use) and Lecture Theatres 1, 2 and 7 (saved 58% electricity use)
  - One-off cost of $112,800 resulting in ongoing savings of $63,750 per year
- Power factor correction
  - Ensures electricity is used more efficiently
  - One-off cost of $39,338 resulting in ongoing savings of $55,700 per year
- Chilled water pumps
  - Variable speed pumps added so that less chilled water is pumped around campus when demand for air-conditioning is low
  - One-off cost of $25,600 resulting in ongoing savings of $38,535 per year

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Electricity initiatives – engineering

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Outcome of energy saving initiatives since 2014

- Combined *one-off* investment was **$216,763**
- Combined ongoing savings of **$174,285** *per year*
- Average payback period for these initiatives was **1.2 years**

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Initiatives to reduce water use

Real time monitoring of water use

- Smart controls and upgrades to BMS allow real-time system monitoring - enables consistent use of free lake water in air-con cooling towers
- One-off cost was $26,277
- Saves $15,000 per year

Swimming pool

- Sophisticated system of water treatment and monitoring has enabled use of lake water in swimming pool
- One-off cost was $45,200
- Saves at least $20,000 per year

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Demand management – electricity

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Why demand management?

- The demand charges for an entire month are based on highest electricity use for any single 30 minute period in that month
- Demand charges are about 25% of monthly account
- Peak use is usually in hottest part of each day
- To reduce costs, we need to minimise the peak amount of electricity used each day
- This is known as managing the University's demand profile

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Future opportunities

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Proposal – use chilled water storage to manage demand for electricity

- Water is chilled to use for air-conditioning purposes and accounts for 50% of electricity used at USC
- Most electricity is used during the day time when demand for air-con is highest
- But day time electricity use is expensive - peak rates
- Plan is to shift chilling of water to night time - off-peak rates
- Involves building large tank to store chilled water – water is chilled at night time and stored for use during day time
- Tank acts like a large battery

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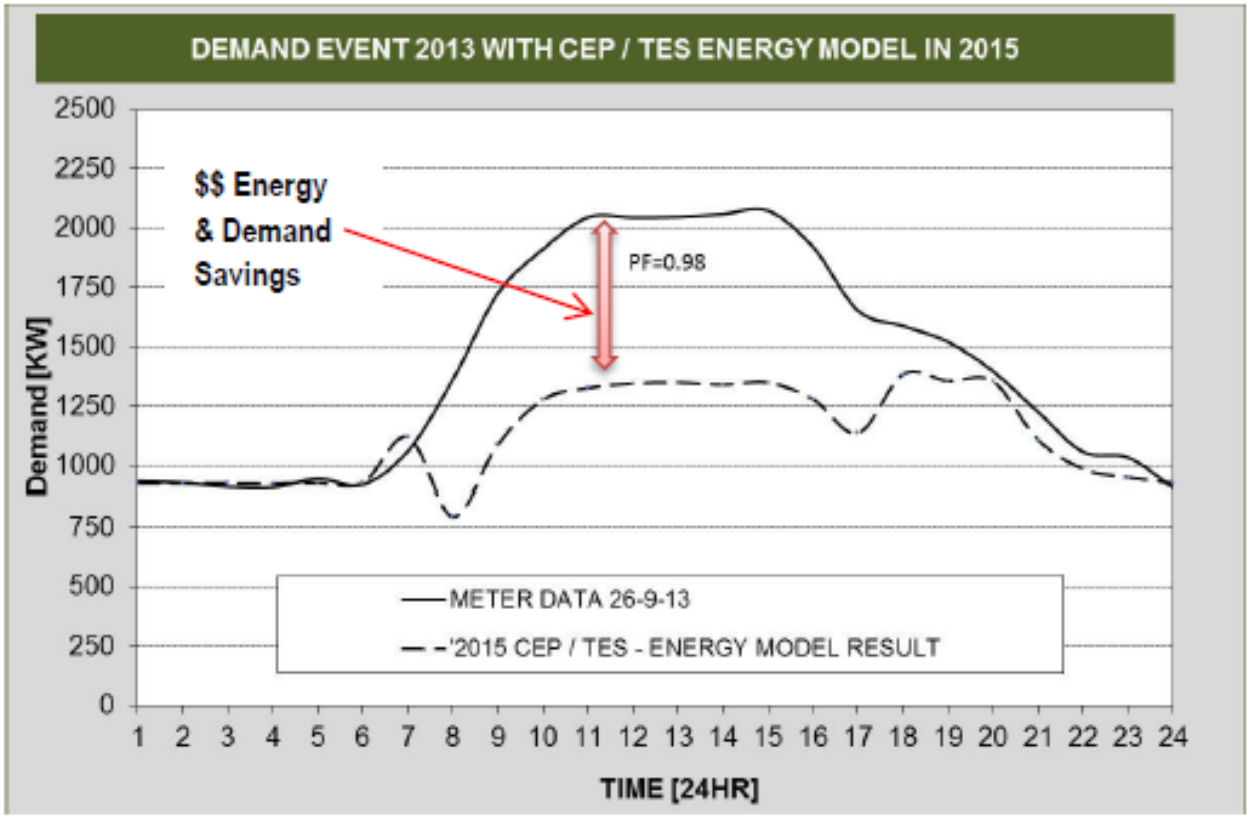
Impact of chilled water storage on demand profile

Figure below show the impact of the proposed higher efficiency CEP and TES system (full storage) combination on site electrical load profiles for the site.



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Chilled water storage overview

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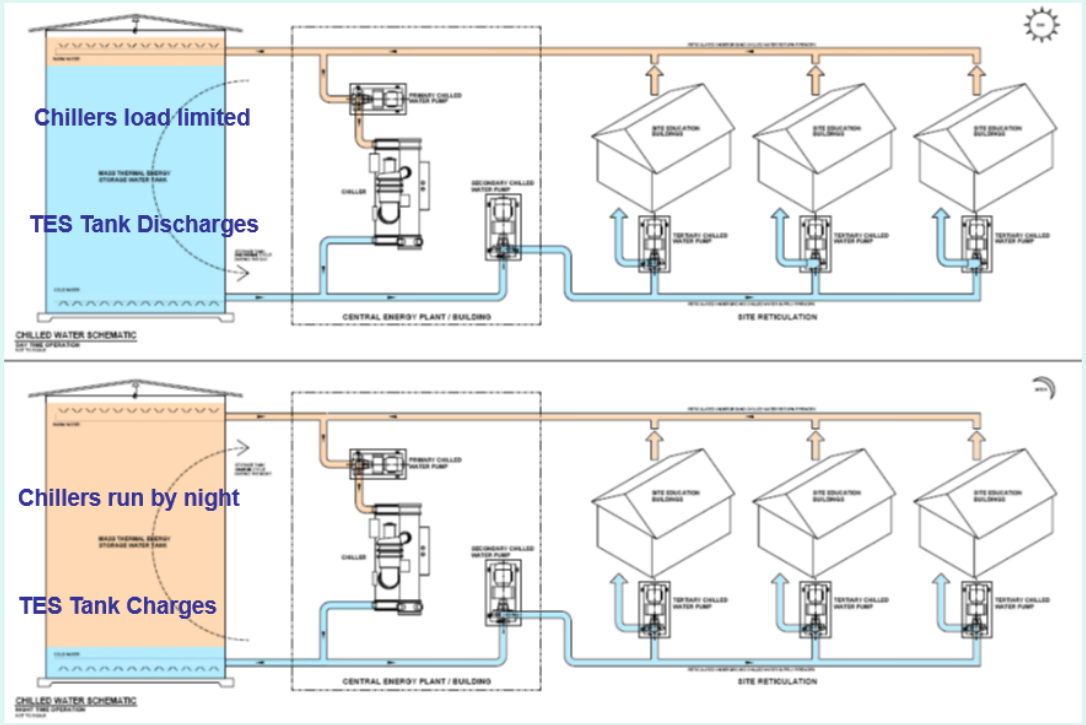
System Overview

Schematic of the day time and night time CEP / TES operation.



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Chilled water storage overview

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Benefits of chilled water storage

- Flattens demand profile for campus over 24 hour period
- Minimises cost as electricity use is shifted to cheaper off-peak rates at night time
- Minimises amount of electricity used due to high efficiency chillers and smart controls
- Minimises carbon emissions – KPI of Strategic Plan
- Improves institutional effectiveness – Strategic Plan
- Demonstrates leadership in sustainability – Strategic Plan

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The way forward

Proactive utilities management

=

Significant cost savings

=

Leadership in sustainability

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