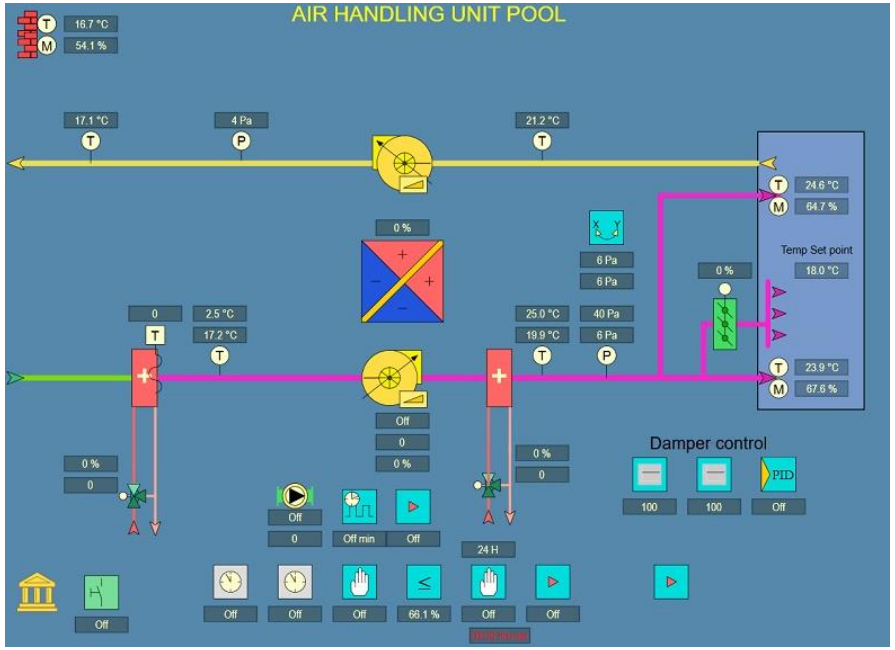
ESBS | Engineered Solutions for Building Sustainability Pty. Ltd.

Indoor Swimming Pools:
Monitoring and Diagnostics



20th November 2017

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Affil. AIRAH, GradIEAust
www.esbsconsult.com.au

Agenda

- Aquatic Centres
- BMS - Capabilities
- Project Case Study – BMS monitoring in an aquatic centre
  - Junee Aquatic Centre
- Lessons learnt

Aquatic Centres

- High humidit
  - Poor v
- High risk
  - Damag
  - Electri
- Chlorinat
  - Humar
  - Corros

Addressing These Issues

- Through passive measures – natural ventilation .etc
- Through mechanical HVAC plant

- Control is important – automated and/or manual
  - Manually opening louvres
  - HVAC plant operating on time schedule

- To maintain space temperature (°C) and relative humidity (%)

ESBS

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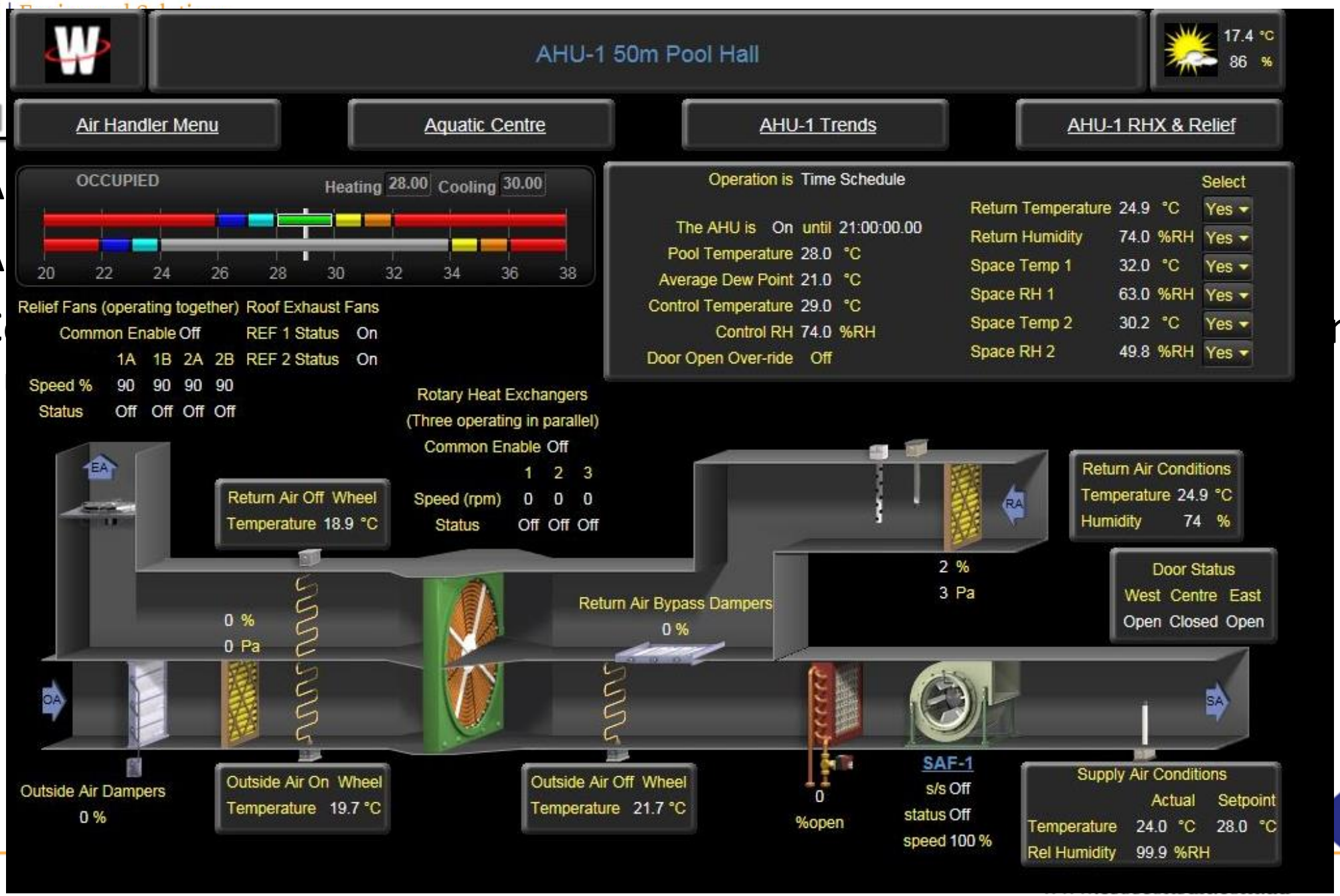
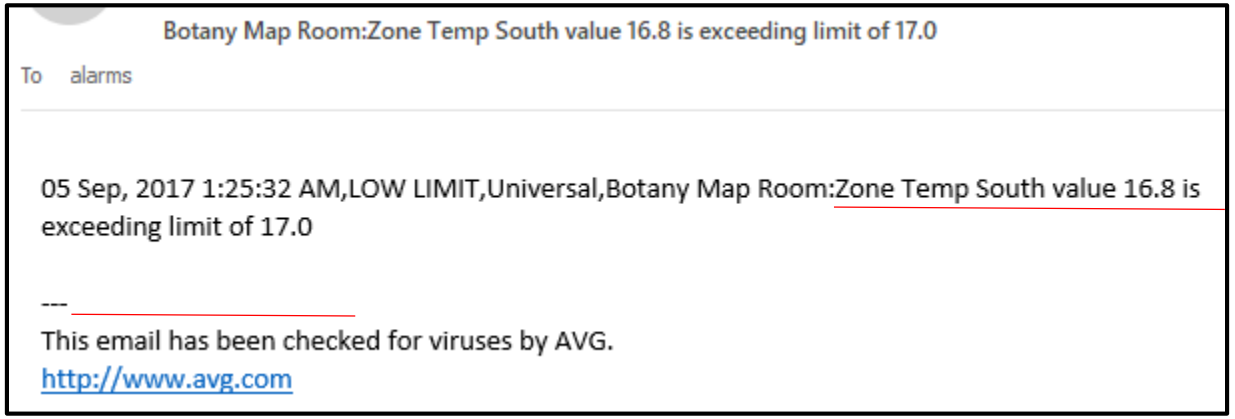


Capabilities

- Control
- Monitoring
  - System
  - Monthly energy targets – keep track of monthly energy consumption
- Remote access - Diagnostics
- Alarming / exception reporting


Botany Map Room:Zone Temp South value 16.8 is exceeding limit of 17.0

To alarms

05 Sep, 2017 1:25:32 AM,LOW LIMIT,Universal,Botany Map Room:Zone Temp South value 16.8 is exceeding limit of 17.0

This email has been checked for viruses by AVG.

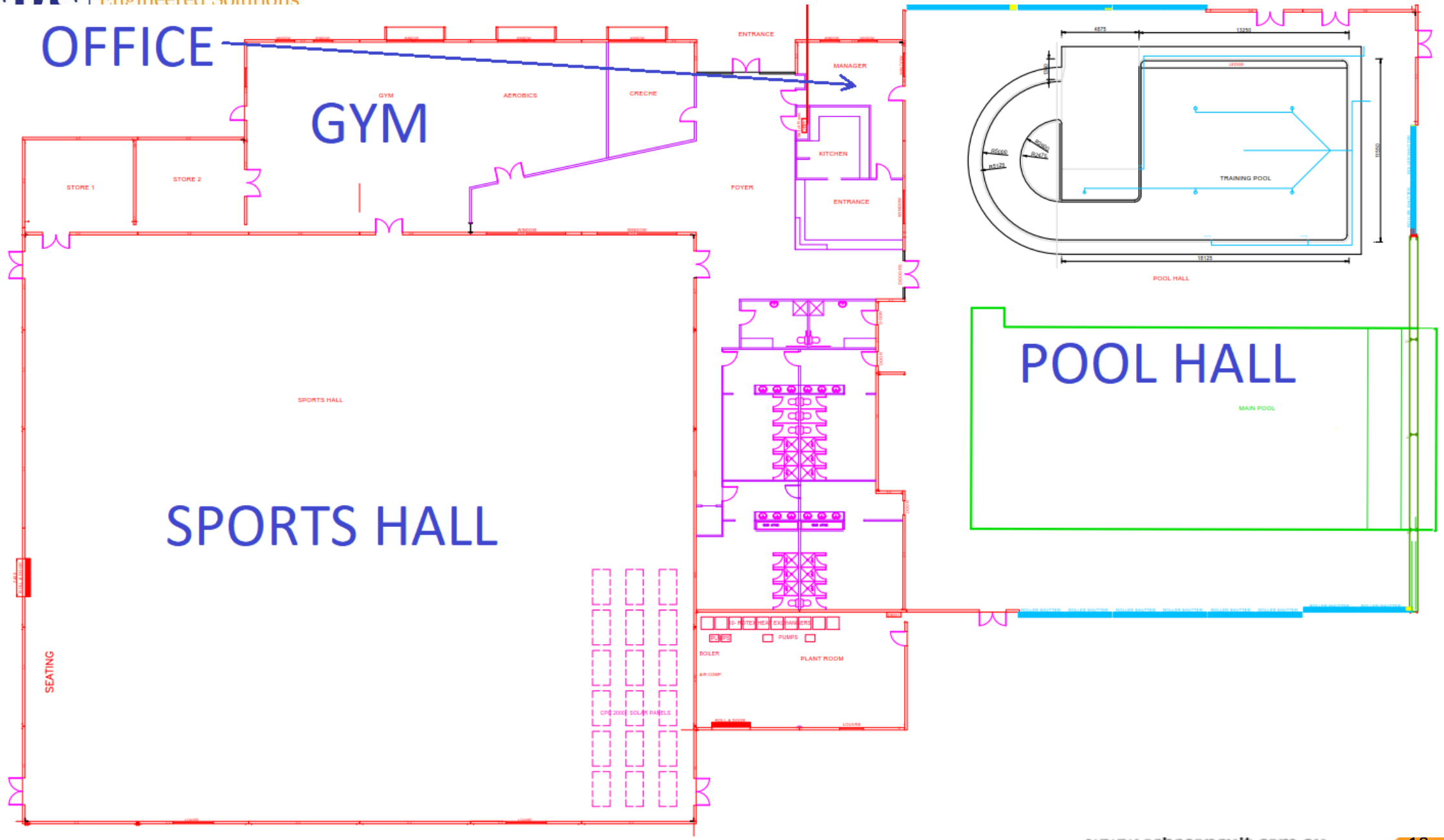
http://www.avg.com

Project Case Study

- Junee Junction Recreation and Aquatic Centre (JJRAC)

Junee Junction Recreation and Aquatic Centre

Junee Junction Recreation and Aquatic Centre


OFFICE
GYM
SPORTS HALL
POOL HALL
GYM
AEROBICS
CRECHE
ENTRANCE
MANAGER
KITCHEN
FOYER
ENTRANCE
STORE 1
STORE 2
SPORTS HALL
SEATING
TRAINING POOL
POOL HALL
MAIN POOL
PUMPS
PLANT ROOM
BOILER

Project

- HVAC Upgrade
- Objectives – to improve:
  - Energy efficiency
  - System reliability
  - Thermal comfort conditions

- Project obtained grant from NSW Office of Environment and Heritage (OEH)'s Energy Saver program

Summary of Project

Before
Pool hall served by obsolete electric heat pump

Summary of Project

Before	After
Pool hall served by obsolete electric heat pump	Replaced with heat exchange unit with heating coil (gas heat source), variable-speed fans

Summary of Project

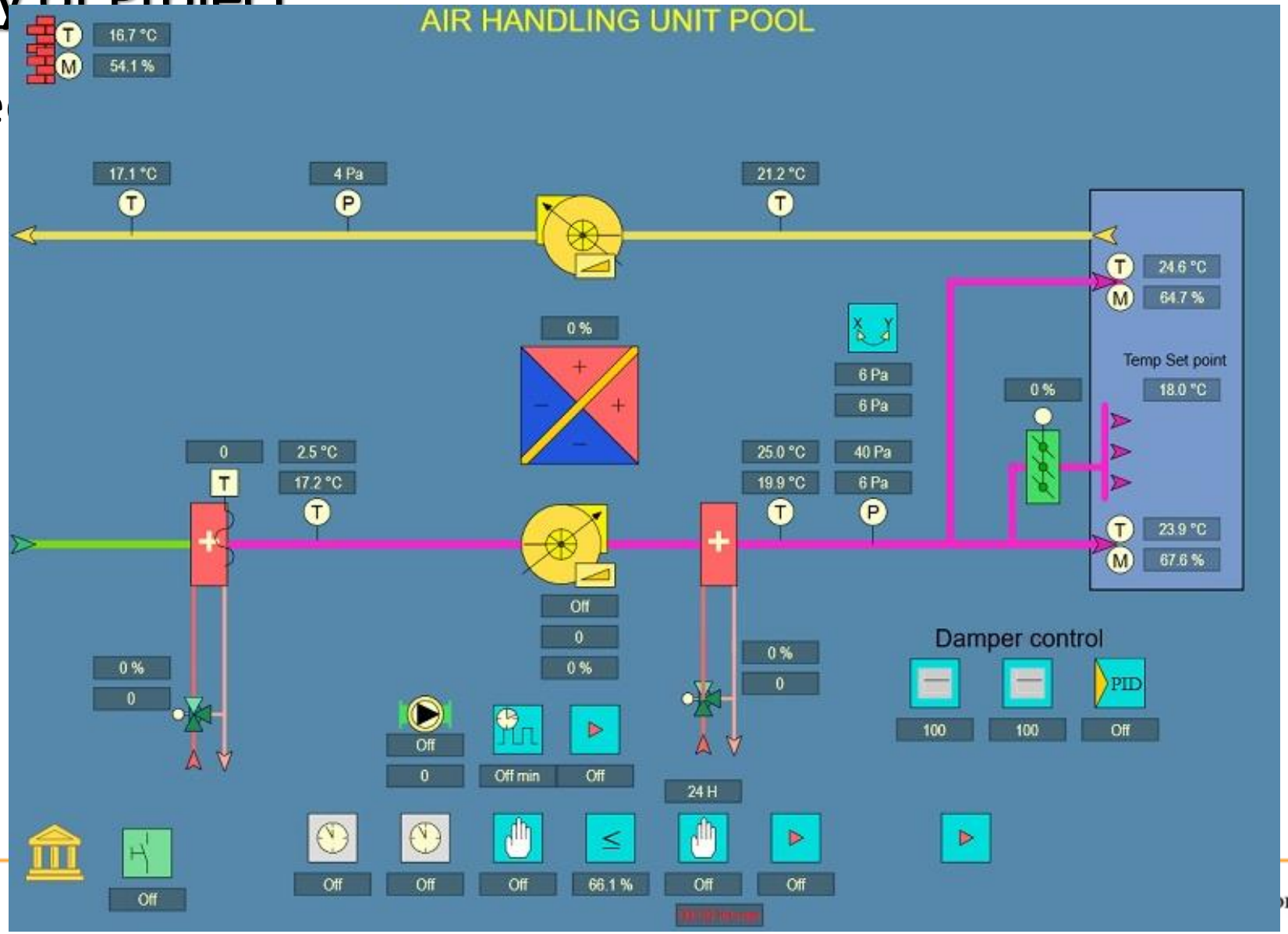
Before	After
Pool hall served by obsolete electric heat pump	Replaced with heat exchange unit with heating coil (gas heat source), variable-speed fans
Five instantaneous hot water heaters provide heat source for pool water, in-slab heating system and DHW - unreliable	

Summary of Project

Before	After
Pool hall served by obsolete electric heat pump	Replaced with heat exchange unit with heating coil (gas heat source), variable-speed fans
Five instantaneous hot water heaters provide heat source for pool water, in-slab heating system and DHW - unreliable	Replaced with three high efficiency condensing-type water heaters (boilers)

Summary of Project

- Installe



Summary of Project – Result

	Before	After Installation, before tuning
Electricity (kWh/y)	366,910	333,015
Gas (MJ/y)	4,230,499	4,227,194
GHG emissions ($tCO_{2\text{-}e}$/y)	635	601
% GHG Reduction	N/A	5

- Better controls
- Improved system reliability
- Objective is not just reducing GHG emissions!

Post-Completion Monitoring

- Preceded by site visit for inspection of installation
- Monitor equipment operation
- Ensure no latent defects remain

- Analysis on energy consumption through:
  1. Demand side
  2. External influences – eg. weather

Der

- Es


ENERGY
ELECTRICAL METER
V1-N 242 V
V2-N 241 V
V3-N 240 V
L1-A 40 A
L2-A 41 A
L3-A 45 A
KWh 256751 kWh
PF 0.96
KW 29 kW
kVA 30 kVA
KVAr 7 kVAr
kWh
Off
FILTRATION PUMP 1
KWh 16797 kW.h
A 0 A
Hz 0 Hz
kWh
Off
FILTRATION PUMP 2
KWh 49585 kW.h
A 16 A
Hz 50 Hz
kWh
Off
POOL MAKE UP WATERMETER
W
8855 m3
GASMETER
G
561088 m3
WATERMETER
W
7766 m3

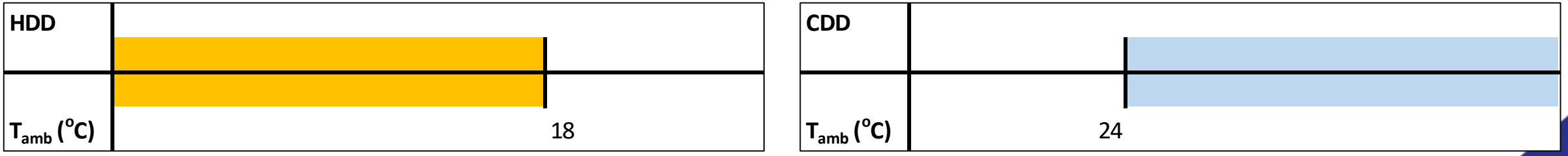
Demand Side: Issues Noted Through BMS Monitoring

- Unusually high gas consumption
  - Boilers incorrectly commissioned – all three boilers operating when only one is required
  - Controls associated with Pool Hall heat exchange unit – excessive OA .etc
- Controls incorrectly set on BMS – time schedule, setpoint
- Washroom, foyer and gym lights on 24/7

Weather Dependency

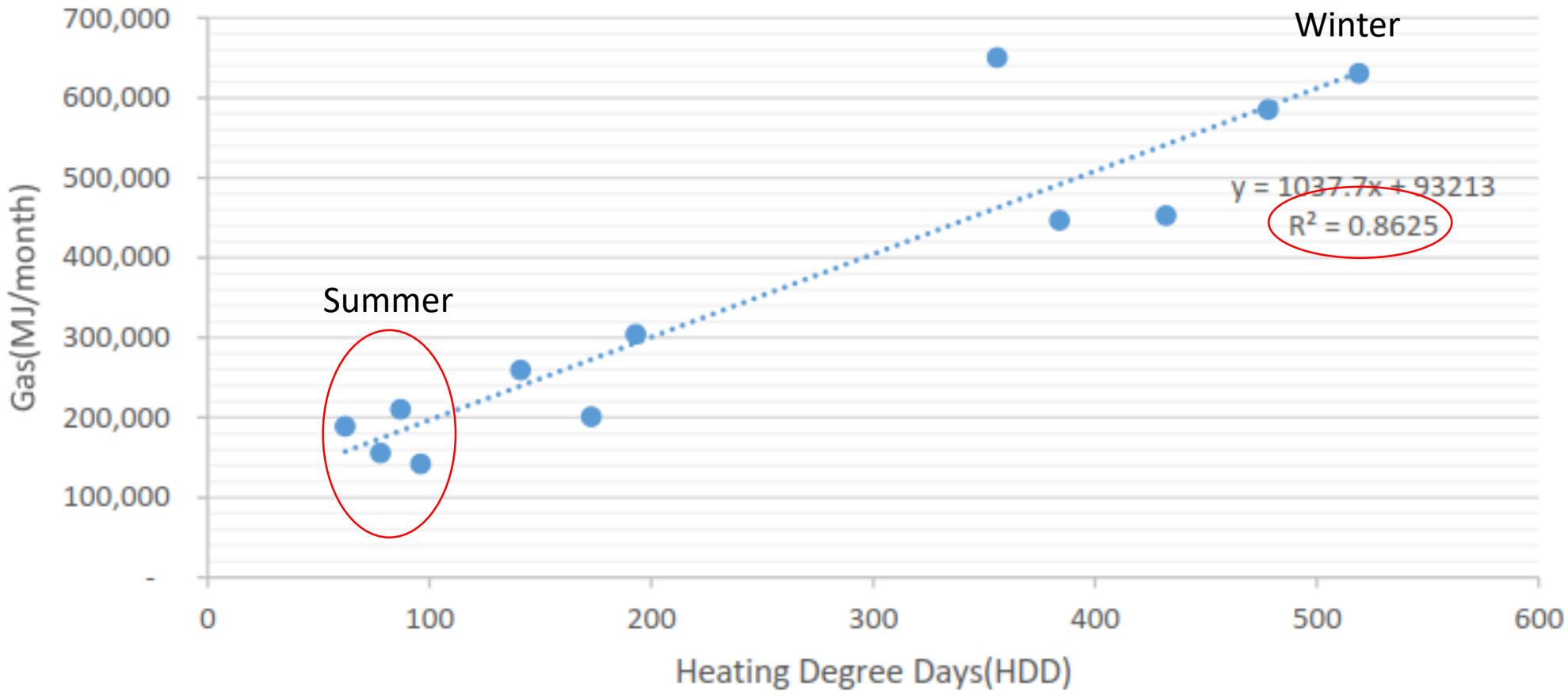
- Through degree day and regression analyses
- Is energy consumption affected by weather?

- Degree day analysis:
  1. Obtain annual weather data from BoM
  2. Nominate base heating and cooling temperature (typically 18°C and 24°C)

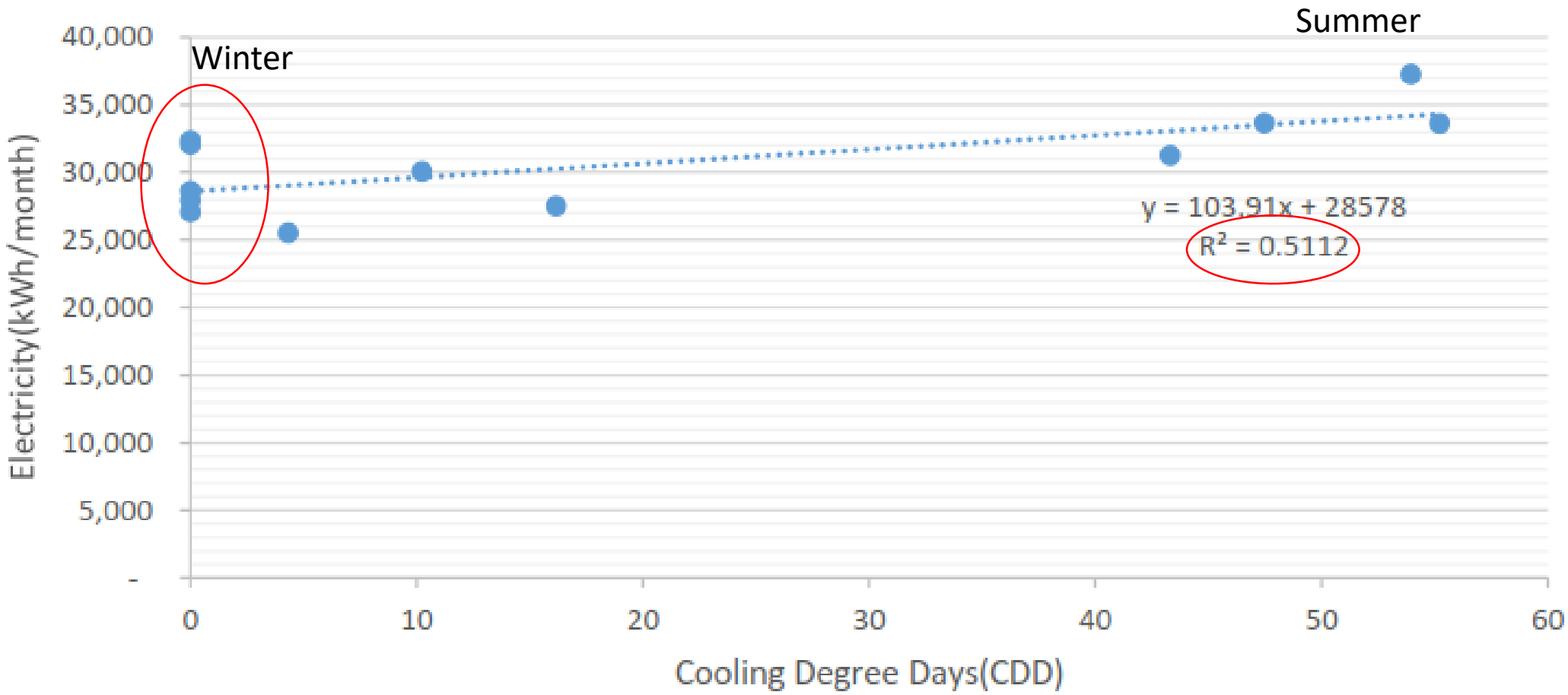


  3. Hypothesis: Higher HDD, larger gas consumption for heating
  4. Hypothesis: Higher CDD, larger electricity consumption for cooling

Heating Degree Days – Regression Analysis



Cooling Degree Days – Regression Analysis

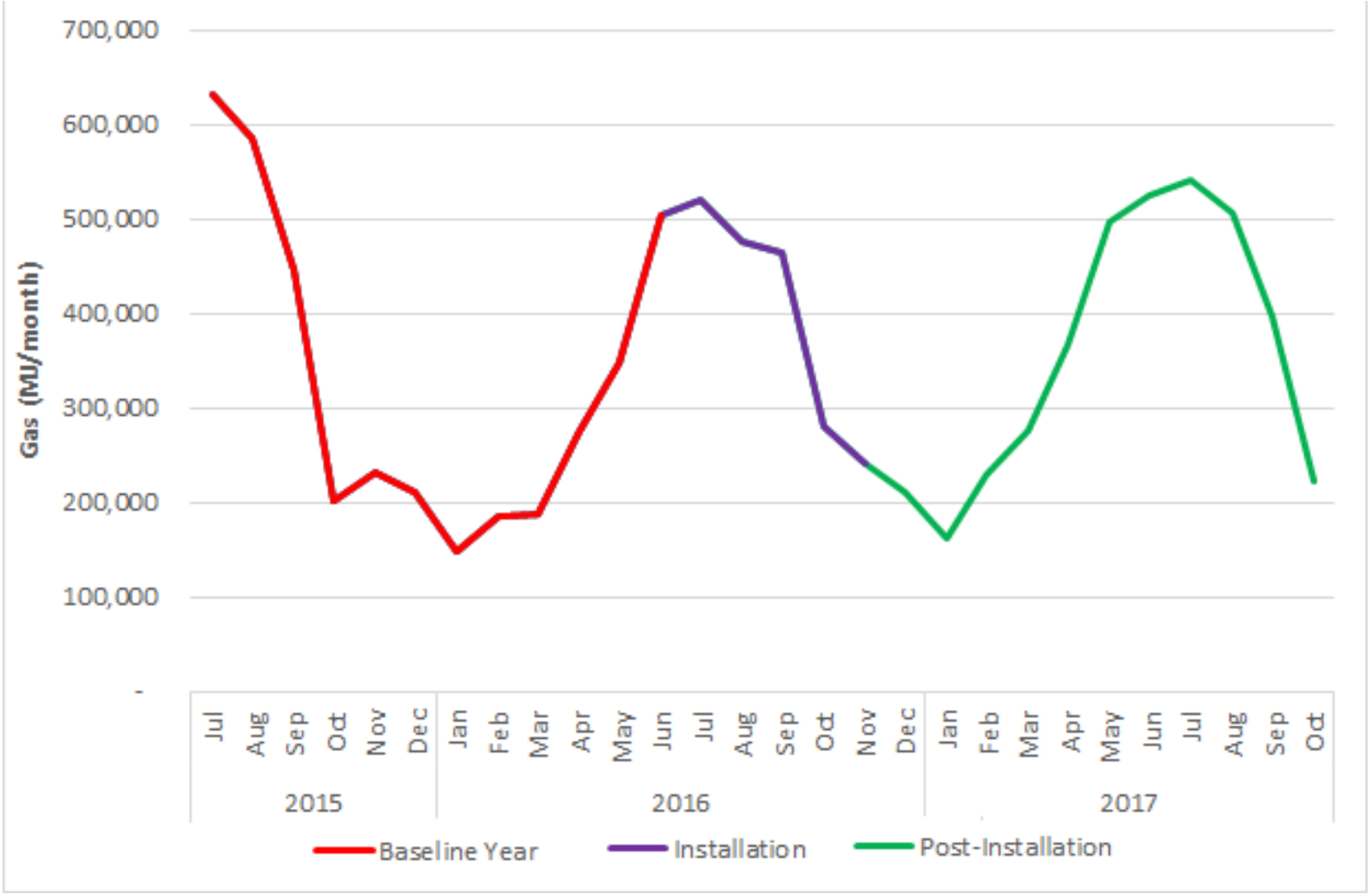


Weather Dependency

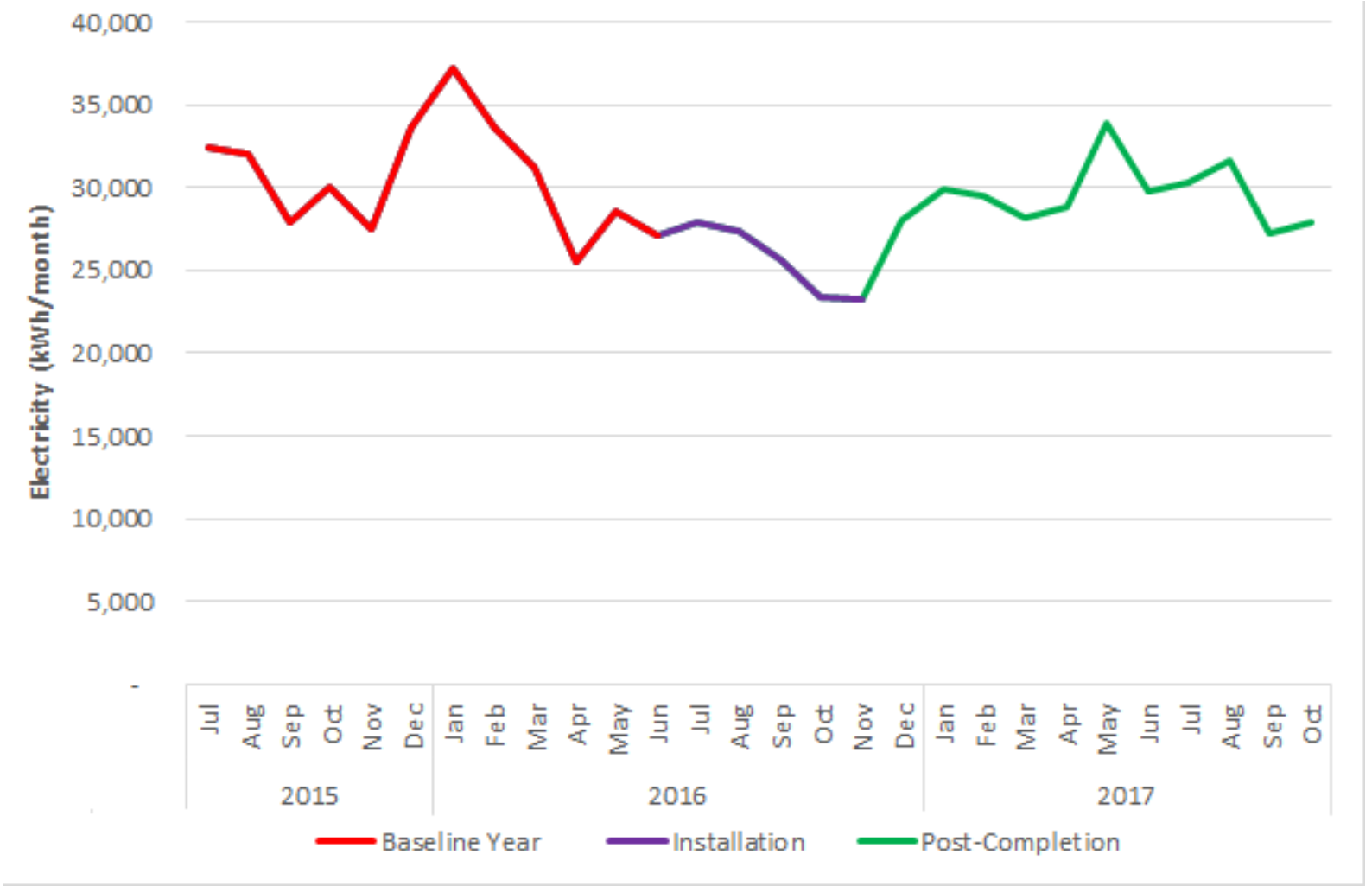
- Heating degree days in 2017 higher than 2016 by 11%
- Colder in 2017!

- One of the reason for high gas consumption
- Benefit of energy-efficient measures may not be evident due to weather effects

Summary of Monthly Gas Consumption



Summary of Monthly Electricity Consumption

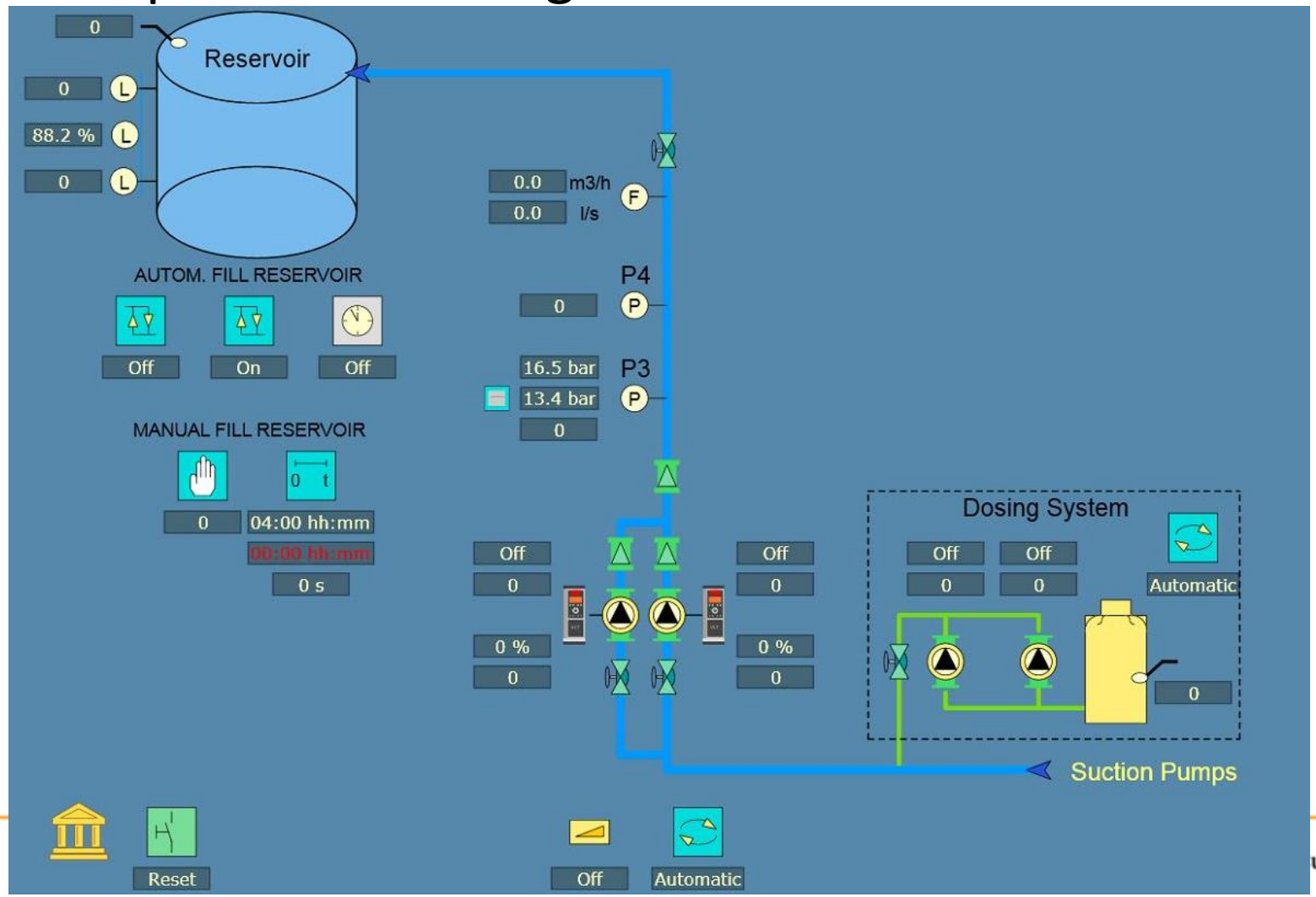


Ongoing Tasks

- Remote monitoring through BMS
  - Alarms
- Issue Measurement and Verification (M&V) report to Council on monthly basis, covering:
  - Energy consumption
  - Weather
  - Issues noted through BMS
  - Recommendations

Future Opportunities

- Pool filtration plant monitoring



Lessons Learnt

- Weather
- Building Staff
- Distance between project teams and site

Summary

- Controls – complex, however beneficial if implemented and used correctly
- Remote access and good BMS functions – allows energy consumption to be monitored
- Good relationship with clients and contractors important

Thank You

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