

An aerial photograph of a CN freight train traveling through a lush, green forested valley. The train, led by a red locomotive, is moving from the bottom right towards the top left. In the center of the valley, there is a large, open green field with a few white buildings. In the background, a large, rounded hill covered in dense forest rises against a blue sky with scattered white clouds. The overall scene is a vibrant, natural landscape.

# The Power of an Energy Management system

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# CN at a Glance



- ❖ the largest rail network in Canada and the only transcontinental network in North America.
- ❖ 19,600 route-miles of track in North America with three coasts Access
- ❖ transporting approximately C\$250 billion worth of goods annually:
  - Intermodal
  - Petroleum and chemicals
  - Grain and Fertilisers
  - Forest Products
  - Metals and Minerals
  - Automotive
  - Coal
  - And others



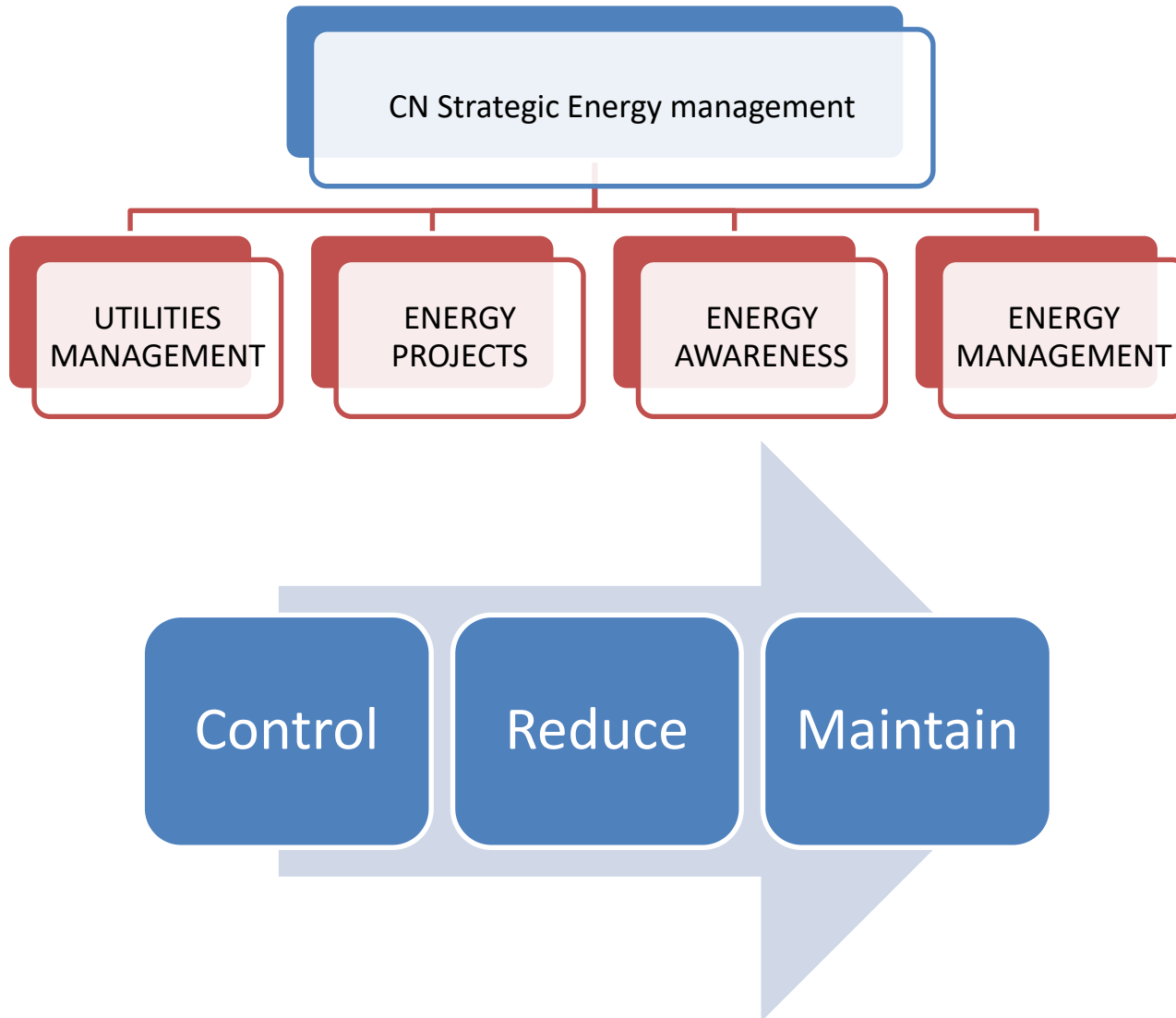
# CN Energy in Numbers

- 22 Major Yard Monitored across North America
- Monitored Yearly Electrical Energy: 100 GWh ( ~ 9300 homes or YVR)
- Facilities: 3600 buildings and shops across CN network. Various equipment including: Compressors, switch heaters, Communications.
- Monitored Peak demand : 25 MW





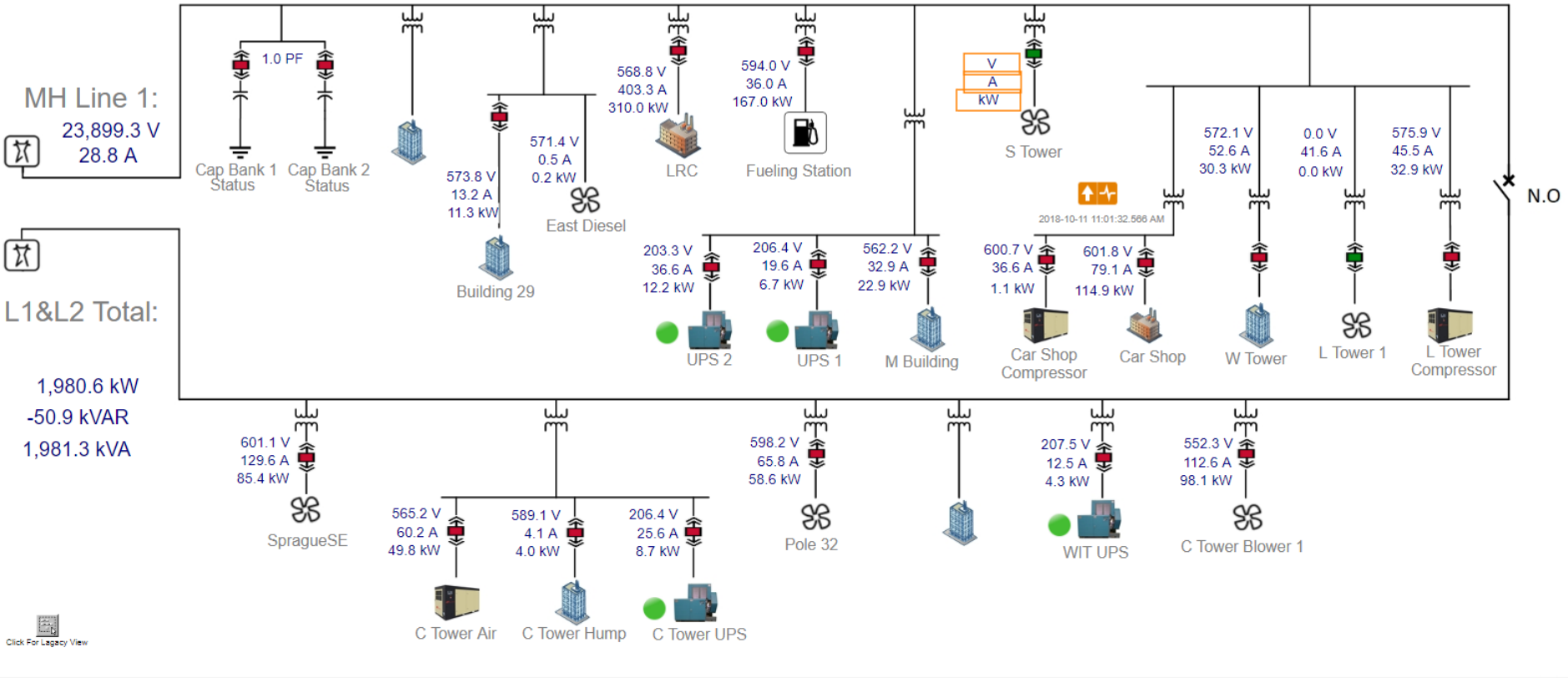
# CN Strategic Energy Management Program



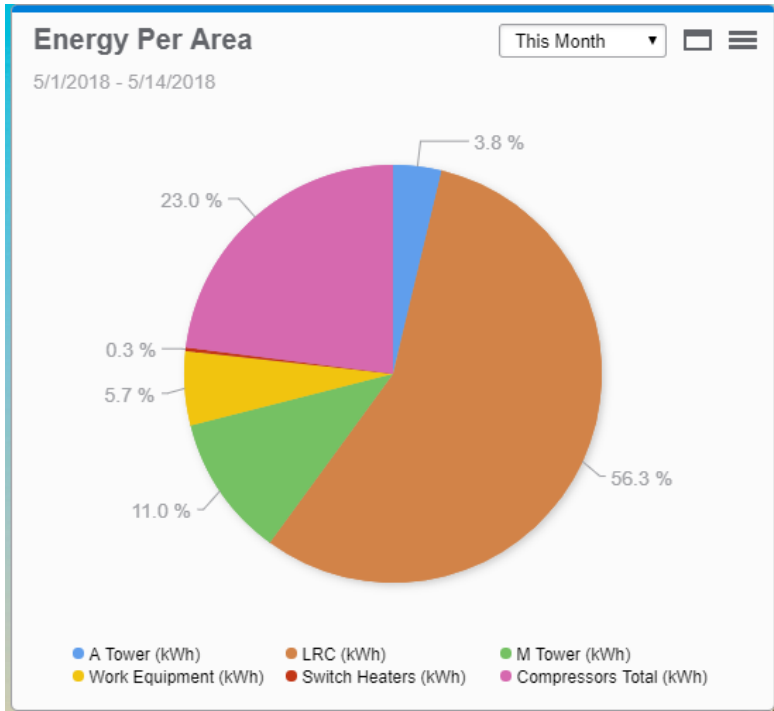
# A Typical Large Yard

## Single Line Diagram

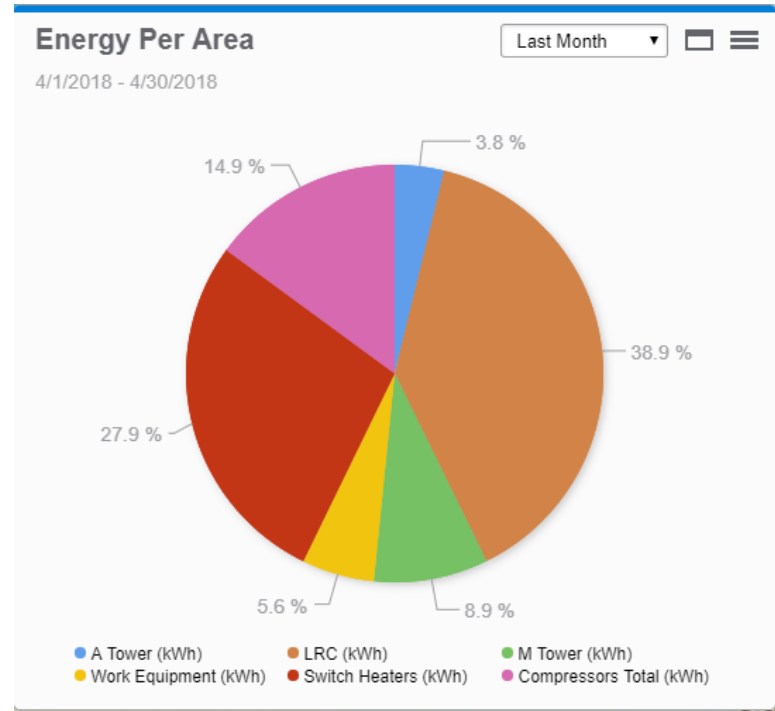
Symington- Single Line



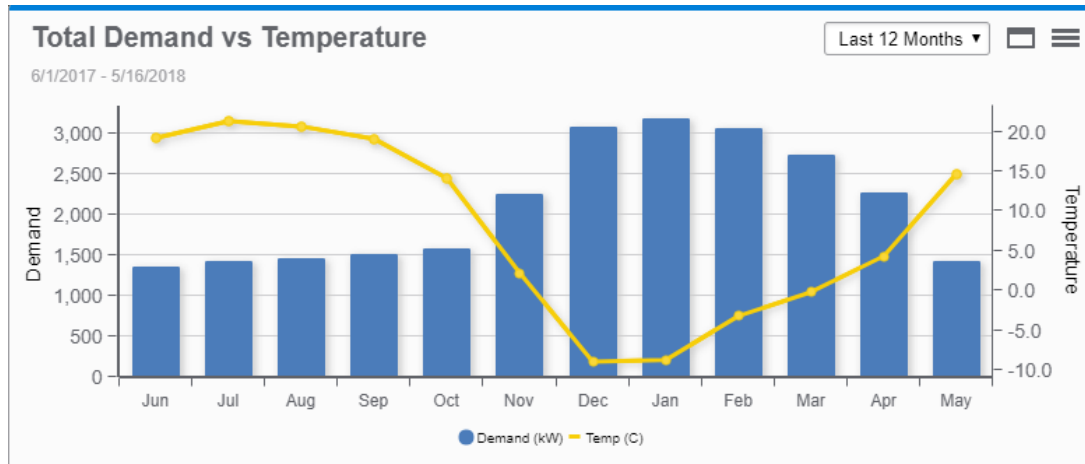
# Sources of Energy Usage



Spring/Summer



Winter



# Compressor Monitoring

Why is it important to monitor?

- Compressors consume between 15-30% of our electrical energy.
- Compressors are used to charge train cars and operate equipment and the system functionality is crucial for CN operations.
- Pressure must be maintained at a certain level.
- Avoid Excessive Airflow from the compressors.
- Verify compressor system work sequence



# Compressor Monitoring

Monitor Pressure

Detect Leakage and high airflow

Vista Screens, Trends, Historical Gadgets



Demand Monitoring

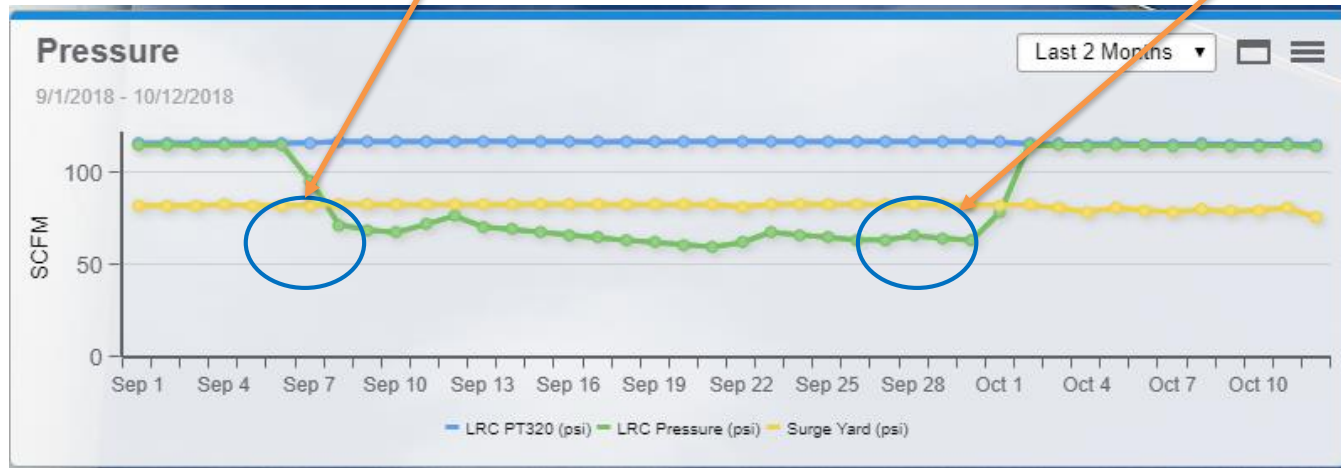
Detect Abnormalities



# Compressor Incident- Vancouver

Sudden Unexplained pressure drop

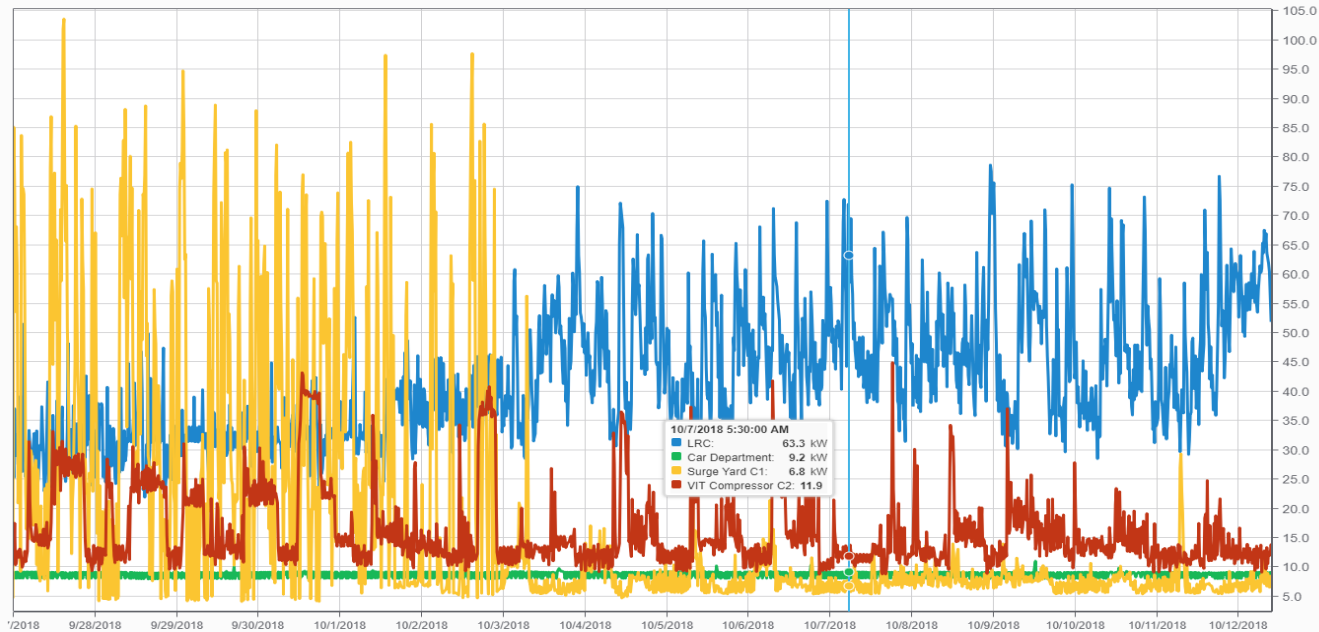
Issue found and valve opened



## Vancouver Compressors Demand

### Vancouver Compressors

Update in 0:06



# Switch heater Monitoring

- Switch Heaters/Blowers are crucial for Track operations in winter season
- They account for up to 40% of our winter demand
- A good candidate for automation and control given their weather dependability.



# Yard Equipment monitoring

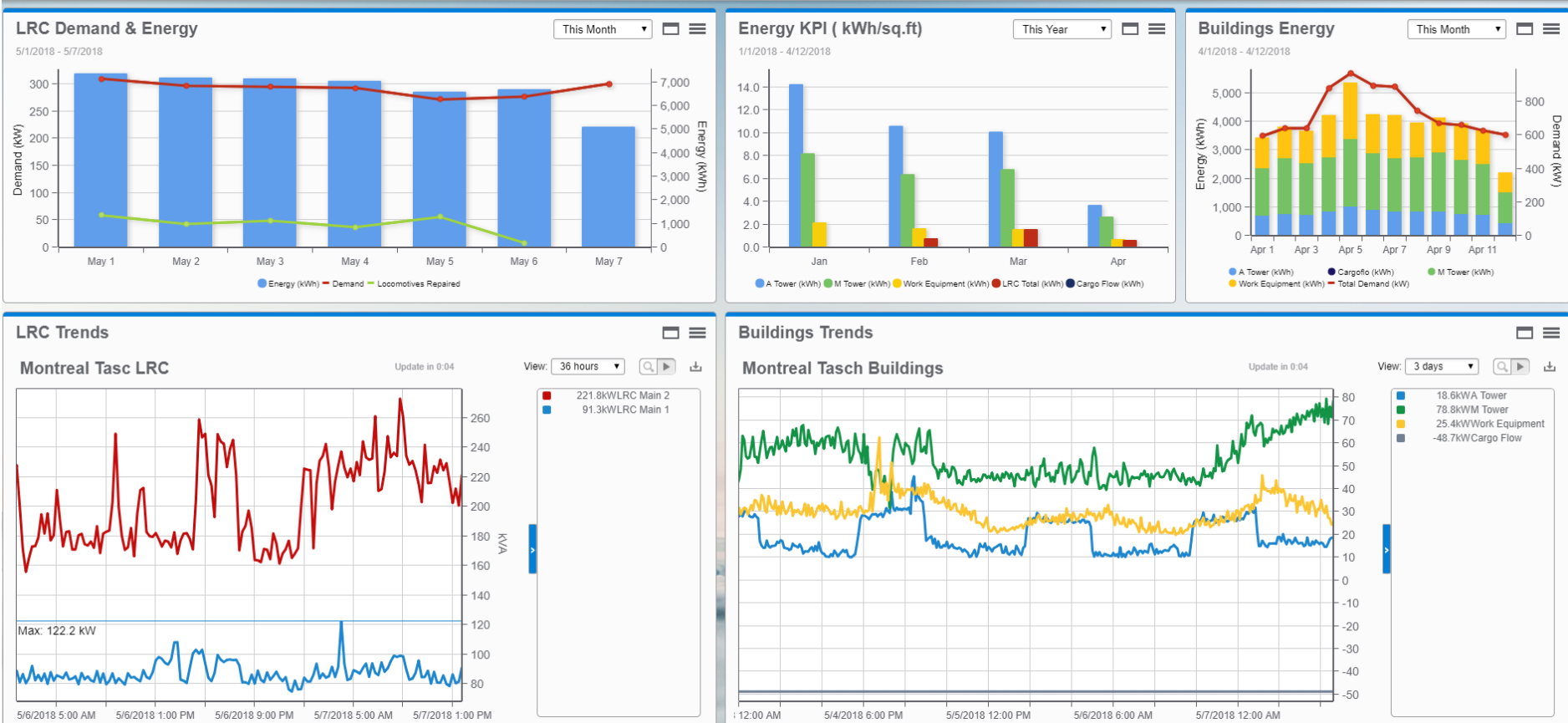
## Blower Status



- Troubleshoot blower panels by looking at real-time current readings.

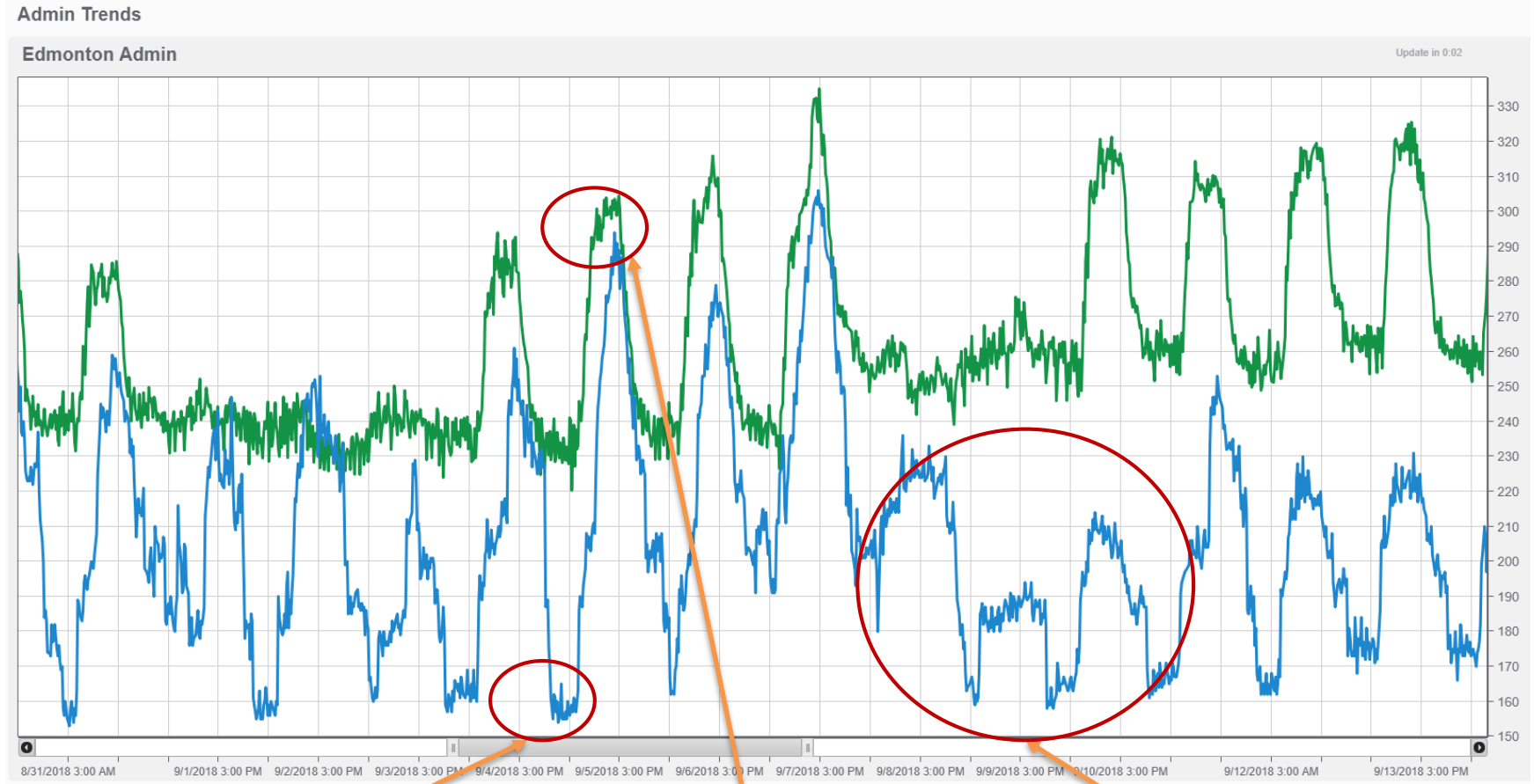
# Buildings Monitoring

- Keep Track of Energy Usage and spot abnormalities in real time
- Track the short term demand and compare it to the long term demand.



# Buildings Monitoring

- Spotting anomalies by comparing similar sized buildings within the same climate zone



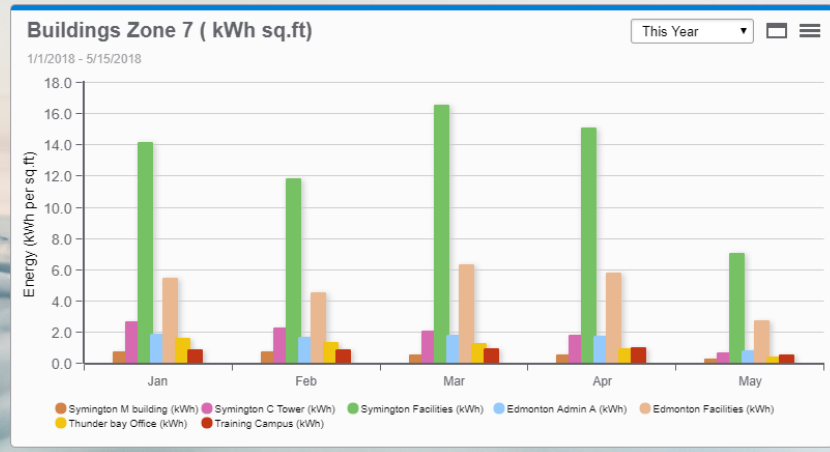
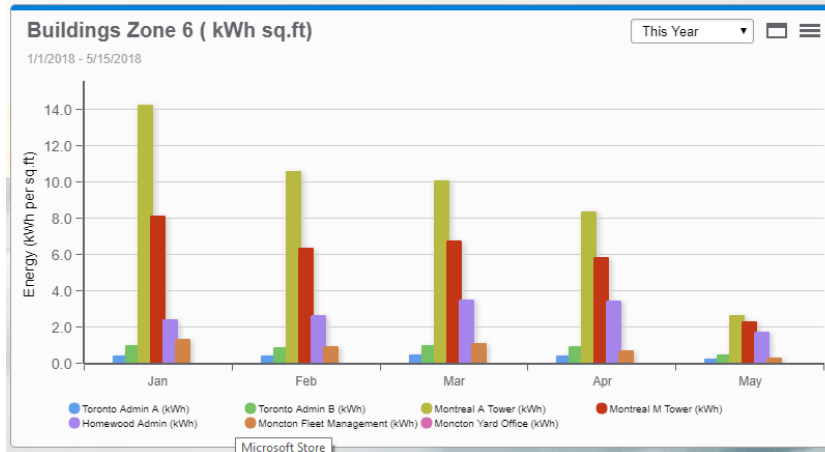
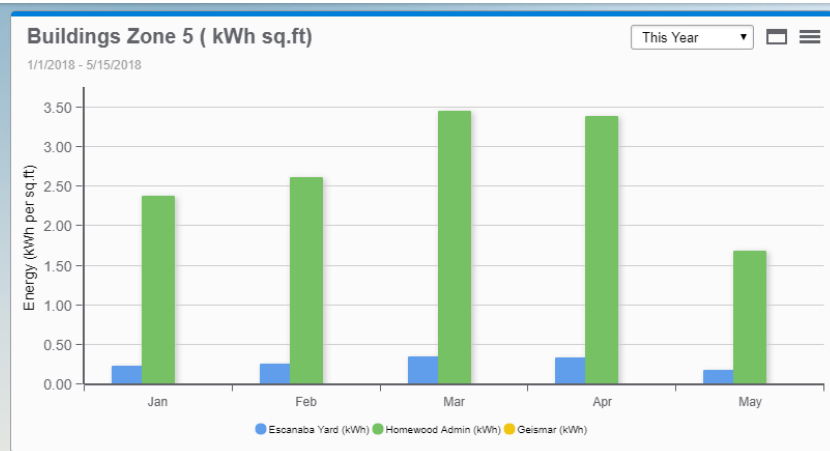
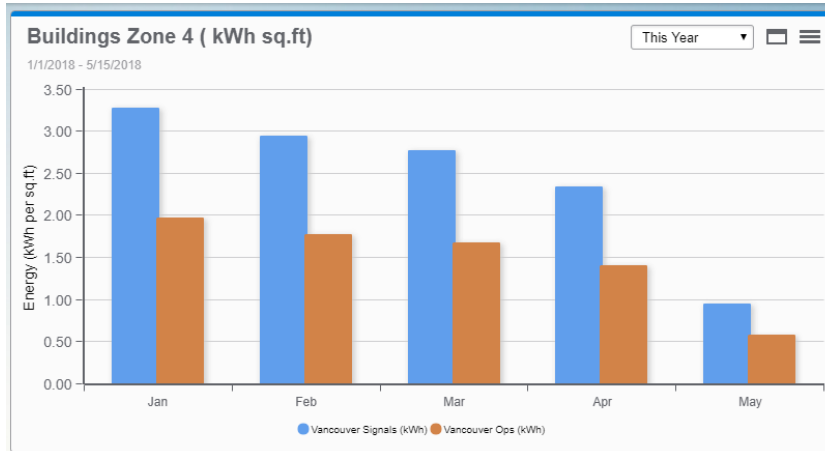
Better night setbacks

Comparable day loads

Weekend shift footprint is lower

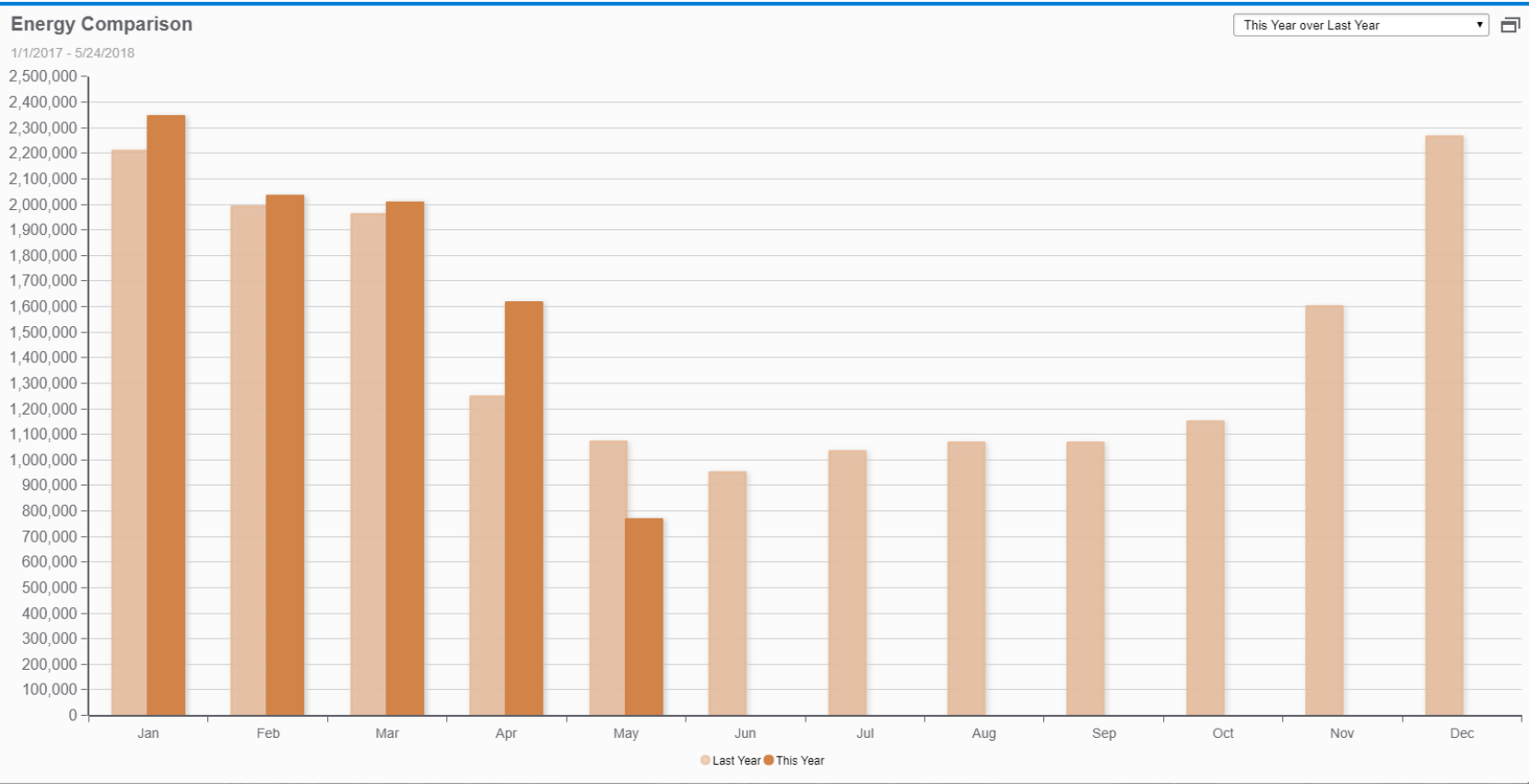
# Benchmarking

- 1- Group Buildings based on ASHRAE climate zone
- 2- Easy to compare building performance and establish benchmarks



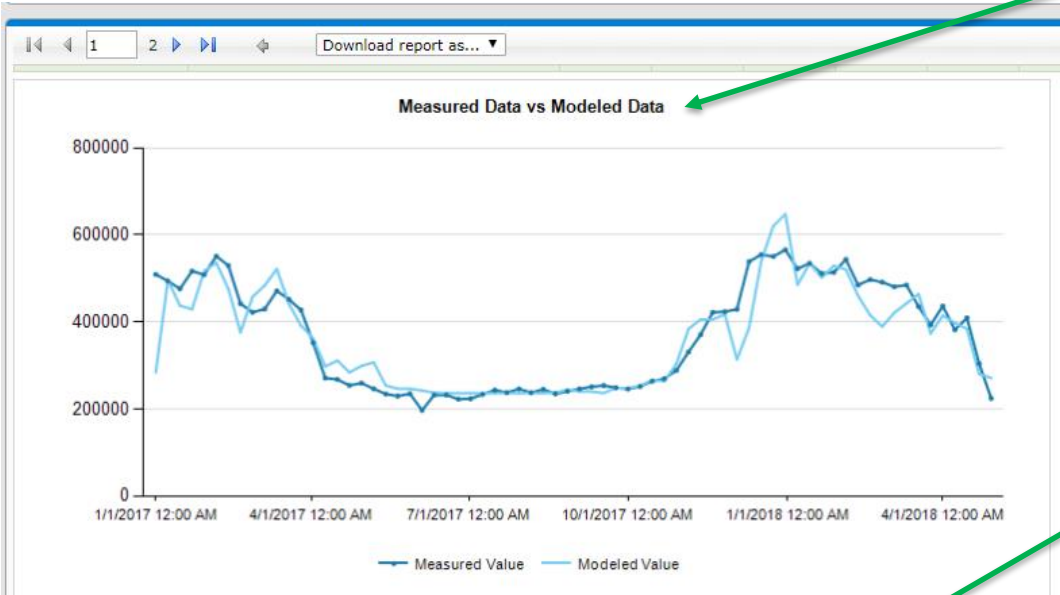
# Why do we need an energy model?

- Analyzing raw data can be tricky
- What drives energy usage in a facility?
- Comparisons can be misleading if the conditions are different ( eg. colder winters).

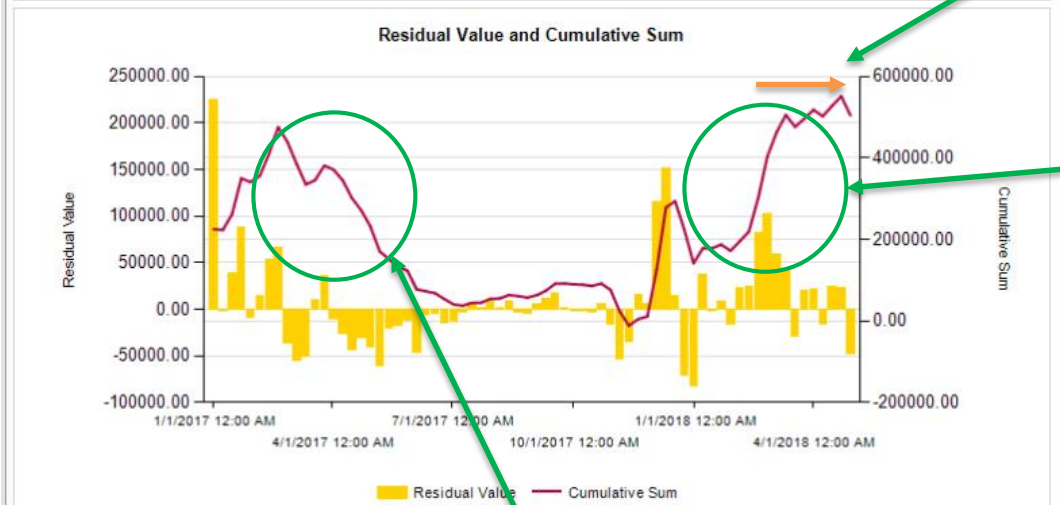


# Utilizing Energy Modelling

Energy vs HDD regression model



Check Progress  
this year using  
Baseline 2017  
model



Abnormality

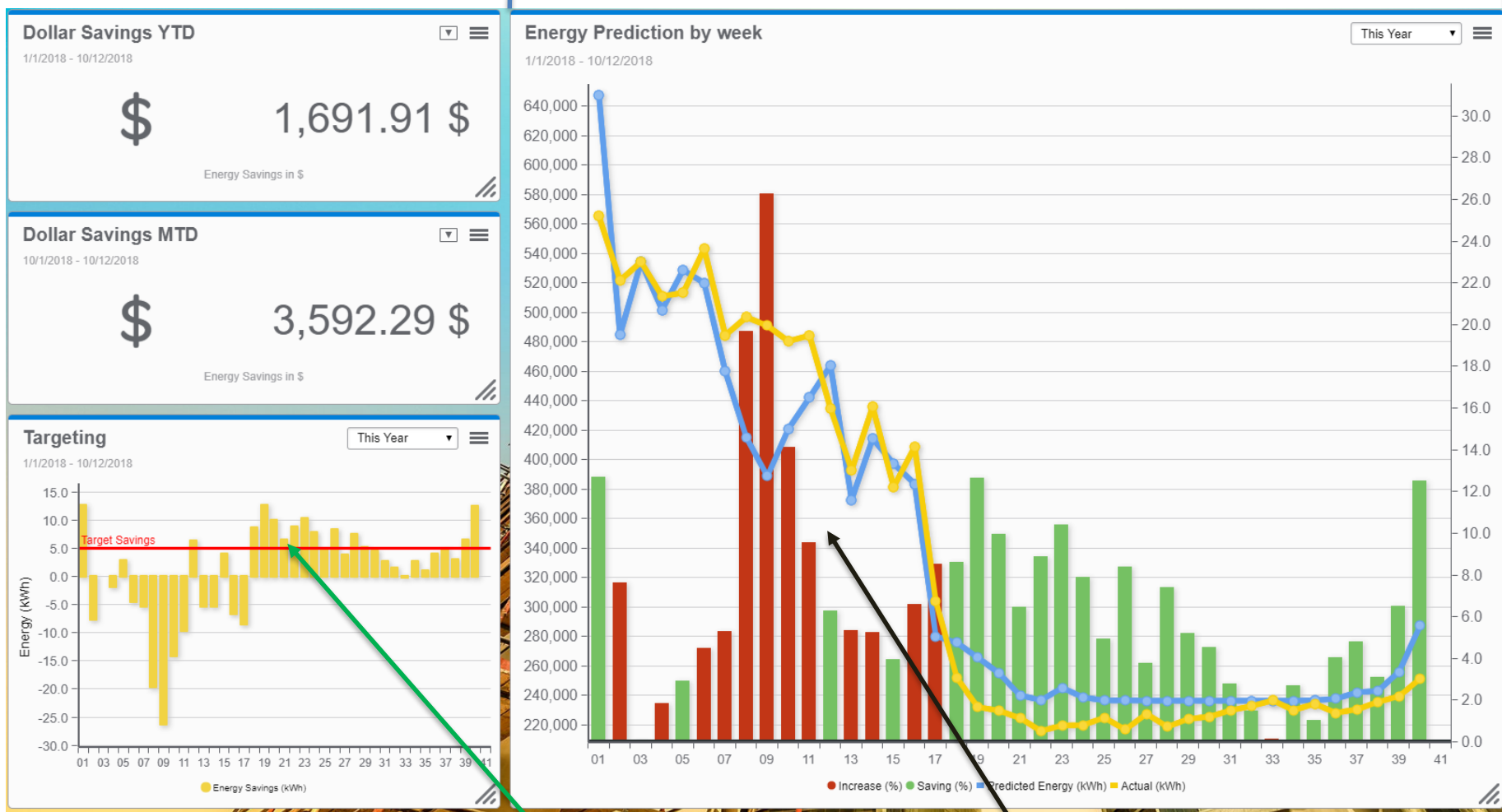
Example: Montreal Yard  
experienced an issue with  
their Switch heater  
automation winter 2018

ECMs in action



# Major Yard Energy Modeling Example

Energy modelling data compared to an established baseline

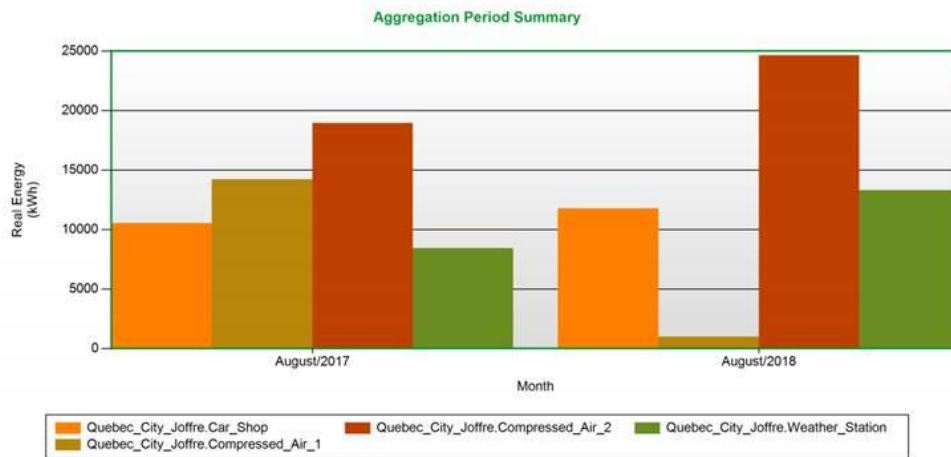
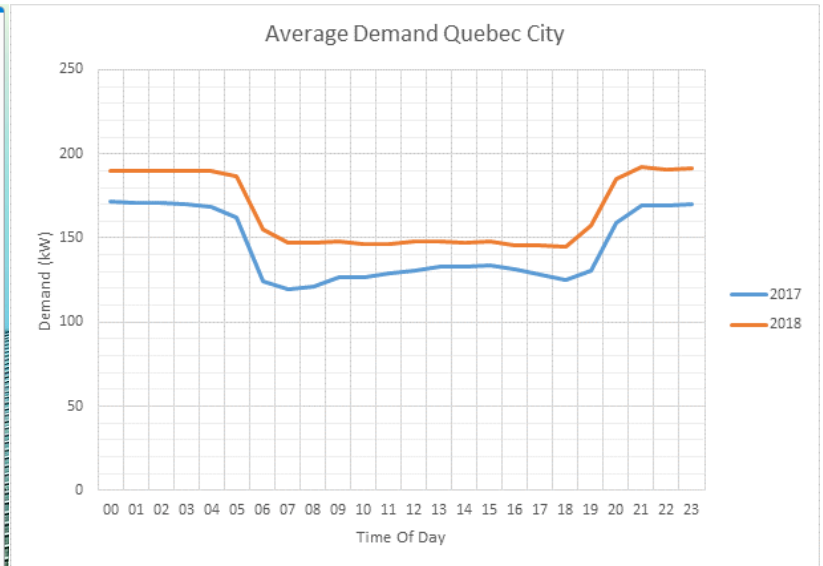
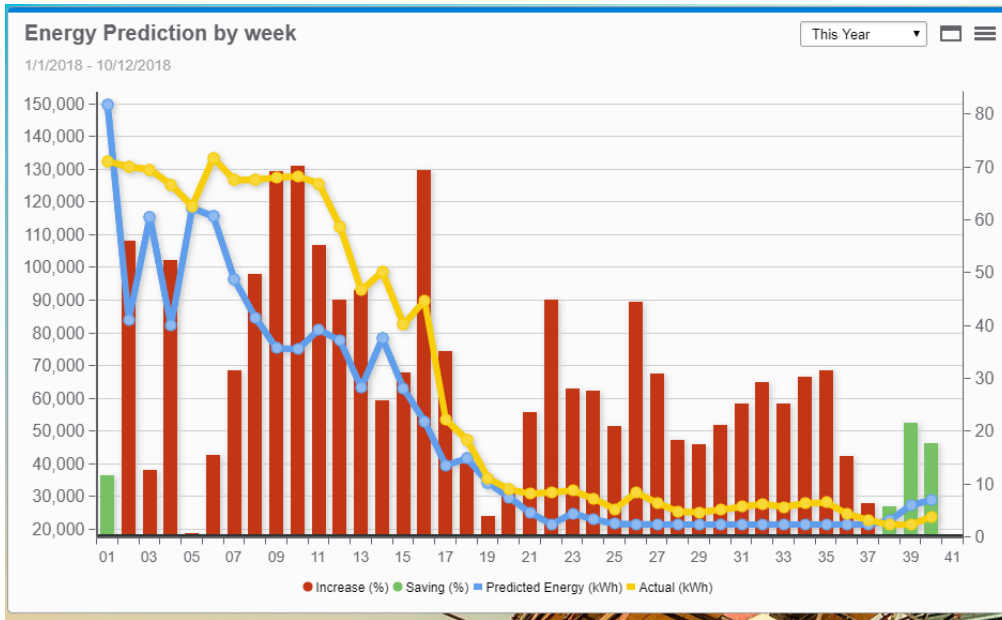


Targeting

Switch heater automation issue

# Quebec city-Success Story

Energy modelling data show green after 38 weeks of red!



- 1- Used sub metering data to find the source of increase was the compressor.
- 2- site inspection found multiple air leaks in the pipes and the compressor regulator.
- 3- Estimated avoided cost \$30,000

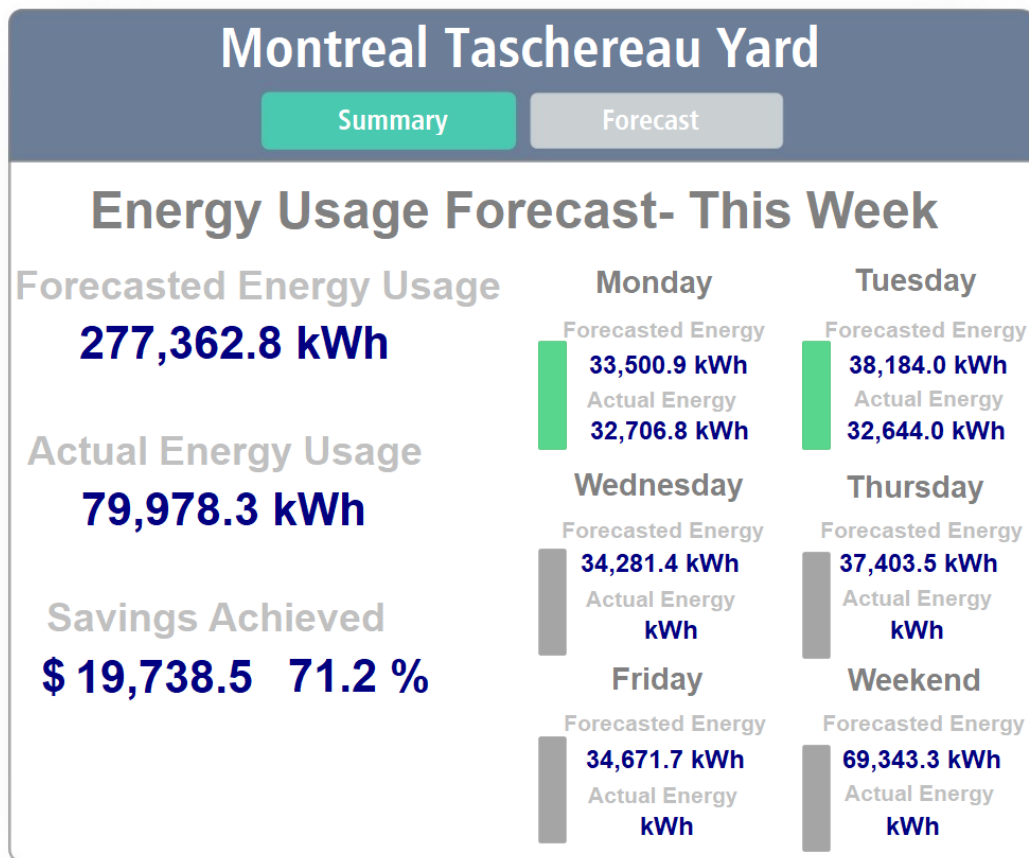
# Energy Forecasting ( still in beta)

Weekly Energy Forecasting:

1- Linear regression formulas from Baseline

2- HDD Weekly Forecast from weather XML service.

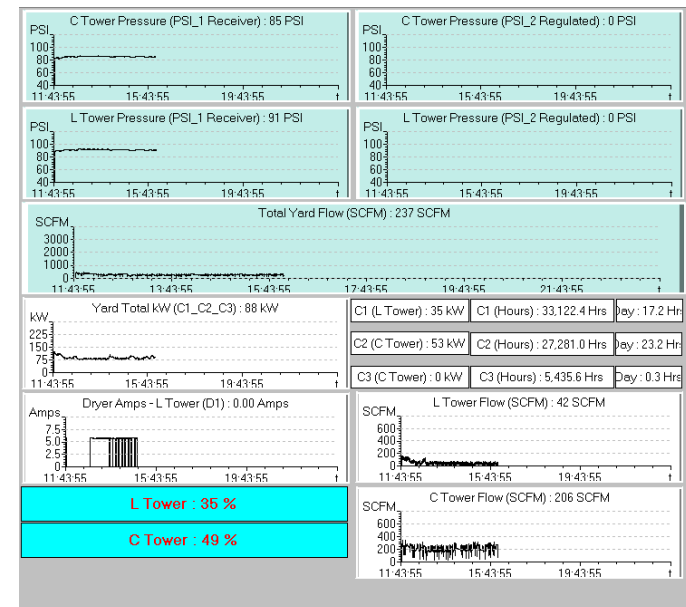
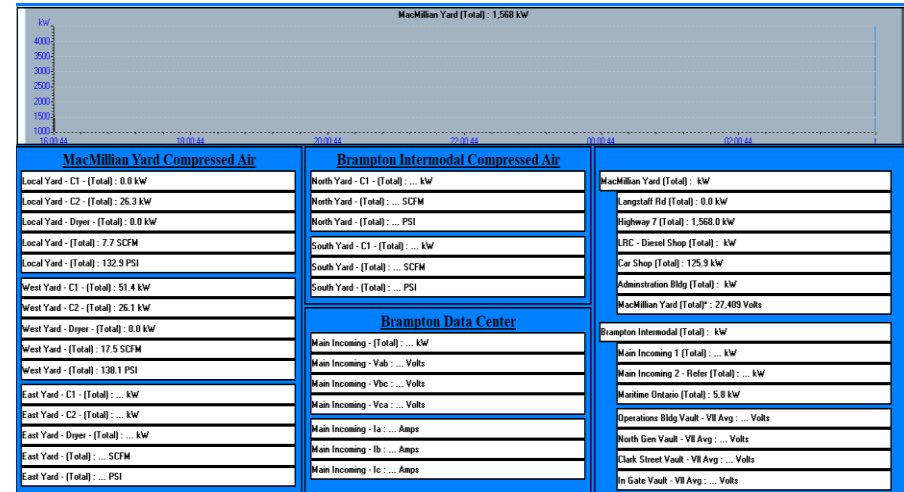
3- Compare with Actual Energy Usage



# Evolution of EMS



## Pre-Upgrade screens



# The Full story- Easy to read

## Sub Metering

## Real-Time Trend

## Vista Screen



## Energy Modeling results

## Historical Data



Thank you!