



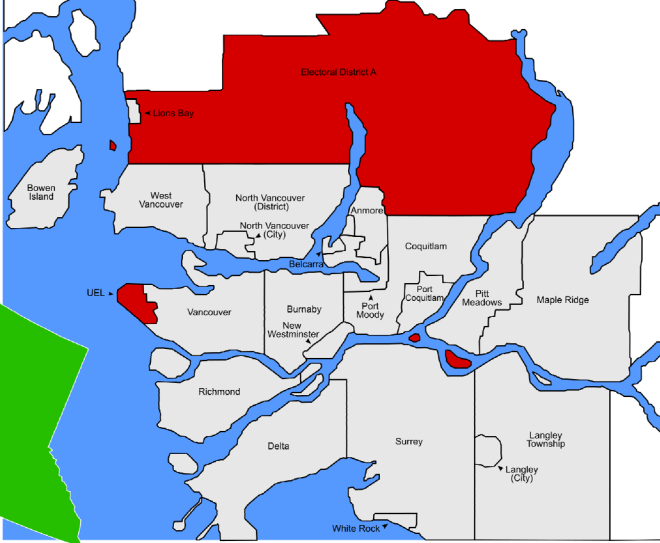
ANALYTICS IN ACTION

UBC's Pathway to Big Data

BLAIR ANTCLIFFE, ENERGY ENGINEER
UBC ENERGY & WATER SERVICES

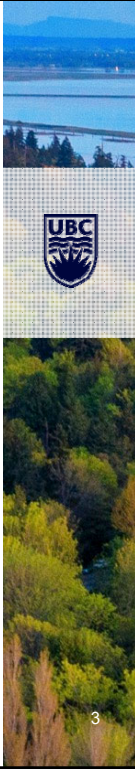


UBC'S GEOGRAPHY

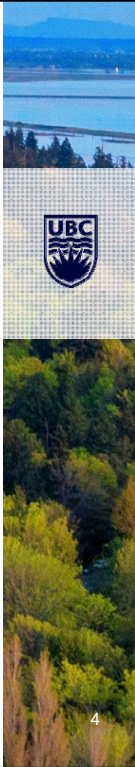
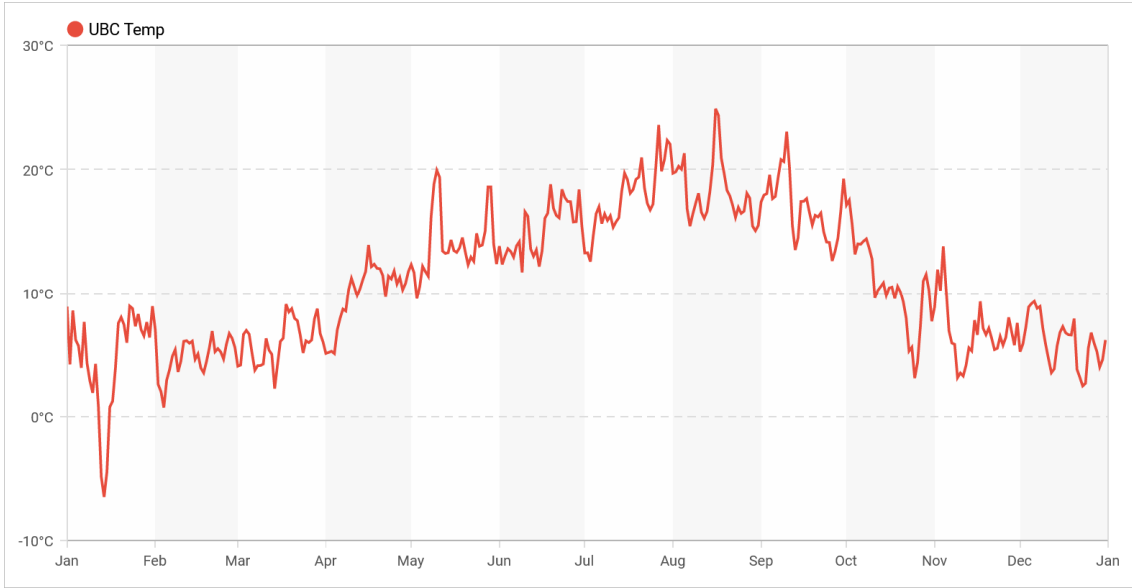


- Not *actually* part of Vancouver
- Utility distribution at UBC is by UBC

https://en.wikipedia.org/wiki/Metro_Vancouver_Electoral_Area_A



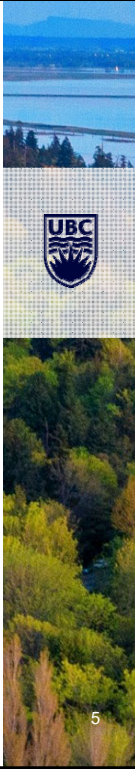
CLIMATE CONTEXT



UBC VANCOUVER FAST FACTS

- 55,000 Students
- 18,000 faculty & staff
- 60,000 daily visitors to campus (pre-COVID)
- > 100 buildings
- > 500,000m² (50 million ft²) academic floor space
- > 200,000m² (20 million ft²) residence floor space

- A small-sized city



SUSTAINABILITY AT UBC

 **2010 UBC GHG REDUCTION TARGETS**

UBC adopted its Climate Action Plan in 2010, committing the university to aggressive greenhouse gas (GHG) reduction targets of:

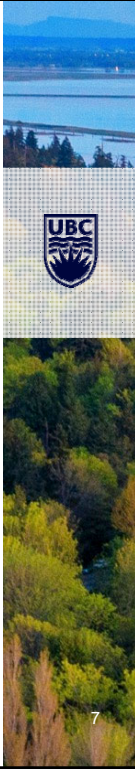


<http://energy.ubc.ca/about-us/ubcs-story/>



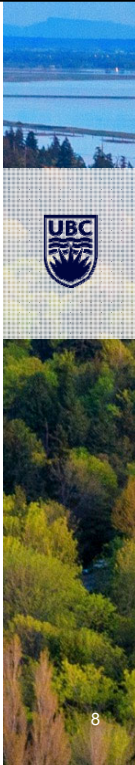
SUSTAINABILITY AT UBC

- Replaced the original steam system from 1917 with hot water DES
- Took 4 years and \$100 million
 - Addressed about \$90 million in deferred maintenance

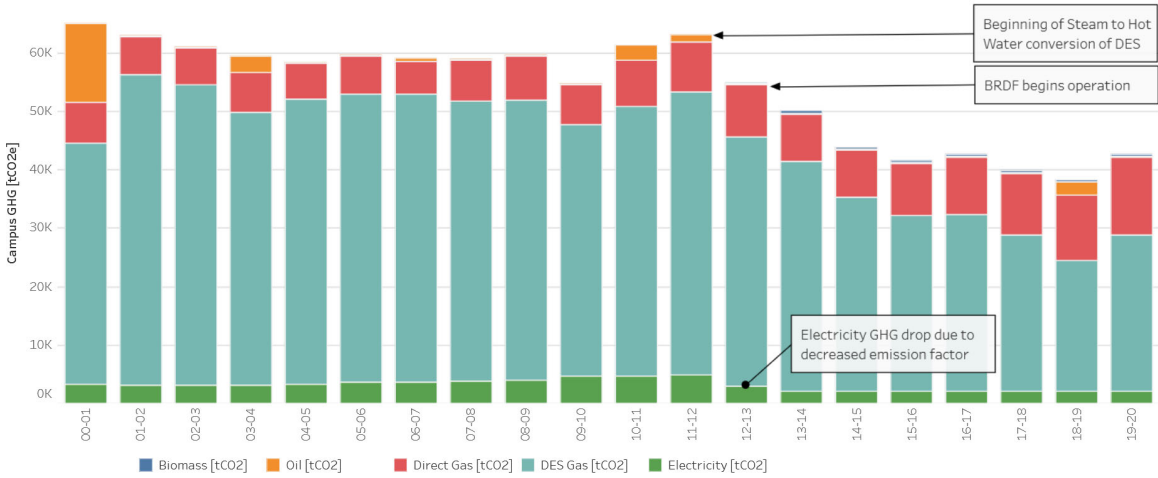


SUSTAINABILITY AT UBC

- Bioenergy facility
- 6 MWth biomass gasifier
- 2 MWth/1.5MWe cogen engine



SUSTAINABILITY AT UBC



<https://public.tableau.com/app/profile/ubc.ews/viz/UBCCampusBuildingEnergyStoryFY20working/UBCCampusEnergyStory>

UTILITIES CONTEXT

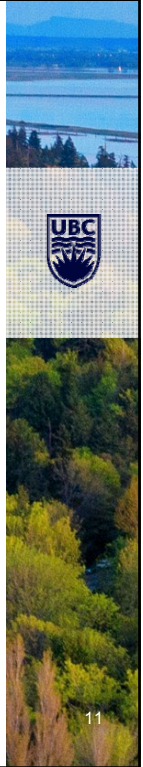
Energy Source	Price	FY2020 Use	FY2020 Cost
Electricity	\$ 70 / MWh	231,000 MWh	\$14.5
Natural Gas (DES)	\$ 7.60 / GJ	535,000 GJ	\$ 2.7
Natural Gas (Direct)	\$ 10 / GJ	270,000 GJ	\$ 2.8
Biomass	\$ 4 / GJ	135,000 GJ	\$ 0.6

<https://public.tableau.com/views/UBCCampusBuildingEnergyStoryFY20working/UBCCampusEnergyStory>

ABOUT ENERGY & WATER SERVICES

- Dep't created in 2014 to manage utilities
- Half of department maintains all utilities *exterior* to buildings
- Other half is Energy Conservation and BMS groups
- Part of mandate is to demonstrate new & innovative energy conservation

<https://public.tableau.com/views/UBCCampusBuildingEnergyStoryFY20working/UBCCampusEnergyStory>



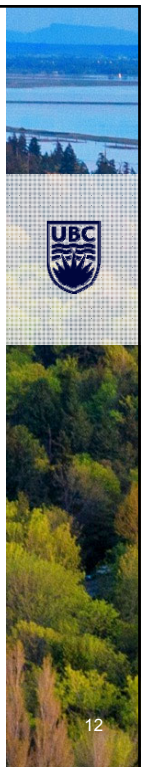
11

ENTER FAULT DETECTION & DIAGNOSTICS

- Started exploring topic in 2016
- Countless webinars and demonstrations by companies
- Decided to demo two options, one of which was SkySpark



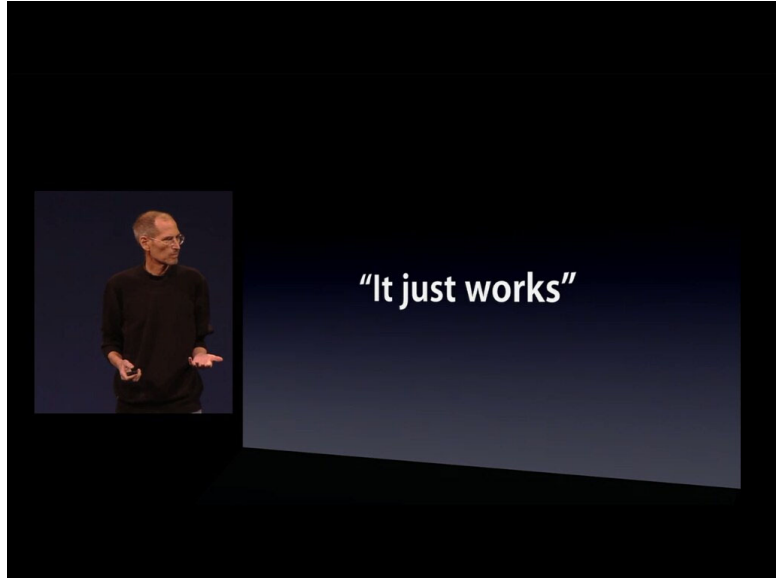
<https://shop.exchange.se.com/en-US/apps/38973/advanced-fault-detection>



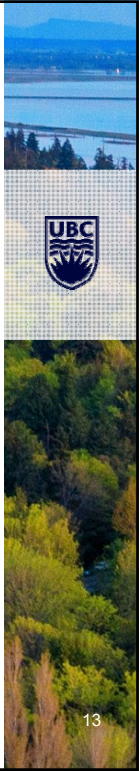
12

FIRST FD&D OPTION

The pitch:



<https://www.flickr.com/photos/curiouslee/5807458526>

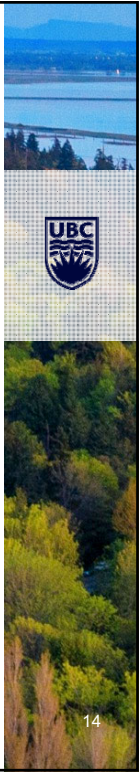


FIRST FD&D OPTION

The reality:

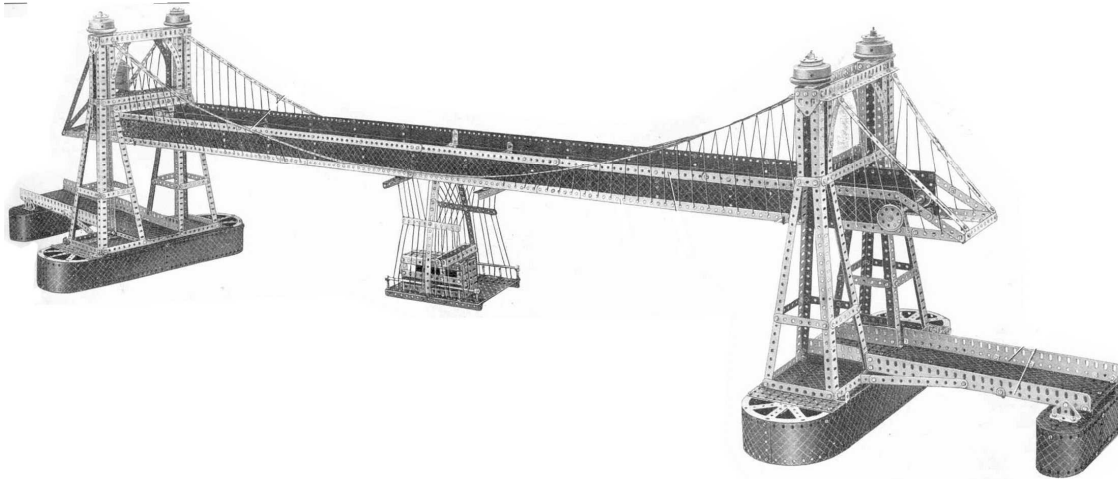


<https://www.youtube.com/watch?v=tcJOWmX-1WY>



THE SKYSPARK OPTION

- Purchased just 200 points through Yorkland to just try it out

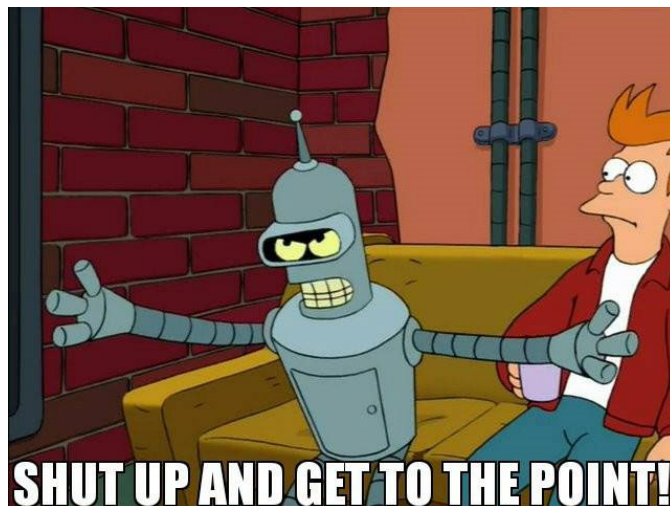


<https://www.meccanoindex.co.uk/Manuals/Models/37/1940-10/1940-10-17-L.jpg>
<https://www.youtube.com/watch?v=a1l0pSR6Uw>

15

GETTING TO THE POINT OF THE PRESENTATION

- So what is it we've done with it?
- How has it added value?
 - Probably not how you think



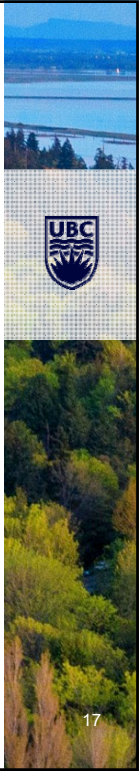
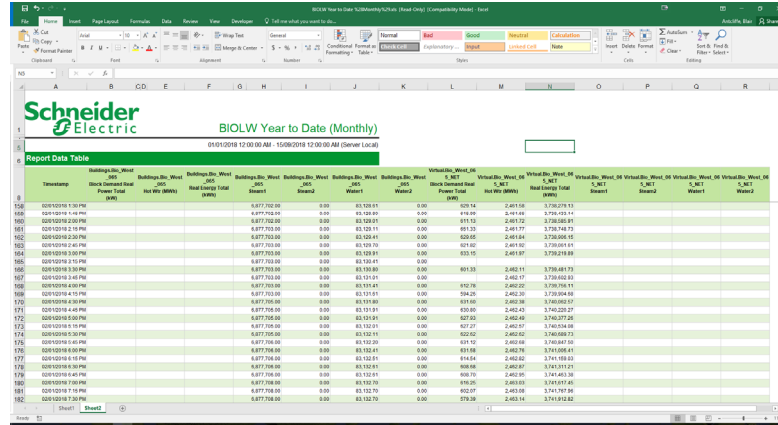
https://www.bingeclock.com/download_meme.php?file=futurama__get_to_the_point.jpg

16

BUILDING BENCHMARKING

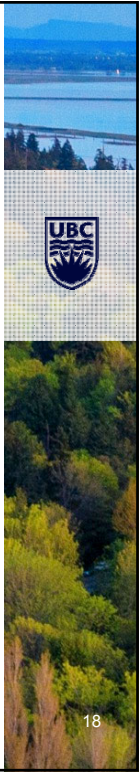
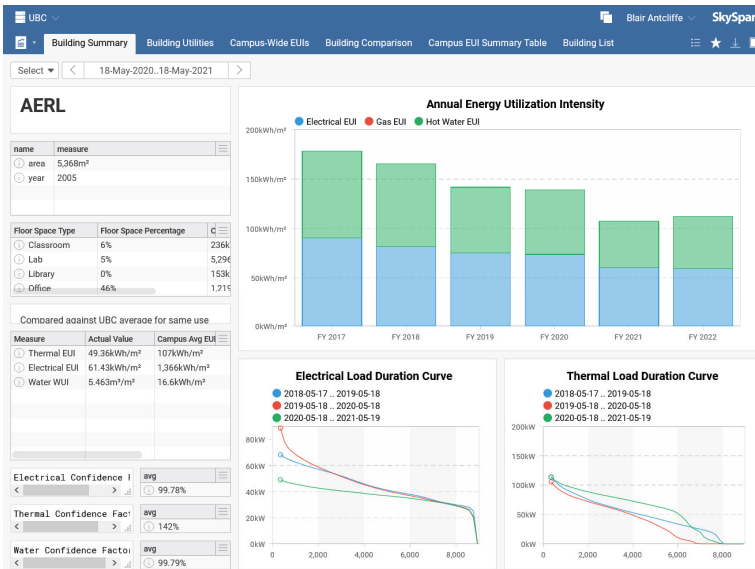
The old way:

- Manually download data
- Paste into special spreadsheet with a gazillion macros
- Max 4x per year

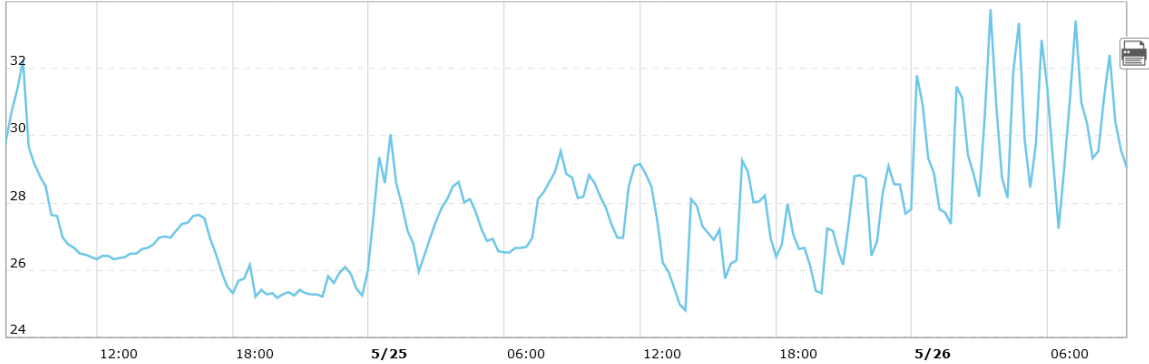


BUILDING BENCHMARKING

- Automatically gets data from metering database
- Calculated in real-time
- Quick error detection



BMS DATA WAREHOUSE



12:00 18:00 5/25 06:00 12:00 18:00 5/26 06:00

Show Sample Data

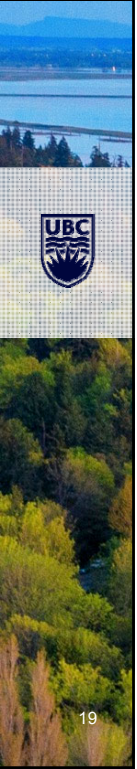
Include Non-Data



Showing Samples (Max 200)

200

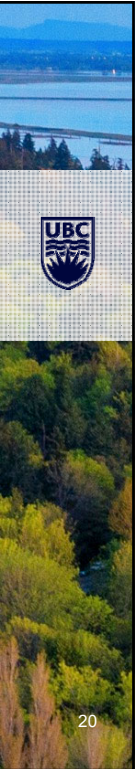
Go

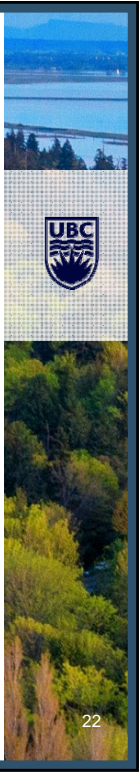
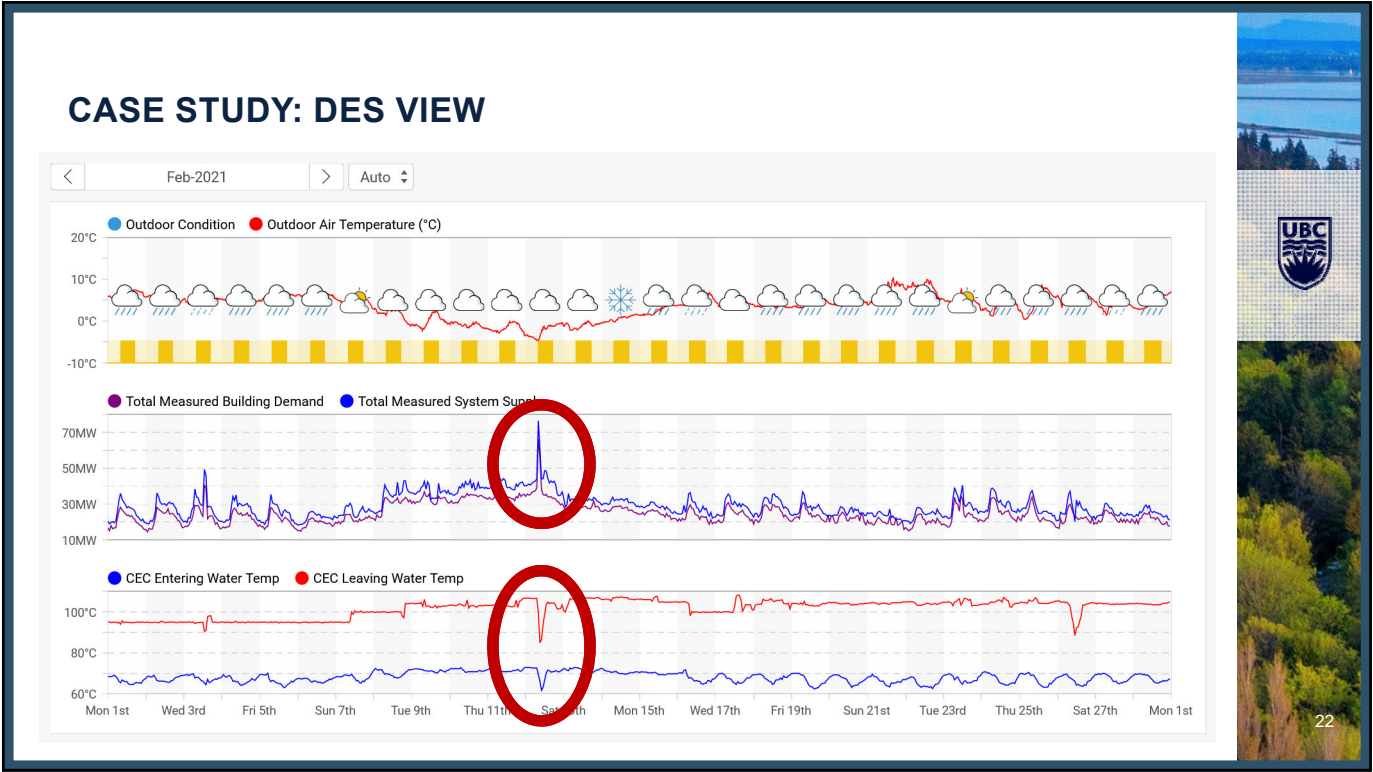
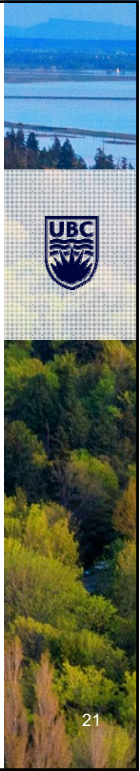
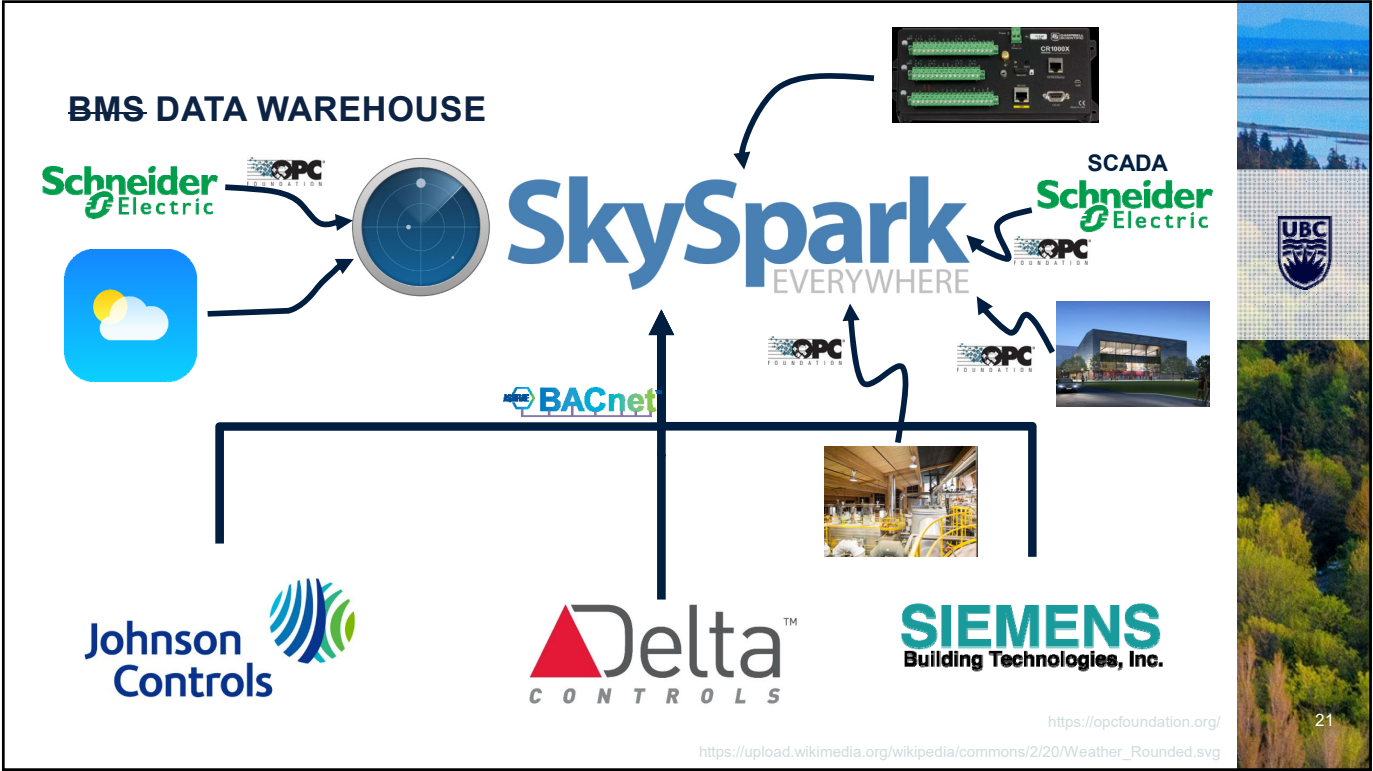


BMS DATA WAREHOUSE



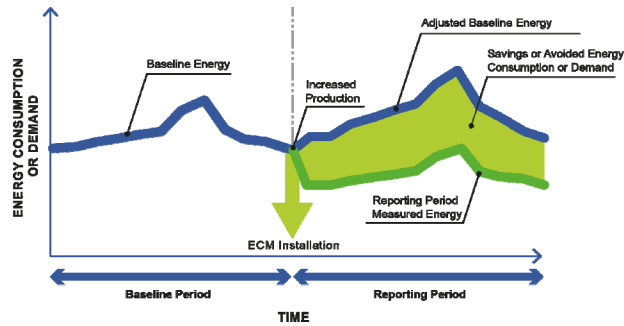
BACnet





PROJECT M&V

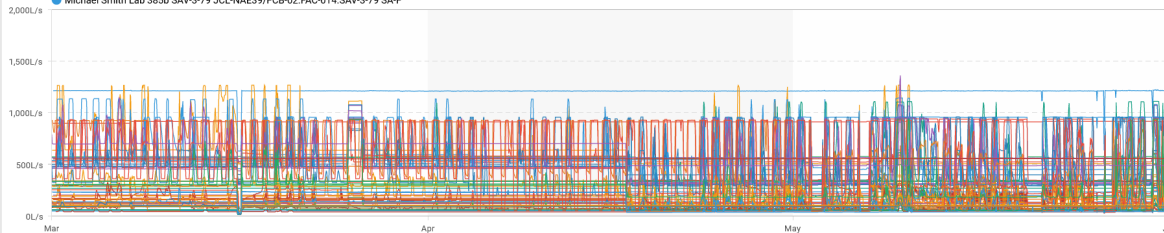
- With BMS and Meter data, trivial to perform project M&V
 - Option C (whole building) using meter data
 - Option A (key parameter measurement) for most projects
 - e.g. before/after of fan speed after programming a static pressure reset



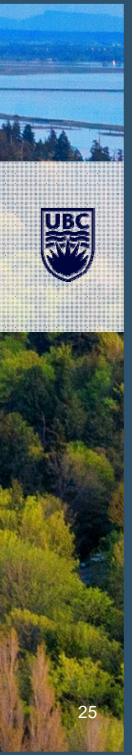
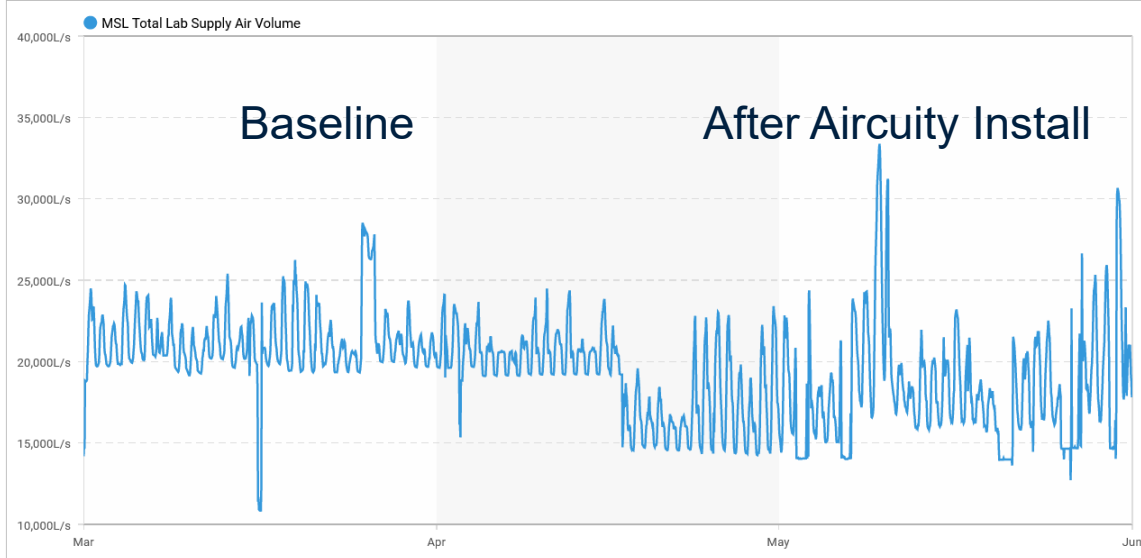
http://evo-world.org/images/denisdocuments/Figure2_ai-01.png

CASE STUDY: AIRCUIITY LAB AIRFLOW

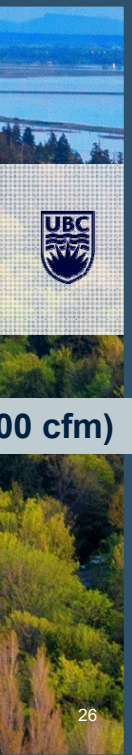
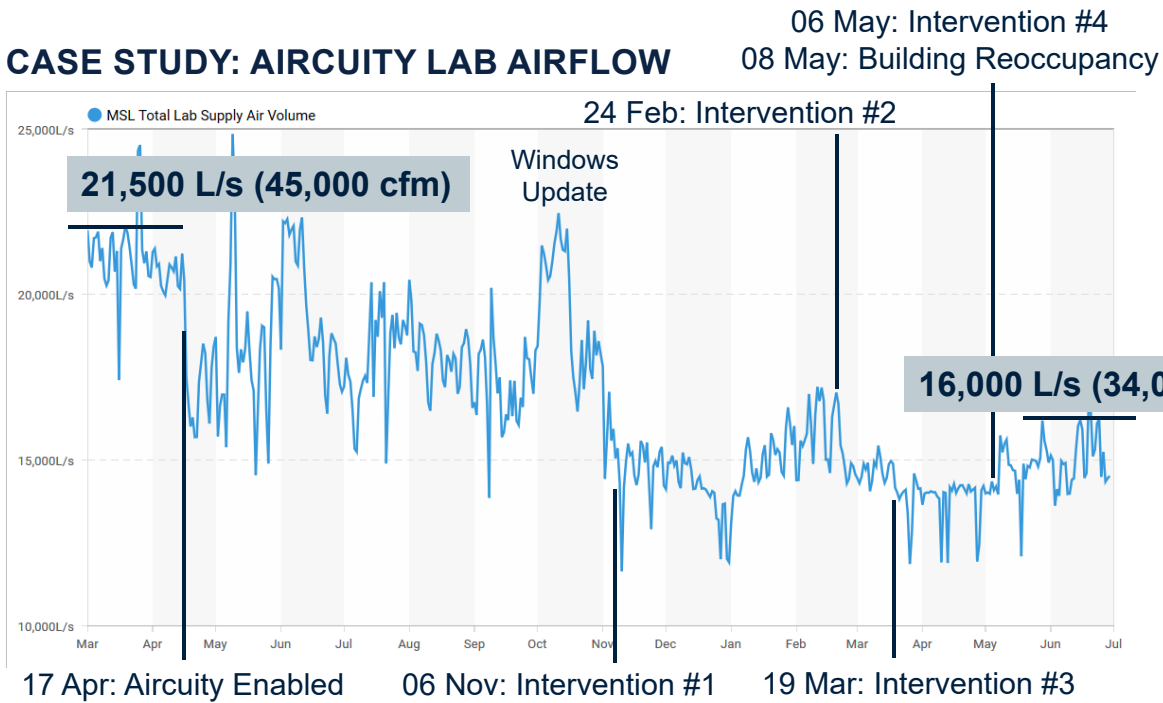
- | | | |
|--|--|--|
| • Michael Smith Lab 001a SAV-B-01 JCL-NAE39/FCB-01.FAC-004.SAV-B-01 SA-F | • Michael Smith Lab 001b SAV-B-07 JCL-NAE39/FCB-01.FAC-004.SAV-B-07 SA-F | • Michael Smith Lab 001c SAV-B-09 JCL-NAE39/FCB-01.FAC-004.SAV-B-09 SA-F |
| • Michael Smith Lab 001d SAV-B-11 JCL-NAE39/FCB-01.FAC-004.SAV-B-11 SA-F | • Michael Smith Lab 105 SAV-1-01 JCL-NAE39/FCB-01.FAC-005.SAV-1-01 SA-F | • Michael Smith Lab 105a SAV-1-06 JCL-NAE39/FCB-01.FAC-005.SAV-1-06 SA-F |
| • Michael Smith Lab 251 SAV-2-01 JCL-NAE39/FCB-01.FAC-006.SAV-2-01 SA-F | • Michael Smith Lab 251a SAV-2-05 JCL-NAE39/FCB-01.FAC-006.SAV-2-05 SA-F | • Michael Smith Lab 251b SAV-2-07 JCL-NAE39/FCB-01.FAC-006.SAV-2-07 SA-F |
| • Michael Smith Lab 253 SAV-2-08 JCL-NAE39/FCB-01.FAC-007.SAV-2-08 SA-F | • Michael Smith Lab 255 SAV-2-15 JCL-NAE39/FCB-01.FAC-008.SAV-2-15 SA-F | • Michael Smith Lab 255a SAV-2-14 JCL-NAE39/FCB-01.FAC-008.SAV-2-14 SA-F |
| • Michael Smith Lab 255b SAV-2-21 JCL-NAE39/FCB-01.FAC-008.SAV-2-21 SA-F | • Michael Smith Lab 255c SAV-2-19 JCL-NAE39/FCB-01.FAC-008.SAV-2-19 SA-F | • Michael Smith Lab 259 SAV-2-22 JCL-NAE39/FCB-01.FAC-009.SAV-2-22 SA-F |
| • Michael Smith Lab 259 SAV-2-24 JCL-NAE39/FCB-01.FAC-009.SAV-2-24 SA-F | • Michael Smith Lab 259a SAV-2-30 JCL-NAE39/FCB-01.FAC-009.SAV-2-30 SA-F | • Michael Smith Lab 259c SAV-2-28 JCL-NAE39/FCB-01.FAC-009.SAV-2-28 SA-F |
| • Michael Smith Lab 261 SAV-2-32 JCL-NAE39/FCB-01.FAC-010.SAV-2-32 SA-F | • Michael Smith Lab 261a SAV-2-36 JCL-NAE39/FCB-01.FAC-010.SAV-2-36 SA-F | • Michael Smith Lab 261b SAV-2-38 JCL-NAE39/FCB-01.FAC-010.SAV-2-38 SA-F |
| • Michael Smith Lab 263 SAV-2-39 JCL-NAE39/FCB-01.FAC-011.SAV-2-39 SA-F | • Michael Smith Lab 263a SAV-2-45 JCL-NAE39/FCB-01.FAC-011.SAV-2-45 SA-F | • Michael Smith Lab 263b SAV-2-80 JCL-NAE39/FCB-01.FAC-011.SAV-2-80 SA-F |
| • Michael Smith Lab 267 SAV-2-46 JCL-NAE39/FCB-01.FAC-012.SAV-2-46 SA-F | • Michael Smith Lab 267a SAV-2-50 JCL-NAE39/FCB-01.FAC-012.SAV-2-50 SA-F | • Michael Smith Lab 269 SAV-2-51 JCL-NAE39/FCB-01.FAC-013.SAV-2-51 SA-F |
| • Michael Smith Lab 269a SAV-2-54 JCL-NAE39/FCB-01.FAC-013.SAV-2-54 SA-F | • Michael Smith Lab 269b SAV-2-57 JCL-NAE39/FCB-01.FAC-014.SAV-2-57 SA-F | • Michael Smith Lab 269c SAV-2-61 JCL-NAE39/FCB-01.FAC-014.SAV-2-61 SA-F |
| • Michael Smith Lab 273 SAV-2-63 JCL-NAE39/FCB-01.FAC-015.SAV-2-63 SA-F | • Michael Smith Lab 273a SAV-2-67 JCL-NAE39/FCB-01.FAC-015.SAV-2-67 SA-F | • Michael Smith Lab 273b SAV-2-70 JCL-NAE39/FCB-01.FAC-015.SAV-2-70 SA-F |
| • Michael Smith Lab 275 SAV-2-73 JCL-NAE39/FCB-01.FAC-016.SAV-2-73 SA-F | • Michael Smith Lab 275a SAV-2-71 JCL-NAE39/FCB-01.FAC-016.SAV-2-71 SA-F | • Michael Smith Lab 275b SAV-2-79 JCL-NAE39/FCB-01.FAC-016.SAV-2-79 SA-F |
| • Michael Smith Lab 275c SAV-2-77 JCL-NAE39/FCB-01.FAC-016.SAV-2-77 SA-F | • Michael Smith Lab 351 SAV-3-03 JCL-NAE39/FCB-02.FAC-004.SAV-3-03 SA-F | • Michael Smith Lab 351a SAV-3-01 JCL-NAE39/FCB-02.FAC-004.SAV-3-01 SA-F |
| • Michael Smith Lab 353 SAV-3-09 JCL-NAE39/FCB-02.FAC-005.SAV-3-09 SA-F | • Michael Smith Lab 353a SAV-3-08 JCL-NAE39/FCB-02.FAC-005.SAV-3-08 SA-F | • Michael Smith Lab 357 SAV-3-13 JCL-NAE39/FCB-02.FAC-005.SAV-3-13 SA-F |
| • Michael Smith Lab 359 SAV-3-15 JCL-NAE39/FCB-02.FAC-006.SAV-3-15 SA-F | • Michael Smith Lab 359a SAV-3-14 JCL-NAE39/FCB-02.FAC-006.SAV-3-14 SA-F | • Michael Smith Lab 359b SAV-3-20 JCL-NAE39/FCB-02.FAC-006.SAV-3-20 SA-F |
| • Michael Smith Lab 363 SAV-3-22 JCL-NAE39/FCB-02.FAC-007.SAV-3-22 SA-F | • Michael Smith Lab 363 SAV-3-24 JCL-NAE39/FCB-02.FAC-007.SAV-3-24 SA-F | • Michael Smith Lab 365 SAV-3-30 JCL-NAE39/FCB-02.FAC-007.SAV-3-30 SA-F |
| • Michael Smith Lab 367 SAV-3-31 JCL-NAE39/FCB-02.FAC-008.SAV-3-31 SA-F | • Michael Smith Lab 367a SAV-3-36 JCL-NAE39/FCB-02.FAC-008.SAV-3-36 SA-F | • Michael Smith Lab 367b SAV-3-38 JCL-NAE39/FCB-02.FAC-008.SAV-3-38 SA-F |
| • Michael Smith Lab 371 SAV-3-39 JCL-NAE39/FCB-02.FAC-009.SAV-3-39 SA-F | • Michael Smith Lab 371a SAV-3-44 JCL-NAE39/FCB-02.FAC-009.SAV-3-44 SA-F | • Michael Smith Lab 375a SAV-3-46 JCL-NAE39/FCB-02.FAC-010.SAV-3-46 SA-F |
| • Michael Smith Lab 375b SAV-3-48 JCL-NAE39/FCB-02.FAC-010.SAV-3-48 SA-F | • Michael Smith Lab 375c SAV-3-50 JCL-NAE39/FCB-02.FAC-010.SAV-3-50 SA-F | • Michael Smith Lab 377 SAV-3-58 JCL-NAE39/FCB-02.FAC-012.SAV-3-58 SA-F |
| • Michael Smith Lab 383 SAV-3-63 JCL-NAE39/FCB-02.FAC-013.SAV-3-63 SA-F | • Michael Smith Lab 383a SAV-3-68 JCL-NAE39/FCB-02.FAC-013.SAV-3-68 SA-F | • Michael Smith Lab 383b SAV-3-70 JCL-NAE39/FCB-02.FAC-013.SAV-3-70 SA-F |
| • Michael Smith Lab 383c SAV-3-71 JCL-NAE39/FCB-02.FAC-013.SAV-3-71 SA-F | • Michael Smith Lab 385 SAV-3-73 JCL-NAE39/FCB-02.FAC-014.SAV-3-73 SA-F | • Michael Smith Lab 385a SAV-3-77 JCL-NAE39/FCB-02.FAC-014.SAV-3-77 SA-F |
| • Michael Smith Lab 385b SAV-3-79 JCL-NAE39/FCB-02.FAC-014.SAV-3-79 SA-F | | |



CASE STUDY: AIRCUIITY LAB AIRFLOW



CASE STUDY: AIRCUIITY LAB AIRFLOW



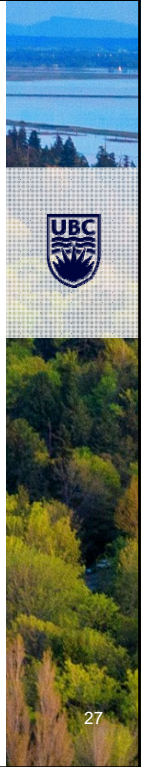
OPPORTUNITY IDENTIFICATION

- With all BMS trends in skyspark, can finally use the system to look for energy conservation opportunities.
- Still not automated though!
 - Looking manually at trends, either with historian view or by running axon scripts



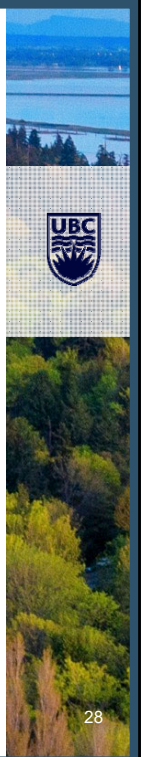
<https://skyfoundry.com/product>

<https://dreamstop.com/wp-content/uploads/2016/02/detective-dream.png>

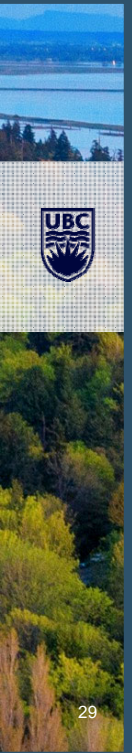
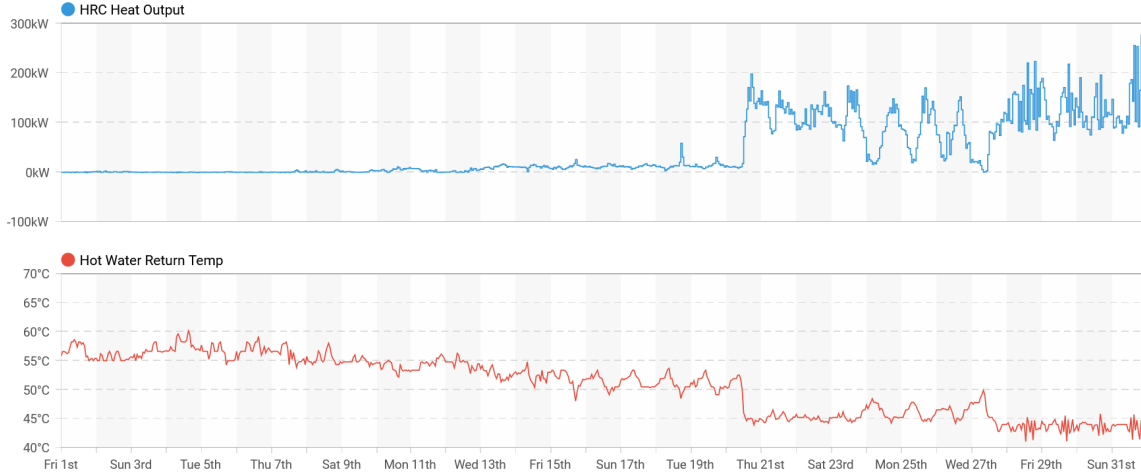


CASE STUDY: MOA REHEAT VALVES

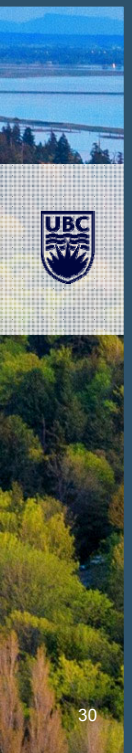
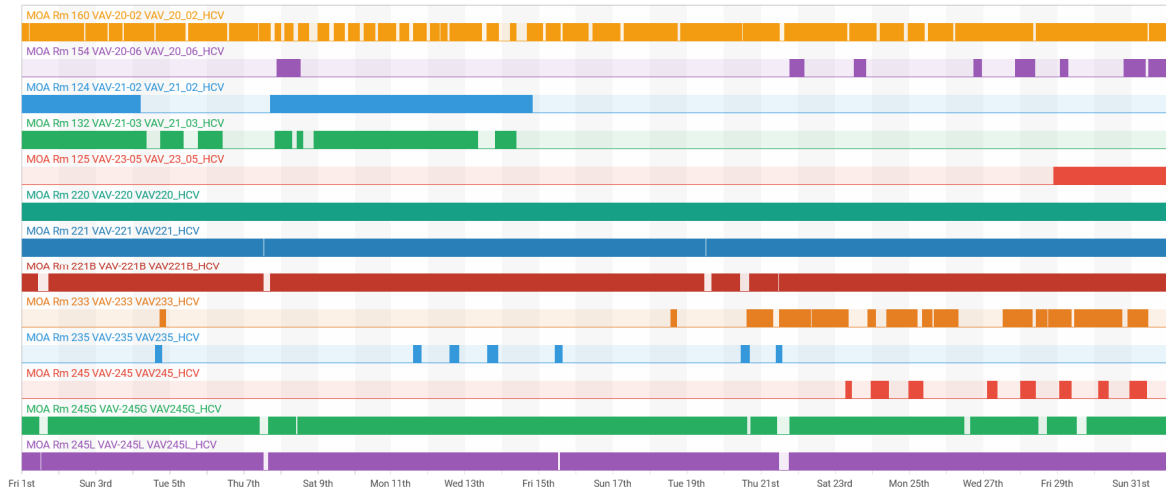
- Spent \$500k on Heat Recovery Chiller
- Installed November 2018



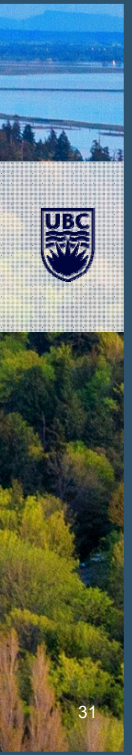
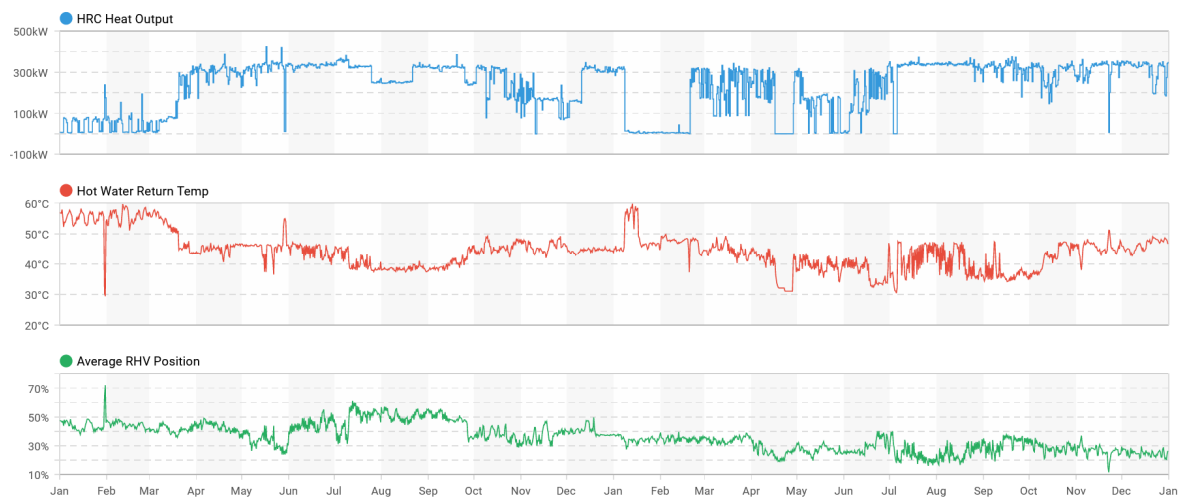
CASE STUDY: MOA REHEAT VALVES



CASE STUDY: MOA REHEAT VALVES

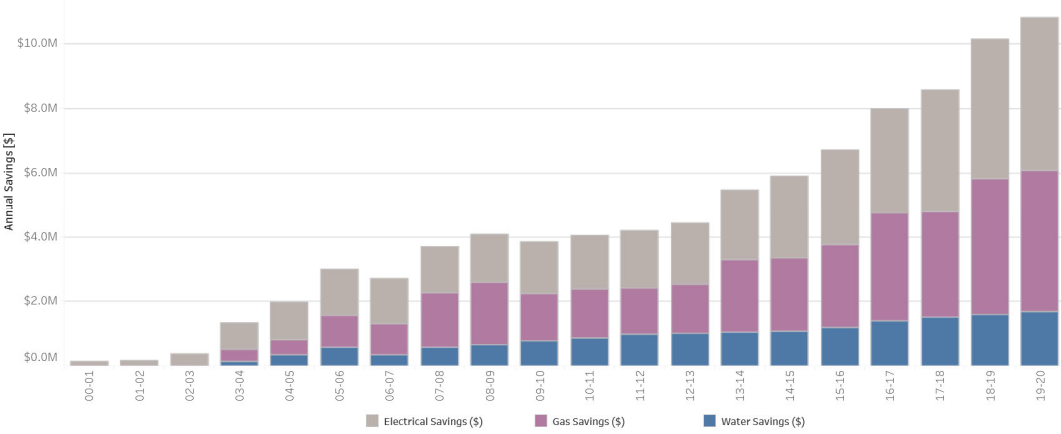


CASE STUDY: MOA REHEAT VALVES



NOW FINALLY (5 YEARS ON)

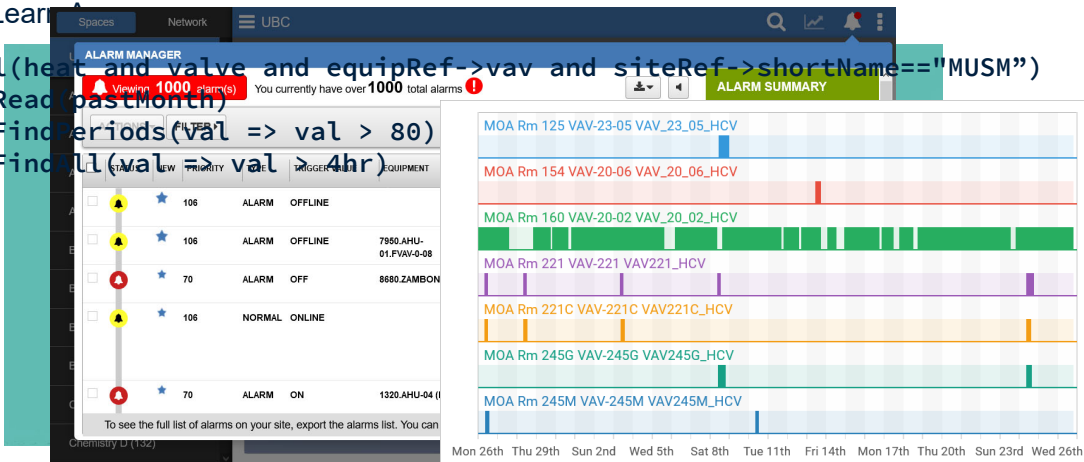
- Now starting on AFD&D
 - Integrating into Continuous Optimization Program
- 100% integrated into team workflow



TAKEAWAY TIPS

- Automate the basic work
- Don't replicate BMS functionality
- Learn

```
readAll(heat and valve and equipRef->vav and siteRef->shortName=="MUSM")
.hisRead(pastMonth)
.hisFindPeriods(val => val > 80)
.hisFindAll(val => val > 4hr)
```



33



THE UNIVERSITY OF BRITISH COLUMBIA

Yorkland
Controls
ENVIRONMENTAL
SOLUTIONS

Thank you for joining Yorkland Controls and Blair Antcliffe, UBC in sharing his path implementing Energy Analytics on the UBC campus.

Hopefully, Blair's presentation has helped you look at defining a journey, to achieve your desired results. If your beginning or looking for advice on your roadmap, we would be glad to assist you.

Some suggested references to consider are:

- Attending an Energy Analytics demonstration session held at by SkyFoundry provides scheduled training dates which can be found under their calendar at - <https://skyfoundry.com/calendar>
- Reviewing references guides below:
 - o <https://skyfoundry.com/file/411/SkySpark-for-Energy-Analysis-Commissioning-and-MV.pdf%60>
 - o <https://skyfoundry.com/file/457/Case-Study-Machine-Learning-with-SkySpark---Energy-Twin.pdf>
 - o <https://skyfoundry.com/file/52/Case-Study-SkySpark-in-an-MV-Application.pdf>
 - o <https://skyfoundry.com/file/183/Case-Study-Sieben-Energy---Monitoring-Based-Commissioning-with-SkySpark.pdf>



THE UNIVERSITY OF BRITISH COLUMBIA



Yorkland Controls has supported the post secondary educational system in Ontario for over 50 years. Initially, we supported power plant operations, HVAC parts for pneumatics, field devices for the facilities in the institutions.

Today, we bring IoT solutions and are a pioneer, by introducing new technologies and concepts to the BAS industry. This is evident with our investment into the Master Systems Integrator initiative and new product portfolio to develop and network of MSI's to develop Smart Building Technology.

Yorkland Controls represents SkySpark in Canada. We support organizations directly and indirectly with a network across the country to implement SkySpark energy analytics.

Mark Coleman
 National Business Development Manager – Smart Solutions
 (o) 905-643-4040
 (m) 416-999-9964
mcoleman@yorkland.net
Yorkland Controls Limited + Environmental Solutions
 710 South Service Road, Unit 5&6, Stoney Creek, ON L8E 5S7
www.yorkland.net

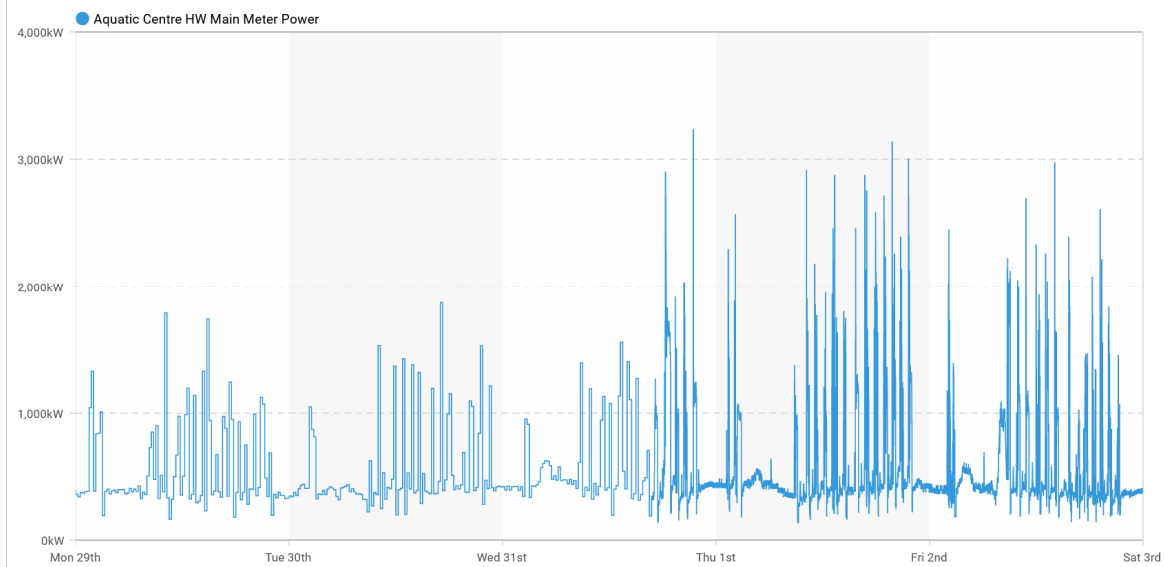


THE UNIVERSITY OF BRITISH COLUMBIA



Questions and Answers

BONUS SLIDE: POWER OF READING REAL-TIME DATA



37

BMS DATA COLLECTION

Point Polling

- Instantaneous feedback
- Doesn't require TLs be created in BMS (extra setup work)
- Flexibility in data collection (CoV interval / sample frequency)
- Potentially more network traffic
- Data lost if comms failure or SkySpark server issue

Trendlog Syncing

- Less network traffic
- More reliable data (can withstand outages)
- More setup work on BMS
- Slower if not done cleverly

38