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OPERATIONS & ENERGY MANAGEMENT

Energy and Operations Review, Analysis, and Findings

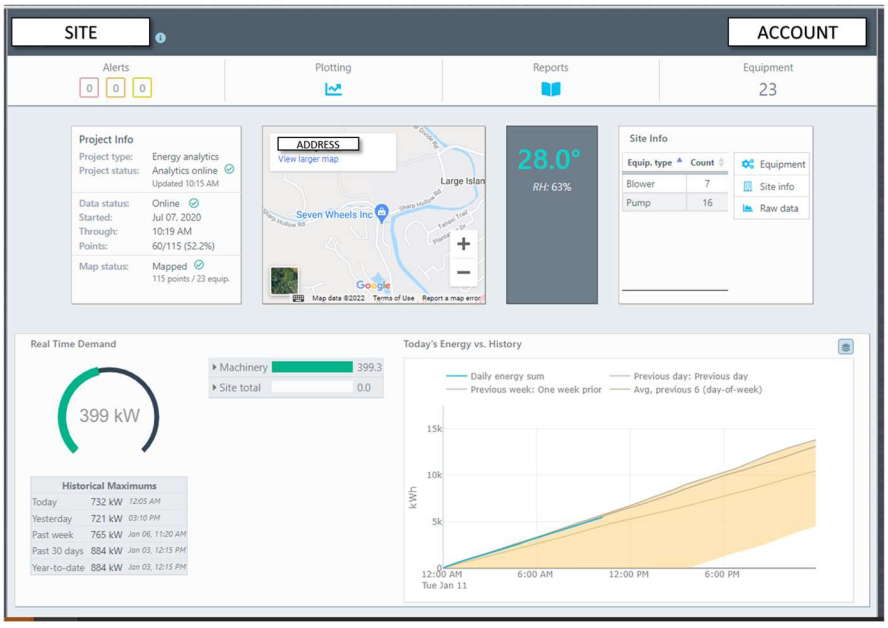
Water Applications – Wastewater Treatment Plant

Executive Summary

Energy monitoring can impact operations in several meaningful ways in wastewater treatment plants, drinking water plants, chilled water plants, any site or application with significant energy use for water conveyance. Data can be used for numerous purposes, affecting sustainability, operations, or even maintenance practices

- **Benchmarking** - Meter and sub-meter data can be used to benchmark energy use by motor control center (MCC), physical area, or system
- **Key Performance Indicators -** Energy data can be combined with production data to establish efficiency metrics or other KPIs
- **Better Maintenance -** Energy data can be viewed by site operators in a predictive maintenance application. Changes in energy use over time can provide early warning of equipment failure
- **Cost Savings -** SiteWatch can work with onsite personnel to identify potential energy cost savings projects, based around operational changes or machine replacements
- **Simplify M&V -** Measurement and verification can be accomplished simply and rapidly using 'before' and 'after' data to validate a project or help with getting incentives from a local utility

Figure 1: Energy Monitoring Dashboard – Summarizes site details (location and conditions), energy monitoring system statistics, and current and historical energy use



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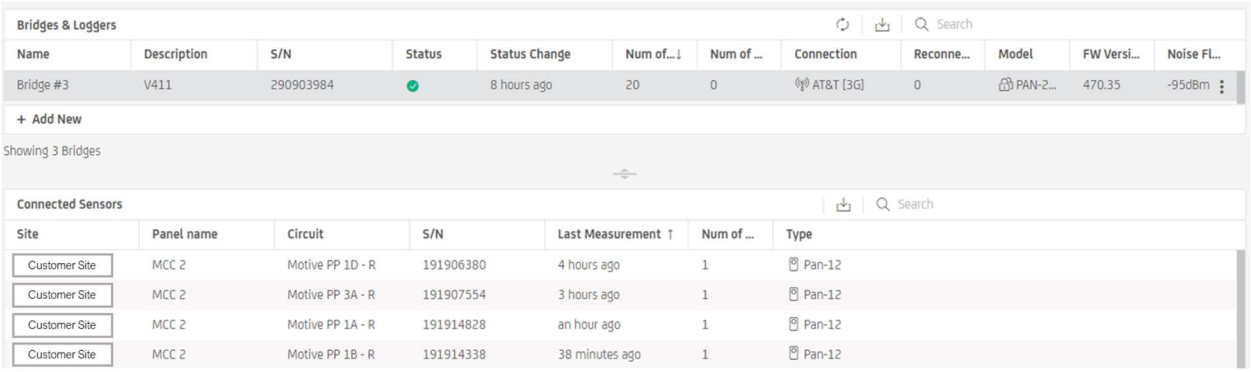
Energy Monitoring System Health Check

Regular reporting includes a system health check that summarizes how energy monitoring hardware is performing, whether any hardware is not operational, and if there are issues with connectivity or data collection affecting the quality of data.

Figure 2: Connected Bridge and Sensors Summary



Bridges & Loggers

Name	Description	S/N	Status	Status Change	Num of...	Num of ...	Connection	Reconne...	Model	FW Versi...	Noise Fl...
Bridge #3	V411	290903984		8 hours ago	20	0	AT&T [3G]	0	PAN-2...	470.35	-95dBm

+ Add New

Showing 3 Bridges

Connected Sensors

Site	Panel name	Circuit	S/N	Last Measurement	Num of ...	Type
Customer Site	MCC 2	Motive PP 1D - R	191906380	4 hours ago	1	Pan-12
Customer Site	MCC 2	Motive PP 3A - R	191907554	3 hours ago	1	Pan-12
Customer Site	MCC 2	Motive PP 1A - R	191914828	an hour ago	1	Pan-12
Customer Site	MCC 2	Motive PP 1B - R	191914338	38 minutes ago	1	Pan-12

Site A for a Water Treatment Plant customer has consistent data collection with a centrally-located gateway. Sensors may be added if machinery is powered through the same MCC without adding additional gateways.

Sustainability Reporting

Energy data can also be used to summarize greenhouse gas emissions for utility meters and sensors. Electricity and natural gas consumption can be presented in units of CO2 per year to allow simple benchmarking between sites, equipment types, or any other customized usage group. With the addition of utility meter information, SiteWatch can help track all energy types (electric, natural gas) and calculate GHG contributions by energy type:

Figure 3: 2020 and 2021 Energy and GHG

Month	Total kWh (2020)[1]	Total mTons CO2 (2020)	Total kWh (2021)[2]	Total mTons CO2 (2021)
January	433,992	193	434,330	193
February	406,989	181	372,983	166
March	431,430	192	413,605	184
April	332,307	148	406,810	181
May	340,320	151	419,165	186
June	403,694	179	417,962	186
July	414,476	184	470,935	209
August	405,359	180	451,815	201
September	354,493	158	410,454	182
October	381,786	170	403,831	179
November	390,696	174	411,695	183
December	423,768	188	386,100	172
Total	4,719,310	2,098	4,999,682	2,222

[1] Total kWh calculated from sum of installed sensors, may not match utility meter total
[2] Report generated mid-December 2021. Total does not include full month for December
[3] CO2 emissions calculated using 0.9778 lbs CO2 per kWh

Equipment Observations, Comparisons, and Savings Opportunities

Digester Blowers

Digester blowers provide air into a wastewater process to help breakdown organic material. Comparing two weeks of operation for digester blowers, the first chart below shows a digester blower (blue lines) cycling completely off 1-2 times per day, while the second chart shows the blower (blue line) remaining on all week, though cycling between lower and higher loaded states. Another blower (orange lines in charts below) runs continuously to provide the base load (or minimum air required) for the system:

Figure 4: Energy profile with a digester blower cycling on and off

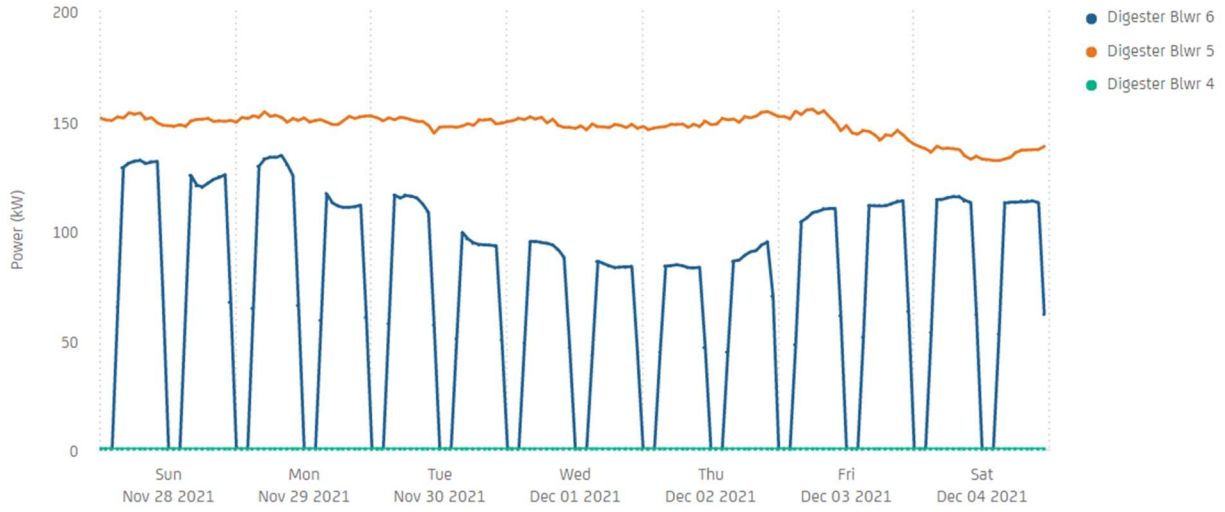
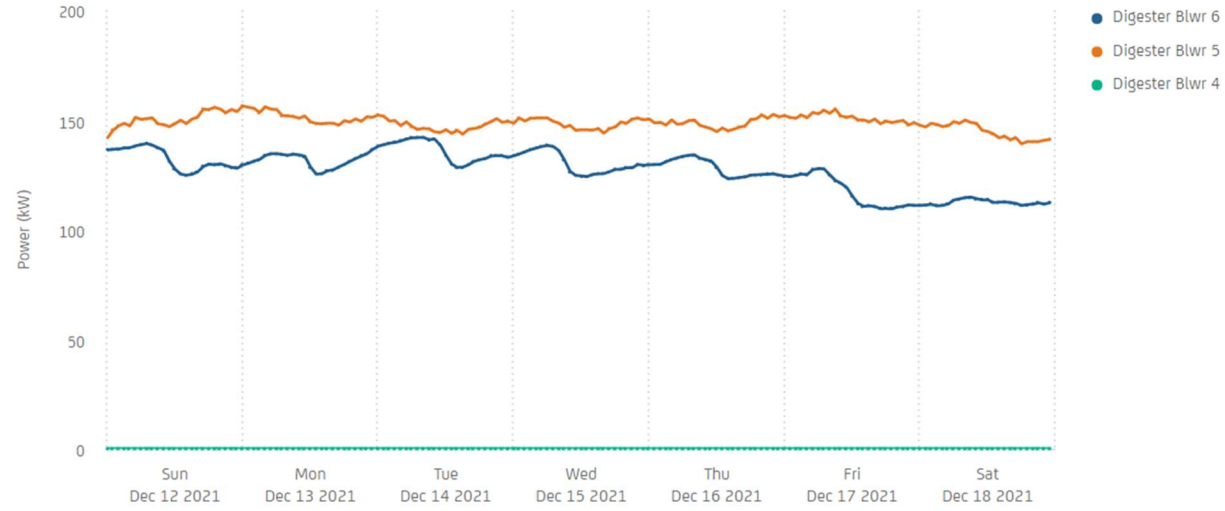


Figure 5: Energy profile with on the same digester blower remaining on



When the second digester blower is allowed to cycle completely off at times, the weekly cost is almost $800 less than when the digester is left on at all hours. This is equivalent to an additional $40,000 in annual electricity costs, a difference shown in Figure 6 and Figure 7

Figure 6: Daily cost for all digester blowers over a week with Digester Blower 6 allowed to cycle off ($1,047 weekly cost for DB-6)

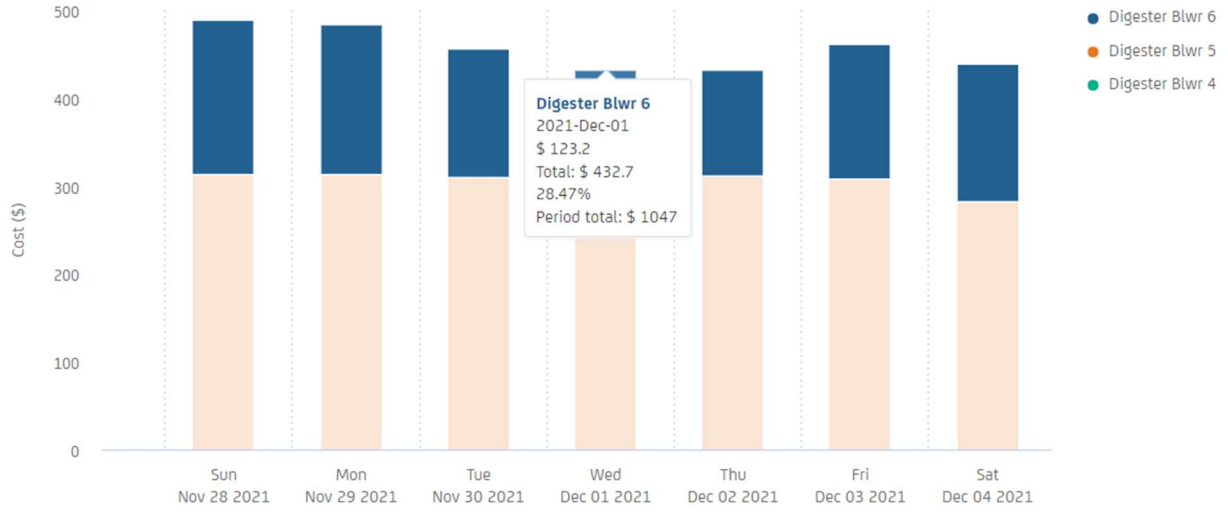
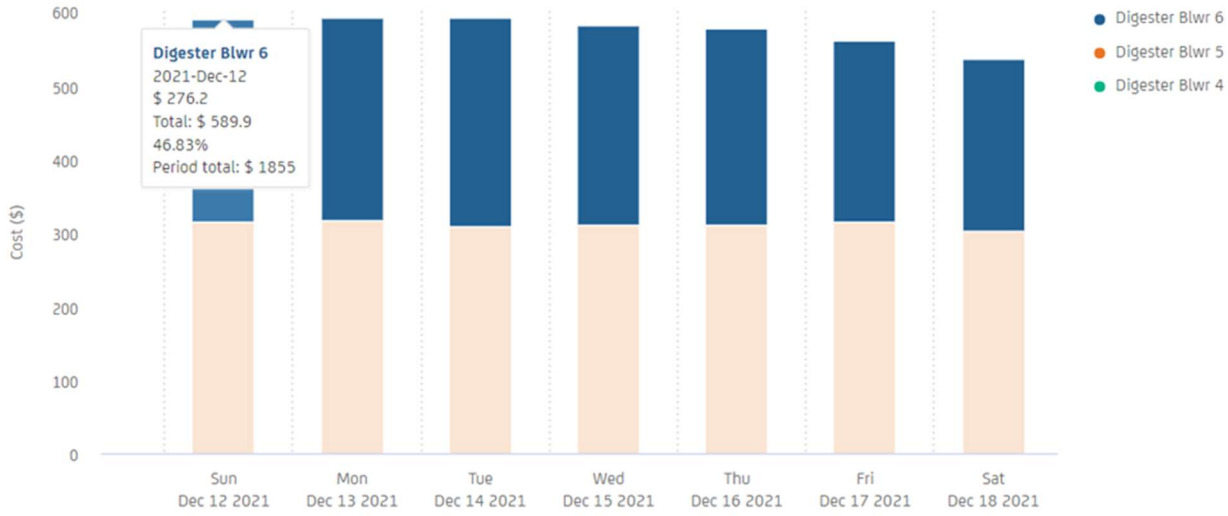


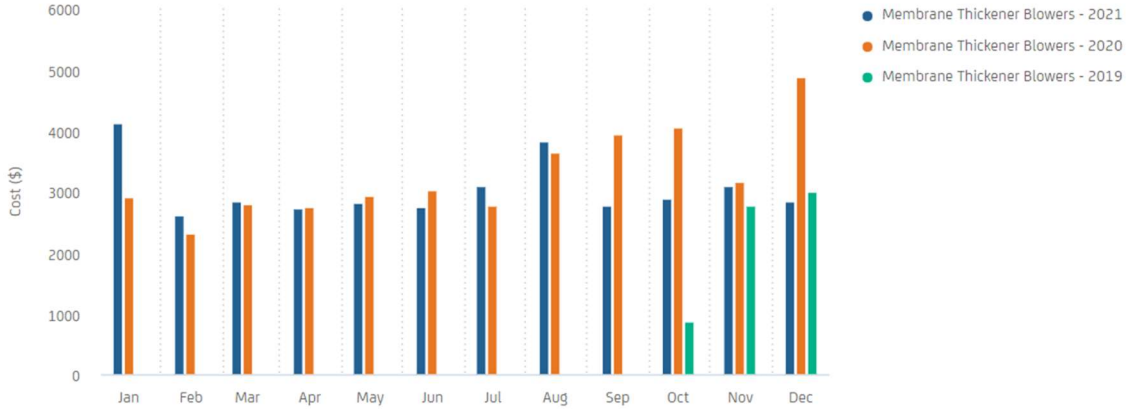
Figure 7: Daily cost for all digester blowers over a week with Digester Blower 6 left on ($1,855 weekly cost for DB-6)



Membrane Thickener Blowers

Energy use for membrane thickener blowers is generally consistent, but there are several week-long periods where three blowers operated instead of two. The periods when this occurs do not depend on the season and appear to occur randomly. The additional cost is likely due to an extra blower being switched on inadvertently.

Figure 8: Over two years of membrane thickener blower energy, monthly peaks from August 2020 through January 2021 due to three blowers operating rather than two



The additional monthly cost can be up to $2,000 more per month (comparing December 2020 to December 2019). Overall, the added expense for these events over two years is around $8,000.

Motive Pumps

Motive pump energy use follows a seasonal pattern, with increased use over warm-weather months and reduced use during the winter. There are 3 lines, with 4 pumps per line. During warmer weather, all 4 pumps (per line) will stage on and run for 5-8 hours before shutting off. In colder weather, only 2 or 3 pumps will stage on.

The process served by these pumps is not fully understood by SiteWatch; however, due to the cycling nature of this equipment, SiteWatch recommends reviewing the age of the motors and considering whether variable speed control would both improve operations and reduce energy use over time. The total electricity cost for this equipment is more than $130,000 per year.

Figure 9: Typical Motive Pump cycling during warm weather (daily chart by hour shown below). Each color area represents a different motive pump running during that hour, the areas stacking as more pumps come online (up to 4)

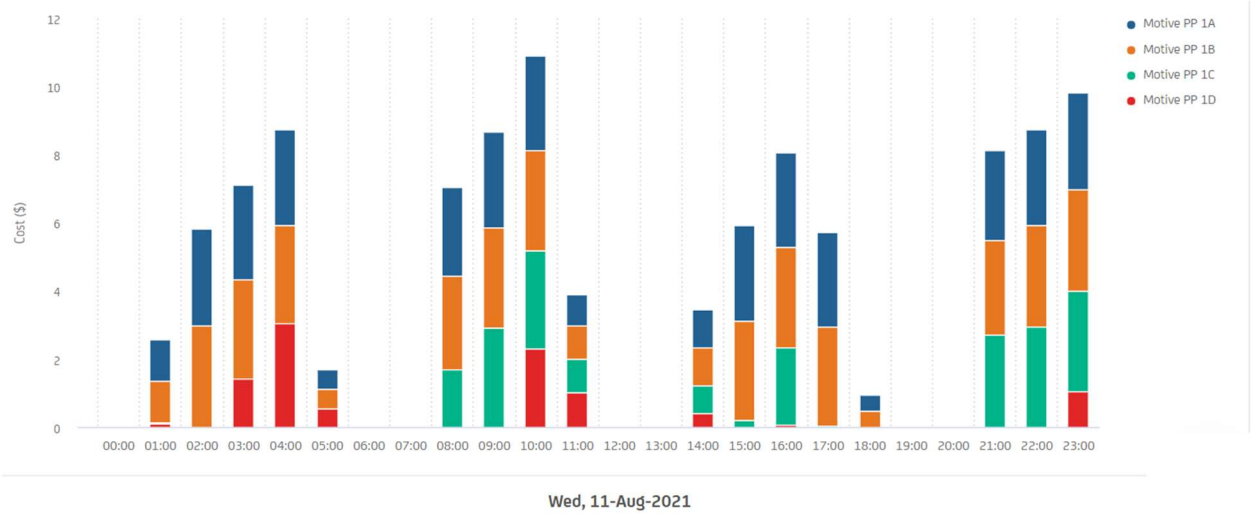
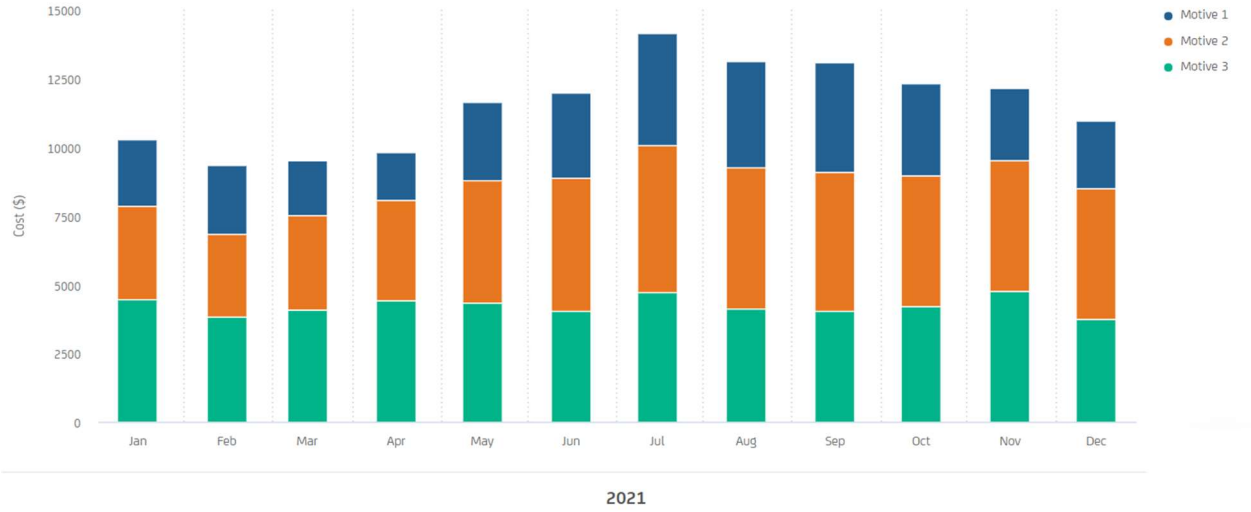


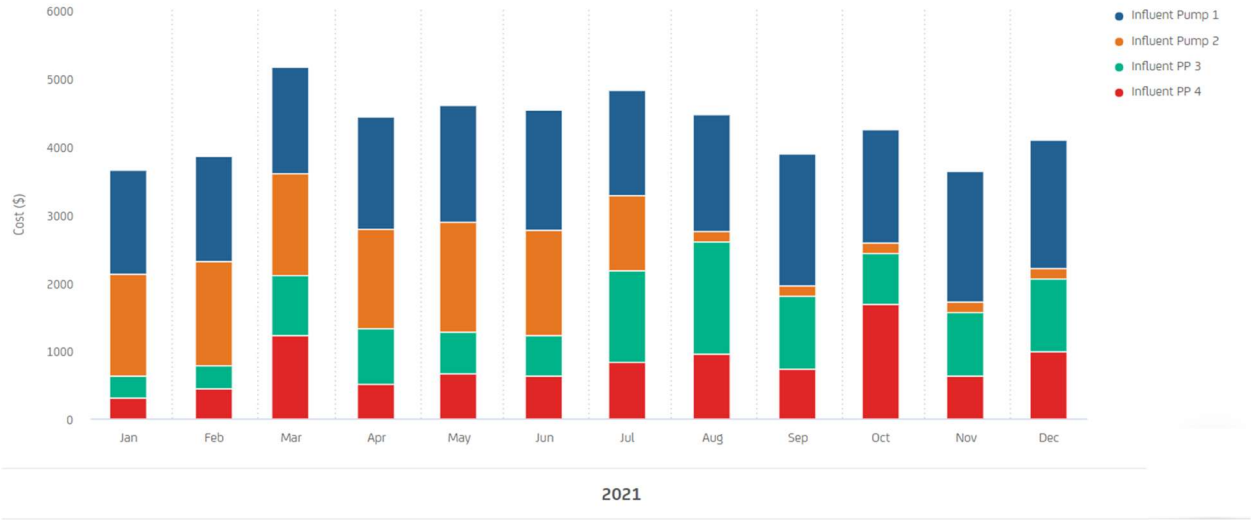
Figure 10: Motive pump monthly cost (by line) from January 2021 through November 2021. Note the increase in energy use during summer months, with line Motive 1 having the most variable use between warm and cold weather



Influent Pumps

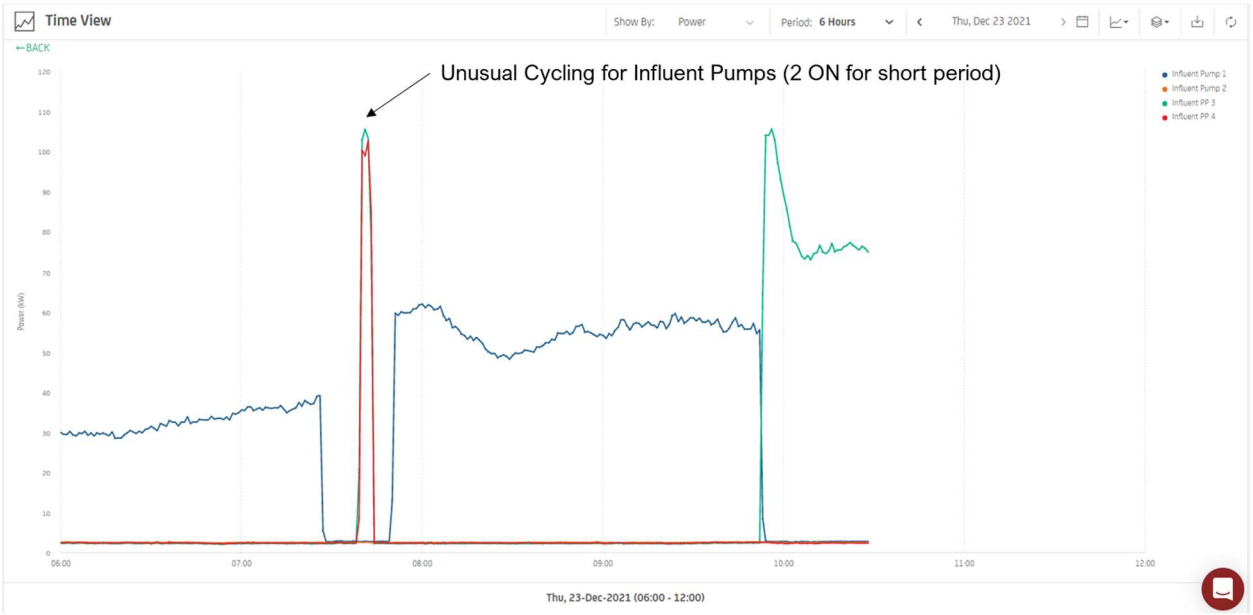
Influent pump energy use is consistent through the year. These pumps are critical to bringing waste water into the plant, and ensuring proper maintenance is likely more important than any potential energy saving recommendations, though annual energy costs for these pumps exceed $50,000 per year.

Figure 11: Influent Pump cost by month for 2021. Note the reduction in costs for Influent Pump 2 (orange)



Pump operations have some irregular loading patterns which should be discussed with site operators to confirm whether maintenance issues can be identified through collected energy data. At times a single pump may operate, cycle off, and other pumps would then cycle on for a very short period (a few minutes) before cycling off again. Short cycling can shorten motor life

Figure 12: Observation on influent pump cycling. Note the short cycle period (4 minutes) to full power for 2 pumps before cycling off again, instead of running at lower levels for longer



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