U.S. ARMY

MDMS *UPDATE*

~ METER DATA MANAGEMENT SYSTEM ~

US Army Corps of Engineers®

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FROM THE PROGRAM MANAGER

Welcome to our June - July 2022 issue of the *Meter Data Management System Update (MDMS),* designed to keep you informed on the growth and latest developments of the Meter Data Management System and the Army Metering Program.

The MDMS Outreach Team has worked with many installations and sites on benchmarking their buildings, setting baselines, and applying thresholds for notifications for when the building is overridden and goes above that threshold.

With this in mind, we felt it timely to detail the importance of benchmarking, take you through the building blocks, identify the benefits, call out the four main components of usage, and highlight some examples. Then we highlight the breakdown of potential savings and discuss the value of doing a Monitoring and Commissioning Process (MCx).

If you would like the MDMS Outreach Team to work with you on benchmarking buildings at your site, please reach out to the Army Meter Service Desk.

As always, our mission is to improve the MDMS experience for end users. Your input is valuable, and we welcome your feedback via the Army Meter Service Desk (AMSD) at: cehnc-army-meter-help@usace.army.mil

From the Program Manager ***1***

The Importance of Benchmarking ***1-8***

THE IMPORTANCE OF BENCHMARKING

The MDMS Outreach Team offers an entire series on benchmarking and these courses get cycled through the training rotation every other month. Because benchmarking is so critical to everything we do from an energy management perspective, we go through all the different aspects of benchmarking in our training courses. Let's look at the building blocks for understanding all the benchmarking classes:

Breakdown of Benchmarking Courses

- Level 1 Benchmarking
    - How to Set Up
    - Overall Relationship of All Components
    - Understanding the Base Load
- Level 2 Benchmarking
    - Base Load and Plug Load
    - Metrics for Base and Plug
- Level 3 Benchmarking
    - Lights
    - Fans and Pumps
- Level 4 Benchmarking
    - Air Conditioner (AC) Baseline
    - Air Conditioner Efficiency Metrics

What is Benchmarking?

According to the U.S. Department of Energy's "Introduction to Benchmarking: Starting a Benchmarking Plan," benchmarking is the process of accounting for and comparing:

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THE IMPORTANCE OF BENCHMARKING (CONT. FROM PG. 1)

- a building's current energy performance with its energy baseline,
- a building's energy performance with the energy performance of similar types of buildings.

Benchmarking can be used to compare performance over time, within and between peer groups, or to document top performers.

The Benefits of Benchmarking

The benefits of benchmarking are numerous, such providing a proactive approach to managing energy use and maintaining continuous improvement as part of a strategic energy management plan. Here are some additional benefits of benchmarking:

- Identify billing errors
- Verify pre- and post-project energy use, GHG emissions, and energy costs
- Communicating results in meaningful terms
- Assess effectiveness of current operations, policies, and practices
- Assist in planning: set goals, targets, and timelines
- Participation in energy challenges or benchmarking programs

So, in our courses, we teach that benchmarking allows you to evaluate buildings – both internally and externally – against a standard.

- When evaluating internally, we do the following:
    - Baseline the building
    - Evaluate/make changes against that baseline
    - Revise the baseline

- When evaluating externally, we check the following:
    - Against other buildings on the installation
    - Against other buildings in the climate zone
    - Against other buildings in the Army
    - Against other buildings in the same category code

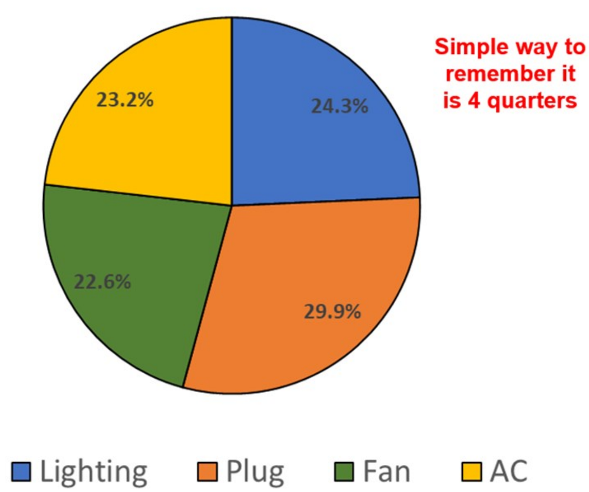
One of the main goals of external benchmarking and utilizing the energy use intensity is to prioritize energy conservation efforts by identifying those buildings that are under performing and over the median. Once those are identified, the focus turns to internal where we baseline, evaluate against that baseline, and then revise the baseline for that building.

4 Major Components of Usage (EIA)

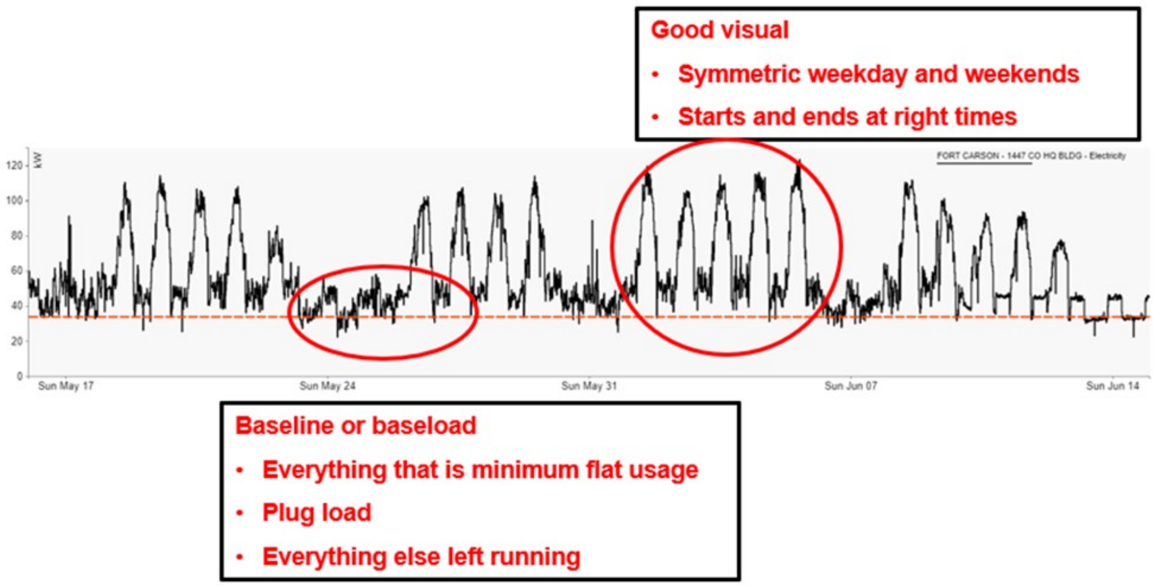
We talk about four major components of usage as identified in the pie chart below: lighting, plug, fans/pumps, and air conditioning. Their usage percentage works out to be roughly in quarters. This is the way it should be when systems are adjusted properly.

So, what does this look like on our interval graph?

(Continued on pg. 3)



THE IMPORTANCE OF BENCHMARKING (CONT. FROM PG. 2)



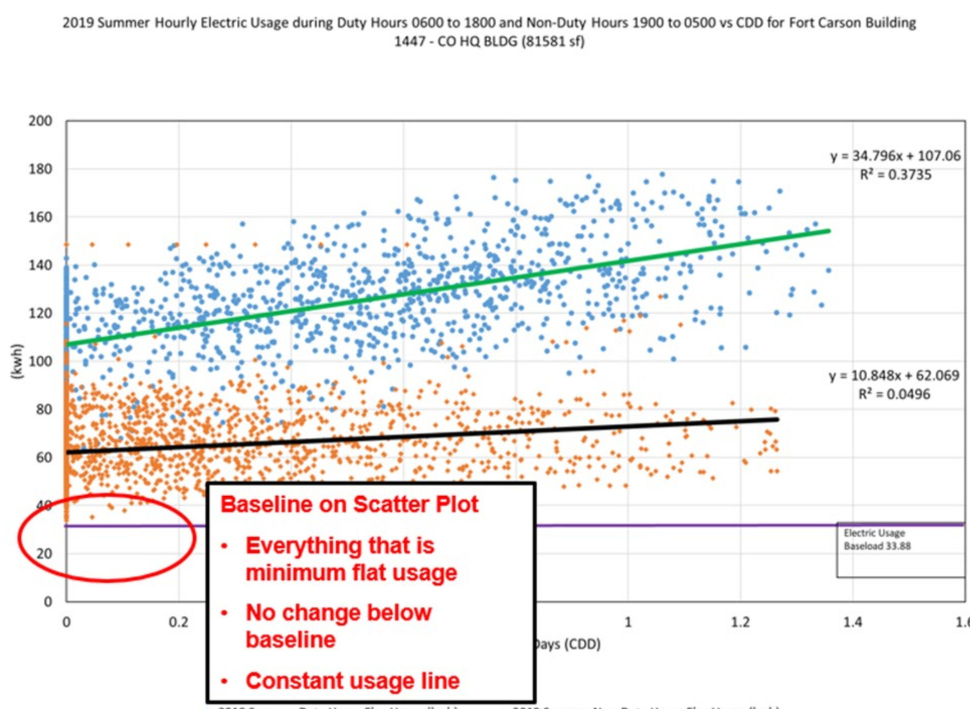
You should be able to clearly see the five days of the week and usage going down on weekends. We are looking for symmetry.

There are approximately 500 barracks in the Army, and they should also have the same symmetry just starting in the afternoon.

In our example to the left, you can see the baseline drawn as a red-dashed line across the graph. Note in the bottom left red circle, a weekend where there was some activity indicating that something was left on in this building and the AC is coming on to match to the loading requirements by outdoor air temperature and/or solar. You can also see activity at nights, which is a response to outdoor air temperature.

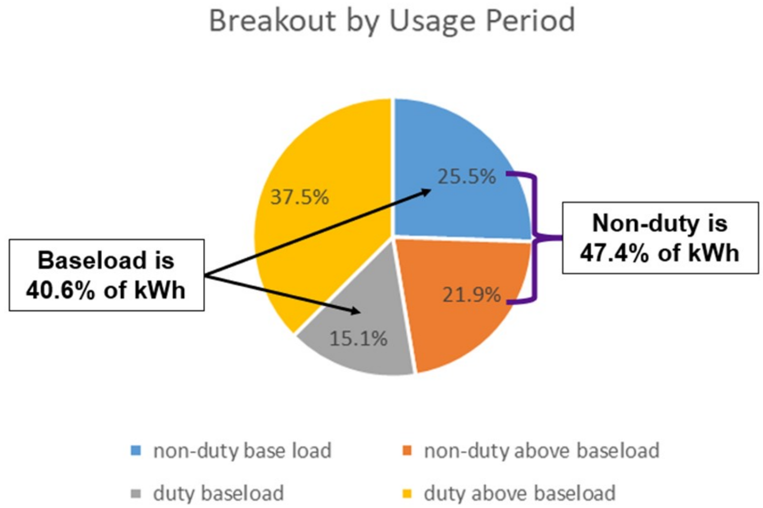
The baseline is generated by the MDMS in the Interval kW module, which can be found on the Energy Management page under the Benchmarking sub-menu. You want the bottom edge of your curves to “kiss” the baseline. Anything below the baseline indicates systems that are left on that run constantly. In our example, the baseline is about 35 kW. That is a constant load on your system(s). That’s why benchmarking is so important. We naturally want to control that excess energy.

Now, let’s look at how that appears on a scatter plot. The scatter plot below takes the hourly kWh used and plots it against the cooling degree days (CDD). Duty hours are shown with blue dots at the top and you can see the slope of the duty hours curve (line shown in green) following the CDD. The orange dots show non-duty hours, such as nights and weekends, where systems are running that are above the base load (line shown in purple). The base load is that flat, constant load. Anything above the base load are systems that are alternating going on and going off like the AC cycling on and off to react to outdoor air temperature. All those orange dots above the base load represent energy that’s being used when no one is in the building. *(Continued on pg. 4)*



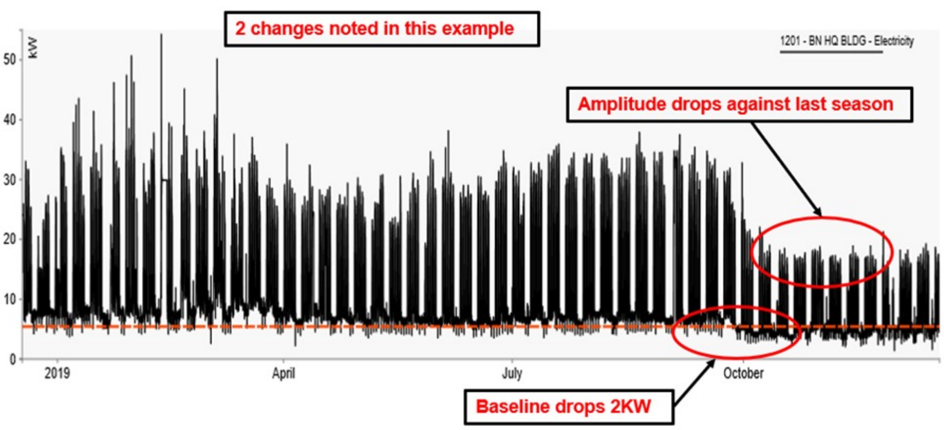
THE IMPORTANCE OF BENCHMARKING (CONT. FROM PG. 3)

The pie chart to the right shows the breakdown of this same building (Fort Carson building 1447 in climate zone 5B) by duty and non-duty hours. As you can see, the non-duty usage is a combined 47.4% of the total kWh. This is quite excessive. It should be a maximum of 20%, which means we have 27% usage that has potential to be reduced. The other important detail of this graph is the combined base load shows 40.6% of the kWh. This represents everything below our purple line in the previous scatter plot, which indicates we have some savings there. This represents plug load and flat load from fans/pumps that can be reduced.



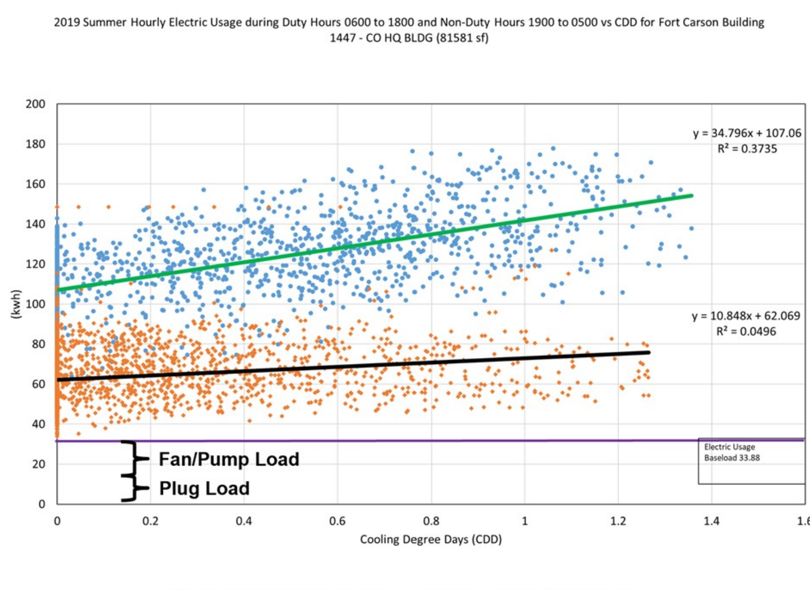
What do we Benchmark?

When using the MDMS Interval kW Benchmarking tool, we focus primarily on kW to find and identify the size of the equipment. We calculate that kW off of the 15-minute intervals, which is the average peak. Again, the base load is auto generated for you. You can select the Calculate option to get the watts per square feet. You can also set a threshold for notification after you have fixed your base load. Set the threshold to 10% above the base load and then you will get an email notification when the building is overridden and goes above that threshold.



In our example on the left, you can see two changes implemented by the DPW. The first is the amplitude of the curve dropped, as compared to the last year, and the base load drops approximately 2 kW. The amplitude change was most likely a change in equipment to make things more efficient, while the base load change had to be equipment like a fan/pump brought under control so it's no longer running constantly.

Remember the base load is the plug load plus everything else that's left on. Why is this important? Because it shows you when things are left on. You need to investigate to see why these systems were left on and if you have enterprise or local controls on those systems. Remember that things left on have major cost implications. Can we manage these things? Yes, they are easily managed if we have controls systems in place, and of course, harder if controls need to be added.



Now, let's go back to our scatter plot example. Based on our analysis of many Army buildings, the plug load is going to be somewhere between 15-30%. The rest of the load below the base load is going to be your fans and pumps. So, that means that usually half of this load is things that have been left on constantly and need to be addressed. *(Continued on pg. 5)*

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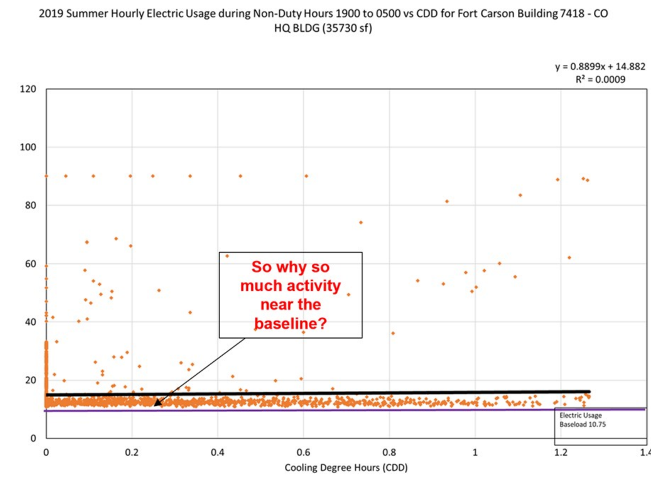
Stay tuned for an upcoming enhancement to MDMS that will automatically generate these scatter plots for you.

In our next example, we show you the scatter plot with only the non-duty hours for Fort Carson building 7418 during the summer. There is a lot of activity between the base load and the intercept (slope of the line). However, there is no slope, which means the usage is not correlated to outside air temperature. So, something is running with a lot of activity near the base load. In this case it was a small 3-ton system where the control schedule was overridden. It was so small compared to the 90 plus tons that it is only minor noise on the graph.



What is Plug Load?

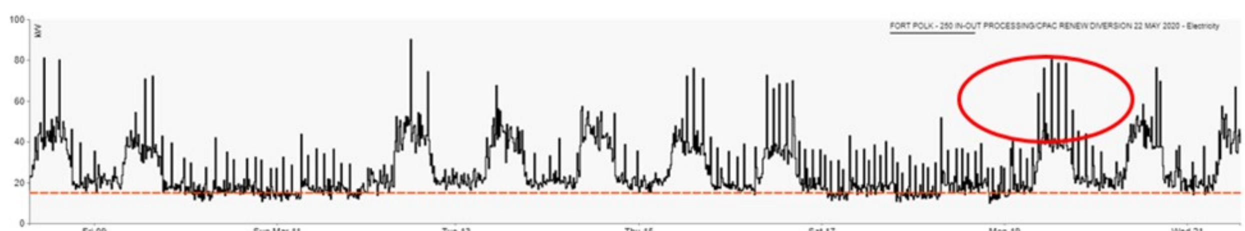
Plug load by definition is all the loading plugged into your receptacles. It is broken down into three areas: computers, office equipment, and all other equipment/devices, such as desk equipment, desk lights, coffee pots/warmers, etc. The load on the plug, for these three primary areas, breaks down into the following percentages:

- Computers: 66%
- Office equipment: 17%
- Desk lights, desk equipment, coffee makers/warmers, etc.: 17%

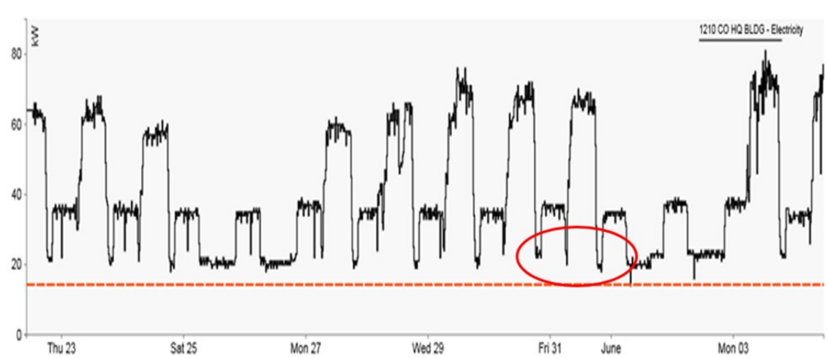
Issues Identified through Benchmarking

Now let's look at some specific examples of issues that can be identified through benchmarking.

AC Short Cycling. In our interval graph below, we can see every hour or two we have a peak on this building. Those jumps are running about 20 kW. It turned out to be two AC units set to return water temperature, every time they hit 55 degrees, they both turned on to control the water temperature and then turned back off because the load was satisfied very quickly. This is called short-cycling because of the overkill of both systems coming on at the same time, quickly cooling the water within that 15-min interval, then cycling off. This short-cycling is not good for your equipment, as it causes equipment failure faster and you are doubling your peak at this point.



Double Peak. This example took us some time to figure out. In our interval chart below, we can see the system coming on about 1800 and going off around 0600 the next morning. But you can see there is a gap between when the people went home in the evenings at 1700 and then coming on at 1800. We were able to determine this was due to perimeter lights. There is approximately a 14kW load from these lights.



This next chart is another look at the same building – using the MDMS Daily Comparison graph. This graph shows the load profiles for each day of the week. You can see perimeter lighting is already on midnight to 0600, then people coming into work during the weekdays between 0600 and 0700. Then, highlighted in *(Continued on pg. 6)*

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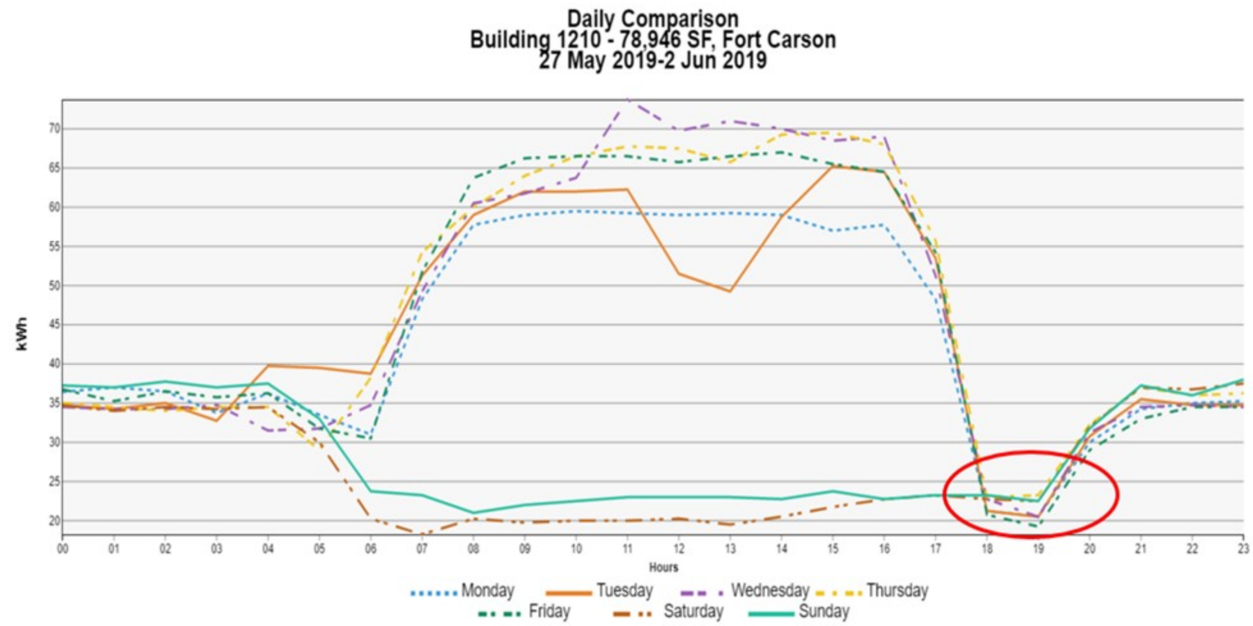
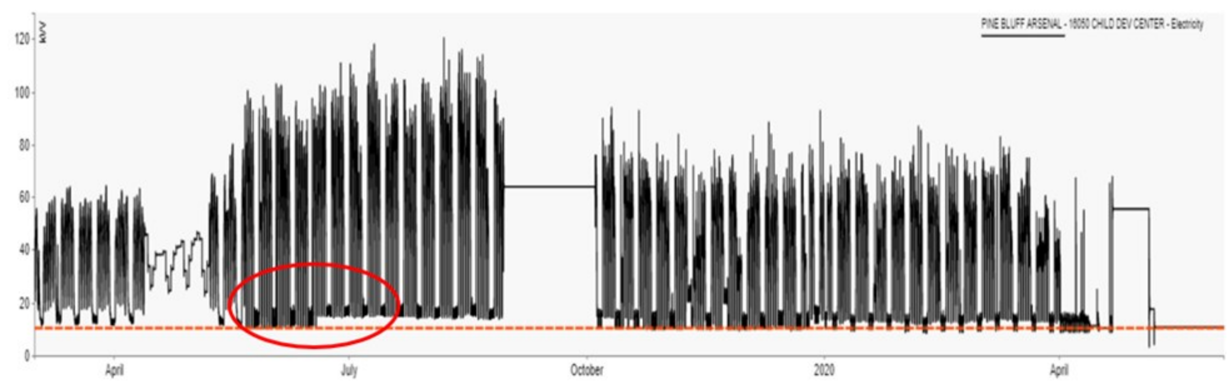
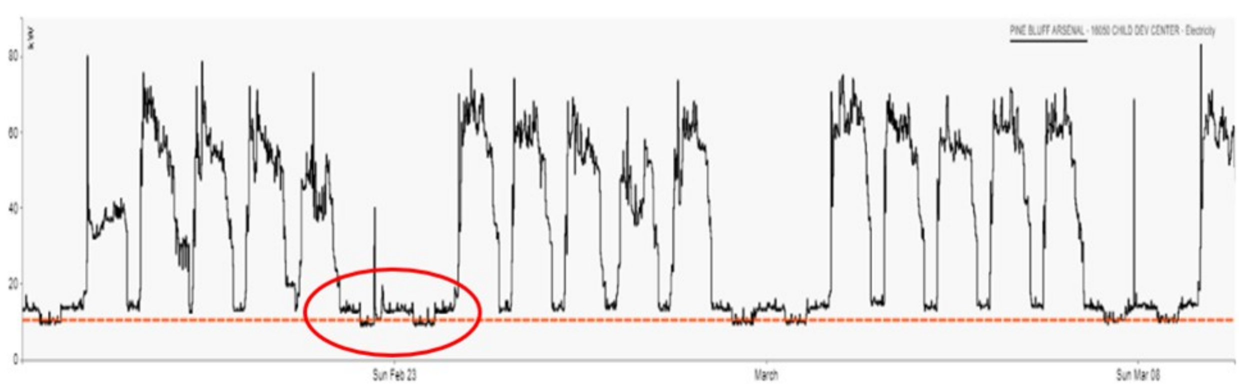
the red circle is when people leave the building at 1800 and the lights coming on at 1900.



Anomaly in Benchmark. In the next interval graph example, you can see things coming on at 1700 and going off at 0700 the next day. This is a childcare center and the culprit turned out to be a supply air fan that wasn't on a controller. It was on a manual timer that happened to be off by 9 hours opposite of what it should be. This could be due to someone setting it incorrectly to start with or repeated power outages have caused the timer to get out of the correct time frame.

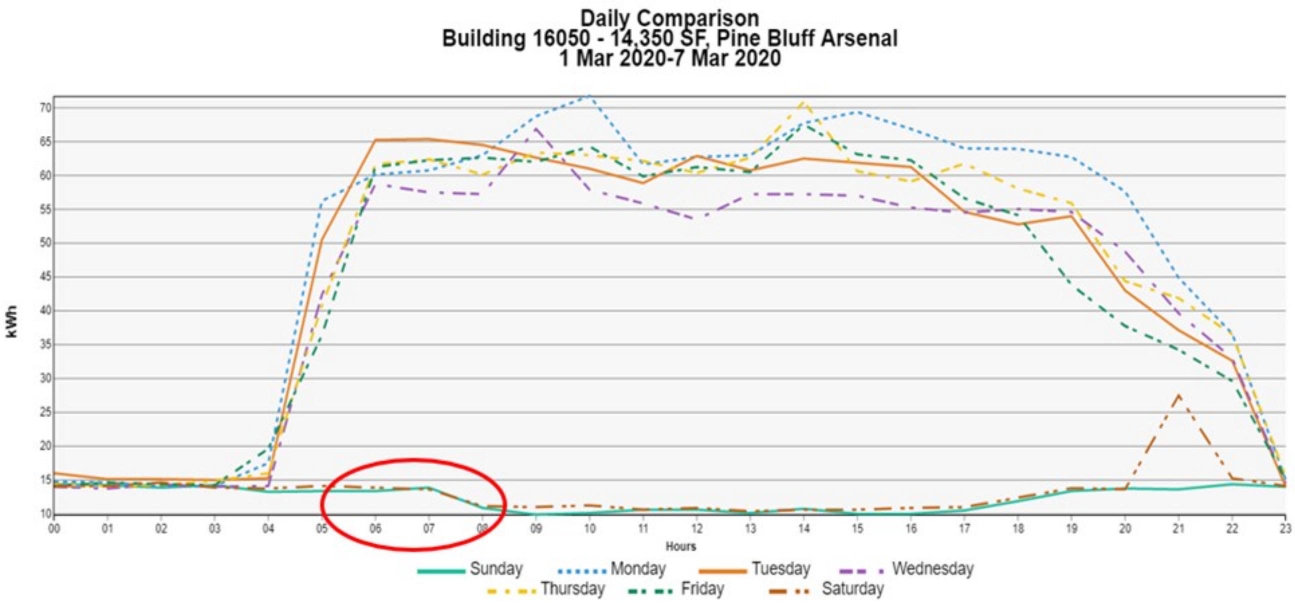


You can see this clearer when we zoom in. Look at the following view of a weekend, highlighted in our graph below with the red circle. You can see it dropping down on the weekends, off during the day and then coming on at night.
(Continued on pg. 7)



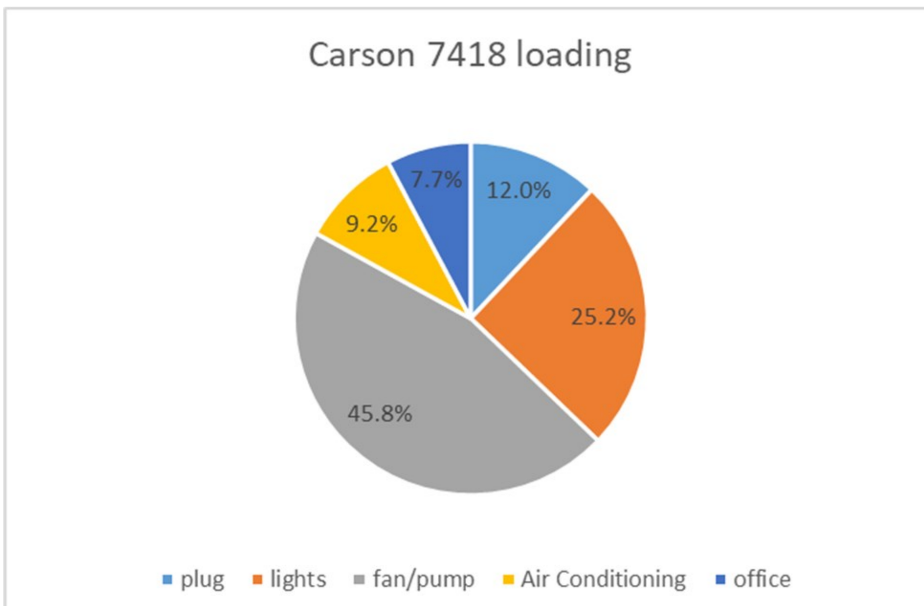
THE IMPORTANCE OF BENCHMARKING (CONT. FROM PG. 6)

Now looking at that building in the Daily Comparison, you can see it staying on until 700, going off and then coming on again at 1700.



Breakdown of Annual Loading

We showed the pie chart earlier that showed – in a perfect world – the usage for the four systems in quarters. But when we take the data out of the scatter plot diagrams, we can generate the pie chart below. The actual loading in the real world is more like the breakdown in our pie chart to the right. The breakdown here indicates that fans/pumps are left on most of the time. We have found that 90% of the buildings in the Army have systems left on 24/7. So, we can see that 45% of our energy is going to fans and pumps, with the rest distributed amongst the remaining systems.



Breakdown of Potential Savings

As we showed earlier, 47.4% of energy used is during non-duty hours. If we take out the plug load for winter and summer for the non-duty hours, you can see in the table below that the total plug load is 38,138.56, which is 5.2% of the total energy consumed. That leaves us with 42.2% of the energy consumed to investigate. Now, what else do we need to take out of that? We should be setting the space temperature back to 55 degrees at night in winter. But it's not going to come on until we reach that 10-degree differential, or the temperature must be below 45 degrees on the outside. So, we let the system calculate the usage below 45 degrees, which is 90,263.04 or 12.4%. After subtracting all that out, we arrive at a 29.8% potential savings, which is similar to the values projected earlier in this article. *(Continued on pg. 8)*

THE IMPORTANCE OF BENCHMARKING (CONT. FROM PG. 7)

		% Of Total Annual kWh Consumed
Total Annual kWh (2019)	729,796.03	
Non-Duty kWh	345,825.03	47.4%
Winter Non-Duty Hour Plug Load	22,222.63	
Summer Non-Duty Hour Plug Load	15,915.93	
Total Plug for Year	38,138.56	5.2%
Potential Savings (Non-Duty minus Plug Load)	307,686.47	42.2%
Energy Used to Keep Space Above 45°F	90,263.04	12.4%
Final Potential Savings	217,423.43	29.8%

What is the Value of Doing a Monitoring Commissioning Process (MCx)?

It is the continuous monitoring and ongoing commissioning – active energy management as in real-time energy monitoring – process to reduce energy use and increase cost savings in buildings at every site/installation. We call this Monitoring Commissioning (MCx) because you can do it constantly from your desk. So, utilizing the benchmarking tool to investigate, identify issues and system overrides, then fixing those issues and getting system controls back on schedule has significant savings potential. In the chart below, you can see that we have almost 6,000 metered buildings from IMCOM and predict doubling that in the future. We have determined that approximately 612 buildings are running 24/7 with 90% of those being overridden. So, the total cost impact for utilities of those buildings is approximately $232M. If we take our 25% savings potential on average (from our previous table on the breakdown of potential savings), that represents a $58M savings. If we are only successful in half of those buildings, we are still at a savings potential of $29M, which is significant and that will double as we continue adding meters.

	Today	Future
Total Buildings Metered	5,973	12,000
612 are 24/7	612	1,200
90% overridden	4,825	9,720
Total Dollars impacted for metered buildings	$232M	$464M
25% savings on average	$58M	$116
Weighted Savings potential	$29M	$58M

We hope this article has shown the importance of benchmarking and the significant potential savings that can be realized from managing the overrides. To learn more, join the MDMS Outreach Team on the benchmarking series of webinars, as well as both the Monitoring Commissioning Process and Understanding and Troubleshooting System Overrides webinars to gain even further insight into the building blocks and importance of a comprehensive and ongoing energy management program. If you would like to schedule a one-on-one session to benchmark your buildings with the MDMS Outreach Team, please submit a request with a help desk ticket with the Army Meter Service Desk (AMSD) via the Feedback/Help Request option under the Support menu in MDMS or you may e-mail them at: cehnc-army-meter-help@usace.army.mil.