Digi-RTU Saved 825,000 kWh/yr
Large Warehouse with Undersized RTUs

Executive Summary

The facility located in Orlando, FL has sixty-seven (67) rooftop units (RTU) with a total cooling capacity of 1,331 tons. Bes-tech proposed to install Digi- RTU optimizers for the compressor and indoor fans with the objective of improving the indoor temperature control and reducing building energy consumption.

Digi-RTU optimizers were installed to these units between April 2023 and October 2023. The units were cutover by November 10th, 2023. Units operating in Digi mode account for 388 tons of cooling capacity which is about 29% of the total installed capacity. This report provides energy savings for these RTUs. Data from Nov 10th to December 5th is used for this analysis.

The measured annual energy savings is **825,906 kWh**. The proposed annual energy savings for these units (388 tons) is **825,218 kWh**. The energy savings accounts for an increase in internal heat gain of 8.1%. The annual cost savings at a utility rate of $0.0966/kWh can be **$79,783**.
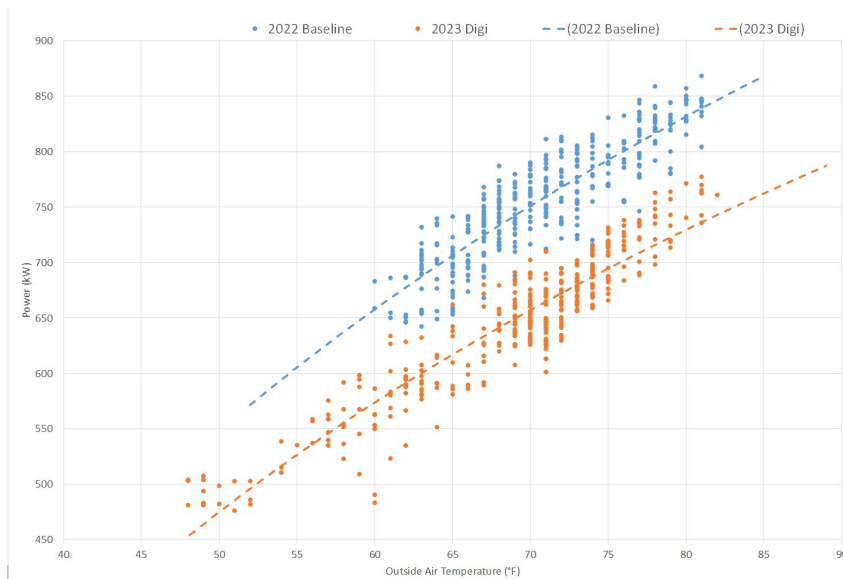

Figure 1 HVAC power vs OAT in baseline and Digi operation modes

Details of energy analysis and data selection are provided in the report. To compare the baseline and Digi operations at similar ambient temperatures and internal loads, Figure 1 excludes data from Nov 17th to Nov 21st and Nov 25th to Nov 28th.

RTU Information

The facility located in Florida has a total of sixty-seven (67) rooftop units (RTU) with capacities varying from 4 tons to 25 tons serving office and warehouse. Digi-RTU has been installed on these rooftop units from April 2023 to Nov 2023.

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Digi-RTU Installation Information

The first batch of Digi-RTUs were installed between April 2023 and May 2023 to forty-eight (48) packaged rooftop units serving the office and warehouse areas with unit sizes ranging from 7.5-ton to 25-ton. The second batch of Digi-RTUs were installed between October 2023 and November 2023 to twenty-one (21) packaged rooftop units serving the office area.

Energy Savings Analysis

Customer provided hourly HVAC energy consumption data from January 1st, 2022 to February 22, 2024. The data were analyzed and reviewed carefully. Energy savings were calculated using BIN hour method and TMY3 weather data.

Baseline and Digi-operation data timeline are determined based on the following considerations.

1. About 29% of the RTUs were cutover to Digi operation in October 2023 and November 2023. The Digi operation data is therefore considered starting from <u>Nov 10th 2023 to December 5th 2023</u>. Since economizer function on the RTUs were not operated as in baseline operation, data from Dec 5th 2023 to February 22nd 2024 is not used for this analysis.
2. Following operation data are not considered for the savings calculation.
   a. Operation from Nov 17th to Nov 21st is not considered due to unusually low ambient weather conditions in baseline operation.
   b. Operation from Nov 25th to Nov 28th is not considered to eliminate impact of differences in internal heat gain and ambient weather.
   c. Data above 82°F ambient weather is not considered due to lack of sufficient data points.

The following observations are made from the measured data.

1. <u>Increase in internal heat gain.</u>
   a. The average conveyer power has increased by 8.1% for Digi operation period in comparison to baseline period. The baseline energy consumption is therefore adjusted for this increase.
2. <u>Zone and Outside Air temperature.</u>
   a. The average warehouse zone temperature is found to be 77.6 °F for the baseline period. During Digi operation, the average warehouse zone temperature is 78 °F. The effect of the zone temperature is negligible.
   b. The average outside air temperature is nearly identical at 69.6 °F in baseline period and 69.7 °F during Digi operation.

The energy savings, conveyer power, average zone temperature and outside air temperature during the period of measurement are presented in the table below.

Parameter	Units	Baseline	Digi	Difference	Percentage
HVAC Energy	kWh	6,611,582	5,785,676	825,906	12.6
Average Conveyer Power	kW	688	743	-56	8.1
Average Zone Temperature	°F	77.6	78	0.4	-
Average OAT	°F	69.6	69.7	-0.1	-

As seen from Figure 2 average conveyer power has increased in Digi operation period in comparison to baseline period. The average incerase in conveyer power is about 8.1%.

Baseline data provided table above is adjusted for this increase in internal heat gain.
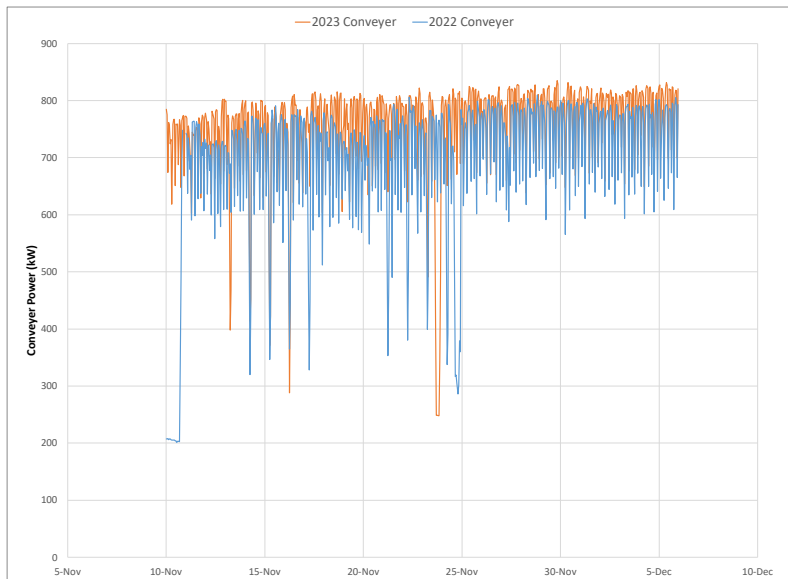

Figure 2 Comparison of conveyer power in baseline vs Digi operation periods

Average outside air and zone temperatures in Digi and baseline operation periods are found to be similar. Figure 3 and Figure 4 provide the plots for average outside air and zone temperatures. Since the average temperatures are almost similar their impact on energy savings is negligible.
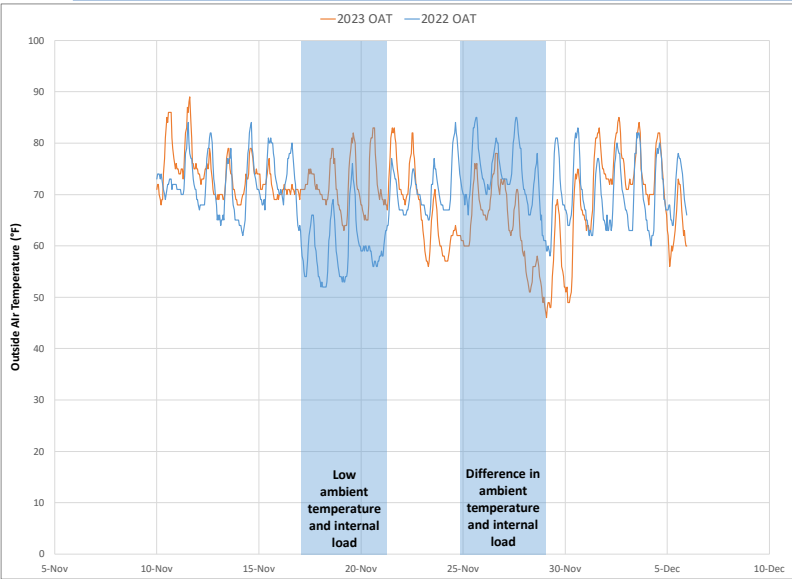
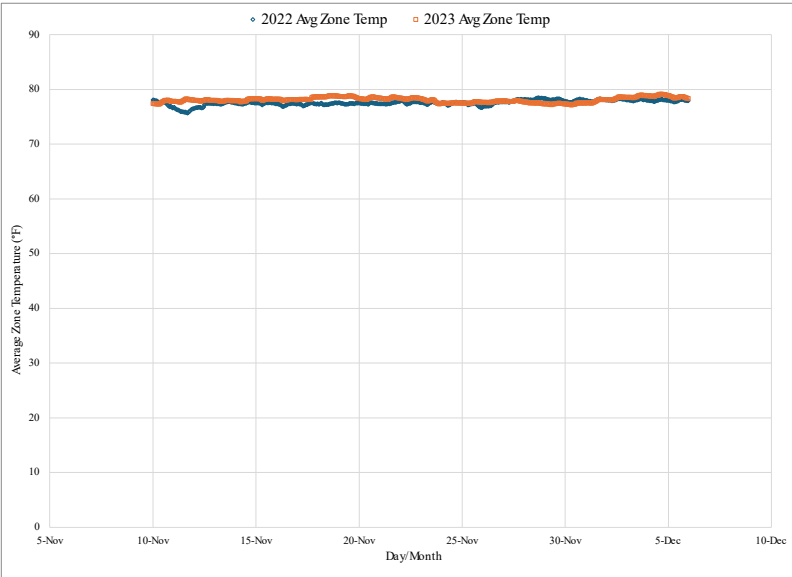**Figure 3 Average outside air temperatures in baseline and Digi operation periods**

Figure 4 Average zone temperature during baseline and Digi operation period

Appendix A: RTU-C-8 Energy Savings

Bes-Tech Digi-SBM was installed on RTU-C-8 for Measurements and Verification (M&V) of energy savings.

System Operation Comparisons

In baseline operation, the system runs one compressor at full load with the second compressor cycling to maintain capacity. Digi-RTU converts the fixed speed compressor to variable speed. In Digi-RTU operation, the system runs both the compressors at lower speed for longer duration.

Figure 5 shows the time series data of compressor speeds, supply air and return air temperatures during the M&V period. The base operation runs the one compressor (Comp1) and cycles the second compressor (Comp2). In Digi-RTU operation, the system runs both the compressors at minimum speed (40Hz) for a longer duration.

The supply air temperature control is improved, which should result in better dehumidification. In addition to this Digi-RTU reduces compressor cycling which increases compressor life.
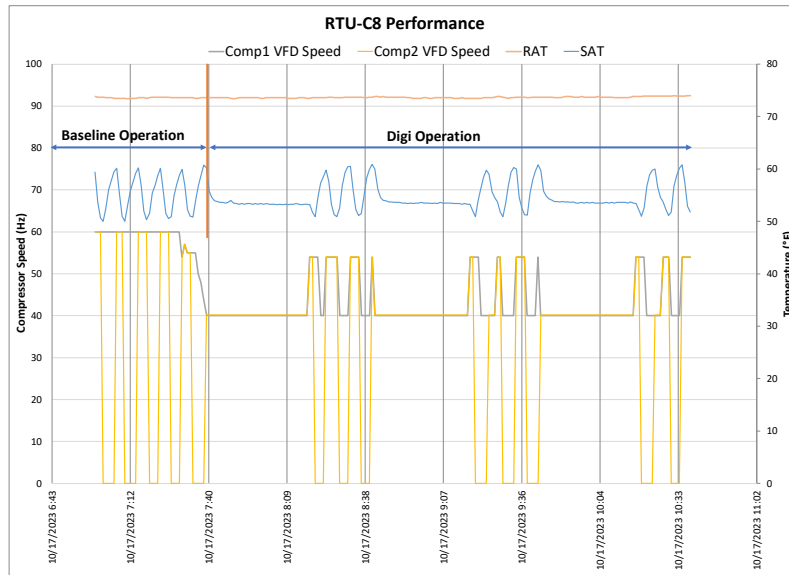

<p align="center">*Figure 5 Performance comparison in Baseline and Digi operation fro RTU-C8*</p>