

Digi-RTU Reduced 1,200,000 kWh/yr

Industrial Facility Application

Executive Summary

The 242,000 square foot building primarily consists of production areas with some office and ancillary spaces. A total of twenty-one (21) Roof Top Units (RTU) serve the building. The total cooling capacity for these units is 1,094.5 tons.

Digi-RTU optimizers were installed in seventeen (17) RTUs with a total cooling capacity of 884.5 tons. Installation started November 2021 and was completed in September 2022. System fine tuning was performed in February 2023 and February 2024. This report provides the energy savings for the RTUs that were included in the project scope and have submetering. The baseline period selected was calendar year 2019 to eliminate the impact of abnormal pandemic operation in 2020 and 2021. The post-fine-tuning period is from February 21st, 2024 to Nov 12th, 2024. Additional 2025 data will be included quarterly as it becomes available.

Submetered data, provided by the customer, is available for twelve (12) units with a total cooling capacity of 790 tons. Five (5) units with a total cooling capacity of 94.5 tons are not submetered and therefore not included in the savings results provided. Please note that the estimated energy savings shown in Table 1 below reflects the savings potential for the 790 tons of units with submetering.

Major observations from the measured data include:

- Measured annual energy savings are 1,227,394 kWh/year which is 108% of the estimated energy savings.
- HVAC energy savings are 33.1% of the baseline energy consumption.
- Measured summer peak demand reduction is 422 kW which is 156% of the projected demand reduction.
- Due to the RTUs electric heating, energy consumption is dominated by winter operation and dependent on internal heat gain.

Table 1: Annual Energy Savings

Baseline Period (Jan 2019 to Dec 2019)	Energy Savings (kWh)	Summer Demand Reduction (kW)
Estimated Savings	1,139,673	271.4
Achieved Savings	1,227,394	422

Percentage of Projected Savings	108%	156%
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Facility Information

The facility is located in Nebraska. The 242,000 square foot building consists of office space, maintenance shop, warehouse, lab, P&SA, and production areas. The office and shop areas are served by seven (7) packaged rooftop units (RTUs); the lab area by one (1) RTU; the production area by ten (10) RTUs; and the P&SA area by three (3) RTUs. All rooftop units operate 24/7. The Building Automation System (BAS) is a JCI Metasys.

Project Scope

The ECO 24/7 engineering team installed the Digi-RTU technology on seventeen (17) RTUs and performed ECO 24/7 commissioning for each respective RTU. The Digi-RTU enables variable air volume and variable refrigerant flow that modulates supply fan speed based on system load, optimizes compressor speed and/or number of compressors in operation to match system load, implements enhanced integrated economizer operation, and CO₂ based demand control ventilation (DCV) for office areas. The ECO 24/7 commissioning fine-tuned the Digi-RTUs and adjusted ventilation air or air changes per hour (ACH) for each industrial space based on actual operating conditions. Table 2 presents a summary of RTU information.

Table 2: List of Rooftop Units with Digi-RTU Installed and Submetered

Unit #	Serving area	Make	Tonnage	Submetered
HVAC-1	Office/warehouse	York	8.5	-
HVAC-3	Office/warehouse	York	8.5	-
HVAC-4	Office/warehouse	JCI (York)	30	-
HVAC-6	Office/Maintenance	JCI (York)	40	-
HVAC-7	P&SA	JCI (York)	15	15
HVAC-8	P&SA	York	15	15
HVAC-9	P&SA	York	20	20
HVAC-10	Production area (molding line)	York	40	40
HVAC-11	Production area (molding line)	York	40	40
HVAC-12	Production area (medical)	York	130	130
HVAC-13	Production area (molding line)	York	130	130
HVAC-14	Production area (injection molding)	York	50	50
HVAC-15	Production area (DD & RR)	York	105	105
HVAC-16	Production area (DD & RR)	York	105	105
HVAC-18	Production area (silicone injection molding)	JCI (York)	60	60
HVAC-19	Office	York	7.5	-
HVAC-21	Production area (injection molding)	JCI (York)	80	80
		Total	884.5	790

Note: Final project scope excluded Rooftop units AC-02, AC-05, AC-17, and HVAC-20.

The 3M submetered data includes 790 tons of RTUs that were part of the scope of this project. Please note that the project included measurement and verification (M&V) of one (1) RTU. OPPD temporary submetering was installed on HVAC-7 during project implementation. Results for HVAC-7 were provided under a separate M&V report (dated 01/24/2023).

Project Timeline

Digi-RTU installation work started on November 8th, 2021, and commissioning was completed on September 2nd, 2022. Due to the critical nature of facility operation, system optimization was performed incrementally. System finetuning for winter operation was performed on February 1st, 2023, by adjusting heating minimum speeds. Further fine tuning was performed on February 21st, 2024, by adjusting ACH for specific units. Figure 1 shows the project timeline.

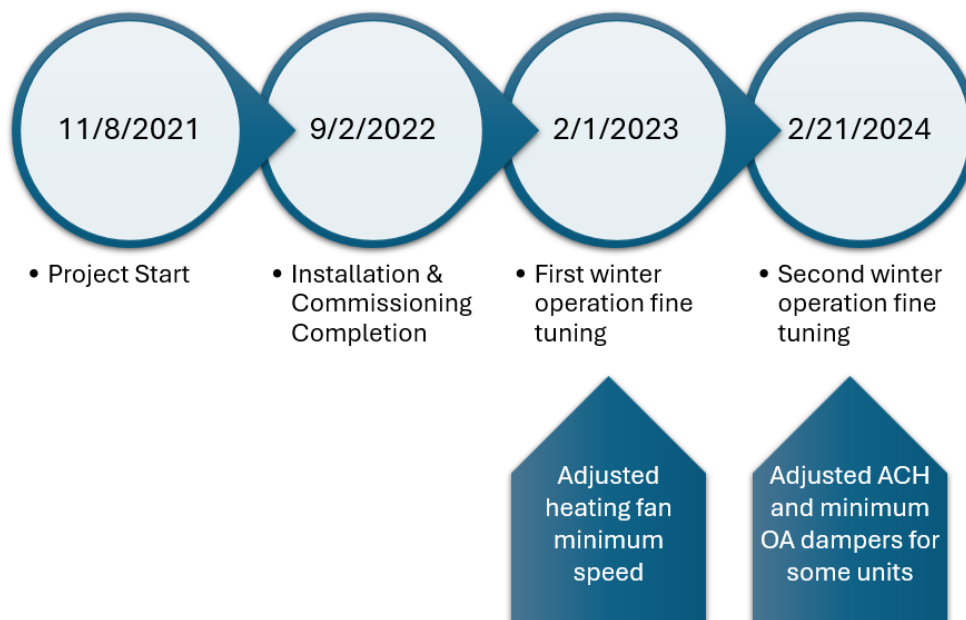


Figure 1: Project Timeline

Measured Results

The energy savings calculation was performed using TMY weather data and BIN hour analysis. Peak summer demand is based on the hourly submetered data provided. Project periods include:

- Baseline Operation: January 1st, 2019, to December 31st, 2019
- Digi Operation: February 21st, 2024, to Nov 12th, 2024

The estimated annual energy savings for 790 tons of RTU capacity was 1,139,673 kWh/year. The measured energy savings achieved is 33.1% or 1,227,394 kWh/year. The energy savings achieved is approximately 108% of the estimated annual energy savings. The measured peak demand reduction of 422 kW is about 156% of the projected 271.4 kW peak demand reduction. Table 3 provides total energy consumption and savings for the measured units.

Table 3: HVAC Energy Consumption and Savings

Baseline Energy consumption (kWh/yr)	Energy consumption in Digi operation (kWh/yr)	Energy Savings (kWh/yr)	Percentage Energy Savings	Peak Demand Reduction (kW)
3,709,516	2,482,122	1,227,394	33.1%	422

Figure 2 below shows a scatterplot of hourly HVAC power vs. outdoor air temperature. The measured electricity consumption in Digi operation (shown in blue) is significantly lower than baseline operation (shown in orange) in both winter and summer.

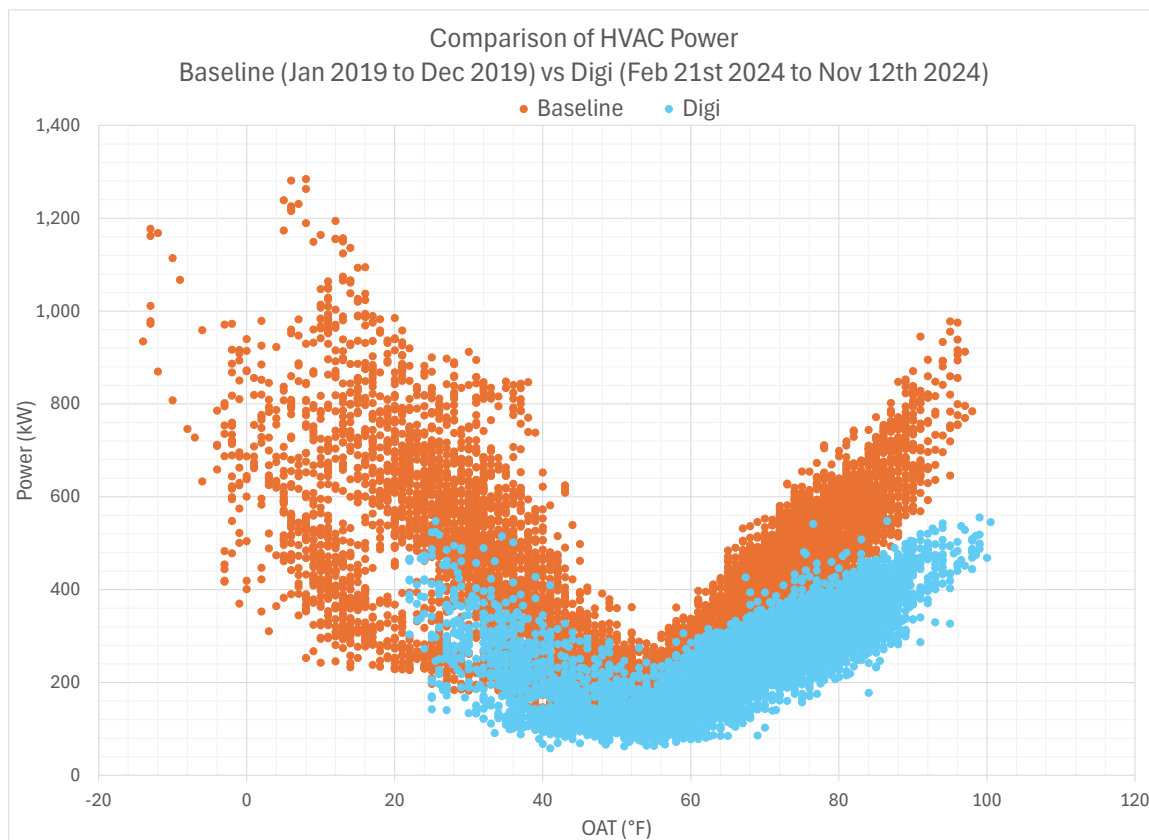


Figure 2: Total HVAC Power vs OAT in Digi and Baseline Operation