

Energy Report 2021-2022

JUNE 6, 2022

School District of the Menomonie Area
Authored by: Justin Schuenemann
Energy Manager



ACHIEVEMENTS

2021-2022

CONSERVATION SUCCESS

WE DECREASED OUR
ENERGY USE BY 17%

ACHIEVEMENTS

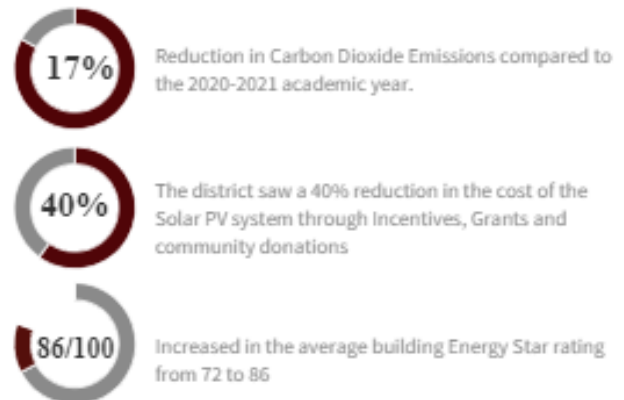
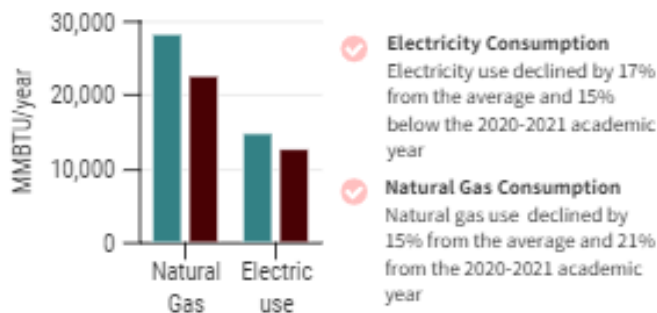


What Changed

Energy reductions came from both electricity and natural gas. Optimizing equipment schedules, preventative maintenance for efficiency and awareness aided in the conservation efforts.

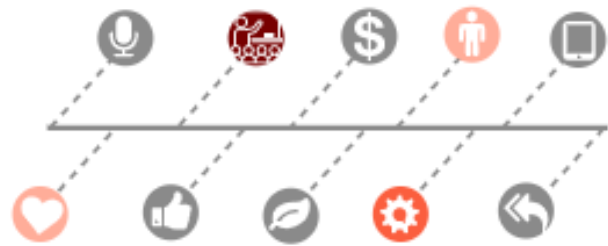
THE BEST OF THE BEST Energy Use Highlights

Energy Use Reductions



NEW GOALS

Goals for the next academic year are to increase student involvement in energy conservation, Decrease district energy use by another 5% through the solar installation, LED upgrades, and behavior



Energy conservation comes from changing habits, raising awareness, continued energy education and investment in efficiency increasing technologies. Reduced expenses and environmental impact are the benefits of conservation measures.

2021-2022 Academic Year at a Glance

SDMA District Energy Policy Excerpt

“In light of the increasing cost and decreasing supply of conventional energy sources, the School District of the Menomonie Area Board of Education recognizes the need for proper energy conservation and investments in sustainable energy initiatives.”

During the 2021-2022 academic year there were numerous significant accomplishments related to how the district uses energy. Below are several of the accomplishments but this is not an exhaustive list.

- 114.5 kW DC solar photovoltaic system added at Menomonie Middle School
- Significant reductions in both electric and natural gas use
- Increased energy awareness through educational programs and opportunities
- Lighting design completed for future use

These accomplishments were made possible through the concerted efforts of the students and staff of the SDMA in response to the directives set in place by the SDMA school board.

Contents

Annual Summary	1
Menomonie High School.....	3
Menomonie Middle School.....	4
Wakanda Elementary School	5
River Heights Elementary School	6
Oaklawn Elementary School	7
Knapp Elementary School	8
Downsville Elementary School	9
Administration Building	10
Proposed Energy Conservation Initiatives.....	11
Energy Market Data and Forecasts	13
References	14

Annual Summary

Between 2016 and 2020 the average district annual electric use was 4,487,000 kWh with an associated cost of approximately \$494,000. Electric use and costs for the 2021-2022 academic year are anticipated to be approximately 3,690,000 kWh and \$475,000. This represents an 18% reduction in use and a 4% reduction in expenses. This reduction can be seen in Figure 1 below. Total carbon emissions were reduced by 800 tons (17%) from last academic year.

Electric charges represent approximately 60-70% of the district's annual energy expenses. Electric costs can be subdivided into use and demand charges. Use is a product of demand and the quantity of time that that demand was recorded. Over the previous 12 months demand charges accounted for approximately 43% of total electric charges. Reducing demand and the associated charges is still a potential opportunity to incur some savings in energy expenses for the district.

Menomonie School District Electric Use & Cost 12-Month Rolling Average

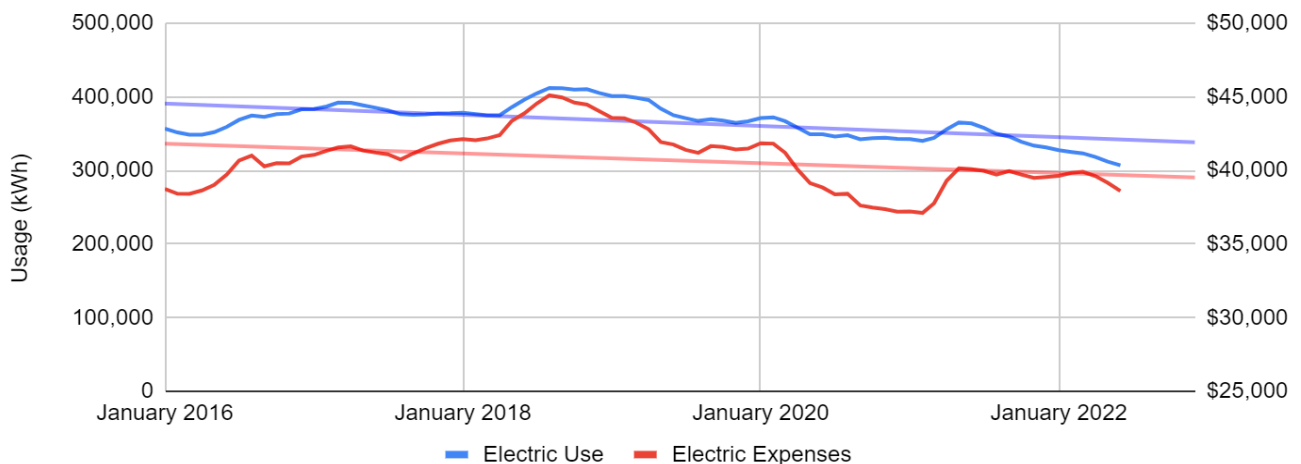


Figure 1: Menomonie School District electric use and cost presented as a 12-month rolling average of monthly data. Linear trendlines are included for each data set.

The school district natural gas usage between 2016 and 2020 averaged 266,000 therms with an associated cost of approximately \$152,000. Natural gas use and costs for the 2021-2022 academic year are anticipated to be approximately 223,000 therms and \$221,000. This represented a 16% reduction in use and a 47% increase in expenses. This increase in cost is due to utility expense recoupment that was in effect from April-December 2021 and market price increases for natural gas. Natural gas use and expense trends are depicted in Figure 2.

Due to the severe winter weather in Texas in February 2021 the utility provider for most of the district's buildings incurred significant extra costs due to natural gas supply shortages. The Public Service Commission of Wisconsin (PSCW) approved on March 31, 2021 for Xcel Energy to recoup the additional 44.8 million in costs through an additional natural gas use charge of \$0.50/therm from April 1, 2021 through December 31, 2021. This incurred the district an additional \$56,000 in expenses.

Natural gas use is primarily confined to domestic hot water supplies, kitchen equipment and building hydronic heating systems through the use of a boiler. Areas for conservation and savings include using scheduling, efficient equipment and appropriate temperature setpoints for the heating season.

Menomonie School District Natural Gas Use & Cost 12-Month Rolling Average

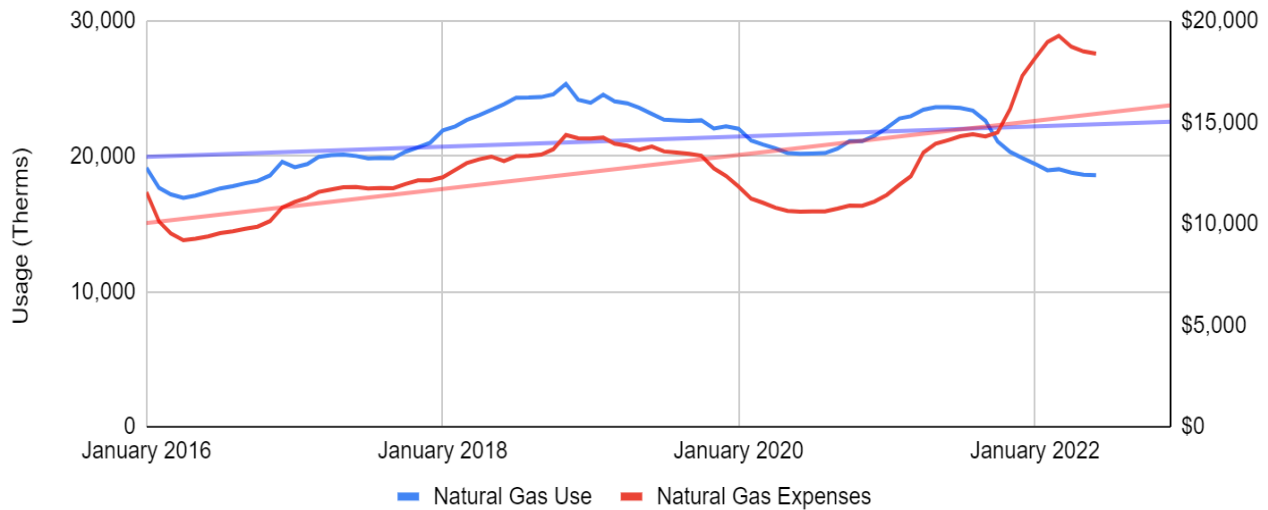


Figure 2: Menomonie School District natural gas use and cost presented as a 12-month rolling average of monthly data. Linear trendlines are included for each data set.

To evaluate the performance of the buildings comparatively the buildings were analyzed on a cost/square foot and use/square foot basis for the school year. Table 1 below summarizes the cost and use data for each building thus far this fiscal year. A 2018 benchmarking report found that the average Wisconsin school kBTU/ft² was 54.3 while average expenses were \$0.73/ ft². Expenses per unit of energy have increases substantially since 2018. This year is anticipated to end at 49.5 kBTU/ft² and \$0.98/ ft². Last year’s totals were 61.2 kBTU/ft² and \$0.92/ ft².

2021-2022 (10 Months of Data)	Cost/ft ²	kWh/ ft ²	Therms/ ft ²	Total Use (kBTU)/ ft ²
Menomonie High School	\$0.97	4.83	0.37	53.7
Menomonie Middle School	\$0.70	3.72	0.23	35.7
River Heights Elementary	\$0.93	4.02	0.37	50.9
Oaklawn Elementary	\$0.67	3.68	0.22	35.0
Wakanda Elementary	\$0.78	3.73	0.33	45.7
Downsville Elementary	\$0.79	5.76	0.03	22.2
Knapp Elementary	\$0.77	3.57	0.31	43.4
Administrative Services Center	\$1.15	11.39	0.01	40.2
District Total	\$0.85	4.43	0.3	45

Table 1: Menomonie School District energy use and expenses per square foot by building.

Menomonie High School

Menomonie High School is the largest consumer of energy in the district. The average annual use for the high school is approximately 2,180,000 kWh and 146,000 therms. Total annual energy expenses at the high school averaged approximately \$311,000 between 2016 and 2020. Trends for energy use data are depicted in Figures 3 and 4 below. Benchmarking was completed using Energy Star Portfolio Manager and Menomonie High School had an energy star score of 85 out of 100 up from a score of 71 a year ago. Electric use for the 2021-2022 year was 22% below average and natural gas use was 21% below average.

Menomonie High School Electric Use 12-Month Rolling Average

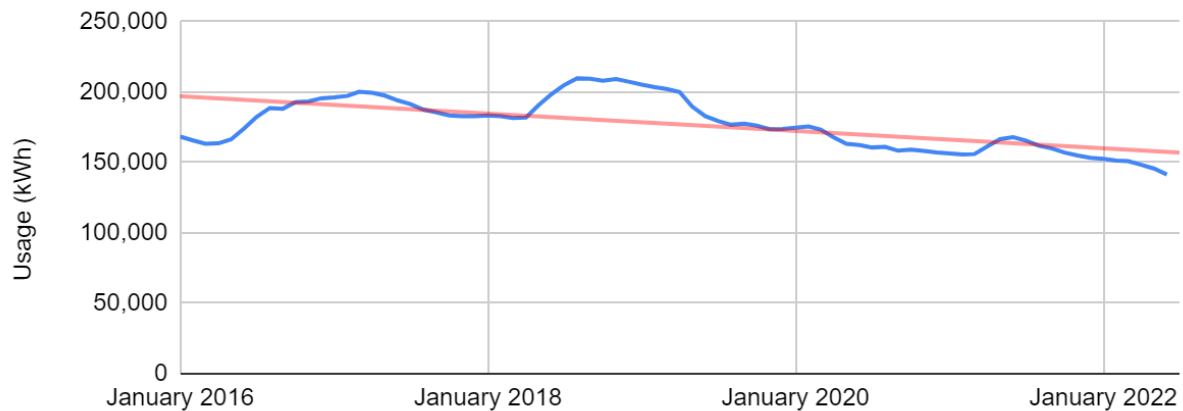


Figure 3: Menomonie High School electricity use presented as a 12-month rolling average of monthly data.

Menomonie High School Gas Use 12-Month Rolling Average

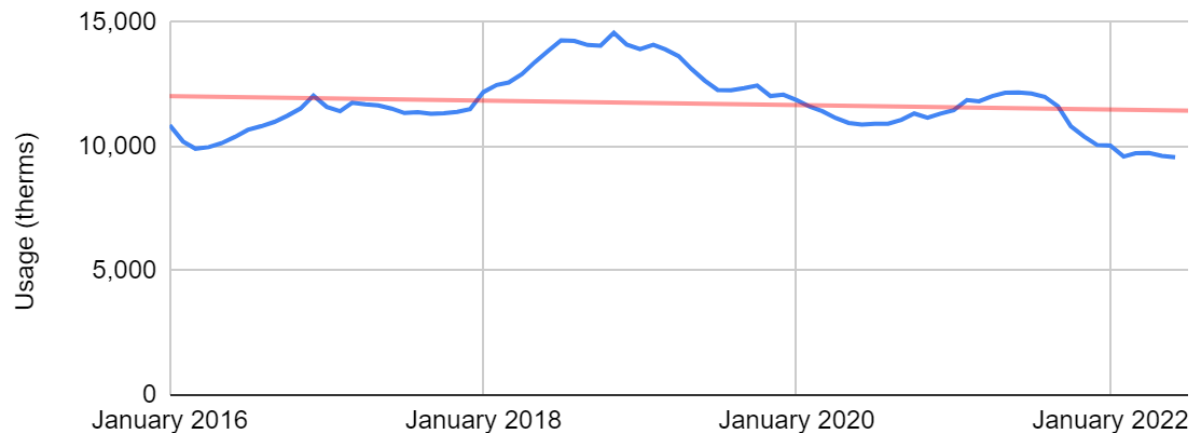


Figure 4: Menomonie High School natural gas use presented as a 12-month rolling average of monthly data.

Reasons for the high school's large energy footprint include its size, features such as a heated swimming pool, separate fieldhouse/gym, technology education equipment and large fluorescent lighting loads. The high school is also occupied during evenings, weekends and breaks more than other buildings in the district.

Menomonie Middle School

Menomonie Middle School is the second largest consumer of energy in the district. The average annual use for the middle school is approximately 784,000 kWh and 43,000 therms. Total annual energy expenses at the middle school averaged approximately \$117,000 between 2016 and 2020. Trends for energy use data are depicted in Figures 5 and 6 below. Benchmarking was completed using Energy Star Portfolio Manager and Menomonie Middle School had an energy star score of 94 out of 100 up from 89 a year ago. Electric use for the 2021-2022 year was 15% below average and natural gas use was 13% below average.

Middle School Electric Use 12-Month Rolling Average

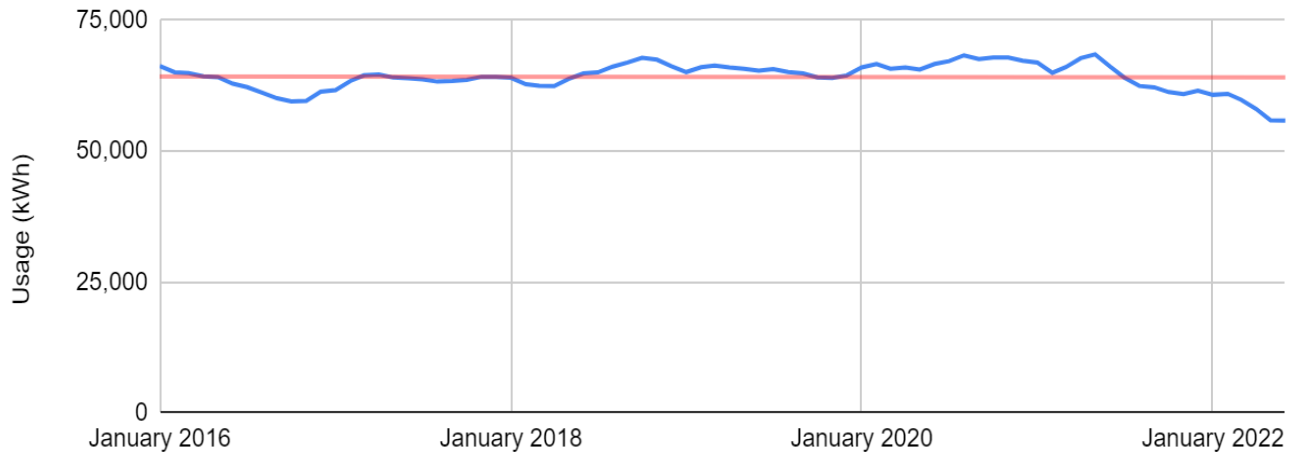


Figure 5: Menomonie Middle School electricity use presented as a 12-month rolling average of monthly data.

Middle School Gas Use 12-Month Rolling Average

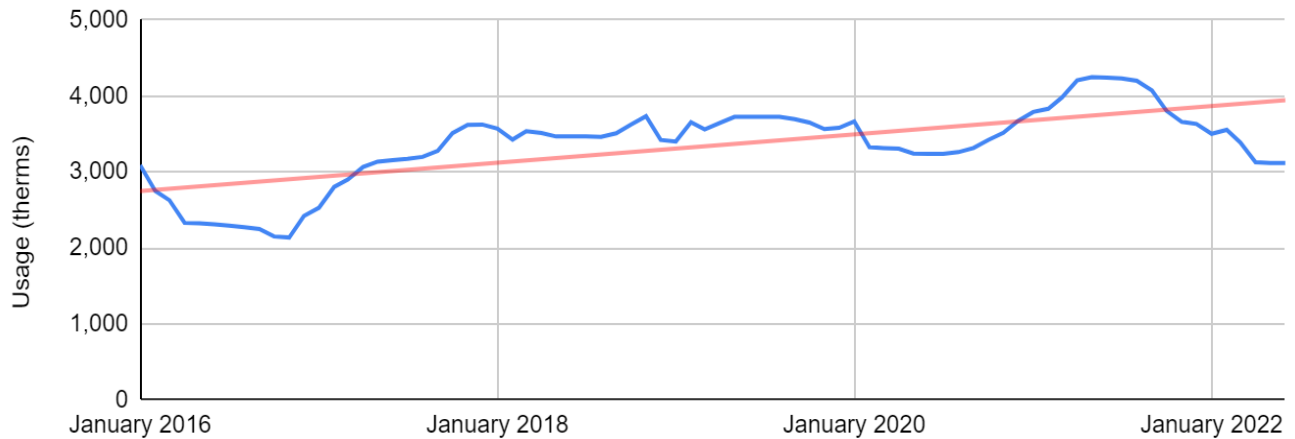


Figure 6: Menomonie Middle School natural gas use presented as a 12-month rolling average of monthly data.

Wakanda Elementary School

The average annual use for Wakanda Elementary is approximately 320,000 kWh and 27,000 therms. Total annual energy expenses at Wakanda Elementary averaged approximately \$51,000 between 2016 and 2020. Both use of electricity and natural gas have been increasing during this time. Trends for energy use data are depicted in Figures 7 and 8 below. Benchmarking was completed using Energy Star Portfolio Manager and Wakanda Elementary School had an energy star score of 85 out of 100 up from 73 a year ago. Electric use for the 2021-2022 year was 15% below average and natural gas use was 20% below average.

Wakanda Electric Use 12-Month Rolling Average

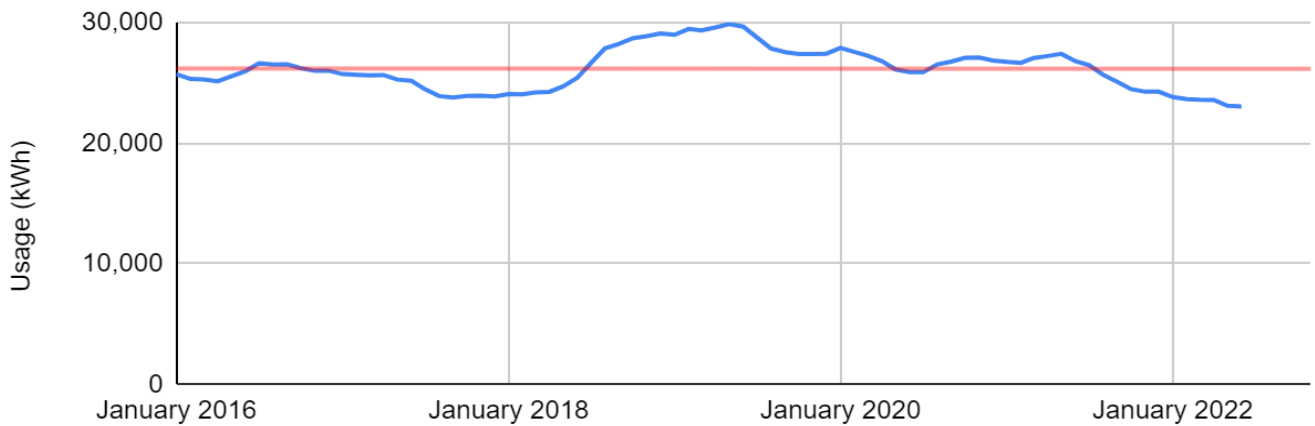


Figure 7: Wakanda Elementary School electricity use presented as a 12-month rolling average of monthly data.

Wakanda Gas Use 12-Month Rolling Average

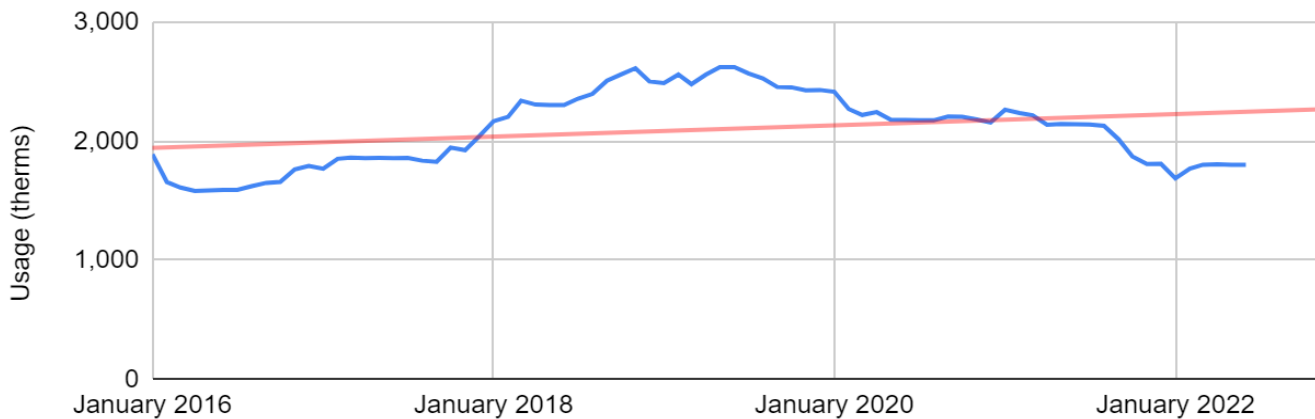


Figure 8: Wakanda Elementary School natural gas use presented as a 12-month rolling average of monthly data.

River Heights Elementary School

River Heights is the largest energy consumer of the elementary schools. The average annual use for River Heights is approximately 380,000 kWh and 26,000 therms. Total annual energy expenses at River Heights Elementary averaged approximately \$63,000 between 2016 and 2020. Trends for energy use data are depicted in Figures 9 and 10 below. Benchmarking was completed using Energy Star Portfolio Manager and River Heights Elementary School had an energy star score of 79 out of 100 up from 70 a year ago. Electric use for the 2021-2022 year was 12% below average and natural gas use was 1% above average.

River Heights Electric Use 12-Month Rolling Average

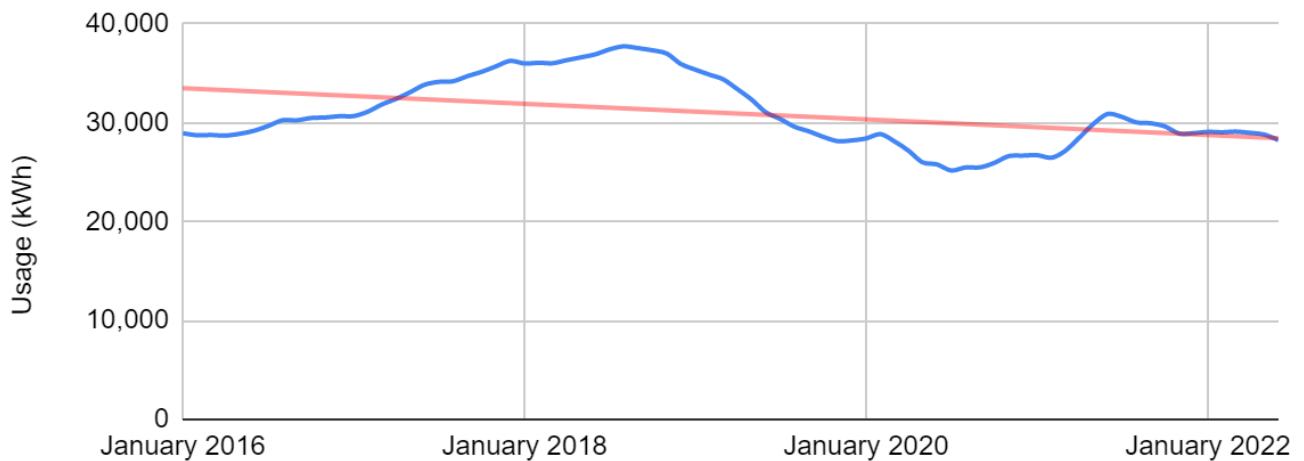


Figure 9: River Heights Elementary School electricity use presented as a 12-month rolling average of monthly data.

River Heights Gas Use 12-Month Rolling Average

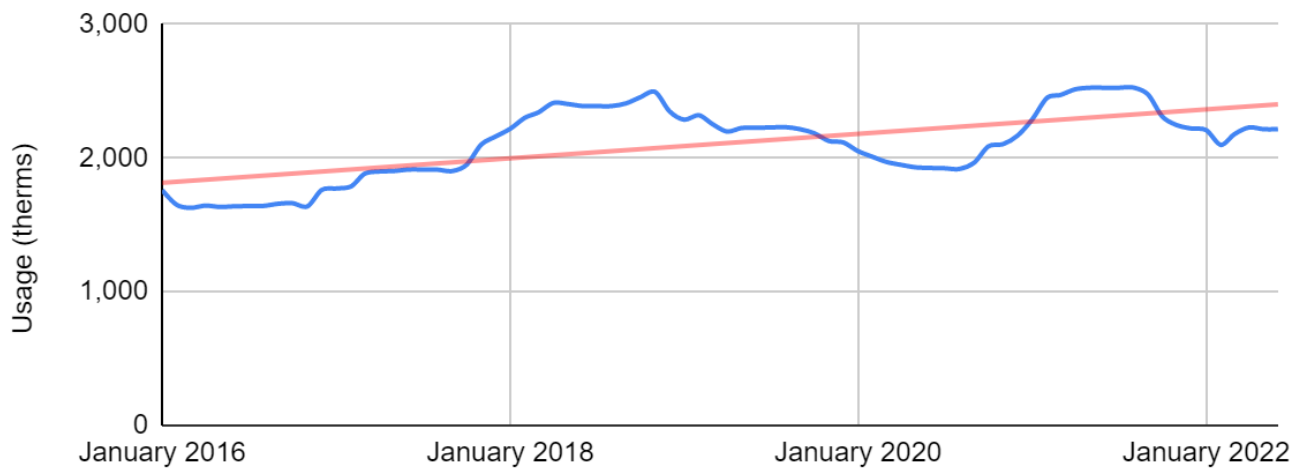


Figure 10: River Heights Elementary School natural gas use presented as a 12-month rolling average of monthly data.

Oaklawn Elementary School

The average annual use for Oaklawn Elementary is approximately 297,000 kWh and 15,400 therms. Total annual energy expenses at Oaklawn Elementary averaged approximately \$44,000 between 2016 and 2020. Trends for energy use data are depicted in Figures 11 and 12 below. Benchmarking was completed using Energy Star Portfolio Manager and Oaklawn Elementary School had an energy star score of 92 out of 100 up from 87 a year ago. Electric use for the 2021-2022 year was 4% below average and natural gas use was 2% above average.

Oaklawn Electric Use 12-Month Rolling Average

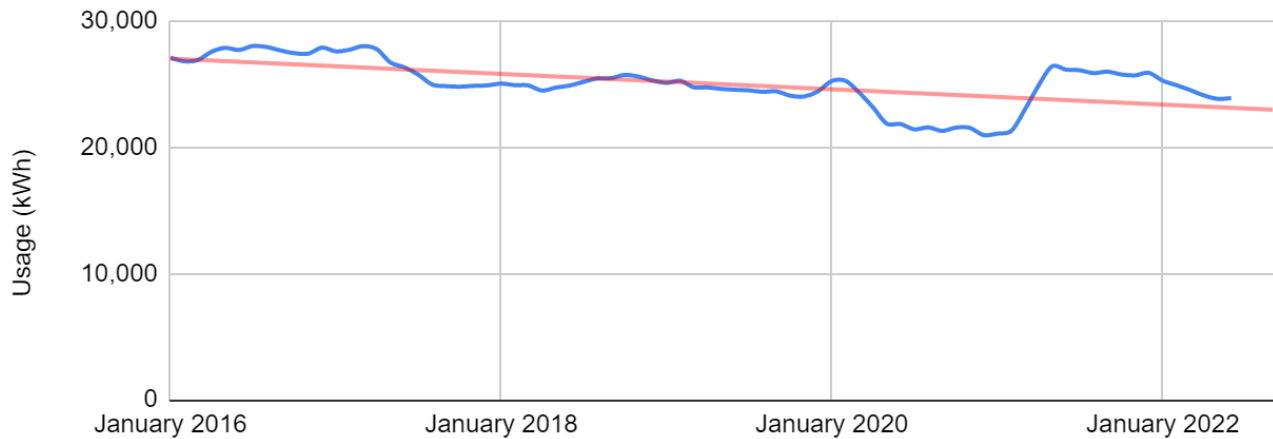


Figure 11: Oaklawn Elementary School electricity use presented as a 12-month rolling average of monthly data.

Oaklawn Gas Use 12-Month Rolling Average

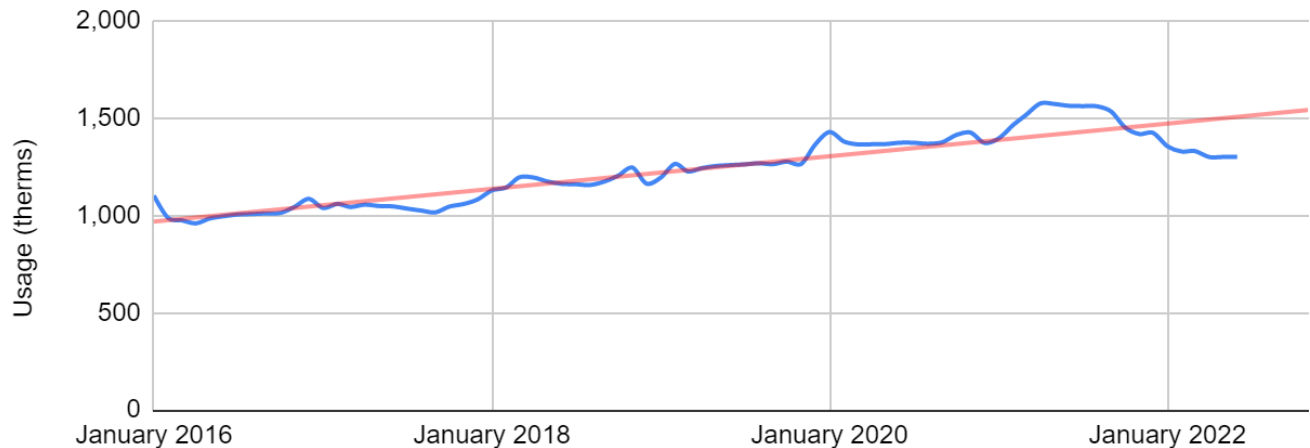


Figure 12: Oaklawn Elementary School natural gas use presented as a 12-month rolling average of monthly data.

Knapp Elementary School

The average annual use for Knapp Elementary is approximately 95,000 kWh and 7,000 therms. Total annual energy expenses at Knapp Elementary averaged approximately \$16,000 between 2016 and 2020. Trends for energy use data are depicted in Figures 13 and 14 below. The increased use during 2020-2021 was attributed to a programming error causing exhaust fans to run continually. Benchmarking was completed using Energy Star Portfolio Manager and Knapp Elementary School had an energy star score of 91 out of 100 up from 55 a year ago. Electric use for the 2021-2022 year was 27% below average and natural gas use was 17% below average.

Knapp Electric Use 12-Month Rolling Average

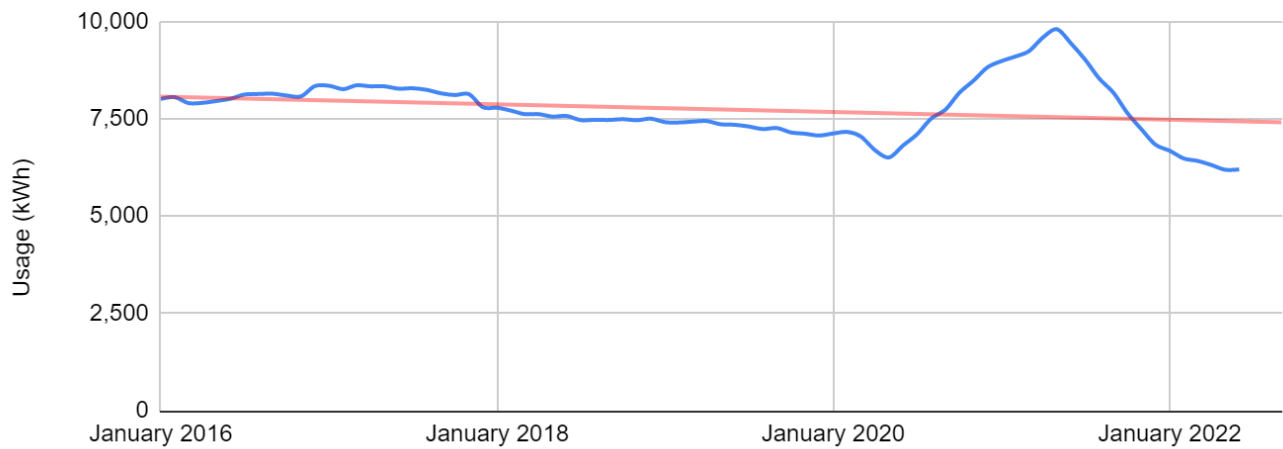


Figure 13: Knapp Elementary School electricity use presented as a 12-month rolling average of monthly data.

Knapp Gas Use 12-Month Rolling Average

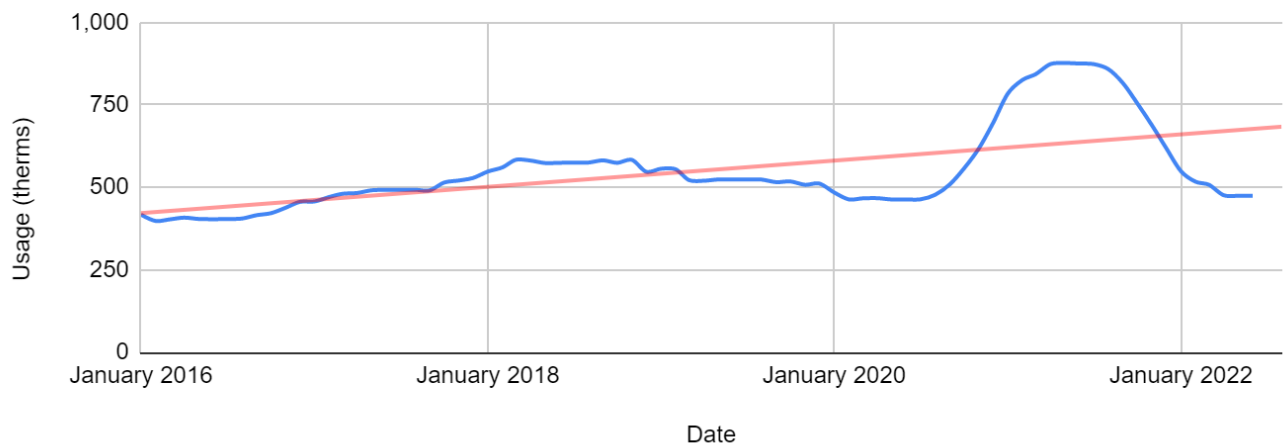


Figure 14: Knapp Elementary School natural gas use presented as a 12-month rolling average of monthly data.

Downsville Elementary School

The average annual use for Downsville Elementary is approximately 158,000 kWh. Total annual electric expenses at Downsville Elementary averaged approximately \$17,000 between 2016 and 2020. The electric use data is depicted in Figure 15 below. Downsville Elementary does not have natural gas supply. There is one propane powered boiler that supplements the geothermal system at the school. Propane is also used for domestic water heating. Benchmarking was completed using Energy Star Portfolio Manager and Downsville Elementary School had an energy star score of 94 out of 100 up from 86 a year ago. This score is likely slightly artificially high due to not incorporating the marginal quantity of propane use at the school. Electric use for the 2021-2022 year was 35% below average.

Downsville Electric Use 12-Month Rolling Average

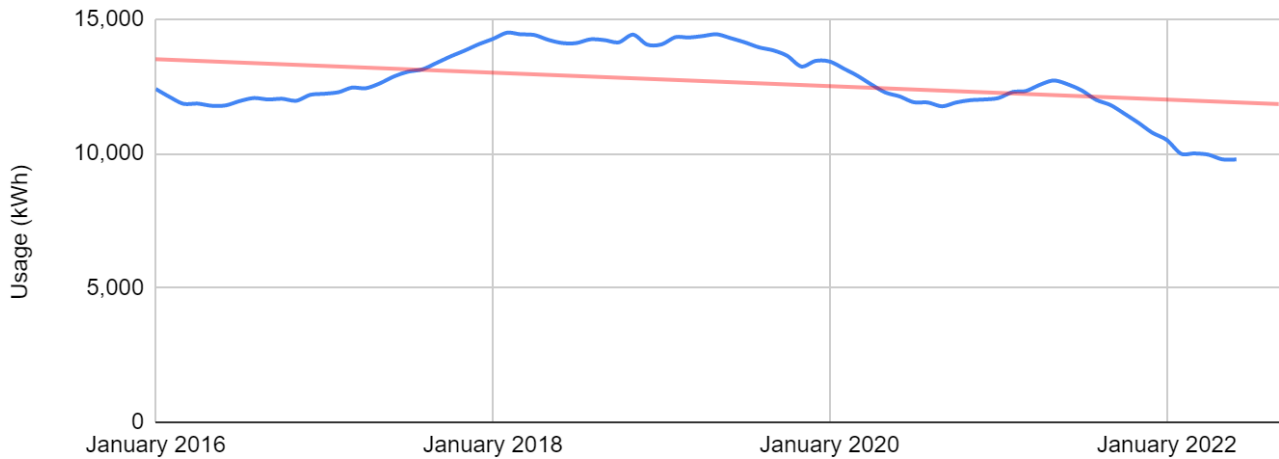


Figure 15: Downsville Elementary School electricity use presented as a 12-month rolling average of monthly data.

Administration Building

The average annual use for the Administration Building (ASC) is approximately 271,000 kWh and 400 therms. Total annual energy expenses at the ASC averaged approximately \$26,000 between 2016 and 2020. Trends for energy usage data are depicted in Figures 16 and 17 below. Benchmarking was completed using Energy Star Portfolio Manager and the ASC had an energy star score of 68 out of 100 up from 48 a year ago. This score is relatively low and more efforts should be taken to improve the efficiency of the building. The efforts should be geared towards electric use as natural gas is only used for domestic water heating purposes. Electric use for the 2021-2022 year was 27% below average and natural gas use was 55% below average.

ASC Electric Use 12-Month Rolling Average

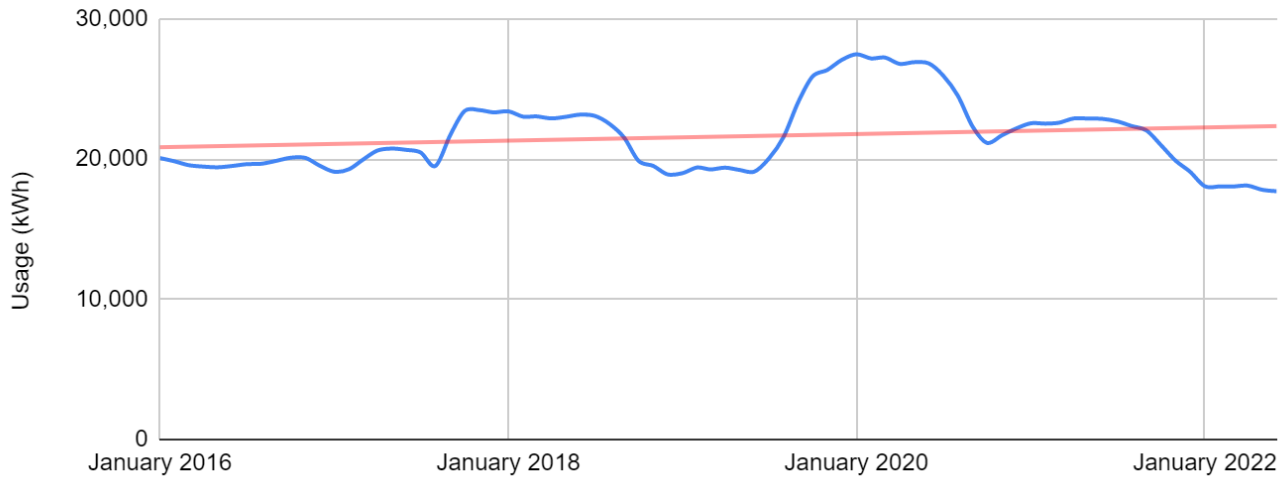


Figure 16: Administrative building electricity use presented as a 12-month rolling average of monthly data.

ASC Gas Use 12-Month Rolling Average

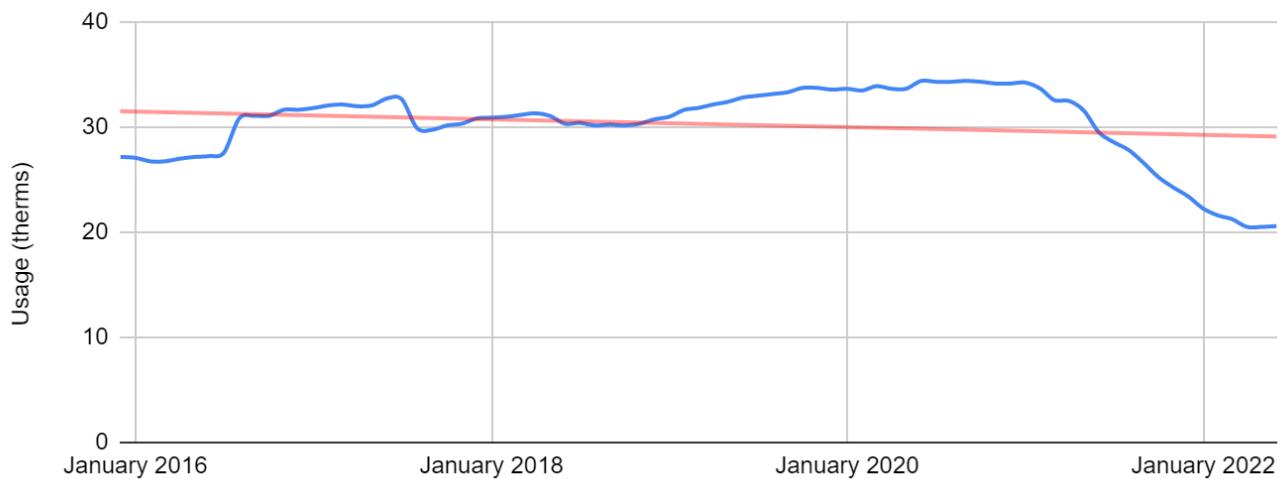


Figure 17: Administrative building natural gas use presented as a 12-month rolling average of monthly data.

Proposed Energy Conservation Initiatives

There are several projects that can be pursued to reduce energy consumption at a district and individual school level. Some projects have been analyzed for their projected savings and simple payback.

LED Fixture Installation at all District Buildings

Light emitting diode (LED) fixtures use approximately 30% the energy of their fluorescent counterparts for the same lumen output. Installing LED fixtures reduced both electric use and demand. Fixture installation is anticipated to have an approximate 8-year payback and fixture lifespan is estimated to be 10-20 years.

New LED fixtures in classroom spaces would be 30-40-watt fixtures and have a light temperature of 4,000 Kelvin. Color tuning fixtures can be considered, but would add significant cost to the project. Cooler colored lighting (bluer light) has been shown to improve attentiveness and performance in schools and warmer lighting (yellow light) has been shown to promote calmness and relaxation [2]. Additional benefits of LED lighting in comparison to fluorescent include reduced flicker that has biological effects such as a general feeling of discomfort, illness, headaches, eye strain and reduced speed of visual search and performance [2]. A color rendering index (CRI) of at least 80 will be obtained. CRI is a measure of how true to the actual color a light reveals in comparison to natural lighting and is independent of color temperature. According to the School District of Menomonie Area Energy Policy this is a project that should be pursued. The pursuit of a summer 2022 project was impacted by contractor availability and availability of dimmers and occupancy sensors. It is recommended that the District pursue 1 to 2 buildings annually to allow for better success during the bidding process.

LED fixtures would be accompanied with dimmer switches for additional functionality for the staff and teachers. Studies show that at least 81% of teachers use dimming features when available [2]. There will be reduced maintenance associated with lighting as there will be no need to regularly replace bulbs and disposal of T8 fluorescent lamps. Using LED replacement bulbs was considered as a lower cost option. Drawbacks to this option include incompatibility with select ballasts and ballast replacement as the projected lifespan of the LED lamps is longer than the ballasts.

Solar PV Installation at Select Schools

Solar generation reduces both electric use and demand (marginally) at the facility that it supplies. The installation of the 114.5 kW DC (100kW AC) Solar PV System will soon be commencing. Total expenses for the installation were approximately \$141,000. The anticipated annual savings are approximately \$15,000 - \$18,000 resulting in a simple payback of 8-9 years. The lifespan of solar photovoltaic systems is typically 25-30 years [1]. At that time the system should produce approximately 85% of its initial production [1].

Using this project as a template for future projects it is recommended that the district pursue an additional 2-3 schools over the next 1-2 years to take advantage of the financial benefits solar PV offers while also reducing the districts carbon dependency as the district policy states. The recommended schools would be Downsville Elementary, River Heights Elementary, Oaklawn Elementary and/or Menomonie High School.

There is an additional goal of incorporating the solar PV energy system(s) into the classroom through educational programs/resources. Elementary, middle and high school students could get involved to see how the system is producing energy and the energy savings incurred. The solar industry is fast growing and in need of educated employees. Using the system to garner interest in careers in solar, engineering or other renewable energy careers would be beneficial to both the students and the growing industry.

Building Envelope

Weather stripping, window coverings, insulation, and capital improvements such as windows and doors are all examples of building envelope improvements. It is recommended that the district consider replacing window coverings with insulating options such as cellular shades in areas prone to unwanted solar heat gain. One area that has significant heat gain causing unseasonably warm temperatures is the second story at the high school. The ventilation systems are not supplied through traditional air handling units and cannot fully economize like other areas of the building. Reducing solar heat gain will help to combat warm classrooms in the early spring and late fall when the chiller would not normally be used.

District Coil Cleaning Program

Dirty condenser coils can reduce a systems efficiency by 30-40% and cause undue stress on the buildings HVAC systems [3]. Professionals recommend cleaning heating and cooling coils at least once annually to maintain peak efficiency [3]. The coil cleaning will take place in the summer of each year and be completed by district staff or a mechanical contractor. The coils include chiller coils, air handler coils, outdoor air units, and blower coil unit coils. Blower fans in air handling units may also be cleaned during this time period. This preventative maintenance measure will be a large assignment but is necessary for optimal efficiency, operation, and equipment longevity. The first coil cleaning was completed in the summer of 2021.

Energy Market Data and Forecasts

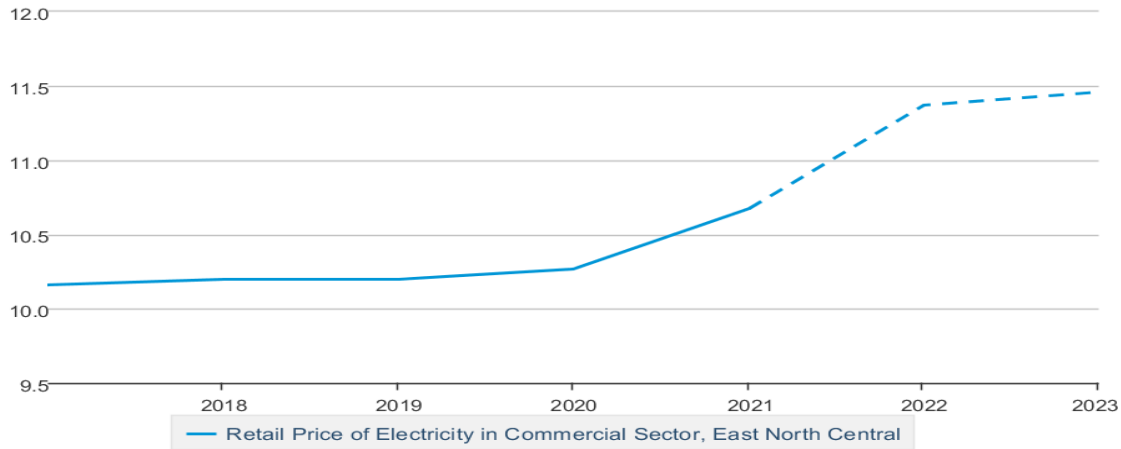
Electric Market Forecasts

Electricity commercial market prices for the East North Central region are expected to average \$0.118/kWh for 2022 in comparison to \$0.102/kWh in 2021. Costs for 2023 are expected to average \$0.118/kWh. Costs in 2020 were \$0.106/kWh. These costs represent an increase of 5.1% in 2022 and 0% in 2023. The increase from 2020 to 2022 is 12.0%.

*Data was sourced from US EIA's short-term outlook.

Retail Price of Electricity in Commercial Sector, East North Central

cents per kilowatt hour



Source: U.S. Energy Information Administration

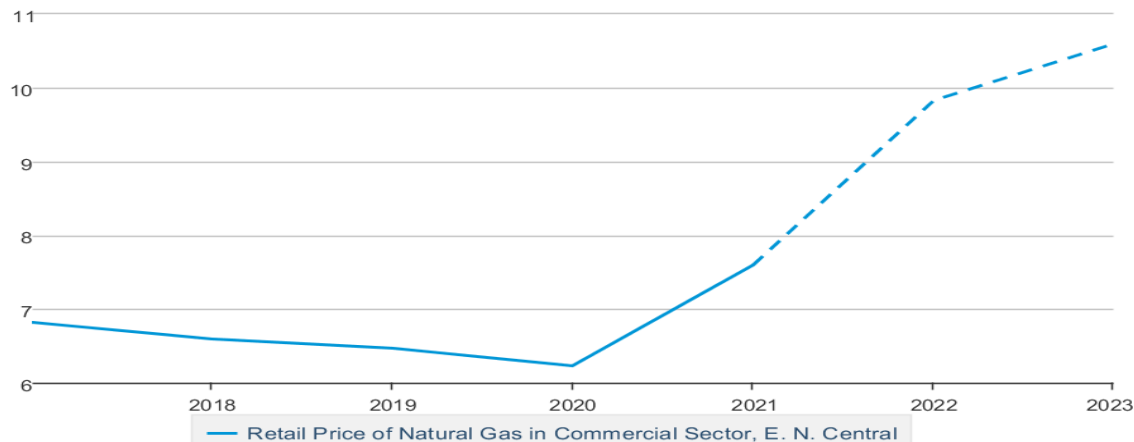
Natural Gas Market Forecasts

Natural gas commercial market prices for the East North Central region are expected to average \$1.173/ccf for 2022 in comparison to \$0.924/ccf in 2021. Costs for 2023 are expected to average \$1.119/ccf. Costs in 2019 (pre-pandemic) were \$0.772/ccf. These costs represent an increase of 26.3% in 2021 and decrease of 4.1% in 2022. The increase from 2020 to 2022 is 51.0%.

*Data was sourced from US EIA's short-term outlook.

Retail Price of Natural Gas in Commercial Sector, E. N. Central

dollars per thousand cubic feet



Source: U.S. Energy Information Administration

References

- [1] Deline, Chris. "Photovoltaic Lifetime Project." *NREL.gov*, www.nrel.gov/pv/lifetime.html.
- [2] L. Morrow, Brenda, and Shireen M. Kanakri. "The Impact of Fluorescent and Led Lighting on Students Attitudes and Behavior in the Classroom." *Advances in Pediatric Research*, 26 Sept. 2018, pp. 1–12., doi:10.24105/apr.2018.5.15.
- [3] NADCA.com, National Air Duct Cleaners Association, 2017, nadca.com/sites/default/files/fieldtestingfindings.pdf.