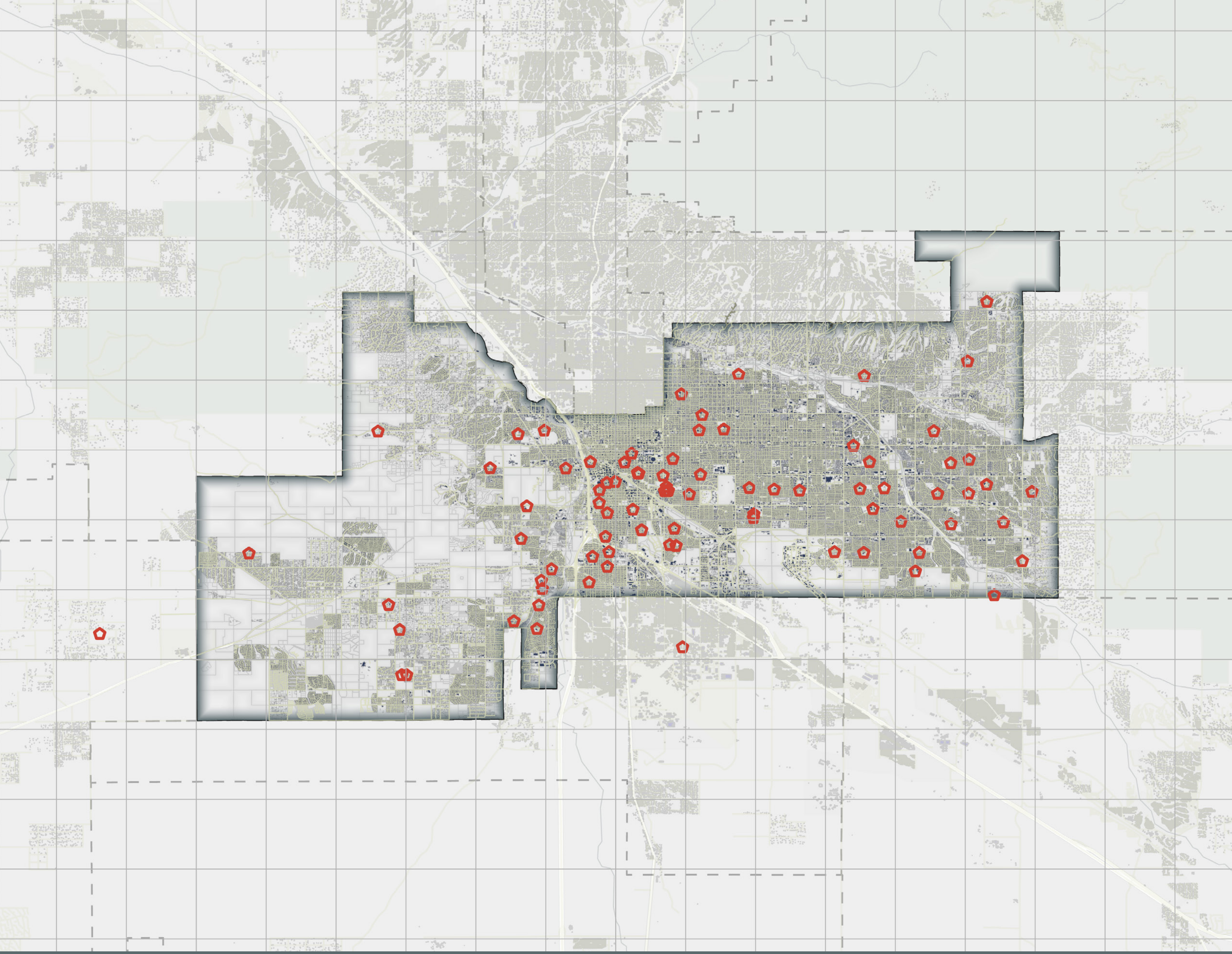

Greenhouse Gas Inventory and Preliminary Energy-Use Analysis of Tucson Unified School District: Fiscal Year 2024

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December 2025

Drachman Institute
for the Built Environment

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Additional support within the Drachman Institute and CAPLA was provided by Courtney Crosson, Jessica McQuillen, and Jeff Javier.

Accessing this Report
This report, along with the accompanying Technical Appendix, Greenhouse Gas Inventory Calculator, and Preliminary Building Energy-Use Analysis Calculator , can be found at:
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To cite this report, use the following information:
Fink, A., & Stoker, P. (2025). Greenhouse Gas Inventory and Preliminary Energy-Use Analysis of Tucson Unified School District: Fiscal Year 2024. Drachman Institute.

Acknowledgements

This report was completed with the support of many partners.

Tucson Unified School District

We thank Dr. Gabriel Trujillo, District Superintendent, and Tina Cook, Energy Project Manager, for their support, guidance, and contributions during the development of this report. We also thank the members of the TUSD Governing Board for their engagement with and questions on a presentation of preliminary findings.

Jobs With Justice

We are grateful to the Jobs With Justice Education Fund and Invest in Our Future for financial support and Arizona Jobs With Justice for their assistance engaging with community and labor partners. In particular, we would like to thank Tamarae McLaughlin, Erin Johansson, Steve Valencia, Jim Cahill, and CJ Jones.

Arizona Youth Climate Coalition

We express our appreciation to several members of the Arizona Youth Climate Coalition who met with the project team and provided feedback on an early draft of this report.

Cumming Group

Several people from Cumming Group provided valuable feedback on early drafts of this report for which we are grateful.

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Acronyms and Abbreviations

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
CAPLA	College of Architecture, Planning, and Landscape Architecture
CASP	Climate Action and Sustainability Policy
CH4	Methane
CO2	Carbon dioxide
CO2e	Carbon dioxide equivalent
ECI	Energy cost intensity
EPA	U.S. Environmental Protection Agency
ES	Elementary school
EUI	Energy use intensity
FY	Fiscal year
GHG	Greenhouse gas
GSF	Gross square foot
HS	High school
HVAC	Heating, ventilation, and air-conditioning
K8	K-8 school
kWh	Kilowatt-hour
MS	Middle school
MT	Metric ton
N2O	Nitrous oxide
T&D	Transmission and distribution
TEP	Tucson Electric Power
TUSD	Tucson Unified School District

1. Executive Summary

This report supports ongoing efforts to improve climate-related impacts from Tucson Unified School District (TUSD) operations, in alignment with the district's Climate Action and Sustainability Policy. It establishes a baseline understanding of some of these impacts through a greenhouse gas inventory covering FY2024, which follows guidance from *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* and includes emissions from seven key district activities. It then provides a more detailed assessment of energy use and costs at TUSD facilities through a preliminary building energy-use analysis, which follows guidance from *ASHRAE Procedures for Commercial Building Energy Audits.* Finally, the report identifies several high-level opportunities for reductions.

Greenhouse gas emissions from the activities included in this report totaled 63,194 MT CO2e in FY2024, which is approximately equal to the amount of carbon sequestered by 63,194 acres of U.S. forests, greenhouse gas emissions from 14,724 gas-powered passenger vehicles, or the energy used by 8,468 homes over the same time period. These greenhouse gas emissions are linked to present and future damages with an estimated financial impact of just over $13 million. Of the seven operational activities examined, the purchase of electricity from the grid accounted for nearly two-thirds (60%) of the district's total greenhouse gas emissions. The second largest contributor was the disposal of refuse generated at TUSD facilities (17%), followed by on-site combustion of natural gas (11%) and district-owned transportation (8%). Of the four types of schools operated by TUSD, high schools accounted for the largest share of district greenhouse gas emissions.

TUSD facilities generally used more energy per square foot of building area than similar institutions in the same climate zone, excluding energy that was lost before it reached the building. The district procured electricity from on-site solar installations at 82 facilities through Solar Service Agreements, allowing these buildings to purchase less electricity from the grid. For many types of TUSD facilities, energy usage per square foot of building area spans a wide range, with several facilities consuming significantly more energy than is typical for TUSD and similar institutions. District-wide energy use in buildings was about 10% higher in FY2024 compared to the average between FY2021 and FY2023.

Key opportunities to reduce emissions include: measures to reduce total and peak energy usage in buildings, increasing the capacity of onsite-solar installations and energy storage, supporting efforts to decarbonize the electricity grid, prioritizing outlier facilities, consolidating summer operations within select facilities, implementing waste reduction and diversion programs, and electrification of building equipment and district-owned vehicles. Pursuing these opportunities could enable TUSD to support student apprenticeship programs in partnership with local building trades. To support future reduction efforts, we recommend that the district identify an optimal baseline year and clearly define and implement tracking systems for the activities that will be included within emission reduction targets.

2. Introduction

2.1 Tucson Unified School District

Tucson Unified School District (TUSD) is the second largest school district in Arizona and the largest in Tucson, operating 89 schools and serving around 40,000 students (Figure 1). The district has a long history of teaching and practicing environmental stewardship, including many energy conservation measures, and was recognized for these efforts in November 2025 with a Net Zero Hero Educational Partner Award from the local electric utility, Tucson Electric Power (Tucson Electric Power, 2025). In October 2024, the TUSD Governing Board passed a comprehensive Climate Action and Sustainability Policy (CASP), which was developed by current and graduated TUSD students as members of the Arizona Youth Climate Coalition in collaboration with district staff and national experts. The goal of this policy is to guide efforts to continue to cost-effectively improve the district's environmental impact while serving the educational needs of the Tucson community. It establishes the aspirational goal of achieving a 50% reduction in district greenhouse gas emissions by 2030 and reaching net-zero greenhouse gas emissions by 2040.

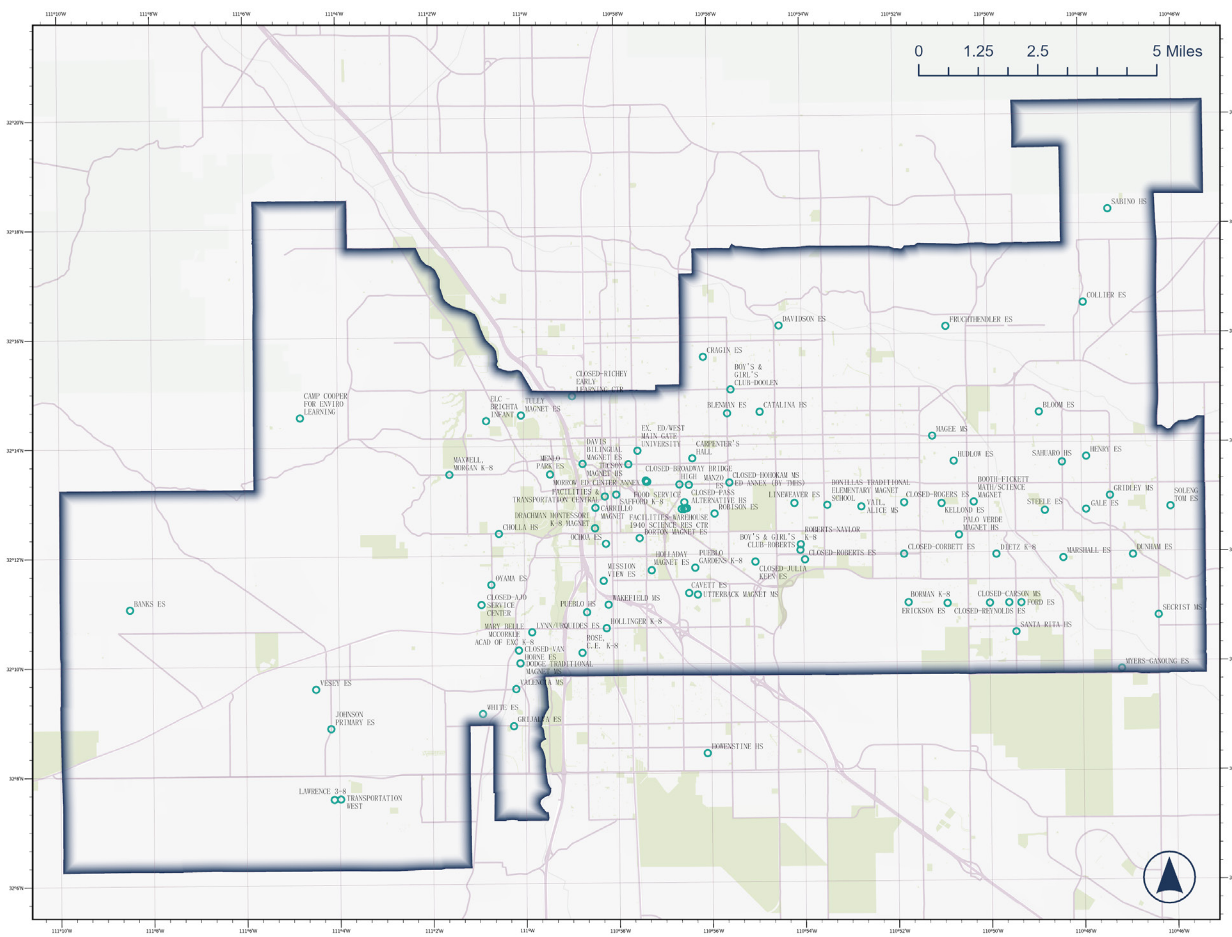

Figure 1: *Map of TUSD boundary and facility locations.*

2.2 Funding

This report was funded by a grant from the Jobs With Justice Education Fund and Invest in Our Future. Jobs With Justice is a non-profit organization supporting workers' rights through research and policy advocacy. The education fund is intended to generate original research on key issues by developing partnerships and projects that accomplish goals related to an economy that benefits everyone. For this project, the grant was provided to support the identification of concrete actions that TUSD can take to decarbonize operations and was intended as an initial step to identify opportunities for high school students to partner with trade unions to develop key skills related to decarbonization that could be implemented across Tucson and wherever these trained students take their work.

2.3 Report Overview

This report supports TUSD's CASP and the objectives of Jobs With Justice by establishing a baseline understanding of the climate-related impacts of district operations through an inventory of greenhouse gas emissions and a preliminary building energy-use analysis. It covers the 2023-2024 fiscal year (FY2024) in accordance with the CASP, which calls for a greenhouse gas inventory covering "the most recent fiscal year" as of the policy's adoption in October 2024. The accompanying calculator tools, developed by the University of Arizona team, can be used by the district to track progress over time compared to the baseline established in this report.

The greenhouse gas inventory and preliminary building energy-use analysis were performed in accordance with best practices outlined in *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (Ranganathan et al., 2004) and guidance from *ASHRAE Procedures for Commercial Building Energy Audits* (Kelsey et al., 2011), respectively.

Greenhouse Gases
Greenhouse gases are a category of gases that allow sunlight to pass through the atmosphere and trap in the resulting heat (U.S. Environmental Protection Agency, 2025).

The greenhouse gas inventory quantifies the release of three gases – carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) – from key aspects of TUSD operations, including natural gas combustion in buildings, purchased electricity, waste disposal, fuel purchases for transportation, electricity transmission and distribution losses, and recycling. The preliminary building energy-use analysis includes total energy use and costs across district facilities, normalized based on facility size, and identification of significant patterns and irregularities. Greenhouse gas emissions and building energy use are compared across TUSD facilities and similar institutions.

The report then identifies high-priority areas for emissions and energy use reductions and proposes some strategies that may help reduce emissions and energy use in these areas. This data-driven prioritization of reduction strategies, coupled with the establishment of a baseline, enables credible and actionable emissions reductions that the district can track over time.

3. Overview of Methods

This section of the report provides an overview of how we produced the greenhouse gas inventory and preliminary building energy-use analysis. A companion technical appendix is available with a more detailed description of the methods.

3.1 Hybrid Approach

This report establishes a baseline understanding of some of the climate-related impacts of TUSD operations through two distinct yet complementary methods: a greenhouse gas inventory and a preliminary building energy-use analysis (Table 1). We chose to adopt this hybrid approach because it enables deeper analysis of the interrelationship between energy use in buildings and greenhouse gas emissions. Additionally, the two methods rely on similar available data sources.

Sections 3.2 and 3.3 provide a brief overview of the methods implemented in performing the greenhouse gas inventory and preliminary building energy-use analysis, respectively.

Characteristics	Greenhouse Gas Inventory	Preliminary Building Energy-Use Analysis
Goal	Calculation of total annual greenhouse gas emissions	Analysis of energy use trends and patterns
Metric(s)	Greenhouse gas emissions in metric tons of carbon dioxide equivalent	Energy use per square foot and per student Energy demand patterns
Scale of Analysis	Across all TUSD facilities	By individual facility
Data Types	Grid electricity bills (usage) Solar electricity bills (usage) Natural gas bills (usage) Facility area & enrollment Yellow/white fleet records (fuel type and quantity) Waste disposal bills (usage)	Grid electricity bills (usage and cost) Solar electricity bills (usage and cost) Natural gas bills (usage and cost) Facility area & enrollment
Data Sources	TUSD	TUSD
Methods	Multiply activity data by emission factors	Normalize energy use by floor area and enrollment Compare between months and across facilities
Reporting Period	TUSD Fiscal Year 2024 (7/1/2023 - 6/30/2024)	TUSD Fiscal Year 2024 (7/1/2023 - 6/30/2024)

Table 1. *Comparison of greenhouse gas inventory and preliminary energy-use analysis methods.*

3.2 Greenhouse Gas Inventory

This greenhouse gas inventory follows the guidance of *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (Ranganathan et al., 2004), which provides internationally recognized best practices for complete, consistent, transparent, and accurate emissions accounting. Of the six greenhouse gases covered by this guiding document, hereafter referred to as the *Corporate Standard*, this report includes carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Three other types of greenhouse gases - hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride - are excluded because they are either not released as a result of district activities or no data were available. Greenhouse gas emissions are estimated using standard calculation procedures rather than direct measurements of gas concentrations. Data on all gases are reported in terms of metric tons of carbon dioxide equivalent (MT CO2e).

Metric Tons of Carbon Dioxide Equivalent (MT CO2e)

This unit standardizes measurement of different greenhouse gases based on how much carbon dioxide would have similar climate impacts. For example, the release of 1 MT of methane into the atmosphere has an estimated warming effect 27 times higher than that of 1 MT of carbon dioxide over a 100-year period, so this is quantified as 27 MT CO2e.

This inventory applies the financial control approach, as defined by the *Corporate Standard*, to determine which facilities fall within the district's organizational boundary for the purposes of this report. This means that facilities that are owned and operated by TUSD are included, as well as those leased from others, while facilities leased out or financially controlled by other entities are excluded. Emissions from purchased electricity are calculated using the market-based method, which reflects the emissions associated with the specific electricity sources and contractual agreements which TUSD has procured.

Scope 1, 2, & 3 Emissions

Activities that release greenhouse gases into the atmosphere are organized into three categories, or scopes, as defined by the *Corporate Standard*. Scope 1 includes direct emissions from activities owned or controlled by TUSD, such as on-site natural gas combustion and transportation fuels. Scope 2 includes indirect emissions from purchased electricity, including both electricity from the grid and from on-site solar installations. Scope 3 includes other indirect emissions from activities such as waste disposal, transmission and distribution losses, and recycling.

The best practices outlined in the *Corporate Standard* require the inclusion of all Scope 1 and 2 activities, while the inclusion of Scope 3 activities is left to the discretion of the reporting organization. This inventory covers greenhouse gas emissions from seven activities within Scope 1, 2, and 3 for which reliable data were available. The following figure (Figure 2) depicts the breakdown of activities that are included or excluded within each scope.

For each included activity, emissions were estimated using a three-step process:

1. Collect data from TUSD's Energy Management System and/or staff records
2. Convert these data into greenhouse gas quantities using established emission factors
3. Aggregate results across the district and, where applicable, by building type

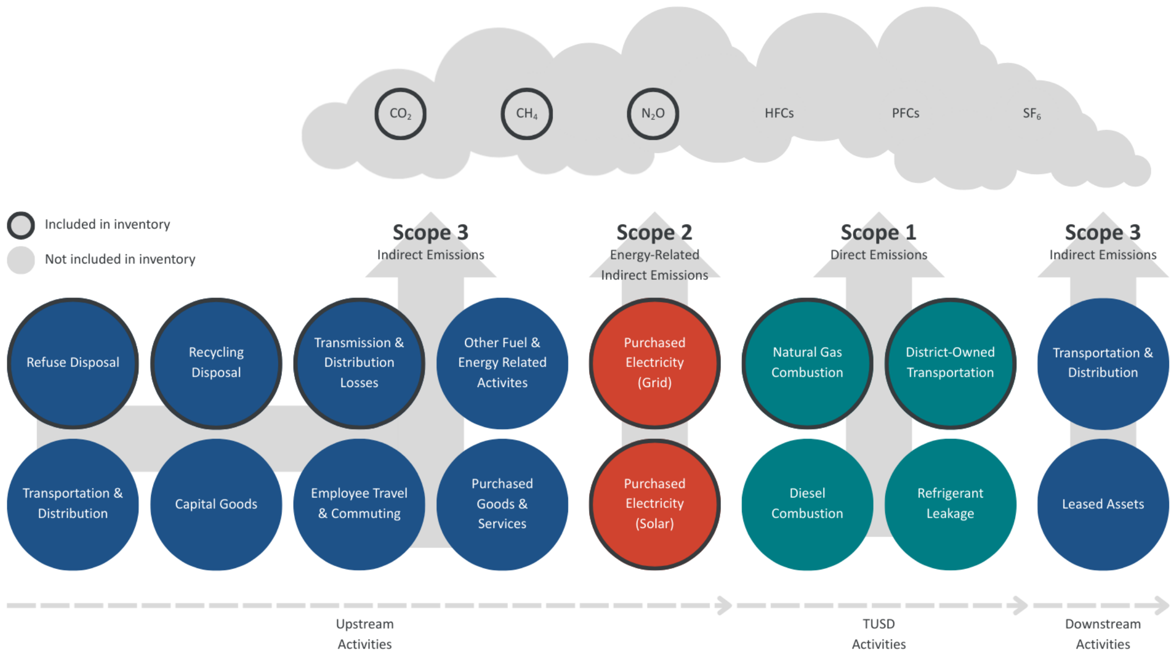

Figure 2: *Activities included in the greenhouse gas inventory by scope.*

3.3 Preliminary Building Energy-Use Analysis

The preliminary building energy-use analysis follows guidance from *ASHRAE Procedures for Commercial Building Energy Audits* (Kelsey et al., 2011). This analysis is designed to evaluate the energy efficiency and energy costs of TUSD facilities as part of the first step in a building energy audit.

Energy Audit

An energy audit involves the assessment of building energy use and costs. There are several different levels of energy audits corresponding to different amounts of effort required and the amount of detail in the outcomes produced. A highly detailed energy audit would include physical inspection of all building systems, performance measurements of components, and facility-specific modeling of the long-term financial and energy impacts of potential conservation measures.

Analysis methods involved the following process:

1. Collect monthly utility billing data from TUSD's Energy Management System
2. Convert energy usage across sources into standard units using established multipliers
3. Normalize total energy use and cost per facility by building area
4. Compare normalized energy use and cost across TUSD and similar institutions
5. Identify energy use patterns and irregularities by facility type, month, and energy source
6. Present recommendations for further analysis

Facility-level energy use is measured in terms of energy use intensity (EUI) to allow meaningful comparison between facilities of different sizes. This report uses source energy to calculate EUI, as it allows better comparison between buildings that use different mixes of fuel types (U.S. Environmental Protection Agency, 2023). We focus on comparisons between facilities of the same facility type (e.g., only comparing elementary schools with other elementary schools), since operational activities and energy demands vary across facility types.

Energy Use Intensity (EUI)

EUI is calculated by dividing total annual energy consumption by building square footage. It is measured in units of energy per square foot per year (kBTU/sq.ft./yr.) and can be expressed using either site energy or source energy.

Site Energy vs. Source Energy

Site energy represents the amount of energy consumed directly by a building, while source energy accounts for all energy required to deliver that power, including losses incurred during generation and transmission.

3.4 Limitations & Assumptions

The primary limitation of this report is that direct measurements of concentrations of greenhouse gas emissions released by district activities were not available. The high cost and logistical complexity of such a measurement system make this a common limitation, which the *Corporate Standard* is designed to address by outlining procedures that help ensure that estimates of greenhouse gas emissions are accurate, consistent, and transparent enough to enable informed decision making. As described above, these procedures involve the application of standard, scientifically backed multipliers and emission factors to convert data on district activities into an estimate of the associated amount of greenhouse gases released into the atmosphere. In some cases, the selection of an appropriate multiplier or coefficient required a number of assumptions due to limitations in data availability. Two assumptions in particular are especially worth considering when interpreting the results of this report, due to their potential impact on estimates of total emissions:

First, data about refuse and recycling included only the capacity of the bins for which TUSD pays for service. The calculation of emissions from these activities assumes that the bins are completely full every month. Additionally, we assumed that all refuse is composed of the general Mixed Municipal Solid Waste category and that all recycling is composed of the Mixed Recyclables category (U.S. Environmental Protection Agency, 2025). While the first assumption may lead to overestimation of emissions, the overall direction and magnitude of impact are unknown because emissions from refuse and recycling vary significantly based on the material composition of the waste.

Second, publicly available emission factors for electricity purchased from the grid represent a total annual emission rate. In other words, they do not account for the ways in which the mix of resources used to generate electricity vary throughout the day and year.

A more detailed explanation of the selection of all multipliers and emission factors is available in the Technical Appendix. We have also developed an Excel-based tool with built-in calculation procedures that presents both the data provided by TUSD and the scientifically backed multipliers and emission factors used to produce this report. This tool, which we have provided to TUSD, allows users to adjust assumptions about the multipliers and emission factors and explore the impact of different scenarios. A template of this tool is publicly available.

Additionally, as previously noted, limitations in data availability do not allow this report to include emissions from all aspects of TUSD operations. Especially of note is the exclusion of two Scope 1 activities, which are standard to include in a greenhouse gas inventory according to the *Corporate Standard*: refrigerant leakage from buildings and district-owned transportation, and diesel usage in five generators.

4. Results

This section of the report details the numerical results of both the greenhouse gas inventory (Section 4.1) and the preliminary building energy-use analysis (Section 4.2). Interpretation of the significance of these findings and opportunities for further research and action can be found in Section 5.

4.1 Greenhouse Gas Inventory

Based on the methods described above and in the technical appendix, we present the results of the greenhouse gas inventory analysis below. Total greenhouse gas emissions across the district are presented first (Section 4.1.1), followed by breakdowns of emissions by activities (Section 4.1.2) and facility types (Section 4.1.3). The greenhouse gas inventory analysis concludes with comparisons to other school districts (Section 4.1.4).

4.1.1 Total Greenhouse Gas Emissions

Greenhouse gas emissions from TUSD operational activities included in this report totaled 63,194 MT CO2e in FY2024 (Table 2). These emissions are approximately equal to the amount of carbon sequestered by 63,194 acres of U.S. forests, greenhouse gas emissions from 14,724 gas-powered passenger vehicles, or the energy used by 8,468 homes over the same time period.

Scope	FY2024 Total
Scope 1	12,078 MT CO2e
Scope 2 (Market-Based) *	38,307 MT CO2e
Scope 2 (Location-Based) *	30,939 MT CO2e
Scope 3	12,809 MT CO2e
Total Scope 1 & 2	**50,385 MT CO2e**
Total Scope 1, 2, & 3	**63,194 MT CO2e**

Table 2. Total greenhouse gas emissions by scope. **While both market-based and location-based scope 2 emissions are included based on the guidance of the Corporate Standard, this report utilizes the market-based because it allows TUSD to take credit for the substantial amount of electricity that it has chosen to procure through Solar Service Agreements.*

Of the three greenhouse gases included in this report, carbon dioxide emissions are by far the most significant in terms of both weight (62,900 MT) and contribution to TUSD's emissions (99.54%). Methane and nitrous oxide emissions totaled just over 4 MT CH4 (or 119 MT CO2e) and just under 1 MT N2O (or 174 MT CO2e), respectively. These greenhouse gas emissions are linked to present and future damages with an estimated financial impact of just over $13 million. This value, known as the social cost of greenhouse gas emissions, is based on calculations that are broadly endorsed by the scientific and economic communities, and accounts for impacts such as increased heat deaths and property damage from flooding. It is likely an underestimate of the true financial cost of damages linked to greenhouse gas emissions (Sarinsky & Weatherford, 2024).

4.1.2 Greenhouse Gas Emissions by Activity

Of the seven operational activities included in this report, four account for the majority of greenhouse gas emissions: grid-purchased electricity (60%), refuse (17%), on-site natural gas combustion (11%), and district-owned transportation (8%). See Table 3 for a more detailed description of the emissions from each activity.

The other three operational activities included in this report – electricity transmission and distribution losses, recycling, and electricity purchased through Solar Service Agreements – contribute relatively small proportions of total greenhouse gas emissions, each no greater than 2% of total emissions. This, however, does not mean that these activities should be ignored. In a school district as large as TUSD, even 1% of total emissions result in climate impacts equivalent to nearly 1.6 million miles of driving. Reducing district emissions by the same amount would have equivalent impact to growing over 10,000 tree seedlings for 10 years.

Scope	Activity	Description	Emissions	%
Scope 1	Natural Gas Combustion	TUSD consumes natural gas, purchased from Southwest Gas, for space heating, water heating, and cooking in over 100 facilities. This activity results in direct emissions from the on-site combustion of natural gas.	6,896 MT CO2e	11%
	District-Owned Transportation	TUSD operates nearly 300 yellow fleet vehicles and nearly 300 white fleet vehicles, which are powered by engines that rely on the combustion of diesel, compressed natural gas, or unleaded gasoline. This activity results in direct emissions from fuel combustion during vehicle operation. The yellow fleet produces around four times as much greenhouse gas emissions as the white fleet.	5,182 MT CO2e	8%
Scope 2	Purchased Electricity (Grid)	TUSD purchases electricity from both Tucson Electric Power and Trico Electric Cooperative to heat and cool buildings and operate equipment and lighting. These activities result in indirect emissions from fuel combustion at off-site power plants.	37,635 MT CO2e	60%
	Purchased Electricity (Solar)	TUSD purchases electricity that is generated by on-site solar photovoltaic systems at 82 district facilities through several Solar Service Agreements. Some of this electricity is used immediately, while the rest is exported to the grid. A net metering agreement with TEP allows TUSD to claim an emissions rate of zero for an amount of grid-purchased electricity equivalent to the amount of solar-generated electricity that is exported to the grid. The district reports greenhouse gas emissions in this category because of a contractual agreement with Trico Electric Cooperative. At district facilities with on-site solar power within the Trico region, TUSD is responsible for the indirect emissions from fuel combustion at off-site power plants required to produce an equivalent amount of electricity.	671 MT CO2e	1%
Scope 3	Transmission & Distribution Losses	TUSD's grid-purchased electricity results in indirect greenhouse gas emissions from transmission and distribution losses that occur as electricity travels through power lines between the generation source and district facilities.	1,505 MT CO2e	2%
	Refuse	TUSD generates solid waste at district facilities that is collected and transported to landfills. The decomposition of materials results in indirect district greenhouse gas emissions.	11,001 MT CO2e	17%
	Recycling	TUSD collects recyclable materials at district facilities. The processing and transportation of these materials consume energy, which results in indirect greenhouse gas emissions.	302 MT CO2e	<1%

Table 3. *Summary of greenhouse gas emissions by activity.*

4.1.3 Greenhouse Gas Emissions Comparison Across and Within Facility Types

The proportional contribution of each operational activity to total emissions holds relatively consistent across all facility types, with a few exceptions (Figure 3). While grid-purchased electricity accounts for around 60% of emissions across most facility types, at elementary schools, this activity accounts for around half of total emissions. At closed schools, grid-purchased electricity accounts for all but 5% of reported emissions, as closed schools did not produce emissions from activities like waste disposal that meaningfully contribute to total emissions at other facility types. At elementary schools, refuse accounts for a larger proportion of total emissions. High schools and middle schools also report a slightly lower percentage of emissions from refuse than other facility types. Emissions from natural gas are lower than emissions from refuse for all facility types but vary significantly by facility type. For example, the combustion of natural gas is responsible for around 6% of reported emissions from childcare facilities, and around 15% of emissions from elementary schools. Note that there is no comparison of transportation emissions across or within facility types because transportation data were aggregated across the district.

Of the four types of schools operated by TUSD, high schools accounted for the greatest amount of greenhouse gas emissions by far in FY2024. Emissions from high school facilities, at over 24,000 MT CO2e, were more than double the amount of greenhouse gas emissions from elementary schools and nearly triple the emissions at either middle schools or K-8 schools (Figure 4).

Some of these differences in emissions may be attributable to the fact that district high schools are typically larger than other types of schools and are designed to support a greater number of more varied activities. In fact, when facility emissions are normalized based on building area, the difference between emissions from high schools, middle schools, and K-8 schools becomes significantly smaller (Figure 5). This means that operational activities in these three types of schools are responsible for similar greenhouse gas emissions per square foot of building area. Operational activities in elementary schools, on the other hand, produce only about half as much greenhouse gas emissions per square foot compared to other school types.

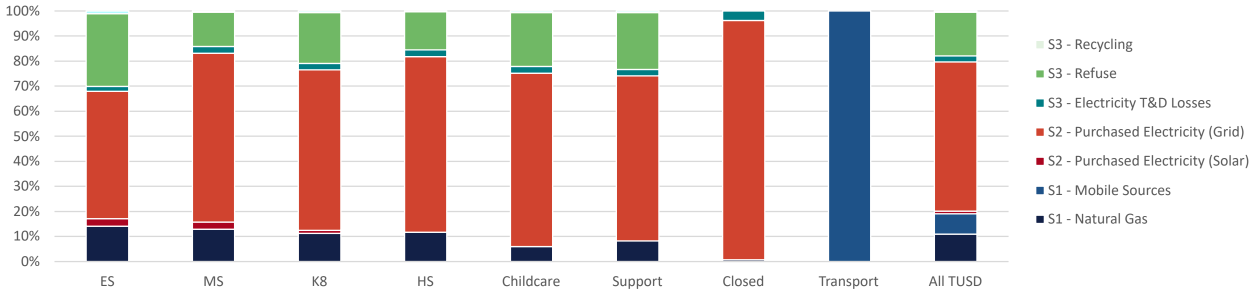

Figure 3: *Distribution of greenhouse gas emissions by activity across facility types.*

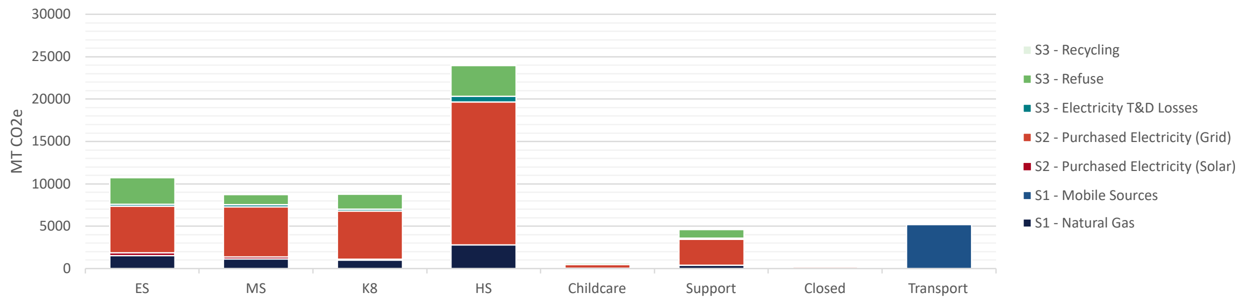

Figure 4: *Total greenhouse gas emissions by facility type and activity.*

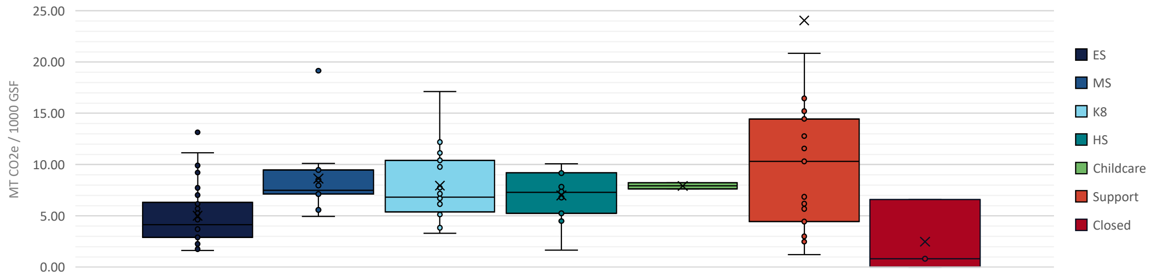

Figure 5: *Distribution of facility-level greenhouse gas emissions per 1,000 gross square feet of building area by facility type.*

A similar pattern emerges when comparing median emissions per student among the four different types of schools (Figure 6). High schools have the highest median emissions per student at 1.89 MT CO2e. Middle school emissions are slightly lower at 1.26 MT CO2e per student, and K-8 school emissions are about 40% lower at 0.85 MT CO2e per student. Elementary schools once again have the lowest median emissions by far at 0.64 MT CO2e per student, which is over 60% lower than that at high schools.

Greenhouse gas emissions from childcare and support facilities are much lower overall, representing 1% and 7% of total district emissions, respectively (Figure 4). This difference, however, seems to be related to facility size rather than the emission intensity of operational activities. When normalized based on building area, emissions from childcare facilities are similar to those from high schools, middle schools, and K-8 schools, while median normalized emissions from support facilities are actually the highest of all the facility types (Figure 5). This means that, while district support facilities are relatively small in size compared to the rest of TUSD, they generally are responsible for operational activities that produce a higher intensity of greenhouse gas emissions than those at district schools.

The four schools that were closed during FY2024 accounted for emissions of approximately 166 MT CO2e from purchased electricity and the combustion of natural gas. Per square foot of building area, these emissions are around 1/5 those at high school facilities. These numbers suggest that the district has reduced many, but not all greenhouse gas-emitting activities at these closed facilities. Regardless, these emissions are still significant, as they are equivalent to burning around 184,000 pounds of coal, or to the carbon sequestered by 166 acres of U.S. forests in one year.

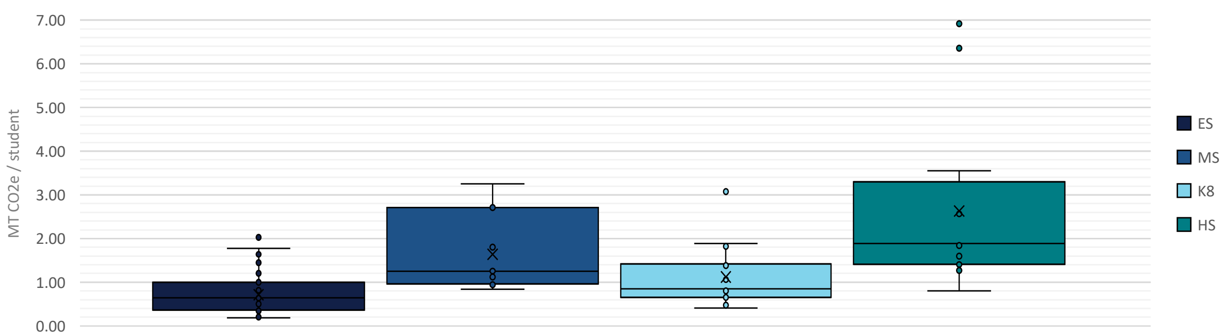

Figure 6: *Distribution of facility-level greenhouse gas emissions per enrolled student by school type.*

Rank	School District	MT CO2e/student	MT CO2e/1000 GSF
1	Ann Arbor Public Schools	1.55	7.58
2	Montgomery County Public Schools	1.26	-
3	**Tucson Unified School District**	**1.11**	**5.96**
4	Portland Public Schools	0.94	5.01
5	Oyster River Cooperative School District	0.92	-
6	Fairfax County Public Schools	0.72	4.66
7	Long Beach Unified School District	0.25	-
	Average (excluding TUSD)	**0.94**	**5.75**

Table 4. *Comparison of greenhouse gas emissions across school districts.*

4.1.4 Greenhouse Gas Emissions Comparison with Other School Districts

During FY2024, TUSD operations produced 1.28 MT CO2e per student and 6.86 MT CO2e per 1,000 gross square feet (GSF) of building area across all activities included in this report. To limit the impact of variation in data variability, however, comparison across districts requires limiting the activities included to those consistently reported across districts – stationary combustion, district-owned transportation, and purchased electricity. Across these activities, TUSD operations produced 1.11 MT CO2e per student and 5.96 MT CO2e per 1,000 GSF of building area.

These greenhouse gas emissions are near the middle of the range of those from six other districts with public inventories from recent years. There are many factors that may contribute to the variation in greenhouse gas emissions across districts as depicted in Table 4, including local climate, stringency of building energy code, energy mix of local utilities, and funding levels, among others. Additionally, the school districts for which greenhouse gas inventories were available may not be representative of all school districts in the U.S. Nevertheless, this comparison does suggest that TUSD emissions in FY2024 are at a scale of magnitude similar to those of other school districts.

4.2 Preliminary Building Energy-Use Analysis

Based on the methodology described in Section 3.3 and in the technical appendix, we present the results of the preliminary building energy-use analysis below. First, we compare energy use intensity (EUI) within each facility type and with similar institutions (Section 4.2.1). Next, we look at how different fuel types contribute to energy use (Section 4.2.2), followed by a comparison of energy costs (Section 4.2.3) and historical trends in energy use (Section 4.2.4). This is followed by an analysis of seasonal patterns in total energy use (Section 4.2.5) and peak electricity demand (Section 4.2.6). We conclude by estimating the energy and financial impacts of achieving energy use reduction targets (Section 4.2.7).

4.2.1 Energy Use Intensity Comparison

Across nearly every facility type, the typical TUSD facility requires less energy on an annual basis than is typical for similar buildings in the same climate zone (Figure 7). For example, the median source EUI for TUSD elementary schools is about half of the median source EUI for other K-12 schools in the same climate zone, and the median source EUI for TUSD high schools is about 20% lower than that of other K-12 schools (data were only available across all K-12 schools). This trend does not apply to the median TUSD warehouse/storage facility, which has a source EUI about 50% higher than typical, nor to vacant facilities, for which a comparison was not available.

This relative efficiency is likely more closely related to the fuel types that TUSD has selected to meet its building energy needs than how much energy the buildings themselves actually consume. TUSD has had solar panels installed through Solar Service Agreements at 82 facilities across nearly every facility type, enabling the district to use more electricity from these installations and less from the grid. While the electrical grid wastes almost twice as much energy as it delivers to customers, on-site solar panels do not waste any energy. Source EUI reflects these [in]efficiencies that are inherent to each fuel type.

The data reflecting site EUI, which removes the energy that is wasted before it reaches the building from the equation, further supports this conclusion (Figure 8). While the typical TUSD building requires less source energy on an annual basis, the amount of site energy consumed by the building itself is actually higher than is typical for similar buildings, at least across most facility types. For example, the median site EUI for district elementary schools is around 45 kBTU/sq.ft./yr, which is nearly 15% higher than the median site EUI for similar facilities.

For many types of TUSD facilities, both the source and site EUIs span a large range, including many facilities with energy usage well above what is typical both for TUSD and across similar institutions (Figure 8). For example, the typical district middle school has a source EUI of about 100 kBTU/sq.ft./yr, but one middle school uses over twice as much

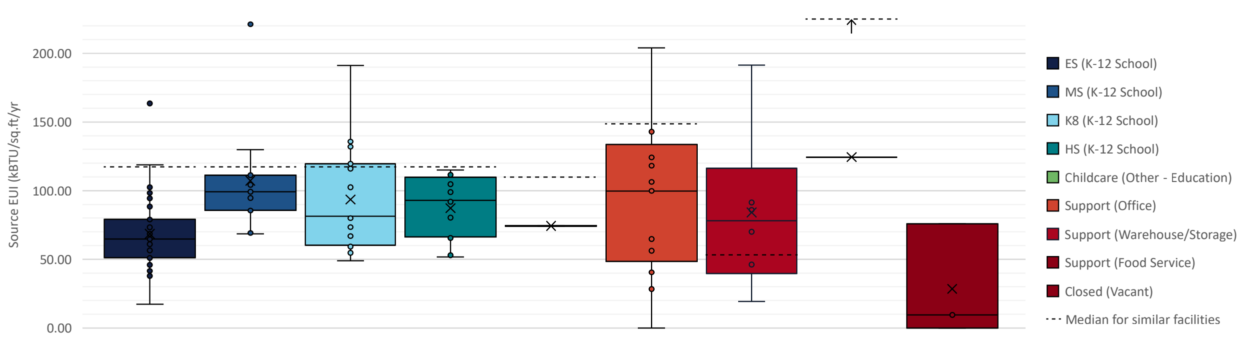

Figure 7: *Distribution of source energy use intensity by primary facility use, compared to the median for similar buildings in the same climate zone.*

energy per square foot, with a source EUI of 221 kBTU/sq.ft./yr. Table 5 contains information about the five schools within each school type (ES, MS, K8, and HS) that have the highest source EUIs. The purpose of this list is not to criticize the design, construction, or operation of these facilities, but rather to present a starting point for future analysis concerning the variation in energy use across district facilities.

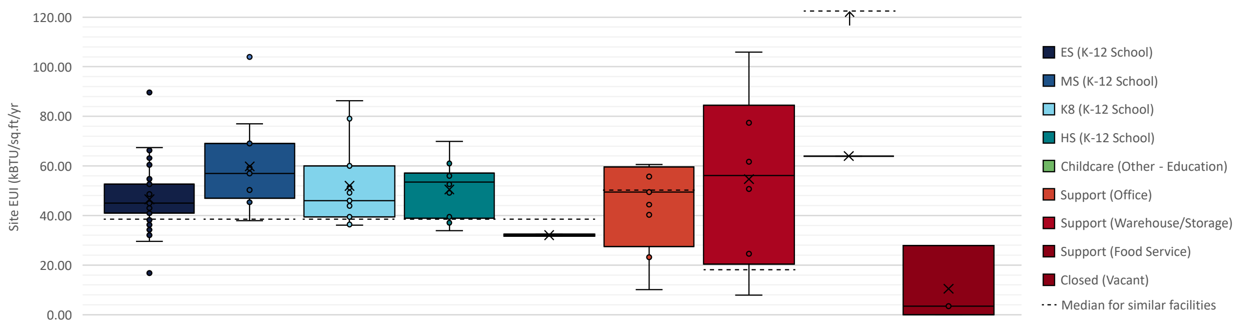

Figure 8: *Distribution of site energy use intensity by primary facility use, compared to the median for similar buildings in the same climate zone*

Rank	Facility	Source EUI (kBTU/sq.ft./yr)	% Above Median		Total Energy Costs	Total GHG Emissions (MT CO2e)
Elementary Schools						
1	Warren Elementary School	164	153%	$	126,978.26	436
2	Borton Magnet Elementary School	119	84%	$	107,843.06	434
3	Davis Bilingual Magnet Elementary School	105	62%	$	90,148.13	379
4	Wheeler Elementary School	104	61%	$	120,617.96	382
5	Sam Hughes Elementary School	102	58%	$	76,017.19	328
Middle Schools						
1	Doolen Middle School	221	123%	$	419,100.86	1,669
2	Dodge Traditional Magnet Middle School	130	31%	$	103,882.41	349
3	Gridley Middle School	111	12%	$	211,476.92	799
4	Valencia Middle School	107	8%	$	225,968.06	794
5	Alice Vail Middle School	104	5%	$	245,518.32	863
K-8 Schools						
1	Borman K-8	191	135%	$	162,913.28	740
2	Safford K-8	136	67%	$	349,413.46	1,468
3	Miles Exploratory Learning Center	132	62%	$	13,414.78	264
4	Morgan Maxwell K-8	120	47%	$	214,538.78	867
5	Roskruge Bilingual Magnet K-8	116	42%	$	194,758.89	876
High Schools						
1	Cholla High School	115	24%	$	639,957.92	3,016
2	Tucson Magnet High School	112	21%	$	1,114,567.80	6,030
3	Teenage Parent High School and Starr Center	112	20%	$	84,339.07	299
4	Mary Meredith K-12/Rosemont	105	13%	$	96,693.03	311
5	Sabino High School	99	7%	$	647,337.82	2,373

Table 5. *Facilities with the highest source EUI by facility type.*

4.2.2 Fuel Type Contribution to Energy Use

Across all seven types of facilities operated by TUSD, electricity purchased from the grid contributes more to total source energy usage than any other fuel type (Figure 9). For most facility types, natural gas meets the second highest proportion of energy needs, ranging in contribution from 12-20%, and electricity purchased from on-site solar installations through Solar Service Agreements contributes the third-highest amount, typically ranging from 11-15% for facilities that have solar installations. Two types of facilities present a break from this pattern – closed facilities, which did not use any natural gas, and elementary schools, which proportionally used over twice as much energy from on-site solar than any other facility type and a comparable proportion of natural gas.

Note that diesel usage data were not available at the time of this report, and TUSD is working on creating a system to track this. Regardless, because the district only utilizes five diesel-powered generators across four facilities, the contribution is anticipated to be minimal.

4.2.3 Building Energy Cost Intensity

The typical energy cost intensity (ECI, measured in total annual energy cost per square foot of building area) for non-closed district facilities ranged from $1.22 to $3.15 per square foot of building area per year (Figure 10). This corresponds to total building energy costs of over $16.5 million in FY2024. Unfortunately, ECI data for similar institutions within the same climate zone were not publicly available for comparison at the time of this report.

The food service facility has the highest ECI at $3.15 per square foot, which is likely related to the fact that food storage and preparation are activities typically require large amounts of energy.

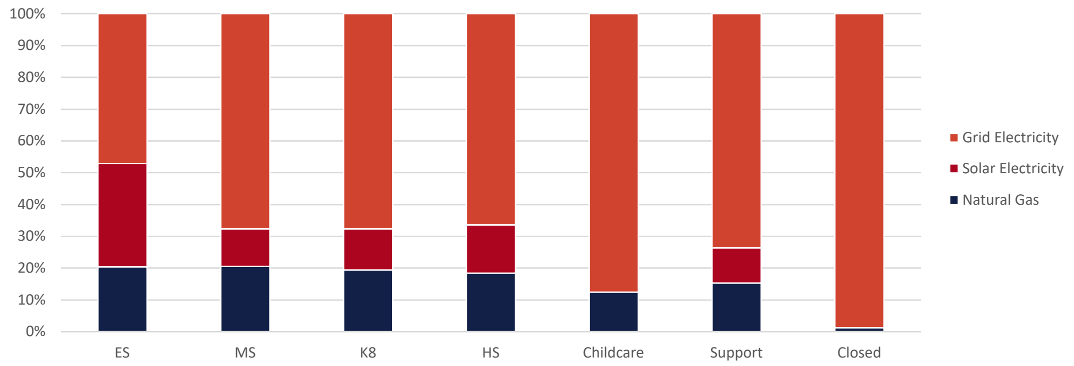

Figure 9: *Fuel type contribution to total source energy use by facility.*

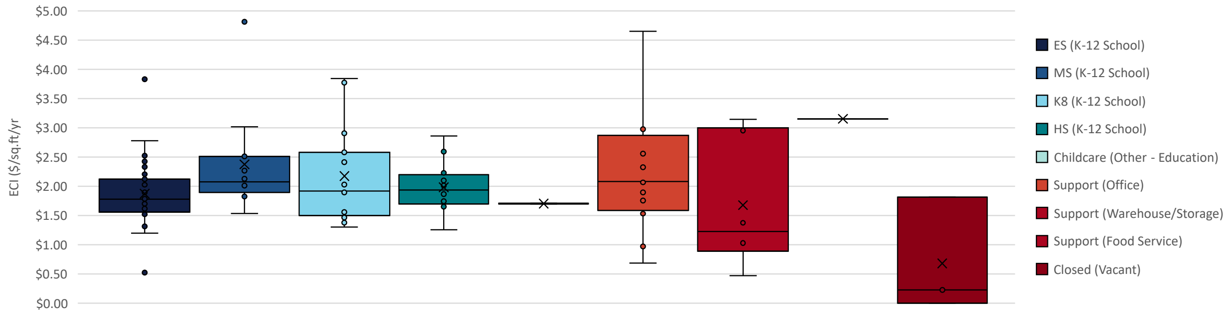

Figure 10: *Distribution of energy cost intensity (total annual energy cost per square foot of building area) by primary facility use.*

For many types of TUSD facilities, the ECIs span a large range, including many facilities with energy costs well above what is typical. For example, the median district middle school has an ECI of about $2.00 per square foot per year, but one middle school costs over twice as much per square foot, with an ECI of around $4.80. While the difference between $4.80 and $2.00 may not seem large, this would correspond to an annual energy cost difference of $140,000 of $140,000 for a 50,000 square foot facility.

These energy costs are not distributed evenly throughout the year. Over the summer, when building cooling needs are highest, electricity usage spikes, and energy costs reach their annual

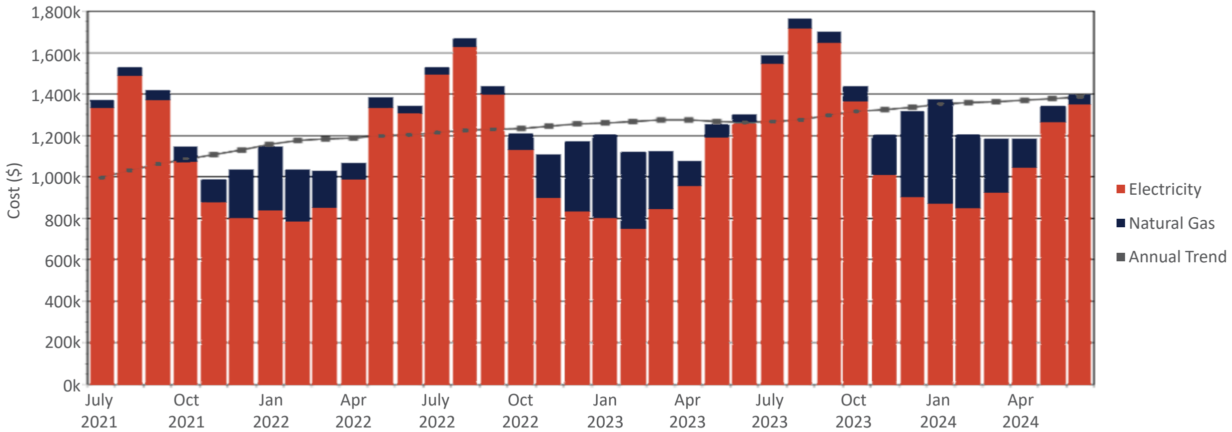

Figure11: *Trends in district-wide monthly energy costs over time.*

4.2.4 Historical Comparison of District-Wide Energy Use

District-wide energy use in buildings was about 10% higher in FY2024 than the average for FY2021 - FY2023, increasing by about 65 million kBTU (Figure 12). While district energy use increased overall, the balance of energy use shifted more towards electricity purchased from the grid and less from electricity purchased from on-site solar installations. In fact, energy use from on-site solar decreased in terms of both absolute energy use and as a percentage of total energy use. As the percentage of energy use from natural gas has remained relatively consistent between the FY2021-2023 average and FY2024, the percentage of electricity from the grid has increased to make up the difference. At around 9%, the decrease in total electricity output from on-site solar is larger than the median degradation rate, which is around 0.5% per year (Jordan & Kurtz, 2013).

District facility types generally fall into three categories based on changes in total energy use (Figure 13). Facility types with relatively consistent energy usage between FY2024 and the FY2021-2023 average include elementary schools and support facilities. Three facility types used more energy in FY2024 than the previous three years – middle schools, K-8 schools, and high schools. Meanwhile, childcare and closed facilities demonstrated a decrease in total energy use.

Without further historical analysis, however, it is unclear if energy use in FY2024 is representative of total district energy use and trends in energy use, or if various factors led energy use in FY2024 to deviate from typical patterns.

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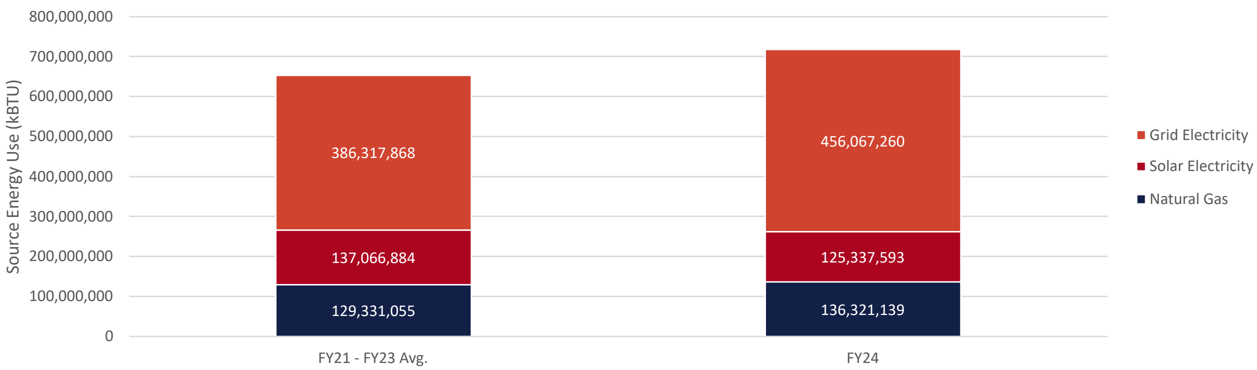

Figure12: *Historical comparison of total source energy use by fuel type between FY2024 and the average of FY2021 - FY2023.*

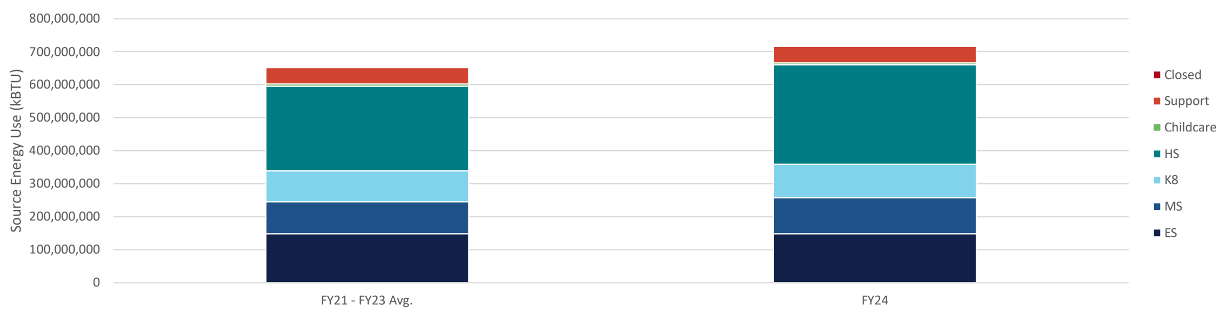

Figure13: *Historical comparison of total source energy use by facility type between FY2024 and the average of FY2021 - FY2023.*

4.2.5 Seasonal Energy Use Patterns

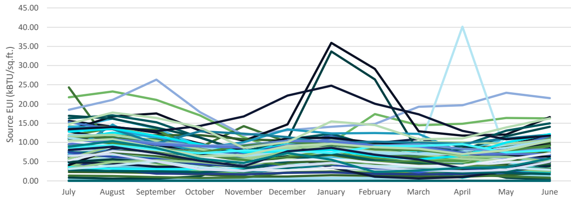

Figure14: *Source EUI by month.*

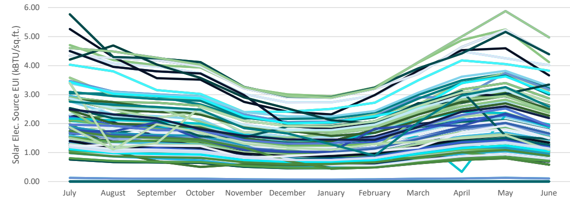

Figure15: *Solar electricity source EUI by month.*

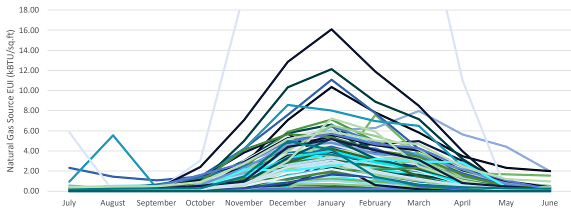

Figure16: *Natural Gas Source EUI by month.*

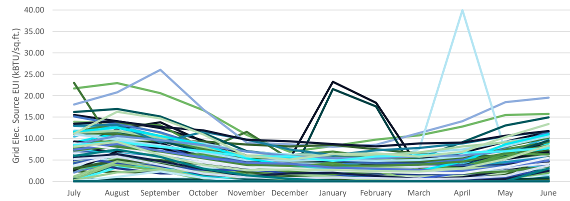

Figure17: *Grid electricity source EUI by month.*

The figures above depict the energy use for each district facility by month (n=112), including total energy use per square foot (Figure 14), on-site solar electricity energy use per square foot (Figure 15), natural gas energy use per square foot (Figure 16), and grid electricity energy use per square foot (Figure 17).

Each fuel type presents a slightly different profile. Natural gas usage, for instance, is minimal throughout the summer months, then increases in the fall and dramatically peaks in January before decreasing throughout the spring. This corresponds to the heating season. Electricity usage from on-site solar presents an inverted pattern, albeit a less dramatic one. While a base level of solar electricity is used throughout the year, usage is slightly lower in the winter months, when less solar radiation is present, and higher from late spring to early fall, when more solar radiation is present. Grid electricity usage is likewise lower throughout the winter, and peaks during the summer months.

While electricity usage measures the amount of electricity that is needed over a period of time, peak electricity demand measures the highest rate of electricity usage that is needed by a facility over that same period of time.

4.2.6 Peak Electricity Demand Patterns

There is some variation in peak electricity demand patterns between different facilities, but in general, it appears that most facilities have an annual peak during the summer months (Figure 18). This means that the point in time where TUSD facilities require the most electricity to be generated in order to power district operations occurs during the summer. For example, electricity demand at Banks Elementary School peaked in August and September at around 3.97 kW/1000 GSF and was lowest in December and January at around 1.61 kW/1000 GSF. As TUSD shifts from natural gas space heating to electrical space heating, however, this pattern is likely to shift so that electricity demand peaks either in the summer and in the winter, or possibly only during the winter.

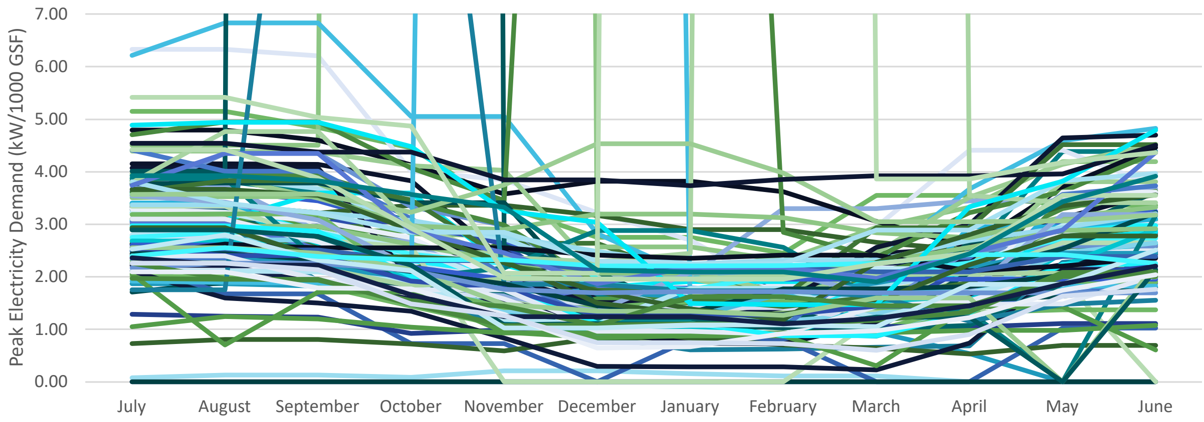

Figure18: *Peak electricity demand by month for each TUSD facility.*

Peak Electricity Demand

The implications of peak electricity demand can be demonstrated using the example of a bathtub. If a bathtub is full of water but has an unplugged drain, and the objective is to keep the bathtub continuously full of water, there are three factors to consider: the rate at which water is draining, the rate at which the faucet can supply water, and the total amount of water added to the bathtub over a period of time. If the rate at which water is draining varies over time, the faucet must be large enough to supply water at the fastest rate that the bathtub may drain at, even if this is much larger than would be required the majority of the time. Peak electricity demand is similar to the fastest rate at which water drains from the bathtub, and it likewise determines the necessary size and capacity of electricity generation facilities, the overall electricity grid, and building systems related to electricity use.

4.2.7 Impact of Achieving EUI Targets

TUSD's Climate Action and Sustainability Policy establishes an aspirational goal to reduce net energy consumption 25% below the baseline year by 2030 (Tucson Unified School District, 2024). Using FY2024 as the baseline, progress toward this goal can be assessed through reductions in both site and source energy use intensity (EUI). A 25% district-wide reduction, applied uniformly across all fuel types, would decrease the average source EUI of school facilities from 84.51 to 63.38 and the average site EUI from 49.79 to 37.35. Achieving this performance would place TUSD facilities below the median for K-12 schools in comparable climate zones, highlighting the district's potential to serve as a regional model for energy efficiency.

This reduction would correspond to an estimated $5 million in annual energy cost savings across elementary schools, middle schools, K-8 schools, and high schools, totaling $100 million in savings over a 20-year period. This value is a high-level approximation intended to illustrate order-of-magnitude impacts. Actual savings would depend on factors such as energy pricing, building occupancy, and weather, among other things. Nonetheless, this estimate underscores the significant cost and performance benefits associated with district-wide energy use reductions.

5. Key Opportunities

This report provides an overview of TUSD's greenhouse gas emissions and an analysis of building energy use throughout FY2024. It is intended to support ongoing efforts to improve the climate-related impacts of TUSD operations, in alignment with the district's Climate Action and Sustainability Policy. In this section, we identify several near-term and long-term opportunities for TUSD to reduce greenhouse gas emissions, improve energy efficiency, and lower operating costs. It begins with four sets of opportunities that relate to the activities that constitute the majority of the greenhouse gas emissions covered by this report, including grid-purchased electricity (Section 5.1), refuse (Section 5.2), natural gas (Section 5.3), and district-owned transportation (Section 5.4). This section concludes by discussing an opportunity for efforts to reduce greenhouse gas emissions to complement TUSD's educational mission (Section 5.5) and opportunities for effective long-term evaluation of progress toward the goals of the Climate Action and Sustainability Policy (Section 5.6).

5.1 Opportunities to Reduce Emissions from Purchased Electricity

5.1.1 Pursue Building Energy Retrofits

During FY2024, TUSD facilities generally used more energy per square foot of building area than similar institutions in the same climate zone, excluding energy that was wasted before it reached the building (Section 4.2.1). This suggests significant opportunities to reduce overall energy consumption and associated greenhouse gas emissions through targeted building retrofits.

Retrofits that address the building enclosure, such as improved insulation, mitigation of thermal bridging, air sealing, and optimizing seasonal heat gain through windows, can lower annual cooling and heating needs. Ensuring cooling, heating, and ventilation systems are operating optimally and replacing aging equipment with more efficient models can meet cooling and heating needs with less energy. Additionally, increasing the efficiency of other systems that use electricity can further reduce energy use without compromising comfort or functionality.

Reducing peak electricity demand is equally critical. As TUSD electrifies heating and cooking equipment (Section 5.3.1) and vehicle fleets (Section 5.4.1), electricity demand patterns will shift—reducing natural gas consumption but increasing winter electricity loads (Section 4.2.6). This trend, observed across many regions in the United States, poses challenges for both grid reliability and decarbonization because solar energy production peaks in the late afternoon during summer months but is lowest in the early mornings of winter, when heating demand is highest (Keskar et al., 2023). If unmanaged, this mismatch could lead to higher electricity costs, increased emissions from peaking power plants, and potential strain on the local grid.

TUSD can help address this challenge through demand management strategies, in addition to the energy efficiency measures described above. Demand management strategies include pre-cooling or pre-heating buildings during off-peak hours, adding thermal or battery storage, and participating in utility demand response programs, among others. Implementing these measures can not only lower electricity costs but also support grid stability as the district and region move toward greater electrification.

By combining building efficiency improvements with demand management, TUSD can help ensure that electrification reduces total emissions rather than simply shifting where they occur. These actions would position the district as a regional leader in supporting the clean energy transition while improving comfort, reliability, and resilience across its facilities.

5.1.1 Connection to TUSD's Climate Action and Sustainability Policy (CASP)

Pursuing this opportunity would contribute to CASP I.B.2 Building Portfolio and Project Level Goals.

5.1.2 Increase Solar Capacity and Energy Storage

TUSD currently operates twelve small solar installations and purchases additional solar power through Solar Service Agreements associated with on-site solar installations owned by a third party. While these installations have reduced dependence on grid electricity, total output from district-owned solar declined by approximately 9% between FY2021-2023 and FY2024 — far higher than the typical degradation rate of about 0.5% per year (Jordan & Kurtz, 2013). This suggests that existing systems may warrant further investigation to determine whether the reduction is due to differences in weather, equipment degradation, maintenance issues, metering discrepancies, or some other cause before expanding solar capacity further.

A cost-benefit analysis of increasing solar capacity is beyond the scope of this report. TEP no longer implements the same net metering policy for new installations that allowed the district to claim an emissions rate of zero for an amount of grid-purchased electricity equivalent to the amount of solar-generated electricity that is exported to the grid, in addition to electricity generated by on-site solar installations and used immediately. Estimating the costs and benefits of a grid-tied solar system without net metering is complex because it requires detailed information in hourly (or shorter) increments about energy use and solar generation to evaluate how much electricity would be consumed on-site versus exported.

One potential approach is to consider the installation of battery storage alongside new solar systems, allowing TUSD to store excess generation on-site and retain the full value of lower-cost solar electricity. Battery storage would also provide resilience benefits, enabling critical functions to continue during power outages without relying on fossil fuel-powered generators.

5.1.2 Connection to TUSD's Climate Action and Sustainability Policy (CASP)

Pursuing this opportunity would contribute to CASP I.B.4. Energy Usage: efforts to achieve a net-zero energy school district by 2040.

5.1.3 Support Efforts to Decarbonize TEP's Energy Portfolio

Electricity purchased from Tucson Electric Power (TEP) accounts for roughly two-thirds of TUSD's total greenhouse gas emissions (Table 3). These emissions stem from TEP's current generation mix, which remains dominated by fossil fuels such as coal and natural gas. As a result, even highly efficient or fully electrified facilities will continue to produce indirect (Scope 2) emissions until the regional grid becomes less reliant on fossil fuels.

While TUSD cannot directly control the energy sources that TEP uses, the district can play a meaningful role in supporting regional decarbonization efforts. TUSD can join coalitions of large customers advocating for clean energy procurement options, participate in renewable energy programs offered by utilities, and publicly share its progress and demand for low-carbon electricity.

We recognize that TUSD is not an advocacy group nor political organization. However, the district's Climate Action and Sustainability Policy provides a valuable framework for education and leadership on environmental issues. By engaging students and the community around the topic of electricity decarbonization, TUSD can advance climate literacy while reinforcing the importance of a sustainable and reliable power system.

If TEP continues to reduce the carbon intensity of its electricity by achieving, for example, a 25% reduction by 2030, TUSD's total greenhouse gas emissions could decrease by over 4,200 MT CO_2e without additional on-site investment. This reduction would be equivalent to driving 10.5 million miles less by car or diverting nearly 1,500 tons of waste from the landfill. Supporting these efforts aligns with the district's own sustainability goals and multiplies the impact of ongoing energy efficiency and electrification initiatives.

5.1.3 Connection to TUSD's Climate Action and Sustainability Policy (CASP)

Pursuing this opportunity would contribute to CASP I.B.4 Energy Usage: striving to attain 100% clean energy usage by 2035.

5.1.4 Prioritize Outlier Facilities

Within each facility type, several TUSD buildings stand out as clear outliers with unusually high energy use per square foot of building area, which results in higher energy costs and greenhouse gas emissions (Table 5). The fact that many other facilities require much less energy to meet similar operational needs suggests that these outlier facilities may present high-impact opportunities for reducing electricity use and related greenhouse gas emissions from purchased electricity.

We recommend that TUSD conduct in-depth energy audits for these outlier facilities to identify underlying causes, such as deficiencies in building enclosures, aging or inefficient HVAC equipment, or malfunctioning controls, among other things. Addressing these issues through building energy retrofits or operational adjustments could yield significant reductions in energy use, operating costs, and emissions. By prioritizing reduction efforts for the least efficient facilities, the district can likely achieve the greatest return on investment per dollar spent and demonstrate visible early progress toward CASP goals.

5.1.4 Connection to TUSD's Climate Action and Sustainability Policy (CASP)

Pursuing this opportunity would contribute to CASP I.B.2 Buildings Portfolio: reducing net energy consumption by 25% below the baseline year.

5.1.5 Consolidate Summer Operations Within Select Facilities

Each year, electricity usage and costs for TUSD facilities spike during the summer as high temperatures drive cooling demand (Figure 11). These peak costs occur when buildings are typically occupied by the fewest students and staff. The understanding of the research team is that this is largely due to a district policy requiring that, if any part of a building is occupied by staff during the summer, the entire building must meet particular indoor temperature requirements. We recommend that TUSD explore the possibility of maintaining comfortable working conditions while reducing energy use and costs during the hottest time of the year by consolidating district operations within a select number of facilities during the summer. If district operations were consolidated within a select number of facilities when classes are not in session, electricity use could be significantly lowered in unoccupied facilities by temporarily turning off equipment that is not in active use and decreasing cooling needs, reducing associated electricity costs and greenhouse gas emissions.

To demonstrate the potential impact of this opportunity, consider district-wide electricity costs in July 2024, which totaled $1,594,268—the highest on record while schools were not in session. If a consolidation of district operations had allowed one elementary school facility, one middle school facility, and one high school facility to remain unoccupied during this month, a 50% reduction in electricity use at these facilities would have saved an estimated $45,000 in electricity costs. Savings would increase with additional consolidation of operations during summer months.

While the UA research team cannot fully assess the logistical challenges of operational consolidation during summer months, this could be an effective opportunity to reduce greenhouse gas emissions that is readily available in the short term, as it requires no new infrastructure and no building modifications.

5.1.5 Connection to TUSD's Climate Action and Sustainability Policy (CASP)

Pursuing this opportunity would contribute to CASP I.B.2 Building Portfolio and Project Level Goals.

5.2 Opportunities to Reduce Emissions from Refuse

5.2.1 Implement Waste Reduction & Diversion Programs

Some of TUSD's emissions from refuse stem from the disposal of materials that might otherwise be composted or recycled. TUSD has already begun experimenting with composting through a pilot program supported by the U.S. Department of Agriculture, the University of Arizona School Garden Workshop, and Compost Cats. Eleven schools now collect cafeteria food scraps and return finished compost to school gardens. Additionally, the district has made recycling bins available across district facilities.

Looking ahead, the district can build on this foundation by focusing on waste reduction in addition to waste diversion. Reducing waste at the source through actions such as thoughtful purchasing, creative reuse, and food waste prevention cuts emissions before they occur. Expanding composting and recycling across schools then ensures that remaining materials are handled responsibly. Together, reducing total waste generation by 10%, diverting 10% of landfill materials to composting, and diverting 10% to recycling, for example, would lower annual emissions from waste disposal by about 25%, and total district emissions by about 5% based on the activities included in this report.

5.2.1 Connection to TUSD's Climate Action and Sustainability Policy (CASP)

Pursuing this opportunity would contribute to CASP I.C Scope 3: Indirect Emissions Outside of TUSD's Control by reducing emissions from waste.

5.3 Opportunities to Reduce Emissions from Natural Gas

5.3.1 Plan for Long-Term Building Electrification

Many TUSD facilities currently rely on the combustion of natural gas to meet space heating, water heating, and cooking needs. Since the chemical process of fossil fuel combustion is inextricably tied to greenhouse gas emissions, shifting all remaining fossil fuel systems to electric alternatives will be essential to meeting greenhouse gas reduction targets, especially as the electricity grid becomes more and more decarbonized. This transition will likely require a long-term approach implemented in phases over a number of years.

If the district achieves full electrification of building systems by 2040, consistent with the goals outlined in TUSD's Climate Action and Sustainability Policy, nearly all direct (Scope 1) emissions could be eliminated. Provided that Tucson Electric Power achieves its aspirational target of net-zero direct emissions by 2050 (Tucson Electric Power, 2023) and Trico Electric Cooperative meets similar reductions, this would allow TUSD operations to be nearly free of combustion-related greenhouse gas emissions.

The associated increase in electricity demand, however, will require careful planning to minimize peak load and ensure that facilities remain affordable to operate, which we discuss in Section 5.1.1.

5.3.1 Connection to TUSD's Climate Action and Sustainability Policy (CASP)

Pursuing this opportunity would contribute to CASP I.B.3 Electrification and Energy Efficiency by achieving full electrification of building systems by 2040.

5.3.2 Pursue Building Energy Retrofits

The opportunity to improve building energy efficiency as discussed in Section 5.1.1 would decrease energy use across different fuel sources, including both electricity and natural gas, thus reducing emissions from natural gas.

5.4 Opportunities to Reduce Emissions from Transportation

5.4.1 Plan for Long-Term Transportation Fleet Electrification

In FY2024, TUSD owned and operated nearly 600 vehicles across the yellow and white fleets that rely on the combustion of fossil fuels, including diesel, unleaded gasoline, and compressed natural gas. As with equipment that involves the combustion of natural gas, full electrification of this transportation fleet provides an essential path to meeting greenhouse gas reduction targets.

The district has already utilized grant funding and rebates provided by national and local sources to procure 10 electric school buses. Long-term planning will enable TUSD to continue this effort and achieve the goal to achieve full fleet electrification by 2040 as outlined in the Climate Action and Sustainability Policy.

5.4.1 Connection to TUSD's Climate Action and Sustainability Policy (CASP)

Pursuing this opportunity would contribute to 1.B.1 Transportation, which establishes the aspirational goal of achieving electrification of the yellow and white fleets by 2040.

5.5 Opportunities to Provide Skills-Based Training to Students

5.5.1 Support Student Apprenticeship Programs in Partnership with Local Trades

Decarbonization efforts across TUSD's portfolio present an opportunity for Tucson's building trades unions to lead essential efficiency upgrades using highly skilled labor, while also expanding skill-based training for emerging high school graduates through pre-apprenticeship programs. One of Jobs With Justice's core objectives is to support workforce development and training for students interested in entering the building trades. A partnership between Tucson Jobs With Justice and TUSD would showcase the critical role of apprenticeships in bringing new talent and technical expertise into the local trades. This career pipeline benefits not only TUSD and its students, but the broader community as well, as the skills these individuals acquire are portable and directly applicable to advancing the decarbonization strategies outlined in this report.

5.5.1 Connection to TUSD's Climate Action and Sustainability Policy (CASP)

Pursuing this opportunity would contribute to CASP III. Education through the development of pre-apprenticeship programs for TUSD students.

5.6 Opportunities for Evaluating Progress

5.6.1 Identify and Select an Optimal Baseline Year

This report covers TUSD greenhouse gas emissions during FY2024 in accordance with the district's Climate Action and Sustainability Policy, which calls for a greenhouse gas inventory covering "the most recent fiscal year" as of the policy's adoption in October 2024. It is important to note, however, that FY2024 may not present the ideal baseline against which to benchmark future progress toward emission reduction goals for two reasons. First, total energy use in district facilities during FY2024 was roughly 10 percent higher than the average of FY2021-FY2023 (Figure 12). The unusually high nature of FY2024 energy usage, which contributes to the majority of greenhouse gas emissions from activities included in this report, may obscure the true scale of future emissions reductions from initiatives to decrease energy use and merits further analysis. Second, TUSD has implemented a number of measures to reduce emissions from energy use in previous years, including replacing the majority of interior and exterior lighting with LED fixtures and pursuing Solar Service Agreements to procure significant amounts of electricity from on-site solar installations. The selection of a baseline year prior to the implementation of such initiatives would enable TUSD to take credit for the substantial progress that it has already made toward emission reduction goals.

Establishing an optimal baseline is essential for accurate tracking of progress under the Climate Action and Sustainability Policy, ensuring that future reductions are measured against consistent and meaningful reference conditions. We suggest that the selection of an optimal baseline year should ensure adequate data availability, minimize the impact of abnormal operating conditions, and account for the timing of past initiatives with significant impact on greenhouse gas emissions. Once finalized, we recommend that this baseline be documented within district sustainability reports and inform interim targets for 2030, 2040, and beyond.

5.6.1 Connection to TUSD's Climate Action and Sustainability Policy (CASP)

Pursuing this opportunity would contribute to CASP 1.A Greenhouse Gas (GHG) Baseline Report by ensuring that the selection of an optimal baseline year.

5.6.2 Explicitly Define Operational Boundaries and Increase Data Availability

Comprehensive and reliable data collection is essential for evaluating progress toward district-wide decarbonization. While this report establishes a strong foundation, several greenhouse gas-emitting activities are not yet tracked in sufficient detail to support estimation of emissions and documentation of reductions (Figure 2). Establishing consistent systems for data collection would allow TUSD to refine its emissions estimates, identify emerging sources, and improve the accuracy of future reporting.

Data were not available regarding two Scope 1 activities, which are included in greenhouse gas inventories under the *Corporate Standard*, making this report incomplete in that respect. One of these activities is refrigerant leakage from HVAC systems in buildings and vehicles, which can release gases with global warming potential thousands of times greater than carbon dioxide. The second activity involves diesel combustion in a small number of generators. TUSD has already begun developing and implementing systems to track these activities as a result of conversations that occurred during the completion of this report, and these data should be incorporated into future greenhouse gas inventories.

In addition, many Scope 3 activities remain unquantified but may contribute meaningfully to the district's overall greenhouse gas emissions (Figure 2). These include some activities explicitly mentioned in the Climate Action and Sustainability Policy, such as employee and student commuting, procurement of products and services, and composting, as well as others that are neither explicitly included or excluded from the CASP, such as emissions from assets that TUSD leases to other entities, downstream transportation and distribution, and other upstream energy and fuel-related activities, among others.

Going forward, we recommend that TUSD carefully consider and define the operational boundaries (i.e., the set of activities) that its greenhouse gas reduction targets will cover. Under the *Corporate*

Standard, only Scope 1 and Scope 2 emissions are required for a complete inventory, yet Scope 3 emissions often represent a substantial portion of an organization's total footprint. Although these emissions occur from sources not directly owned or controlled by the district, TUSD has considerable influence over many of them - particularly those related to transportation, procurement, and waste management. Clarifying the extent to which these emissions will be included in district-wide targets and implementing improved data tracking for all relevant activities will improve transparency, support consistent tracking of progress toward emission reduction targets, and guide the prioritization of future mitigation efforts.

5.6.2 Connection to TUSD's Climate Action and Sustainability Policy (CASP)

Pursuing this opportunity would be required for TUSD to assess the effectiveness of all emission reduction strategies toward the aspirational goals of cutting emissions in half by 2030 and reaching net-zero by 2040 .

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About the Drachman Institute

The Drachman Institute of the University of Arizona College of Architecture, Planning and Landscape Architecture (CAPLA) serves as a nexus for research and design projects that center around outreach work.

The Drachman Institute is committed to advancing equity, resilience, connection and belonging across the built environment through transformational interdisciplinary research, design and outreach partnerships.

The Drachman Institute bridges community needs and CAPLA's knowledge and expertise to advance equity, resilience, connection and belonging across the built environment. The Drachman Institute's research and design work are linked in an iterative process that continues to calibrate the performance of the built environment to meet the goals of the populations it serves.

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