

MIDPENINSULA REGIONAL OPEN SPACE DISTRICT

2022 Greenhouse Gas Inventory Report

June 2023



The newly remodeled, energy efficient administrative office building at 5050 El Camino Real. Photo: Sophie Christel

Executive Summary

This report describes Midpen’s operational greenhouse gas emissions for the year 2022, climate actions that have been taken to reduce emissions, and future work to be done under Midpen’s climate program.

Key findings

Midpen surpassed the 2022 emissions reduction goal of 20%, achieving a total reduction of 30% from the 2016 baseline. This progress includes a 25% decrease in Fleet, Equipment and Business Travel, 42% decrease in Employee Commute, 10% decrease in Facilities, and 34% decrease in Tenant Residences.

Key Terms

GREENHOUSE GAS (GHG): Gases that cause climate change, such as carbon dioxide (CO₂) and methane

METRIC TON OF CARBON DIOXIDE EQUIVALENT (MTCO_{2e}): Standard unit of measurement for greenhouse gases

ADMINISTRATIVE EMISSIONS: Midpen GHG emissions from administration/operations (vehicles, commuting, facilities, residences) for which Midpen set greenhouse gas reduction goals

EMISSION FACTOR: A constant used to convert directly measurable data (e.g. gallons of fuel) into GHG emissions

- If the current trend continues, Midpen is likely to meet the 2030 goal of 40% reductions but may miss the 2050 goal of 80% reductions.
- The new administrative office at 5050 El Camino Real uses 88% less natural gas and 62% less electricity per square foot than the old office. Since systems at the old office ran through August of 2022, the full impact of that efficiency was not captured in this inventory.
- Fleet, Equipment, and Business Travel remains the largest sector of Midpen’s emissions at nearly half the total. The use of renewable diesel (and procurement of diesel vehicles) continues to help reduce fleet emissions, and business travel emissions have fallen thanks to readily available virtual options.
- The new hybrid work schedule for administrative office employees is popular and an effective way to reduce commute emissions. Hybrid work did not encourage employees to move farther away – in fact, average commute distance decreased compared to 2020.

Next Steps and Recommendations

- The biggest hurdle facing Midpen’s emission reductions going forward is the fleet, which will continue to grow along with staff and landholdings. Midpen will develop a fleet transition and decarbonization plan in Fiscal Year 2024. This will provide a roadmap to identify and procure the best low- and zero-emissions vehicles to meet operational needs, build out the necessary EV infrastructure, improve operational efficiency, and continue to reduce emissions.
- Midpen still has blind spots regarding construction and contractor emissions. These emissions could represent a significant portion of Midpen’s footprint, but since they are not currently tracked, it is challenging to develop and implement actions to reduce them. In Fiscal Year 2024, staff from the Natural Resources, Engineering and Construction, and Land and Facilities departments plan to develop data-collection methodologies and standardized contract language to aid in quantification of these emissions going forward.
- Reducing emissions has been Midpen’s climate action priority since 2018. However, the annual emissions total is offset many times over by sequestration on preserve lands, and Midpen can increase its impact by focusing on adaptation and resilience across that landscape. Climate-smart land management protects the landscape’s ability to sequester and store carbon, and buffers sensitive species and habitats from climate changes that are already occurring and will continue regardless of Midpen’s emission reduction efforts. Infrastructure resilience is also important to maintain safe public access and reduce repair costs after fire or severe weather events. There is an opportunity to incorporate adaptation and resilience into the District-wide work program by developing an action plan, akin to the Climate Action Plan, with a menu of adaptation and resilience actions for each work program area and measurable goals to maintain accountability. Staff plan to begin this planning and goal-setting process in Fiscal Year 2024.
- Carbon sequestration is another important area under the climate program. In Fiscal Year 2024, Midpen will collect baseline carbon sequestration and storage data and develop a carbon monitoring protocol to track how the carbon stored in redwood forests – the region’s sequestration champions – responds to management practices. It may take decades after treatment to see a verifiable carbon capture increase, but it is worth investing in future sequestration capacity because CO₂ released today can linger in the atmosphere anywhere from 300 to 1000 years. As a large-scale manager of natural and working lands, which scientists and

the state and federal governments have identified as key to carbon drawdown, Midpen also has a responsibility to be proactive about carbon management. The long residence time of CO₂ in the atmosphere also necessitates that future carbon-reducing mechanisms are set in place today to offset the District's ongoing emissions.

- Several other climate-related projects are planned for the next Fiscal Year, including preparing for a study of the effects of biochar application on native grassland, various fire program efforts, repairs and improvements to infrastructure damaged in the 2022-2023 winter storms, and development of a drought response plan.

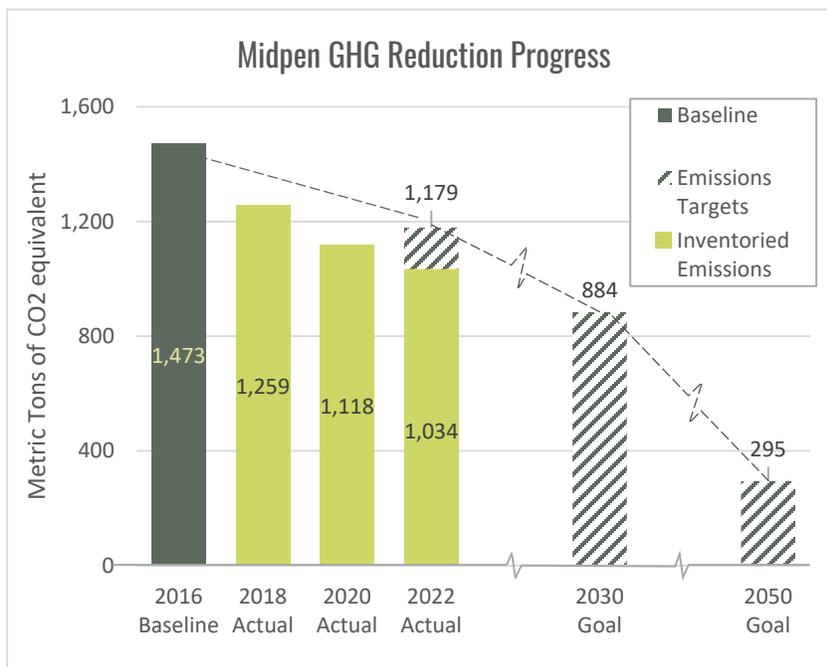
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Introduction

Midpen’s Board adopted the Climate Action Plan in October 2018 to reduce the agency’s greenhouse gas (GHG) emissions and ensure that, in line with our mission to protect the environment in perpetuity, Midpen is doing its part to act on climate change. The Climate Action Plan commits to reducing administrative greenhouse gas (GHG) emissions **20% below a 2016 baseline by 2022, 40% by 2030, and 80% by 2050**, in line with California’s climate change goals set in 2016 by AB 32 and the Paris Climate Agreement¹. The Climate Action Plan lists dozens of changes Midpen can make to reduce emissions.

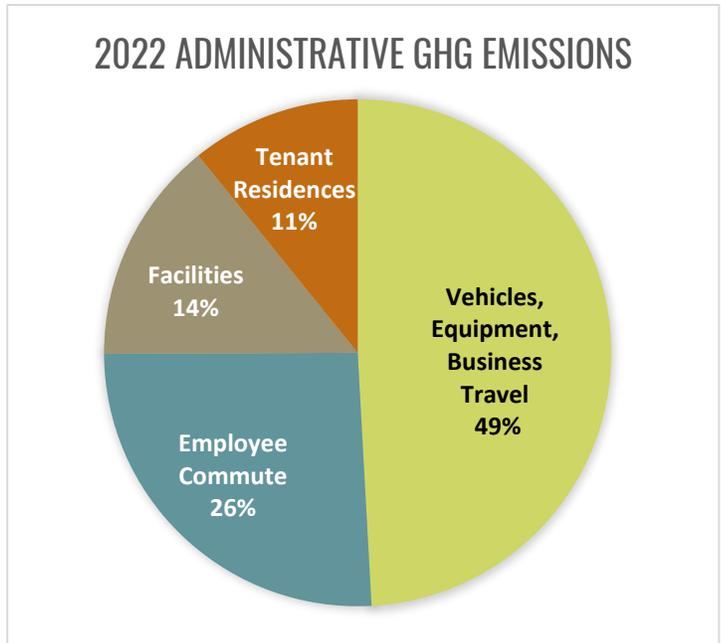
Midpen conducts a GHG inventory every two years to measure progress towards the GHG reduction goals and assess the effectiveness of Climate Action Plan items that are implemented. The data collection process and resulting report are presented to the Board of Directors and the public. This report summarizes Midpen’s GHG inventory for the year 2022. It also discusses two other growing areas of Midpen’s climate program: adaptation and resilience, and carbon sequestration and storage.



ADMINISTRATIVE GHG EMISSIONS (MTCO ₂ E)	2016	2018	2020	2022	CHANGE FROM 2016
Vehicles, Equipment, Business Travel	676	608	500	508	-25%
Employee Commute	463	389	287	267	-42%
Facilities	163	136	220	147	-10%
Tenant Residences	170	125	110	112	-34%
Administrative GHG Emissions Total	1,473	1,259	1,118	1,034	-30%

¹ Following the passage of Senate Bill 100 in 2018, Governor Newsom issued an Executive Order setting a statewide goal of carbon neutrality by 2045. The goal is to be achieved through a combination of emission reductions and increased sequestration. Annual sequestration on Midpen land is approximately 60 times the annual administrative emissions. Even with the addition of visitor emissions (measured at 6 preserves, then scaled to represent all 24 preserves) and livestock emissions, sequestration still outweighs emissions by 2.5 times.

Midpen analyzes GHG emissions in six sectors: 1) Vehicles, Equipment and Business Travel, 2) Employee Commute, 3) Facilities, 4) Tenant Residences, 5) Livestock, and 6) Visitor Transportation. The first four sectors are considered “administrative emissions” – emissions resulting directly from Midpen operations and over which Midpen has significant influence. The Climate Policy’s GHG reduction goals apply to these sectors. Livestock and visitor transportation are “non-administrative emissions” – emissions related to Midpen activities and over which Midpen has less control. Though non-administrative emissions are not part of the policy’s GHG reduction goals, Midpen tracks them and works to reduce them as well. They are addressed in Appendix 1: Non-Administrative Emissions.

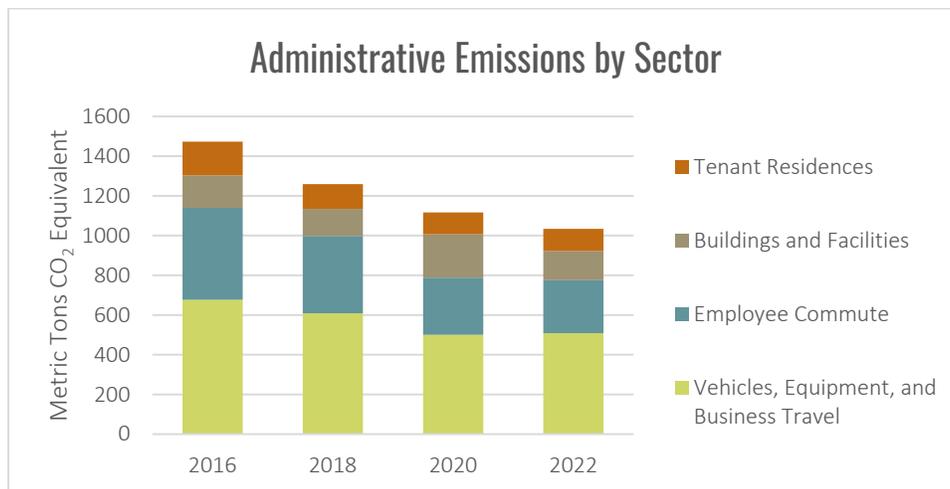


In 2022, as in past years, Vehicles, Equipment, and Business Travel is the largest administrative emissions sector, making up nearly half of Midpen’s GHG footprint. Employee Commute remains the second largest sector at just over a quarter of administrative emissions, followed by Facilities and finally Tenant Residences.

2022 Overview – Administrative Emissions

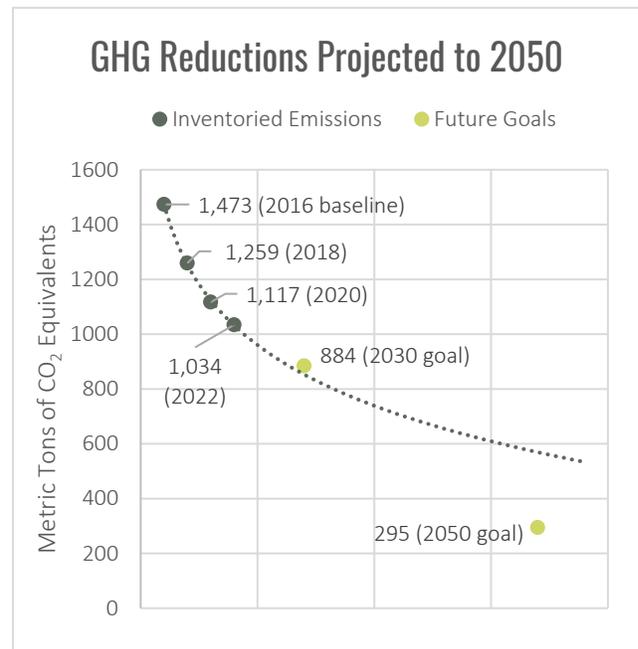
Overall: 30% Decrease Since 2016 – Surpassing the 2022 Goal

The 2022 GHG Inventory found that **administrative GHG emissions decreased 30% from 2016 to 2022 and 8% from the previous inventory in 2020**. Administrative GHG emissions for 2022 totaled 1,034 metric tons of carbon dioxide equivalent (MTCO₂e). Since 2016, Vehicles, Equipment and Business Travel emissions have decreased 25%, Employee Commute emissions have decreased 42%, Facilities emissions have decreased 10%, and Tenant Residences emissions have decreased 34%. Key actions resulting in these decreases since the last inventory in 2020 were the continued use of renewable diesel fuel and zero-carbon electricity, implementation of a hybrid work policy allowing administrative staff to work from home up to three days each week, and the move to the newly remodeled administrative office building at 5050 El Camino Real, which was designed to be far more energy efficient.



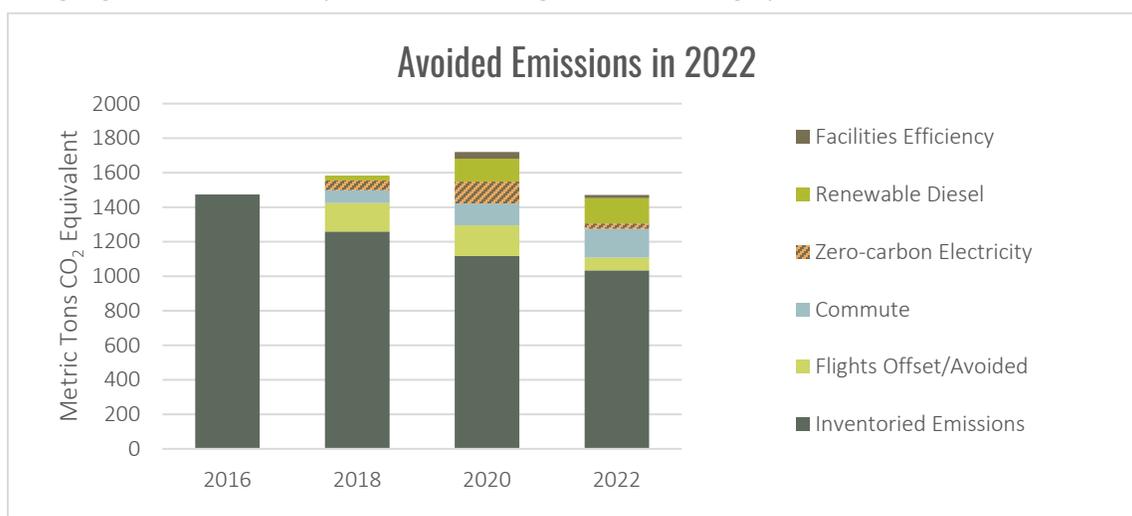
Progress Towards Climate Policy Goals

Midpen surpassed the 2022 goal of 20% reductions by an additional 10% of baseline emissions, or 145 MTCO₂e, for a total of 30% reductions from baseline. However, the rate of reduction has decreased annually, following a logarithmic trend. If this trend continues, Midpen is likely to meet the 2030 goal of 40% reductions but miss the 2050 goal of 80% reductions. Importantly, this mathematical projection may not reflect the reality of what is needed to meet these goals. Available technology may limit or facilitate future reductions, especially for fleet, and with this uncertainty Midpen should be prepared to implement bold operational changes. The hybrid work policy demonstrated that such changes can happen without compromising Midpen’s mission.



Greenhouse Gas Emissions Avoided

In 2022, Midpen avoided 436 MTCO₂e through emissions-reducing actions, without which administrative emissions would have been equal to the 2016 baseline. Avoided emissions are a second way to quantify how effective emission reduction actions are. Rather than comparing to the 2016 baseline, it compares to a hypothetical “business as usual” (BAU) scenario for the same year as the inventory, i.e., what *would* emissions have been in 2022 if Midpen had taken no emissions-reducing actions. As Midpen grows, the BAU scenario is generally expected to increase year to year. However, the 2022 BAU is lower than the 2020 BAU (and equal to the 2016 baseline) because of external changes, particularly the incorporation of more renewables in the regional electricity mix, and the widespread availability of virtual options for conferences and trainings that would have previously required staff to travel. In the 2020 inventory, the BAU scenario assumed pre-COVID levels of business travel. This helped demonstrate the impact of the pandemic on Midpen’s 2020 emissions, however, virtual options are now widespread and a return to pre-COVID levels of business travel is highly unlikely. The lower BAU for 2022 represents this “new normal.” This better demonstrates what is truly avoided by Midpen’s action (e.g. offsetting flights) rather than by circumstance (e.g. virtual meeting options).



ACTIONS TAKEN OR CONTINUED IN 2022, BY SECTOR*	MTCO ₂ E AVOIDED
Vehicles, Equipment, Business Travel	219
Renewable Diesel	146
Flights Offset/Avoided	73
Employee Commute	167
Hybrid Schedules	167
Facilities	29
Energy Efficiency at 5050 El Camino	18
Renewable Electricity Plan Enrollment	20
Tenant Residences	11
Renewable Electricity Plan Enrollment	11
TOTAL AVOIDED EMISSIONS	436

*This table enumerates actions for which avoided emissions can be calculated. It is not possible to calculate the precise impact of all actions taken due to limitations in data collection.

In 2022, the continued use of renewable diesel avoided 146 MTCO₂e. Of this, 17 MTCO₂e was enabled by the procurement of diesel-engine instead of gasoline-engine models when available (five trucks purchased since 2019), and 129 MTCO₂e was from existing diesel vehicles and equipment.

In 2022, Midpen avoided 73 MTCO₂e from air travel by purchasing carbon offsets from a third party verified provider. Midpen has purchased offsets for air travel emissions annually since 2016. Employees traveled far less for business (by car and by airplane) in 2022 than in previous years, likely due to the growing availability of virtual attendance for conferences, webinars, and trainings.

Midpen's new hybrid work policy, which allows most administrative employees to work from home up to three days each week, avoided 167 MTCO₂e from staff commutes. Respondents to the 2022 Commute Survey overwhelmingly supported the hybrid work policy, though some voiced frustration that completely remote work is no longer allowed. Many expressed a desire for more telecommuting flexibility, including hoteling at other offices, additional telecommute days, or a once-weekly administrative office closure during which all administrative staff would work from home. Several also pointed out that aligning all 9/80 schedules and/or closing the office once a week would improve the feasibility of carpooling by concentrating commuting into fewer days. A few respondents noted that without the hybrid work policy, the stress of their long commute would be difficult to bear.

Moving to the remodeled administrative office (AO) building at 5050 El Camino Real avoided 18 MTCO₂e through energy efficiency improvements. At current occupancy, the new AO building uses ~88% less natural gas per square foot for heating than the old office building at 330 Distel Circle. It also uses ~62% less electricity per square foot than 330 Distel Circle and the rental suites at 4984 El Camino. High electricity and gas usage continued at 330 Distel Circle for four months after the move (per a requirement from the County), so savings in electricity emissions were not realized in 2022. Going forward, the new AO is expected to produce approximately 0.6 MTCO₂e less annually from electricity, and 61 MTCO₂e less from natural gas, than the old office and rental suites would.

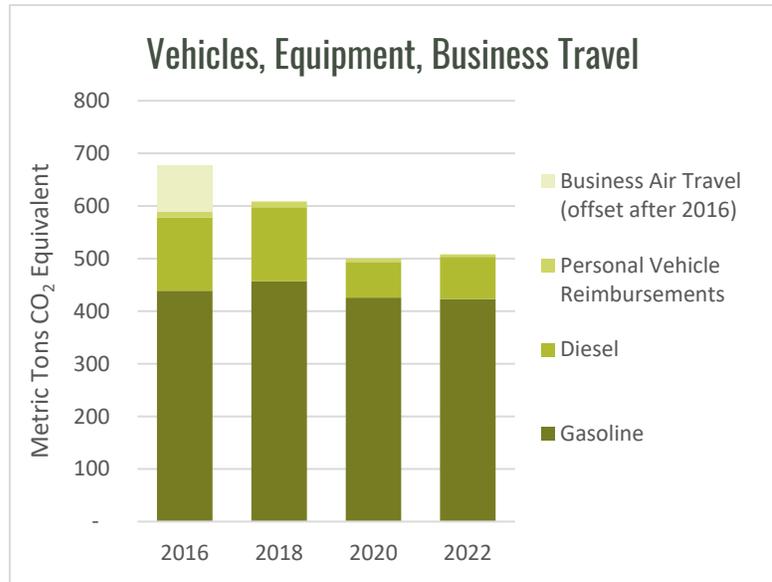
The continued use of renewable and zero-carbon alternatives to PG&E electricity avoided 32 MTCO₂e in 2022, 21 MTCO₂e facility electricity use, and 11 MTCO₂e from residential use. This is less than the 2020 estimate for avoided electricity emissions for three reasons. First, the PG&E energy mix included more renewables in 2022, meaning the BAU emissions factor (MTCO₂e per kWh of electricity) was much lower than in 2020. Second, Midpen used less electricity in 2022. This decreased avoided emissions because for each kWh not used, the BAU decreases more than the actual emissions because the BAU has a higher emissions factor. Finally, in 2022 it was determined that in 2020, some facilities were mistakenly reported as using 100% renewable plans from Community Choice Providers (CCPs), but were actually using the CCPs' default 50% renewable plans. Comparisons to 2020 made in the Facilities section of this report use a corrected calculation for 2020 emissions. The correction makes a small difference, because the facilities not on 100% renewable plans had low electricity usage, and the 50% renewable plans are still "carbon-free" meaning they do not include fossil fuel sources like coal or natural gas. They do include large hydropower and geothermal generation, which are not considered renewable by the state of California, and which generate small amounts of emissions.

2022 Greenhouse Gas Inventory by Sector – Administrative Emissions

Vehicles, Equipment, Business Travel: 25% Decrease Since 2016

Vehicles, maintenance equipment, and business travel continue to be the largest source of Midpen’s administrative emissions, making up 49% of 2022 emissions. Emissions in this sector decreased by 25% from 2016 to 2022. This decrease was driven by several factors:

- The continued use of renewable diesel made from agricultural byproducts,
- Preferentially purchasing diesel-model vehicles to take advantage of renewable diesel’s low emissions,
- Opening the new South Area Office in 2021, which shortened patrol and maintenance routes for staff servicing preserves in the southern part of the District,
- Purchasing carbon offsets for business flights, and
- Increased availability of virtual options for meetings, trainings, and conferences, allowing staff to travel less while still participating in professional development opportunities.



Gasoline: 4% Decrease Since 2016

Gasoline is the largest contributor to Midpen’s vehicle and equipment emissions. Though Midpen’s fleet and landholdings have grown since 2016, gasoline emissions from fleet operations have decreased. One reason is efficiency in patrol/service routes originating from the new South Area Office (SAO), which opened in 2021. This office is much closer to southern preserves (e.g. Sierra Azul, Bear Creek Redwoods, Picchetti Ranch, and St. Joseph’s Hill) than the other field offices. Without telematics to track miles driven by each vehicle, exact savings cannot be calculated, however, the stationing of staff at the SAO certainly reduced vehicle miles traveled for staff on routes in that region. For example, driving distance from the SAO to Sierra Azul is 14 miles, versus 23 miles from the Foothill Field Office or 34 miles from the Skyline Field Office. Driving distance from the SAO to Bear Creek Redwoods is 9 miles, versus 16 miles from the Foothill Field Office or 19 miles from the Skyline Field Office.

Another contributor is the selection of low-emission options when purchasing new vehicles. Since 2019, Midpen has added one electric car to the administrative fleet and purchased five diesel-engine trucks, four replacing retiring gas-engine trucks, and one as a new addition to the fleet. In 2022, these five trucks collectively used 3,117 gallons of renewable diesel, resulting in only 10 MTCO_{2e} compared to 27 MTCO_{2e} for the same amount of gasoline.

Diesel: 43% Decrease Since 2016

Diesel consumption increased by 7,360 gallons compared to 2016, but emissions decreased by almost half because of the use of renewable fuel derived from agricultural byproducts. The increase in Midpen’s consumption is partly due to the preferential procurement of diesel-engine vehicles described above, and partly due to a large increase in the use of equipment for fuel-clearance projects.

Business Ground Travel: 52% Decrease Since 2016

Continuing the trend from 2020, personal vehicle reimbursements and other business-related ground travel (e.g. ride-share or taxi) have decreased as staff travel less for local meetings, conferences and trainings, and other business needs, thanks to readily-available virtual options. This sector may be underestimated because it is dependent both on self-reporting (of personal vehicle use and of other ground travel) and because while personal vehicle miles can be calculated from reimbursements based on the year’s cents-per-mile rate, miles traveled are not easily determined for ride-share, taxi, and other non-personal vehicle ground transportation. These miles are estimated based on fees either charged to District credit cards or reported out-of-pocket. These charges are not always easily identifiable in the accounting records, meaning some are likely left out, and the conversion of dollars-to-miles is a very rough estimate as it cannot account for the high variability in pricing by locality, company, current traffic conditions, driver availability, tips, etc. In early 2023, staff added a “miles traveled” section to the HR form for conference travel reporting that will hopefully improve data quality for future inventories.

Business Air Travel: All Emissions Offset

In 2022, emissions from business air travel totaled 73 MTCO₂e. These are not counted in the inventory because they are offset. Since 2018, Midpen has purchased carbon offsets for business air travel from Terrapass, a third party verified offset provider. Despite recent press revealing issues with many carbon offsets, Terrapass remains highly regarded and adheres to strict standards for verifying the legitimacy of carbon offset projects they fund, as well as maintaining transparency in their data.

Flights are the only emissions source for which the Climate Action Plan recommends purchasing carbon offsets. Originally, this was because there was no viable alternative to reduce emissions from flights other than staff not attending certain conferences. Now, with more virtual options, staff do sometimes have the choice to attend conferences without travelling. However, there are definite networking and collaboration benefits to convening in-person, and not all conferences offer a virtual or hybrid option. It may be reasonable to encourage staff to choose a virtual option when doing so would not reduce the value of attending, but it would not make sense to require virtual attendance in all cases. Therefore, Midpen will continue to offset air travel emissions, though it is likely that these emissions will remain lower than pre-pandemic levels going forward.

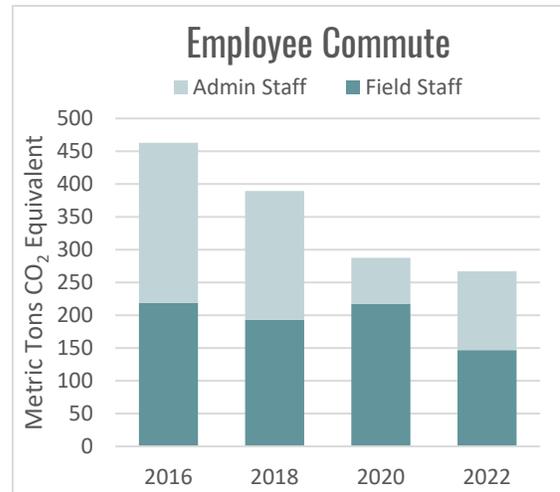
Performance Indicators

VEHICLES, EQUIPMENT, BUSINESS TRAVEL INDICATORS	2016	2018	2020	2022
On-road vehicle fleet average miles per gallon (excluding service/commercial trucks)	15.8	16.5	20.1	20.1
Portion of annual fuel used that is renewable	0%	6%	25%	29%
Annual miles flown for business travel	50,000	93,000	7,500	44,000

Employee Commute: 42% Decrease Since 2016

Employee commuting remains Midpen’s second-largest sector, making up 26% of administrative emissions in 2022. Employee commute emissions decreased by 42% from 2016 to 2022. Contributing actions were:

- Implementation of a hybrid work policy
- Monetary incentives and safeguards for choosing a non-driving commute, and
- Opening the new South Area Office.



Administrative Staff: 51% Decrease Since 2016

Commute emissions from administrative staff have decreased by more than half since 2016, though they increased by 73% compared to 2020. This latter change was expected given the shift from nearly 100% telecommuting for most of 2020 to hybrid (2-3 commute days per week) in 2022. Commute incentives have also enabled more staff to choose non-driving commutes, though the overall effect may be small. In the 2022 survey of staff commute habits, 19% of responding administrative staff (91% response rate) said that they use the commute incentives regularly, 58% knew about the incentives but did not find them useful, and 20% indicated that they know the incentives exist, but either forget or do not know how to use them. One person did not know about the incentives at all.

Field Staff: 33% Decrease Since 2016

Commute emissions for field staff decreased by a third since 2016, partly due to decrease in the average commute distance, which was aided by the opening of the South Area Office in 2021. As for patrol and maintenance routes, this new office decreased miles traveled for staff living closer to the southern preserves. Field staff commute emissions also decreased 31% compared to 2020, but this may not be a meaningful data point. It is likely that temporary changes to the inventory calculation methods in 2020 overestimated field staff commute emissions for that year. In general, it is best to use the same methods for every inventory, but the unique circumstances of the COVID pandemic required a change in methods. In 2022, the original methods were used again.

Of field staff responding to the commute survey (51% response rate), 15% said they use the commute incentives, 70% do not find them useful, and 10% knew about them but were forgot or were unsure how to use them. One respondent was not aware of the commute incentives. Better messaging and instructions or training about the incentives and how to use them could increase their effectiveness.

Performance Indicators

EMPLOYEE COMMUTE INDICATORS	2016	2018	2020	2022
Average AO commute distance (miles round-trip)	36	39	43	38
Average field office commute distance (miles round-trip)	41	37	40	39
Percentage of employees who typically drive alone (non-EV)	83%	82%	88%	83%
Percentage of employees who drive EVs	N/A	N/A	6%	12%
Percentage of employees who utilize commute incentives	N/A	N/A	21%	17%

Facilities: 10% Decrease Since 2016

Emissions from the operation of Midpen’s facilities result from electricity, heating fuels (natural gas and propane), solid waste (trash, recycling, and compost), and wastewater. Emissions for this sector made up 14% of total administrative emissions in 2022 and decreased 10% from 2016 to 2022. Primary drivers were:

- Continued use of renewable and zero-carbon energy plans
- An increase in renewables in the standard PG&E electricity mix
- Natural gas emissions have increased since 2016, but decreased compared to 2020 because of improved energy efficiency at the remodeled 5050 EI Camino office.



Electricity: 93% Decrease Since 2016

Electricity emissions decreased by 93% from 2016 to 2022. The decrease is primarily from the purchase of 50% renewable electricity from Peninsula Clean Energy and Silicon Valley Clean Energy, which began in 2017. These “community choice energy” providers purchase power from renewable and carbon-free² sources, offering 50% and 100% renewable alternatives to the standard mix provided by PG&E. The 50% renewable default plans have only slightly higher emissions factors than the opt-in 100% renewable options offered by these providers, because all electricity sources for both plans are carbon-free. The 2020 inventory report stated that Midpen switched most facilities to 100% renewable electricity in January 2019, however, during the 2022 inventory it was determined that only a few facilities were opted in to 100% renewable plan. Due to the minimal emissions of the 50% renewable service, the impact of this error was small, and the revised electricity emissions for 2020 increased only 2 MTCO_{2e}. All accounts except Skyline Field Office were switched to 100% renewable in early 2023.

Skyline Field Office remains on PG&E because it lies very close to the county line and the two counties’ community choice programs disagree about who should cover that address. Repeated attempts to enroll have been unsuccessful. Fortunately, PG&E’s default electricity mix has incorporated significantly more renewables since 2016. In 2021 (the most recent data available) PG&E’s electricity came from 48% renewable sources, 39% nuclear, 9% natural gas, and 4% large hydroelectric. Staff are considering enrolling Skyline Field Office in the PG&E “Solar Choice” program which would provide 100% solar electricity to that facility, similar to the 100% renewable options from the community choice providers.

² Carbon-free sources include large hydropower and nuclear, which are not considered renewable by the state of California, but which nonetheless have a minute carbon footprint compared to fossil fuels. The main renewable sources of electricity in California are solar and wind.

Electricity consumption decreased for the first time since 2016, a drop of 38% from 2020. This was driven by a two-thirds improvement in electricity efficiency at the remodeled office at 5050 El Camino Real. This more than offset added consumption from the new SAO opening in 2021 and continued, high-intensity use of the HVAC system at the 330 Distel Circle after the administrative offices moved in May. The HVAC system at 330 Distel Circle could not be turned off as doing so risked it failing completely, and Santa Clara County (the new owner) required the system to remain operational until the property transfer was complete. A hot summer added to the strain on the system, which ran non-stop until Santa Clara County took over management of the building in August. While electricity consumption at the SAO and 330 Distel Circle increased from 2020 by 12,000 and 39,000 kWh respectively, energy efficiency improvements to the remodeled 5050 El Camino office resulted in a 360,000 kWh decrease in electricity consumption for that building, which now uses only 5.4 kWh annually per square foot of office space compared to 14.3 kWh per square foot for the combined 330 Distel Circle and 4984 El Camino offices.

Heating Fuels: 70% Increase Since 2016

Heating fuel emissions increased by 70% from 2016 to 2022. This was due to running systems at both the old and new administrative offices leading up to and after the move in May of 2022. After the move, natural gas use continued at the old administrative office through August due to the need to keep the boiler in the HVAC system running. From May through August, that system used 3,210 therms of natural gas, resulting in 18.7 MTCO_{2e} of emissions. During the same period, the 5050 El Camino building used 505 therms, 84% less in total and 90% less per square foot than 330 Distel Circle. Annually (factoring in higher gas use in winter) it should use an estimated 88% less. The 5050 El Camino building also uses much less natural gas now than it did prior to the remodel. A comparison of 2020 (pre-remodel) vs. 2023 shows a 67% improvement in annual therms per square foot.

Propane use by the Foothill and Skyline field offices was just over half of use in 2020, and 63% of baseline. Propane use is variable because it is used both for heating (and thus is weather-dependent) and for powering the field offices during outages. The likelihood of power outages complicates the phasing out of propane for these field offices. While it would be preferable from an emissions standpoint to run entirely on electricity, it is not feasible to maintain operations – including emergency response capacity – without propane as a backup. Some refineries are beginning to produce renewable propane, which like renewable diesel, is made from vegetable sources and agricultural byproducts. This product is not yet readily available, but it may be an option to reduce emissions in the future.

Solid Waste: 50% Increase Since 2016

Solid waste emissions increased by 50% from 2016 to 2022. Midpen sent 83 tons of trash to landfill in 2022, a tonnage increase of 56% from baseline. The office move contributed to this increase as a large amount of material was disposed of when the old office was cleaned out. Three-bin systems (trash, recycling, and organics) are implemented at most offices, though Skyline Field Office does its own composting of kitchen scraps. In 2022, Midpen's overall diversion rate (the percentage of waste not sent to landfill) was 56%. This includes waste from field projects, which sometimes produce large loads of woody debris that is diverted to composting facilities, or other materials that go to landfill or are disposed of as hazardous waste, including pressure-treated wood, concrete, and refuse from dump sites remediation work. The office-only waste diversion rate in 2022 was 49%.

An error in the previous inventories was also corrected this year; an incorrect emissions factor was used for waste from AO2-4 when the waste emissions method was changed in 2020. The newer method utilizes a model developed by the EPA that is more precise than what was available in 2016, and in 2020 all previous year waste emissions were also recalculated using that model. The solid waste emissions for past years changed only slightly with this year’s correction, from 36 to 34 MTCO₂e for 2016, 44 to 43 MTCO₂e for 2018, and 53 to 52 MTCO₂e for 2020.

Wastewater: 31% Decrease Since 2016

Wastewater treatment emissions decreased 31% from 2.4 to 1.7 MTCO₂e. In 2019 the wastewater treatment plant decommissioned its incinerator and began drying and hauling away solids, which reduced its GHG footprint. Data on the new operation’s GHG footprint were available only as of 2022, so there is no correction to the 2020 inventory based on this change.

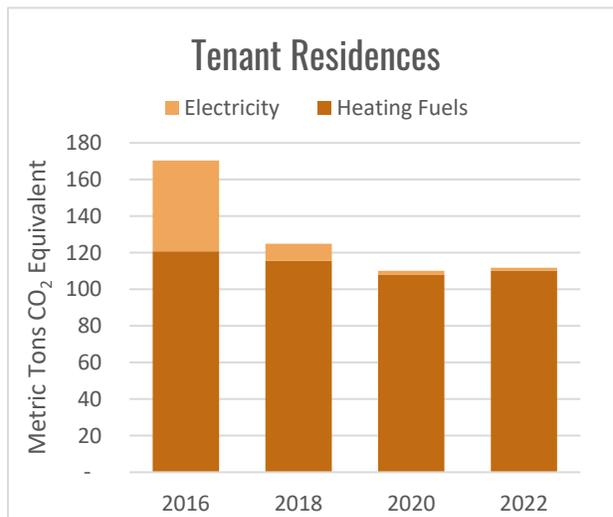
Performance Indicators

FACILITIES INDICATORS	2016	2018	2020	2022
330 Distel Circle and 4894 El Camino electricity use (annual kWh/ft ²)	11.3	16.9	8.5	14.3
5050 El Camino electricity use (annual kWh/ft ²)	-	-	12.9	5.4
Field office electricity use (annual kWh/ft ²)	5.4	5.1	5.6	5.5
Percentage of electricity from renewable sources	33%	50%	49%	69%
330 Distel Circle natural gas use per square foot (annual kWh/ft ²)	0.3	0.6	0.3	1.2
5050 El Camino natural gas use per square foot (annual kWh/ft ²)	-	-	0.5	0.2
Solid waste diversion rate (% diverted from landfill)	34%	37%	43%	56%

Tenant Residences: 34% Decrease Since 2016

Midpen leases residences located on its land to staff, agricultural leaseholders and their workers, and some members of the public. Emissions from residential electricity and heating fuels (propane and wood) made up 11% of administrative emissions in 2022, and have decreased 34% since 2016. This decrease was driven by:

- An increase in renewable electricity, and
- Variance in vacancies and whether residents heat with propane or wood.



Electricity: 97% Decrease Since 2016

Electricity emissions decreased 97% from 2016 to 2022. The main drivers were automatic enrollment in 50% renewable electricity plans in 2017. Midpen does not have access to tenants’ PG&E accounts, so the inventory estimates electricity use based on square footage, and assumes no tenants opted out of 50% renewable electricity or opted up to 100% renewable electricity. Tenants could be polled in future years to improve data accuracy, but given the very low emissions factors for both the 50% and 100% renewable plans, this would be unlikely to result in a significant change to the emissions estimate.

Heating Fuels: 9% Decrease Since 2016

Emissions from heating fuels (wood and propane) decreased by 9% from 2016 to 2022. Currently all of Midpen’s rental residences use wood and/or propane as their primary heat source because electric heating is both too expensive and too unreliable. In 2022, four residences were vacant, three of which utilize woodstoves and one of which is heated with propane. According to the Energy Information Administration (EIA), the average rural household that uses wood for its primary heat source emits 5.7 MTCO₂ annually compared to 1.9 MTCO₂e for propane, so vacancies in wood-warmed homes make a larger difference to the inventory than vacancies in homes heated with propane. However, some residences also switched from propane to wood as their primary heat source.

The tradeoffs between propane and wood are complex. Wood has a greater emissions factor, and a bigger impact on local air quality and health outcomes due to particulate pollution. However, wood is renewable, whereas propane is a fossil fuel. Any addition of GHGs to the atmosphere contributes to climate change in an immediate sense, but the release of long-sequestered carbon via the burning of fossil fuels is what has driven the long-term increase in atmospheric carbon, resulting in the catastrophic impacts the world is now experiencing. It would be best to use renewable electricity instead of either wood or propane, but given the frequency of power outages and the high monetary cost to run electric heaters, most tenants are very reluctant to make this change.

One way Midpen can ease the switch to electric heating systems (likely while retaining propane or wood as a backup for outages) is to improve the energy efficiency of the buildings. Many of the residences are very poorly insulated. Simple upgrades such as blow-in insulation and double-paned, well-sealed windows can produce significant energy savings. In 2022, Land and Facilities inventoried the energy-efficiency needs of Midpen’s residences and began to implement upgrades, installing new windows at two homes. Additional window replacement projects are planned for 2023 and 2024. A rough estimate of annual GHG savings for each window project is 0.6 MTCO₂e (based on a rudimentary calculator from myglazing.com). These potential savings were not factored into the reported GHGs for this sector because this is a low-confidence estimate, but are given to provide a rough sense of the possible emissions reduction. By this estimate, if double-paned windows were installed at all of Midpen’s residences, emissions might be reduced by as much as 24 MTCO₂e.

Update to 2020 Tenant Residence Emissions

The method for estimating tenant residence emissions uses data from the EIA, which publishes regional averages for home energy usage based on square footage and energy source. In 2022, the EIA released a new report with data from 2020, so the 2020 inventory of tenant residence emissions has been updated from 117 MTCO₂e to 110 MTCO₂e. That change is reflected in 2020 numbers referenced in this report.

Performance Indicators

TENANT RESIDENCES INDICATORS	2016	2018	2020	2022
Number of residences vacant for >6 months of inventory year	6	6	3	4
Percentage of occupied residences using wood for heat	52%	48%	46%	45%
Number of homes receiving energy-efficiency improvements	0	0	1	2

Moving Forward

Midpen has been highly successful at cutting emissions thus far, thanks largely to a combination of “low-hanging fruit” actions implemented early on and major changes that arose from the COVID-19 pandemic. Additional reductions will be harder to achieve. Meaningful action is likely to require more investment of staff time and budget and may also be dependent on available technologies. The following Climate Action Plan items are included in the Fiscal Year 2024 Budget and Action Plan:

CLIMATE ACTION PLAN ITEM	BUDGET	DEPARTMENT
Commute-4: Continue incentives for employees commuting via carpool, public transit, bike, or walking	\$15,000	Administrative Services
Vehicles-2: When a viable electric truck option comes on the market, acquire and test utility for operations. (Two EV trucks for FY 2024)	\$170,000	Land and Facilities
Vehicles-14: Purchase carbon offsets for business flights	\$500	Natural Resources
Vehicles-X: Develop a transition plan to decarbonize Midpen’s fleet	\$109,936	Land and Facilities
Transportation-3: Assess options for installing EV chargers at preserve parking lots	\$0*	Land and Facilities, Engineering and Construction, Planning
Residences-3: Make basic energy efficiency upgrades to residences e.g. insulation and double-paned windows.	\$20,000	Land and Facilities
Commute-1: Expand and encourage telecommuting (IT for hybrid work)	\$0*	Information Systems and Technology
CLIMATE-RELEVANT ACTIONS NOT RESULTING IN ADMINISTRATIVE EMISSIONS REDUCTIONS		
Livestock-3: Implement carbon sequestration projects identified in carbon farming plan	\$25,000	Natural Resources
(No Number): Develop carbon sequestration and storage baseline and monitoring plan for La Honda Creek redwood forest treatment sites.	\$10,000	Natural Resources
(No Number): Implement fuel reduction and prescribed fire treatments to maintain resilience of existing carbon stocks.	\$2,311,980	Land and Facilities, Natural Resources

*No budget; staff time only

Sequestration, Adaptation and Resilience

Midpen’s Climate Change Policy goes beyond greenhouse gas reduction, also including elements for carbon sequestration, adaptation, and resilience. Adaptation and resilience are related but distinct concepts, as are sequestration and storage. In this context, adaptation refers to changes within a system that reduce risk and potential future impacts from climate change. Resilience is the ability of a system to withstand and recover from disturbance – resilience is typically a goal of adaptation work. Sequestration is the process by which carbon is removed from the atmosphere (primarily by plants, algae, and soil microorganisms), while storage refers to the amount of carbon held in biomass and mineral forms.

The quantitative reduction goals for emissions have motivated a focus on that element thus far, but in truth, Midpen can have a more meaningful impact through work promoting sequestration, adaptation and resilience. Each of the more than 65,000 acres in Midpen’s preserves sequesters an average of one ton of CO₂e every year - while in 2022, Midpen’s administrative operations emitted the same amount of CO₂e as a coal power plant running for just two and a half hours. Climate change threatens the resilience

of this region's landscape, its ability to sequester and store carbon, and the function of its ecosystems. The severe storms that occurred from December 2022 through March 2023 also illustrated the importance of resilience for Midpen's public access infrastructure.

Midpen has already begun some projects that help habitats and species adapt and which manage for resilience both of ecosystem function and carbon stocks. In 2019-2021, staff, consultants, and members of the Santa Cruz Mountains Stewardship Network (Network) collaborated to produce the Santa Cruz Mountains Climate Change Vulnerability Assessment and Adaptation Strategies Synthesis Report. This project used climate models to project future conditions to 2060 and identify potential impacts to, and adaptation strategies for, key habitats and organisms selected by District staff and members of the Network. Midpen has since used the data and reports to begin identifying priority locations for adaptation and ecosystem health work, where projections either show major changes in climate, or minimal changes, indicating a potential refugium for sensitive species. This analysis is being incorporated into the prioritization algorithm for fuel projects that focus on forest health.

In 2019, Midpen worked with the San Mateo Resource Conservation District (RCD) to produce a Carbon Farming Plan for the Bluebrush Property at Purisima Creek Redwoods OSP. The RCD assessed soil health and carbon storage at Bluebrush and produced recommendations to increase carbon sequestration and storage on the rangeland. Recommendations included planting native hedgerows, expansion and protection of wooded riparian corridors, developing a savannah mosaic by planting oaks, and soil amendments such as compost or biochar. Staff are currently planning a study to determine how biochar might affect native grassland and hopefully clear the way for a rangeland application in the future.

In 2021, Midpen worked with a consultant on an ecosystem carbon inventory for the San Gregorio Watershed. The consultant modeled carbon cycles and estimated sequestration rates and total storage for various vegetation types within District lands in the watershed. Their estimates indicated that most preserve lands are in a state of recovery from past disturbance and are actively accruing carbon, in large part thanks to Midpen's preservation and management of the land. Conifer forests, particularly redwood, are the champions of carbon sequestration and storage in the watershed. The report drew on peer-reviewed science to suggest that the biggest threat to the watershed's carbon stocks is fire, and that rather than trying to manipulate sequestration rates (which are already favorable), management should focus on enhancing resilience to fire through fuel management and forest health work. Midpen's ongoing fuel reduction work, soon to include the new prescribed fire program, protects the carbon stored in the landscape by reducing the likelihood of an intense fire that would kill large trees.

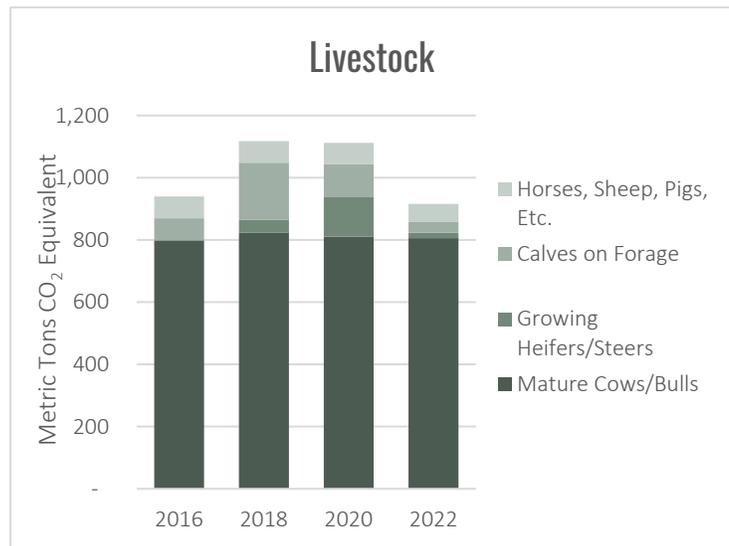
Looking forward to the next few years, staff are undertaking several more projects with a climate change benefit: developing a drought response plan to ensure that agricultural operations on Midpen land remain sustainable and do not compromise the water needs of wildlife; creating a work plan for adaptation and resilience, similar to the Climate Action Plan, with goals and action items for each department or program area; assessing the carbon sequestration and storage baseline for redwood forests in La Honda Creek OSP and creating monitoring protocols to track how the trees respond to forest health treatments; and repairing this winter's storm damage with consideration of resilience to future extreme or back-to-back precipitation events.

Appendix 1: 2022 GHG Inventory by Sector – Non-Administrative Emissions

In addition to administrative GHG emissions, Midpen also tracks enteric emissions from livestock and vehicle emissions from visitor transportation to and from preserves. Livestock emissions increased by 28% from 2016 to 2018 due to more cattle on the land. Visitor transportation emissions were not included in the 2016 baseline GHG Inventory, but were calculated for 6 preserves beginning in the 2018 GHG Inventory. The visitor transportation figure is *not* an estimate of total visitor emissions but can serve as a snapshot of general trends in visitation over time. These sectors represent opportunities to reduce emissions above and beyond Midpen’s administrative GHG reduction goals.

Livestock: 3% Decrease since 2016

Livestock on Midpen lands include cattle, horses, pigs, and a handful of other animals managed by leaseholders. Livestock emissions have decreased 3% since 2016, mostly because severe drought conditions in 2022 necessitated lower stocking rates. Most of Midpen’s livestock emissions come from cattle, which are grazed by agricultural leaseholders on approximately 9,000 acres of Midpen property in San Mateo County.



Conservation grazing with a low density of cattle (~5 animals per 100 acres) enables

Midpen to reduce fuel loads, promote unique grassland biodiversity, and uphold the Coastside Mission to “preserve rural character [and] encourage viable agricultural use of land resources.” These benefits come with the tradeoff of methane emissions, which Midpen is actively seeking methods to reduce where possible. Livestock emissions are not included in the administrative scope because livestock managed for conservation exist within a complex biological system in which they both produce emissions, and reduce the risk of losing carbon to a fire by removing fuel from the landscape. Livestock offer a time- and cost-effective alternative to mechanical vegetation management and prescribed fire, each of which also has its place and its tradeoffs (e.g. soil compaction, particulate and GHG emissions, permitting difficulties, noise, cost, infeasibility in certain terrain types, and staff time).

Midpen is actively seeking ways to offset livestock emissions through carbon-negative rangeland management practices. These include sparsely planting oak trees (oak savanna silviculture), restoring and widening wooded riparian corridors and preventing cattle from entering streams, and applying biochar to the soil. Biochar is a mostly-inert carbon product that results from burning biomass (usually wood) at very high temperatures and low oxygen concentrations. Biochar does not readily decompose and it is an effective way to store carbon for hundreds to thousands of years. However, its application to native California grassland systems has not been well studied. Midpen plans to test the feasibility of biochar as a soil amendment applied in a pilot project at Rancho San Antonio. The pilot will study the

effect of biochar application on native biodiversity and soil health. If there is no negative effect, in-house biochar production could potentially be a way to convert woody biomass removed in Midpen’s fuel reduction projects to long-term carbon storage.

Performance Indicators

LIVESTOCK INDICATORS	2016	2018	2020	2022
Animals with high enteric emissions (cattle, not counting calves on milk)	383	494	486	376
Animals with low enteric emissions (horses, sheep, pigs, etc.)	182	182	182	134
Number of acres grazed	8,092	8,092	8,490	8,964

Visitor Transportation : 64% Increase Since 2018

The data used to estimate visitor transportation emissions have only been available since 2018, and only for specific parking lots at a handful of preserves. While this subset does not provide a complete picture of visitor emissions, it does demonstrate two things: visitation to Midpen preserves is growing, and the emissions from visitor vehicles are significant. In 2022, visitor emissions to the six preserves in the sample totaled 6,239 MTCO₂e, six times Midpen’s administrative emission total. This is lower than in 2020, however, when the pandemic shelter-in-place orders resulted in record visitation as people sought outdoor venues for relaxation, socialization, and exercise. It is also important to note that though visitor transportation emissions are substantial and increasing, Midpen preserves both protect land from development (land use change being one of the largest sources of GHGs) and provide a close-to-home option for residents of the Peninsula to recreate in a natural setting, reducing the need to drive to more distant options like state or national parks. Therefore, while visitation does create emissions, the existing scenario likely results in lower emissions than an alternative without Midpen preserves.

In 2022, staff developed a machine-learning algorithm to interpolate missing data from the car counters, which sometimes malfunction due to vandalism, electrical issues, high winds, or even insect damage. These issues result in days with low or missing counts, and occasionally artificially high counts. The algorithm learns the patterns connecting daily vehicle counts, weather, and air pollution data, and creates a model to fill in the days with counter errors. Weather and air pollution correlate with visitation because people are more likely to go to preserves on days with good weather, and because more cars on the road creates more local air pollution (specifically, the model uses carbon monoxide and nitrogen monoxide, two pollutants in vehicle exhaust). This modeling approach produces more realistic data than the old method, which was to use the annual average daily visitation number for any day with a malfunction. The mileage and emissions for 2018 and 2020 were also corrected in this inventory using the algorithm-enhanced data. 2018 estimates for Russian Ridge are based on visitation trends at Monte Bello because there was no counter at the Russian Ridge main lot in 2018 (see footnote to table). Russian Ridge had a counter at the Mindego Hill lot prior to 2020, and the past inventories used data from that counter. Because the Mindego lot is half the size of the main lot, those numbers have been replaced with the main lot estimates to better show visitation trends.

An update to Midpen’s 2017 Visitor Use Survey would aid in developing a more complete assessment of visitor emissions. The visitor emissions estimate uses ZIP code data from this survey, and periodic updates would capture changes in this demographic over time. Additionally, an update could collect ZIP

code data from visitors to Mt. Umunhum, which was not open during the first survey, but which does now have a car counter.

Visitor Mileage and Emissions Estimates for Preserve Lots with Car Counters

PRESERVE/PARKING LOT	VISITOR MILES DRIVEN			EMISSIONS (MTCO ₂ E)			% CHANGE FROM 2018
	2018	2020	2022	2018	2020	2022	
Rancho San Antonio – Main Entrance	6,945,461	11,806,161	11,099,004	2,383	4,051	3,808	60%
Russian Ridge – Main Lot	1,252,077*	2,671,941	2,220,896	430*	917	762	77%
El Corte de Madera	880,552	2,438,472	1,508,179	302	837	517	71%
Purisima Creek Redwoods – North Ridge Lot	1,430,716	2,051,875	1,484,422	491	704	509	4%
Windy Hill – Lower Lot	967,789	1,177,786	1,088,383	332	404	373	12%
Monte Bello	630,285	1,071,820	782,010	216	368	268	24%
TOTAL	14,377,517	22,411,817	19,959,018	608,665	971,271	893,908	47%
<p>*2018 numbers for Russian Ridge are estimated and not from counter data. There was not a car counter at the main lot at Russian Ridge in 2018. These numbers assume an increase in visitation from 2018 to 2020 proportional to what was observed at Monte Bello, the nearest preserve with a counter in all three years.</p>							

Appendix 2: Detailed Table of Greenhouse Gas Emissions Changes 2016-2022

ADMINISTRATIVE EMISSIONS (MTCO ₂ E)	2016	2018	2020	2022	CHANGE
Vehicles, Equipment, Business Travel	676	608	500	508	-25%
Gasoline	439	457	426	423	-4%
Diesel	140	141	68	80	-43%
Personal Vehicle Reimbursements	10	11	7	5	-52%
Business Air Travel	88	0*	0*	0*	-100%
Employee Commute	463	389	287	267	-16%
Administrative Staff	244	196	71	120	-51%
Field Staff	219	193	217	147	-33%
Facilities	163	136	220	147	-14%
Electricity	74	6	6	5	-93%
Heating Fuels	51	85	160	87	+70%
Solid Waste	36	44	52	54	+50%
Wastewater	2.5	2.0	1.8	1.7	-31%
Tenant Residences	170	125	110	112	-34%
Electricity	50	9	2	2	-97%
Heating Fuels	121	116	108	110	-9%
Administrative GHG Emissions Total	1,472	1,259	1,118	1,034	-30%
NON-ADMINISTRATIVE EMISSIONS (MTCO ₂ E)	2016	2018	2020	2022	CHANGE
Livestock	939	1,118	1,112	915	-3%
Mature Cows/Bulls	787	812	799	802	+2%
Growing Heifers/Steers	0	41	127	17	-
Calves on Forage	71	184	106	34	-52%
Horses	53	52	52	52	-2%
Other Livestock	17	18	18	6	-64%
Visitor Transportation – 6 Preserves	-		7280	6239	
*Midpen’s flight emissions were 165 MTCO ₂ e in 2018, 13 MTCO ₂ e in 2020, and 73 MTCO ₂ e in 2022. These emissions were offset and are not counted toward the inventory total.					

Acknowledgments

Report by Sophie Christel

GHG Inventory tool developed by Cascadia Consulting Group

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