Middlebury CO_2 Emissions - 2023 Progress Report

Update on the Town of Middlebury's Progress in Reducing CO2 Emissions from Town Operations

(Richard Hopkins, Dan Rafferty, Jamie Hand)

CONTEXT

On January 21, 2021, the Middlebury Selectboard established a goal for reductions in greenhouse gas emissions.

Be it resolved that,
(1) The Selectboard establishes the goal that emission of carbon dioxide-equivalents as a result of Town operations be reduced by 80% compared to 2018-2019 fiscal year levels, in or before fiscal year 2029-2030.
(2) The Town's Energy Committee is directed to make an annual report by the end of each calendar year to the Selectboard and the Town Meeting on the previous fiscal year's greenhouse gas emissions.
This document is that annual report, through the town fiscal year ended June 30, 2023.

GOOD NEWS, BAD NEWS

The good news:

- 42.5% reduction in CO2e over five-year period
- So we are almost half-way to our goal with little effort on our part

The bad news:

- Almost all the reduction so far is attributable to lower-carbon GMP electricity, not anything we did
- Annual use of each fossil fuel is not clearly going down yet

STRATEGIES

There are three main **strategies to get to an 80% reduction in greenhouse gasses**:

- **Decarbonize the electricity**
- **Electrify everything**
- **Reduce all energy consumption, especially of fossil fuels**

More detail about how to implement these strategies appears later in this report.

NOTES ON METHODS

The data sources for tracking are the bills the town pays for:

- Gasoline
- Diesel fuel
- Natural gas
- Fuel oil
- Propane
- Electricity

We rely on known coefficients relating gallons or watts of fuel use to CO2 emissions

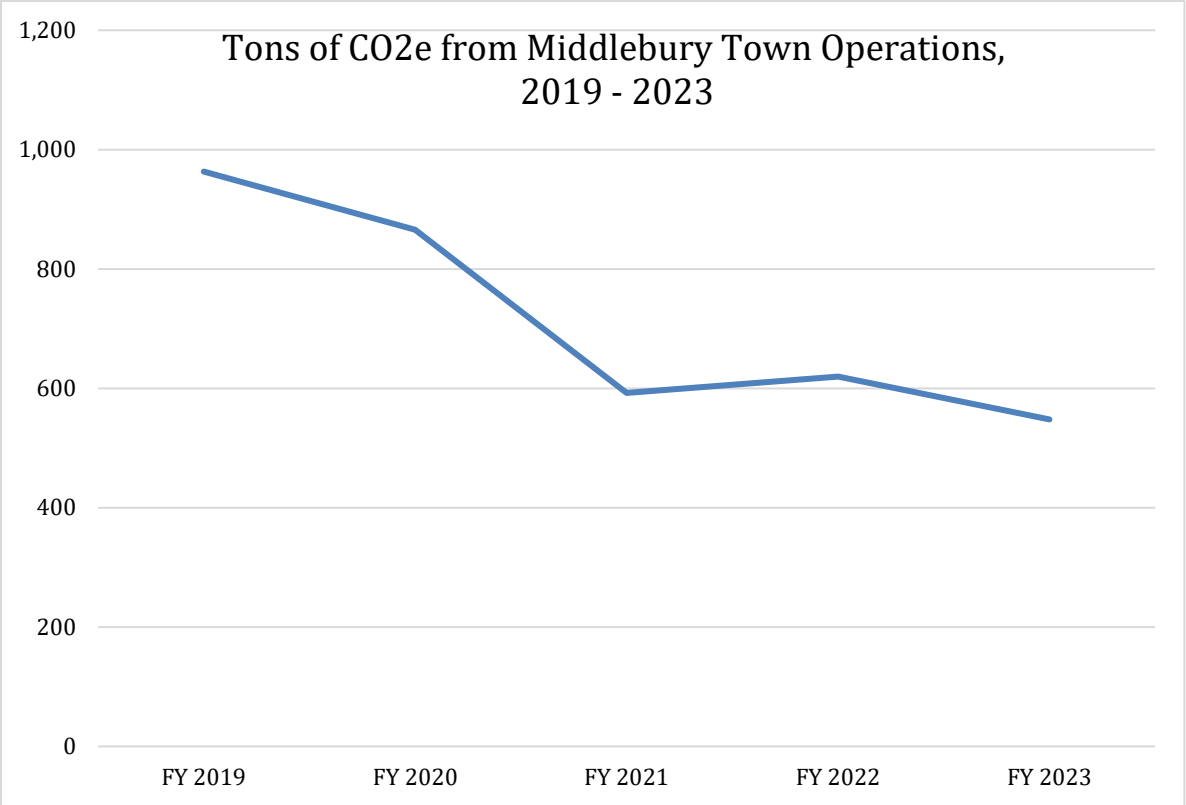
We assume 3% release of methane in the extraction, processing and transportation of natural gas. This increases the amount of CO2-equivalents released per unit of gas from 11.7 to 15.6 pounds per ccf (hundred cubic feet) of gas consumed.

We estimate 50 pounds of CO2e per megawatt-hour of electricity from GMP (average New England value is around 700). GMP itself reports a value of zero to the Public Utility Commission, by factoring in buying and selling of renewable energy credits. We use the actual mix of electricity from various sources that GMP reports before accounting for renewable energy credits.

In any case the methods used are the same for all years, so we can rely on trends over time.

PROGRESS

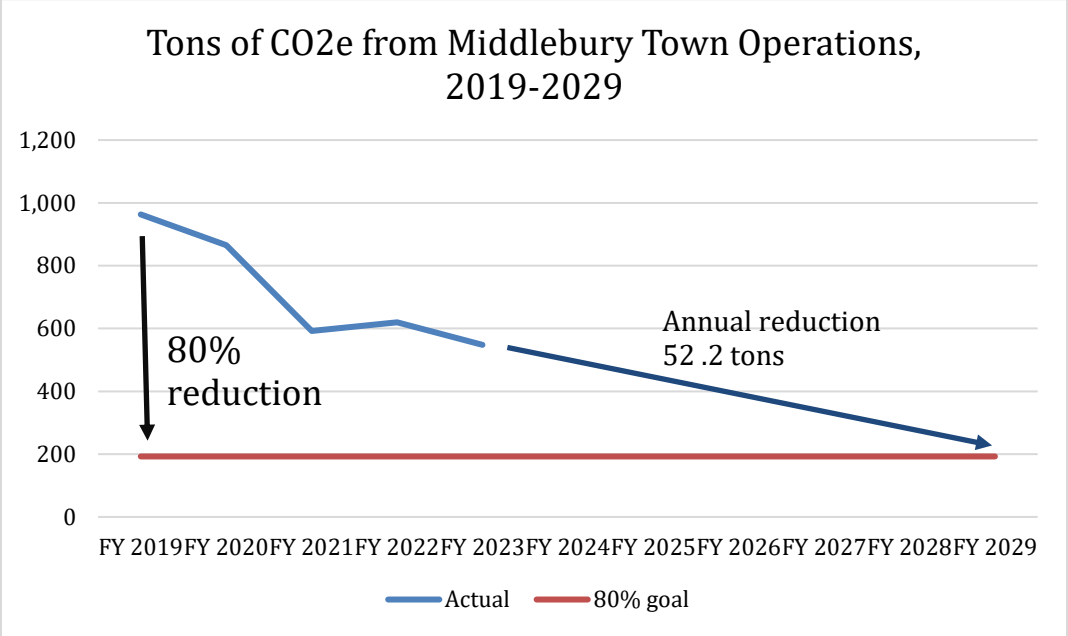
At first glance, we appear to be making excellent progress:



This trend line really has two parts:

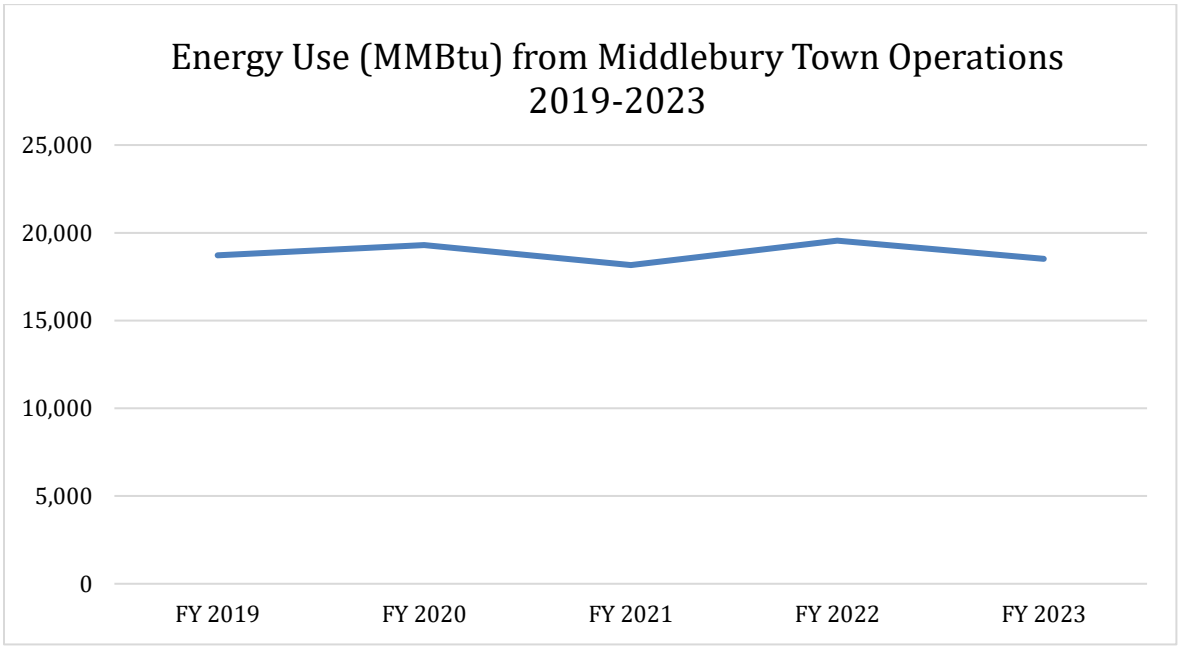
- From 2019 to 2021, there was a marked reduction in the CO2 content of the electricity we buy from GMP, which accounts for essentially all of the reduction.
- From 2021 to 2023, there is very little further reduction.

Here is what we have to do to get to an 80% reduction in our GHG releases:

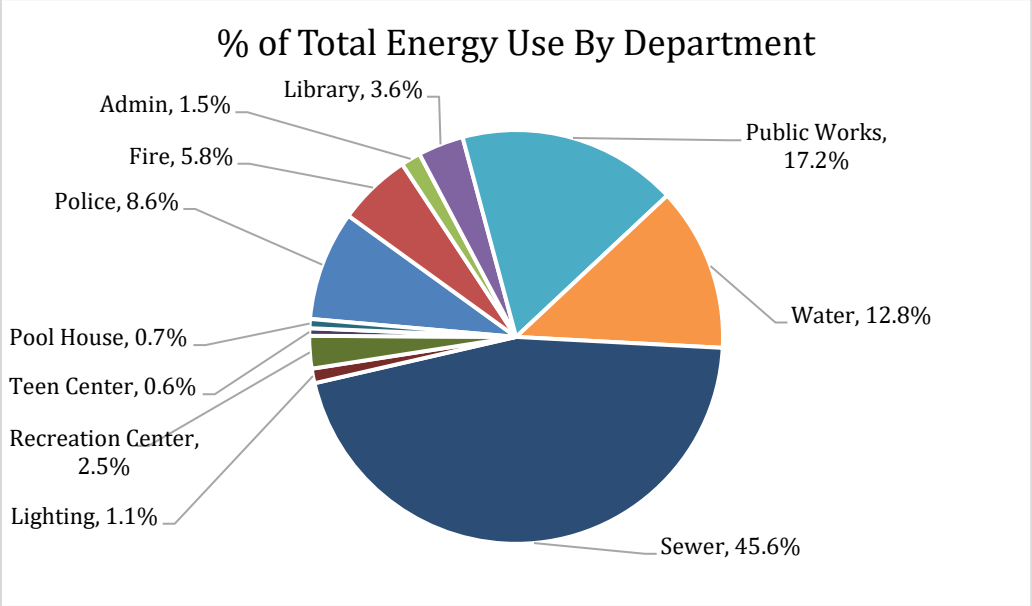


The flat red line is where we need to be by 2030 to reach our 80% reduction goal. The black arrow shows the path we need to be on, with further reductions every year till 2030. The trend for the 2021 to 2023 is promising but it won't continue unless we take specific actions.

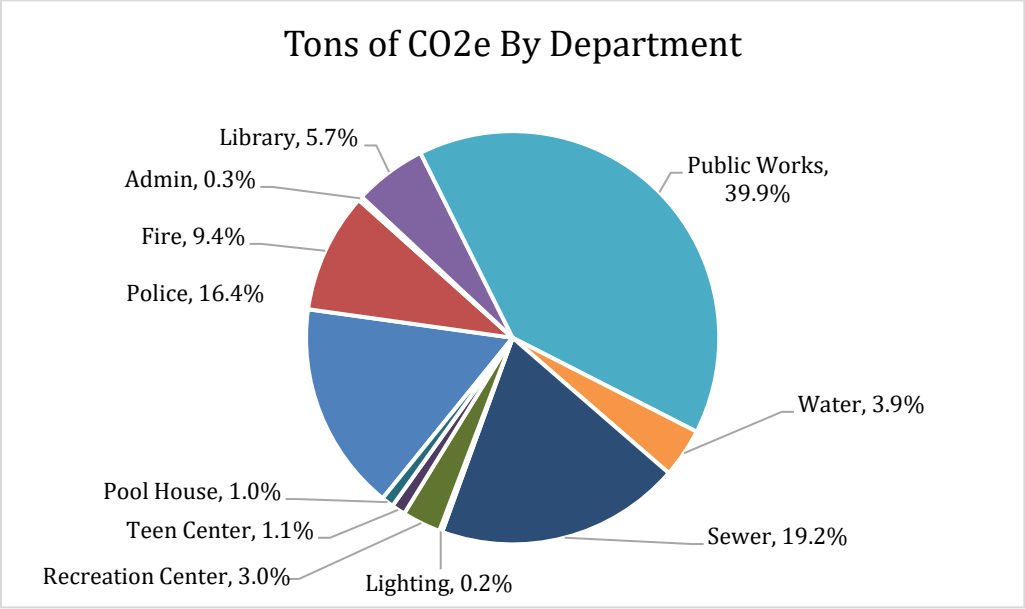
The next graph shows that the downward trend in GHG releases is NOT due to reductions in energy use (which is flat) - we do not have to reduce energy use greatly if we take every opportunity to replace fossil-fuel-powered activities with electric equivalents:



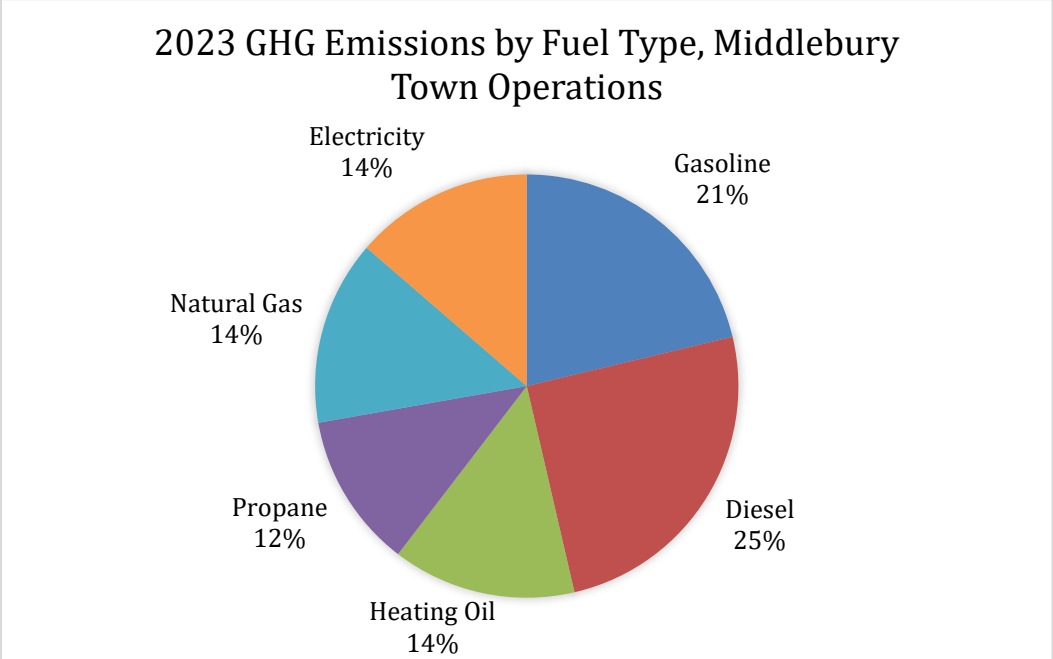
By department, we can see that the waste-water treatment plant (labelled ‘sewer’ here) is the biggest user of energy in our operations. The large share labelled ‘public works’ is mostly for gasoline and diesel fuel. (Some of the diesel may be used by vehicles belonging to other departments.)



Because the WWTP’s energy use is largely electricity, which is very low in carbon content, the CO2 production by department is not so much driven by the WWTP.

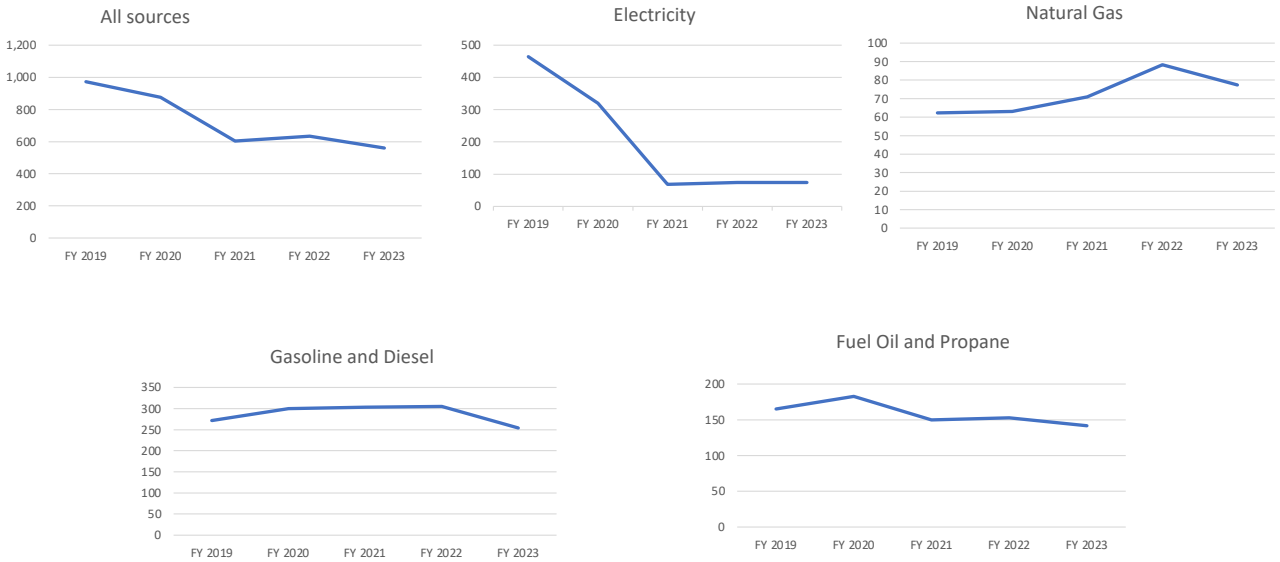


If we look at CO2 production by fuel type, we see that no one fuel predominates:



Let's look at the CO2e released by our use of various fuels over our five-year period:

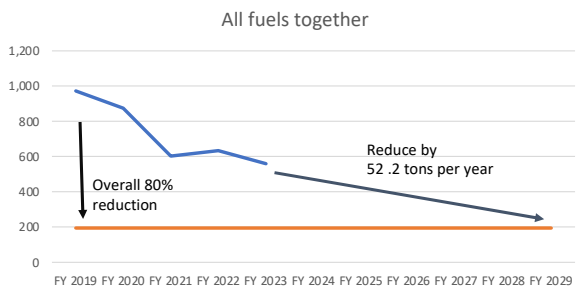
Tons of CO2-equivalent from all fuels together and from four types of fuel, Middlebury Town Operations, 2019-2023

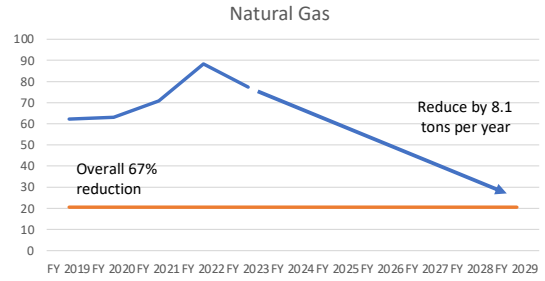


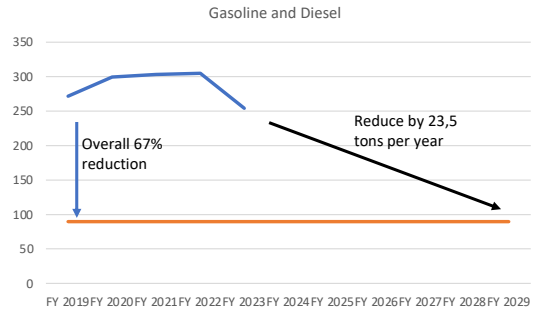
The overall reduction in tons of CO2e released is due entirely to our electricity from GMP being cleaner.

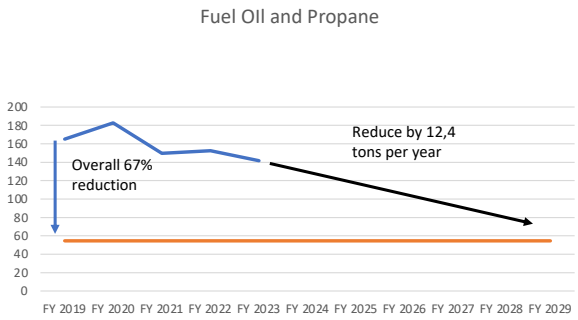
The next side-by-side graph shows the path we need to be on for each fuel type, if we are to reduce each one proportionally to reach our 80% goal:

Tons of CO2-equivalent from all fuels together and from three types of fossil fuel, Middlebury Town Operations, 2019-2029









This set of graphs does not include one for electricity, as we actually want our electricity use to go up as our use of fossil fuels goes down.

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BACK TO THE MAIN STRATEGIES

The **first** is to **decarbonize the electricity** - that is, reduce the amount of carbon-rich fossil fuels that have to be burned to make the electricity we use. Without any effort on the Town's part, Green Mountain Power has made great progress in delivering us low-carbon electricity. This is required by the state's Renewable Energy Standard. In addition, the town has increased the amount of locally-generated solar electricity it uses, though that is still only a small part of our electricity use.

The **second** goes along with the first: **electrify everything**, so that we no longer burn any fossil fuels directly, but instead use electricity for almost all our energy needs.

Operationally, this means we need to replace equipment that burns a fossil fuel with an electric equivalent every time that equipment needs replacing. We don't have to do it all the first year, but every time we buy new fossil-fuel-burning equipment, we make it that much harder to reach our 2030 goal. This means replacing all gasoline and diesel powered vehicles with electric equivalents, and replacing heating systems that use natural gas, fuel oil or propane with cold-climate heat pumps.

Since electric equivalents do not yet exist for all our gas- and diesel-powered vehicles, we should replace regular diesel with biodiesel where possible until we can transition. Similarly, buildings can have electric heat pumps added to their heating systems even before their current fossil fuel boiler needs to be replaced; this can reduce CO2 emissions substantially.

The **third** main strategy is to **reduce energy use**, whatever the fuel used. This will reduce expense as well as greenhouse gas production. This can be done by a combination of weatherization and use of smart thermostats, to make sure buildings are warm when we need them and don't consume much energy when we don't need them. Increasing the use of B20 biodiesel in selected vehicles will reduce CO2 production by 20% for those vehicles, pending replacement by electric equipment when it becomes available. We should strongly favor new vehicles that are economical in energy use if electric equivalents are not yet available and a new vehicle is necessary. Plug-in hybrid vehicles can help us transition to a fully electric fleet.

The biggest single user of electricity currently is the wastewater treatment plant. Because our electricity is so low-carbon, this electricity use for the WWTP accounts for a smaller proportion of CO2 production than of energy use, but it still accounts for 19% of our CO2 production. As plans move forward to replace or upgrade the existing plant, there is an opportunity to both save money and reduce our CO2 production, but this will not happen unless we pay attention to both money and CO2.

Some additional considerations:

- Conservation and efficiency can be implemented quickly and often inexpensively, but can't by themselves get you to 80% reduction in greenhouse gas emissions.
- As our electricity is close to carbon-free, investing in conserving it does not save much in the way of greenhouse gas emissions. It does save $$, which could be reinvested in other GHG-reducing measures.
- The market for electric vehicles and equipment and for heat pumps is very dynamic. The choices available for electric equivalents of fossil fuel vehicles and heating systems are already much broader than in 2018. Expect further innovation and cost decreases in the near future.
- The use of lime in our wastewater treatment plant does not produce CO2 emissions at our site, but manufacturing the lime is very expensive in greenhouse gas terms. We may have an opportunity with our WWTP redesign to reduce our indirect CO2 emissions by eliminating or reducing lime use.

SOME STEPS ALREADY TAKEN OR PLANNED

Thermal:

- Conference Room in Police Building has been renovated to reduce heat leakage (Pre-2023)
- Future plans to weatherize Teen Center (on the books)
- Future plans to replace Library heating with heat pumps as part of renovation

Vehicles and Equipment:

- Added the use of biodiesel in 2022
- Biodiesel mix was increased from B5 to B20
- There are four fewer vehicles using biodiesel since they were replaced with new vehicles which are now under warranty. The biodiesel is used only on vehicles no longer under warranty
- Purchase of two EVs
- Purchased electric mower, however it was not sufficient to meet the workload

Renewable Energy:

- 15% share of Bristol array in 2021
- Consultant hired to develop design and performance specifications for solar array on town office building.