Town of Kennebunk, Maine

# 2016-2018 Municipal and Community Greenhouse Gas Emissions Inventories

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# EXECUTIVE SUMMARY

The Town of Kennebunk is a coastal community in York County in Southern Maine well known for its scenic beaches and coastlines. These beaches and coastlines are central to the identity of Kennebunk and contribute significantly to the tax-based revenue of the town. Recognizing this area as susceptible to climate change impacts, Kennebunk has recently begun to act. They joined the Global Covenant of Mayors for Climate and Energy in 2018 and began the town's first greenhouse gas emissions inventory shortly after. This first inventory was completed and expanded into multiyear municipal and community inventories, and this report contains their findings and conclusions.

The municipal inventory encompasses the 2016, 2017, and 2018 calendar years and was created by mostly following guidelines set by the ICLEI Local Government Operations Protocol. It uses 2016 as the baseline year and follows an operational control boundary. Total emissions from municipal operations in 2016 were 3,472 metric tons of carbon dioxide equivalent (MT $CO_2$e). The largest contributing sectors were electric power production (34%), vehicle fleet (22%), water and wastewater treatment facilities (21%), and buildings and facilities (13%). Of these emissions, 40% are categorized as scope 1, or direct emissions from municipal operations, 53% are scope 2, or indirect emissions from the usage of electricity in municipal operations, and 7% are scope 3, or indirect emissions that are a consequence of municipal operations. All three years of the inventory are similar across both scopes and sectors. By 2045, municipal emissions are projected to be reduced by 58% from 2016 levels as a result of Maine's Renewable Portfolio Standard and national fuel efficiency standards, if these standards are followed. However, the additional 42% of reductions must be made by the town if they are to achieve carbon neutrality by 2045, a goal set by the Maine State Governor.

The community inventory includes the 2016, 2017, and 2018 calendar years and was created by following a combination of the guidelines set by the ICLEI U.S. Community and ICLEI Global Community Protocols. It uses 2016 as the baseline year and utilizes a geographic control boundary. Total community emissions in 2016 were 244,449 MT $CO_2$e. The biggest sectors were consumption-based (38%); transportation and mobile sources (18%); and residential energy, commercial energy, industrial energy, and upstream impacts of activities (each approximately 10%). 38% of these emissions were categorized as scope 1, or emissions from sources located within the town, 13% as scope 2, or emissions occurring due to the use of electricity within the town, and 49% as scope 3, or emissions that occur outside the town as a result of activities taking place within the town. Like the municipal inventory, all three included years are similar by both sector and scope. Unlike the municipal inventory, community emissions will not be appreciably reduced by state and national standards; therefore, town-wide reduction programs will be necessary to reduce emissions.

When discussing any social issue, it is important to consider diversity, equity, and inclusion. Kennebunk has a detailed history regarding these topics, and they are still at the forefront of local current events and issues. While some work has recently been done to address these issues, more work is needed. The strong connection between diversity, equity, and inclusion and climate change provides a unique opportunity to advance both environmental and social progress by integrating all these topics together in emissions reduction strategies.

To most effectively reduce emissions from the municipal inventory, reduction strategies should focus on the vehicle fleet and fuel oil usage. The partial transition to high efficiency vehicles and incremental decrease in fuel oil usage can decrease projected 2045 emissions by almost 50%. Variations can easily be made that could increase the effectiveness of the reductions. It is important to note that due to the general uncertainty of projections, the municipality must make additional emissions reduction efforts to successfully reach carbon neutrality.

It is harder to reduce community emissions than it is to reduce municipal emissions, but it is still very important to implement effective reduction strategies. It is recommended that educational programs be implemented and strategically targeted to increase residential energy efficiency, increase the use of electric vehicles, and decrease consumption-based emissions. The creation of a public transportation system is also strongly recommended to reduce vehicle emissions and increase equity throughout the town. Strategies such as these could decrease projected 2045 emissions by up to 10%; however, additional reduction strategies will be necessary to make a larger impact.

The completion of Kennebunk’s first municipal and community greenhouse gas emissions inventories is an important first step in becoming an environmental leader along the coast of Maine. By utilizing the data and analysis in this report, Kennebunk can credibly create detailed reduction strategies and a climate action plan to work toward carbon neutrality and to protect its key coastal region. However, continual work is necessary to make a notable impact. Specifically, a formal municipal and community greenhouse gas emissions reduction target should be established, the inventory process should be made annual and standardized through collaboration with other regional towns and efforts, and steps should be taken to increase the accuracy and applicability of each successive inventory.

# 1. INTRODUCTION

## 1.1 Background

The Town of Kennebunk, founded in 1820, is a coastal community in York County in Southern Maine with an area of approximately 44 square miles and a population of 10,798, according to the 2010 census. A prominent and well-known fixture of Kennebunk is its scenic beaches and coastlines. These beaches and coastlines are central to the identity of Kennebunk and contribute to 40% of the tax-based revenue of the town. Recognizing this area as susceptible to sea level rise, storm surge, coastal erosion, and other effects of climate change, the Town of Kennebunk has begun to take action to mitigate these impacts.

In 2000, Kennebunk's Energy Efficiency Committee was established to be responsible for recommendations and education in the areas of energy efficiency, trash, recycling, composting, and waste management. More recently, the committee has worked to elevate issues surrounding climate change. In 2018, the town joined the Global Covenant of Mayors for Climate and Energy (GCOM) showing their steadfast dedication to climate action and sustainability. Work on the GCOM commitments began in 2019 through a partnership with The New School, an alternative high school in Kennebunk, to begin the town's first greenhouse gas emissions inventory.

## 1.2 Updated 2003 Comprehensive Plan Drafts

In 2003, the Kennebunk Planning Board passed an update to the existing 1991 Comprehensive Plan, which is the town's most recent policy document that outlines a vision for the future of the town. Beginning in 2016, the Comprehensive Plan Committee drafted updates to the 2003 plan. Included in these updates is a chapter about climate change and sea level rise. Contained within this drafted update chapter were the following recommendations:

- The Town should collaborate in local and regional efforts to address climate change and sea level rise.
- The Town should increase its use of renewable energy resources.
- The Town should make carbon-free decisions and purchases whenever and wherever feasible.

Partnering with The New School and beginning the town's first greenhouse gas emissions inventory was the first step in working toward these recommendations, as a thorough accounting of climate impacts is a necessity in the creation of actionable plans. The completion and expansion of the first inventory into multiyear municipal and community inventories along with this accompanying report serves as the next step toward a more sustainable Kennebunk. It is the hope of those who have worked on this inventory project that it will not only identify emissions sources and reduction strategies in Kennebunk to aid in the creation of a climate action plan, but also be used as a blueprint for conducting inventories and evaluating climate actions in other communities along the coast of Maine.

# 2. MUNICIPAL INVENTORY

## 2.1 Overview

Municipal greenhouse gas emissions inventories allow municipal or local governments to identify emissions sources within the selected boundary, create a baseline against which future inventories can be compared, select applicable reduction strategies, and demonstrate environmental leadership. This inventory encompasses the 2016, 2017, and 2018 calendar years and the methods used to collect data were kept as consistent as possible across each year.

## 2.2 Methodology

The municipal inventory in this report was created using ICLEI ClearPath, a program published by the International Council for Local Environmental Initiatives (ICLEI), and mostly follows the guidelines set by the ICLEI Local Government Operations Protocol. It uses an operational control boundary when determining which emissions sources to include. In other words, anything over which the municipality has full authority to introduce and implement operating policies is included in the inventory. The inventory uses 2016 as the baseline year against which 2017 and 2018 are compared. Details about emissions factor sets, a value used in calculations, can be found in Appendix G. Intergovernmental Panel on Climate Change (IPCC) 5$^{th}$ Assessment 100 Year Values were selected as the global warming potential, a value also used in calculations and projections. All results are expressed in metric tons of carbon dioxide equivalent (MT $CO_2$e).

### *2.2.1 Sectors, Sources, and Scopes*

This municipal inventory can be easily broken down into emission sectors and the sources within each sector. The eight sectors included were taken directly from the ICLEI ClearPath Government Track program. These sectors and sources are shown in Table 1 below.

Table 1. Municipal Inventory Sectors and Emissions Sources

| Sector | Emission Sources |
|---|---|
| Buildings and Facilities | Town Offices, Fire and Police Stations, KLPD Facilities, Parks and Recreation Facilities |
| Streetlights and Traffic Signals | Independent Accounts, Town-Wide Street Lighting |
| Vehicle Fleet | Town Hall Vehicles, Public Works Vehicles, Fire and Police Vehicles, KLPD Vehicles, Sewer District Vehicles |
| Transit Fleet | Summer Trolley and Shuttle Service |
| Employee Commute | Employee Vehicles, Employee Air Travel |
| Electric Power Production | KLPD Transmission and Distribution Losses |
| Solid Waste Facilities | Municipal Employee Trash Generation |
| Water and Wastewater Treatment Facilities | Sewer District Buildings and Facilities, Wastewater Treatment Process, Septic Systems |

Municipal greenhouse gas emissions inventories can also be broken down into three categories, or scopes. Scopes provide a comprehensive accounting framework for managing and reducing direct and indirect emissions. It is recommended at a minimum to include scopes 1 and 2 and to include scope 3 whenever possible. These scopes are shown in Table 2 below.

Table 2. Municipal Inventory Scopes

| Scope | Description |
|---|---|
| 1 | Direct emissions from facilities owned or operated by the municipality |
| 2 | Indirect emissions from the consumption of purchased or acquired electricity |
| 3 | Indirect emissions that are a consequence of municipal operations |

### *2.2.2 Data Collection*

Buildings and Facilities

Municipal buildings and facilities, as listed in Table 1, are comprised of town offices, fire and police stations, Kennebunk Light & Power District (KLPD) facilities, and parks and recreation facilities. Most of these buildings and facilities utilize electricity and heating fuel. The three types of heating fuel used are distillate fuel oil No. 2, kerosene, and propane. Emissions from the usage of electricity are categorized as scope 2 while emissions from the stationary combustion of fuel oil are categorized as scope 1. Data for this sector was collected from KLPD, Champagne Fuels, and Garrett-Pillsbury Fuels. Maine Regional School Unit (RSU) 21, the local public-school district, and The New School were not included in the municipal inventory because both are stand-alone, independent organizations over which the Town of Kennebunk has no operational control.

Streetlights and Traffic Signals

Streetlight and traffic signal data was collected from KLPD and Central Maine Power (CMP). There are 28 individual KLPD accounts ranging from park lights, to streetlights, to school zone lights that fall in the inventory's operational control boundary. There is also one large account split between KLPD and CMP that comprises the remaining lights and signals that fall within the boundary. The electricity used for this account was extrapolated using the average cost per kilowatt-hour and total dollar amount charged. All the emissions in this sector are scope 2.

Vehicle Fleet

The municipal vehicle fleet is composed of town hall vehicles (gasoline, diesel, and liquefied petroleum gas), fire department vehicles (gasoline and diesel), police department vehicles (gasoline), public works vehicles (gasoline and diesel), KLPD vehicles (gasoline and diesel), and sewer district vehicles (gasoline and diesel). Data for this sector came from each individual department, although a portion of the three-year span was missing for each. Specifically, the first half of 2016 had to be estimated using future data for each department except for the sewer district. In the case of the sewer district, data from 2018 was used as a proxy for 2016 and 2017 because data for those years was unavailable. All emissions from this sector are categorized as scope 1.

Transit Fleet

The only transit fleet run by the municipality is the Shoreline Explorer Trolley and Shuttle Service. This service is provided in partnership with York County Community Action Corporation

(YCCAC) during the summer months only. Many different transit lines are provided by YCCAC, but only the lines that serve Kennebunk - the aqua and blue lines - were included in the inventory. This data was collected directly from YCCAC and all emissions from this sector are categorized as scope 1.

Employee Commute

Municipal employee commute is a significant source of emissions and is categorized as scope 3. It is scope 3 because the Town of Kennebunk does not own or operate the employee vehicles or airplanes used for employee travel, but these emissions are a consequence of municipal operations. This data was collected through a simple survey sent out to all 124 municipal employees. This survey asked questions about the employee’s vehicle, the number of total miles the employee drives to and from work in a normal week, if any employee carpools with any other, and the number of total air travel miles the employee has in a normal year. The collected data from the 87 survey responses received was extended for 50 workweeks in a year and normalized to include all 124 employees. Potential variation between years was deemed insignificant so the same data was used for 2016, 2017, and 2018.

Electric Power Production

The Town of Kennebunk has operational control over KLPD which is the utility that provides most of the electricity to the town. However, KLPD does not generate electricity and instead simply purchases the electricity from an external generation source and transports it to the town through a transmission and distribution (T&D) system. As the electricity is transported through this T&D system some of it is lost due to energy dissipated in the conductors, transformers, or other equipment. The T&D losses are what is represented in this sector. To estimate this lost electricity, calculations were performed using methods and data from the Maine Public Utilities Commission (MPUC). According to the MPUC, KLPD has T&D losses of approximately 4.1%. The emissions from this sector are categorized as scope 2.

Solid Waste Facilities

The Town of Kennebunk does not have operational control over any landfills or trash facilities; therefore, the only emissions in this sector are from the trash generated by municipal operations. To estimate the amount of trash produced by municipal employees, population data and community-wide trash production data provided by Casella Waste Systems were combined to extrapolate per capita trash production. This per capita value was then multiplied by the number of municipal employees to create a rough estimation of municipal trash production. This method contains many assumptions and is unlikely to be highly accurate, so in the future it is recommended that an official accounting of municipal trash be conducted. Emissions from trash generation are categorized as scope 3 as they are a consequence of municipal operations.

Water and Wastewater Treatment Facilities

Potable water is supplied to the town by the Kennebunk, Kennebunkport, and Wells Water District, and wastewater is treated by the Kennebunk Sewer District. According to ICLEI protocol, the water district is a special district, or a political subdivision established to provide a single public service, which is not included in the boundary of the municipal inventory. The sewer district, however, is included because the town has sole operational control. Emissions in this sector include electricity usage for the sewer district buildings, treatment locations, and pumping stations and distillate fuel oil No. 2 usage for heat in the buildings. Also included in this sector are emissions from the wastewater treatment process. All information needed for these calculations was provided directly by the sewer district or found on their website. Beyond emissions from the sewer district, the Public Services building and the Blueberry Plains Fire Station are not served by the sewer district and instead have septic systems. These septic systems give off fugitive emissions that are also counted in the inventory. Heating fuel, process, and septic system emissions are categorized as scope 1 and emissions from electricity usage are scope 2.

## 2.3 Results

### *2.3.1 Baseline in Detail*

Before all three years of the municipal inventory can be compared, 2016, which was chosen as the baseline against which to compare future inventories, must first be analyzed. Figure 1 below breaks down the baseline by percentage.

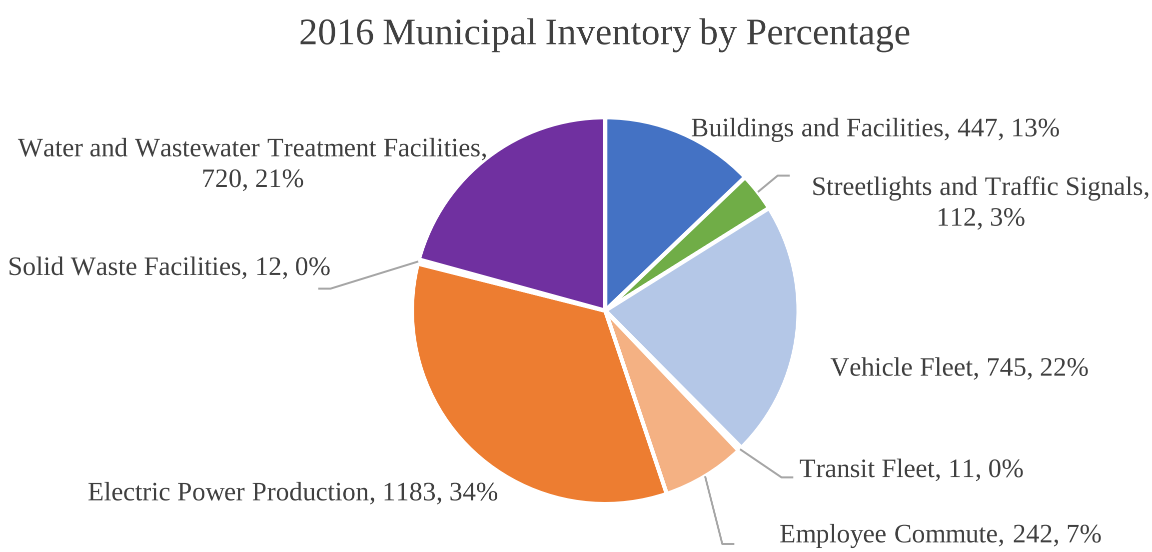


Figure 1. 2016 Municipal Inventory by Percentage

Total emissions from municipal operations in 2016 were 3,472 MT $CO_2$e. The largest contributing sectors were electric power production (34%), vehicle fleet (22%), water and wastewater treatment facilities (21%), and buildings and facilities (13%). To fully understand the significance of these results, emissions must also be categorized by scope to separate direct and indirect emissions. Recall, the scope descriptions are shown in Table 2 in the methodology section. Figure 2 below shows the breakdown of the 2016 emissions by both sector and scope.

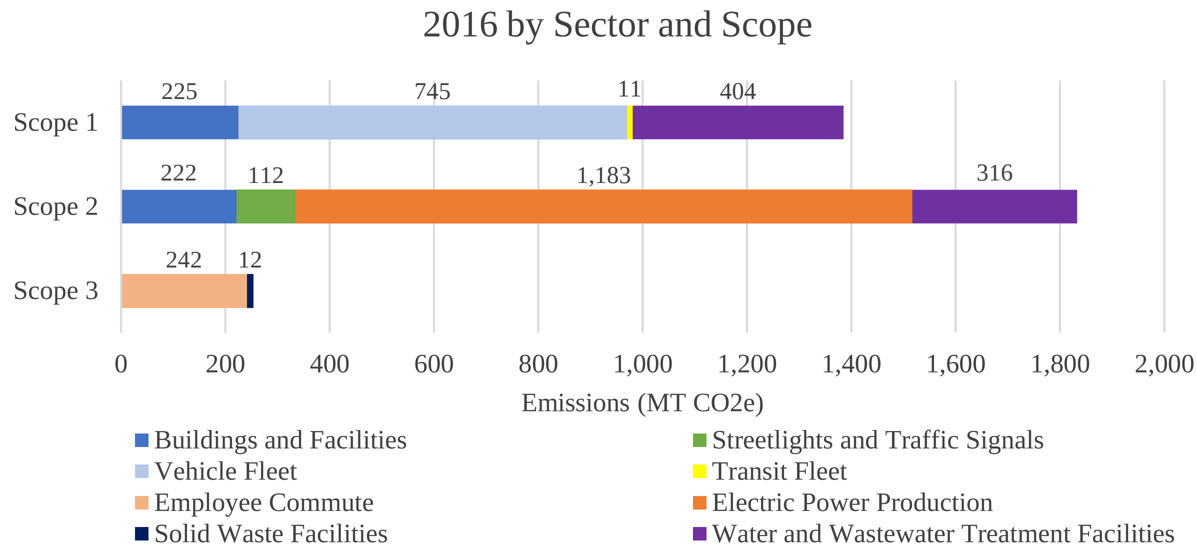


Figure 2. 2016 Municipal Inventory by Sector and Scope

Of all the 2016 emissions, 40% are categorized as scope 1, or direct emissions from municipal operations, 53% are scope 2, or indirect emissions from the usage of electricity in municipal operations, and 7% are scope 3, or indirect emissions that are a consequence of municipal operations.

The scope 1 emissions are mostly from the combustion of heating fuels and the use of vehicles. These are the easiest emissions for a municipality to reduce. The other portion of scope 1 emissions are process emissions from the wastewater treatment facilities and fugitive emissions from septic systems. Seeing as these are not easily reduced, offsets might need to be considered.

The scope 2 emissions are a result of the electricity used due both to the combustion of fuel to create the electricity and KLPD T&D losses. These emissions are often harder to reduce, but since the municipality has operational control of KLPD, which provides most of the electricity to municipal buildings, reductions can be easily made by choosing where the electricity that is distributed is purchased from and by making the KLPD T&D system more efficient.

The scope 3 emissions will be hard for the municipality to reduce as they have no control over the types of vehicles their employees drive which is the largest contributor in this sector.

A summary of the 2016 baseline results is shown below in Table 3.

Table 3. 2016 Municipal Inventory Summary

| | Emissions (MT $CO_2e$) | | | | |
|---|---|---|---|---|---|
| | Scope 1 | Scope 2 | Scope 3 | Total | Percentage |
| Buildings and Facilities | 225 | 222 | 0 | 447 | 13% |
| Streetlights and Traffic Signals | 0 | 112 | 0 | 112 | 3% |
| Vehicle Fleet | 745 | 0 | 0 | 745 | 22% |
| Transit Fleet | 11 | 0 | 0 | 11 | 0% |
| Employee Commute | 0 | 0 | 242 | 242 | 7% |

| | | | | | |
|---|---|---|---|---|---|
| Electric Power Production | 0 | 1,183 | 0 | 1,183 | 34% |
| Solid Waste Facilities | 0 | 0 | 12 | 12 | 0% |
| Water and Wastewater Facilities | 404 | 316 | 0 | 720 | 21% |
| Totals | 1,385 | 1,833 | 254 | 3,472 | 100% |
| Percentage of Total Emissions | 40% | 53% | 7% | | |

### *2.3.2 Comparison by Sector*

Figure 3 below shows the comparison by sector of 2017 and 2018 to 2016, the baseline year. A brief observation shows that emissions are relatively consistent across years both by sector and in totality. Beneath this graphic is Table 4, which shows a summary of the data as well as a percent change compared to the baseline year.

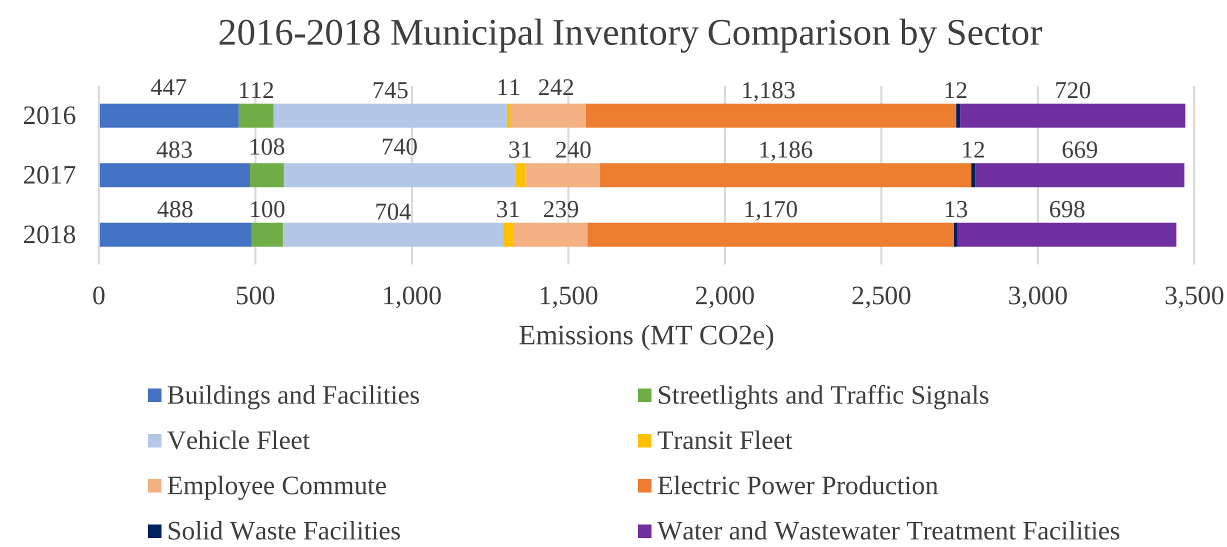


Figure 3. 2016-2018 Municipal Inventory Comparison by Sector

Table 4. 2016-2018 Municipal Inventory Comparison by Sector Summary

| | Emissions (MT $CO_2e$) | | | | |
|---|---|---|---|---|---|
| | 2016 (Baseline) | 2017 | % from Baseline | 2018 | % from Baseline |
| Buildings and Facilities | 447 | 483 | +7.7% | 488 | +8.8% |
| Streetlights and Traffic Signals | 112 | 108 | -3.6% | 100 | -11.3% |
| Vehicle Fleet | 745 | 740 | -0.7% | 704 | -5.7% |
| Transit Fleet | 11 | 31 | +95.2% | 31 | +95.2% |
| Employee Commute | 242 | 240 | -0.8% | 239 | -1.2% |
| Electric Power Production | 1,183 | 1,186 | +0.3% | 1,170 | -1.1% |
| Solid Waste Facilities | 12 | 12 | 0.0% | 13 | +8.0% |
| Water and Wastewater Facilities | 720 | 669 | -7.3% | 698 | -3.1% |
| Totals | 3,472 | 3,469 | -0.1% | 3,443 | -0.8% |

As the table shows, the only noticeable changes across the years are in the transit fleet, streetlight and traffic signals, and buildings and facilities sectors. The difference in the transit fleet sector, which is large in percentage but small in magnitude, was due to the addition of the blue trolley line in 2017 and 2018. The streetlight and traffic signal sector's difference was most likely due to the retrofitting of old lights. The difference in the building and facilities sector could have been due to differences in winter weather across years that necessitated heating fuel usage. Overall, though, the difference across years is less than 1% and all three years of the municipal inventory are very similar by sector.

### *2.3.3 Comparison by Scope*

Just as before, the results across years categorized by scope are also important and must be analyzed to prove their similarity. Figure 4 below shows this analysis and visually proves that the emissions by scope are relatively consistent across all three years. Beneath is Table 5, which shows a summary of the data from the graph along with percent change compared to the baseline year.

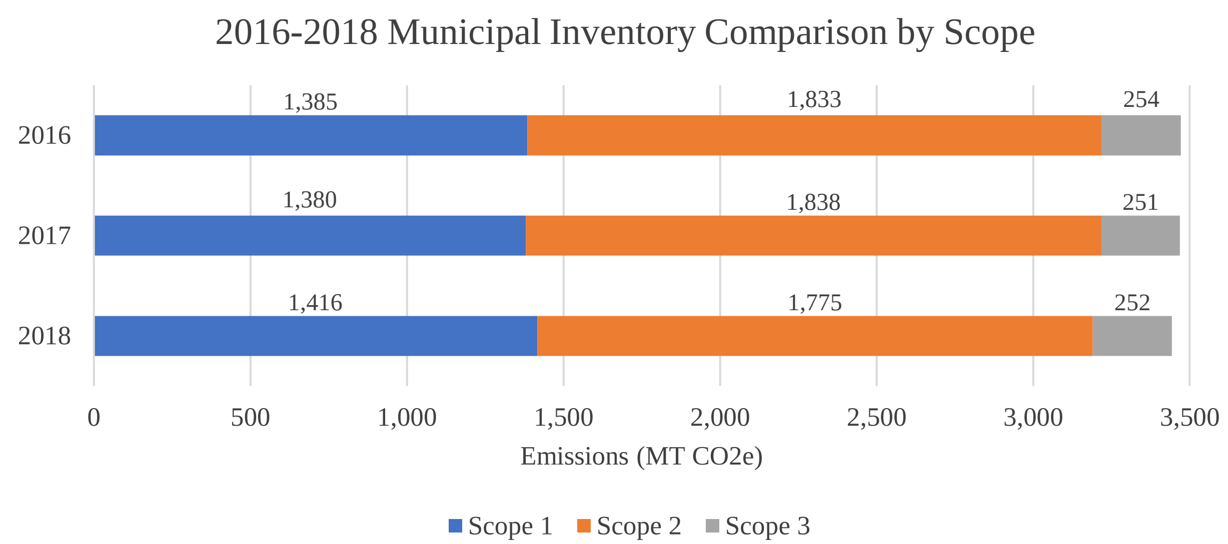


Figure 4. 2016-2018 Municipal Inventory Comparison by Scope

Table 5. 2016-2018 Municipal Inventory Comparison by Scope Summary

| | Emissions (MT $CO_2e$) | | | | |
|---|---|---|---|---|---|
| | 2016 (Baseline) | 2017 | % from Baseline | 2018 | % from Baseline |
| Scope 1 | 1,385 | 1,380 | -0.4% | 1,416 | +2.2% |
| Scope 2 | 1,833 | 1,838 | +0.3% | 1,775 | -3.2% |
| Scope 3 | 254 | 251 | -1.2% | 252 | -0.8% |
| Totals | 3,472 | 3,469 | -0.1% | 3,443 | -0.8% |

The data in this table shows that the largest difference is less than 4%. This small difference shows that all three years of the municipal inventory are also very similar by scope. Since all three years are similar by both sector and scope, the detailed breakdown of the 2016 baseline year in section 2.3.1 is also an accurate representation of the municipal emissions in 2017 and 2018.

## 2.4 Projections

Projections of emission sectors from the baseline year are helpful to visualize how emissions will change in future years if no reduction efforts are made by the municipality. All projections were done until the year 2045 as that is Maine's carbon neutrality deadline set by the state Governor. To create these projections, specific growth indicators were needed to extrapolate emissions in future years. Specifically, town population, municipal employment, Maine's 1999 renewable portfolio standard (RPS), and national vehicle fuel efficiency standards were used. Table 6 below shows the growth indicators used for each sector's projection according to ICLEI Forecasting Guide standards. More details about the growth indicators are included in Appendix G.

Table 6. Municipal Inventory Projection Growth Indicators

| Sector | Growth Indicator(s) |
|---|---|
| Buildings and Facilities | Municipal Employment, Maine RPS |
| Streetlights and Traffic Signals | Municipal Employment, Maine RPS |
| Vehicle Fleet | Municipal Employment, Vehicle Fuel Efficiency |
| Transit Fleet | Population, Vehicle Fuel Efficiency |
| Employee Commute | Municipal Employment, Vehicle Fuel Efficiency |
| Electric Power Production | Population, Maine RPS |
| Solid Waste Facilities | Municipal Employment |
| Water and Wastewater Treatment Facilities | Population, Maine RPS |

The next four figures show the emissions projections of the largest contributing sectors to the municipal inventory. The final figure in this section shows the overall projection of all combined sectors.

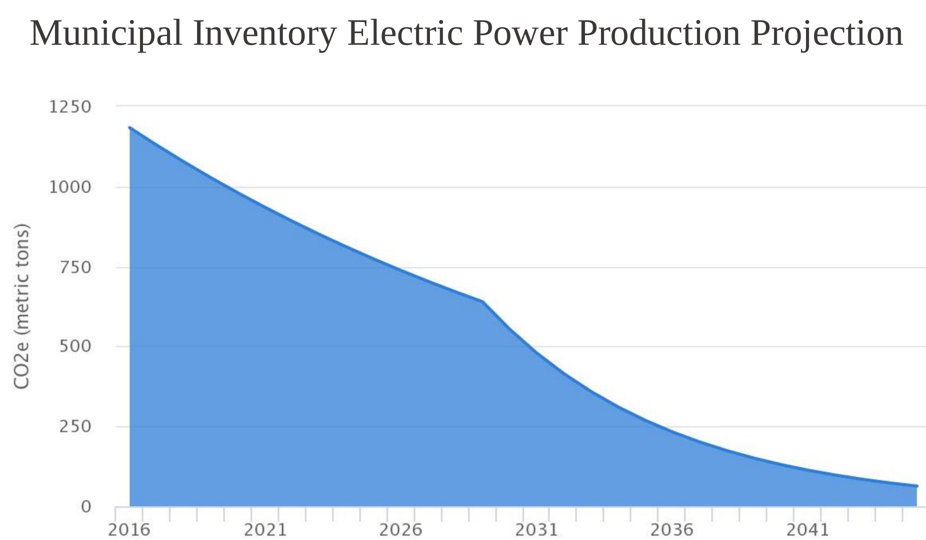


Figure 5. Municipal Inventory Electric Power Production Projection

Figure 5 above shows the projection of the electric power production sector, the municipal inventory's largest sector. There is a steep drop in emissions that is clearly shown. This drop is caused by Maine's RPS which has a goal of 80% renewable electricity generation by 2030 and

100% by 2050. Overall, these emissions should be reduced without any necessary action by Kennebunk if the RPS is successful. However, improving the efficiency of KLPD's T&D system as recommended before would still be a viable option to save the town money.

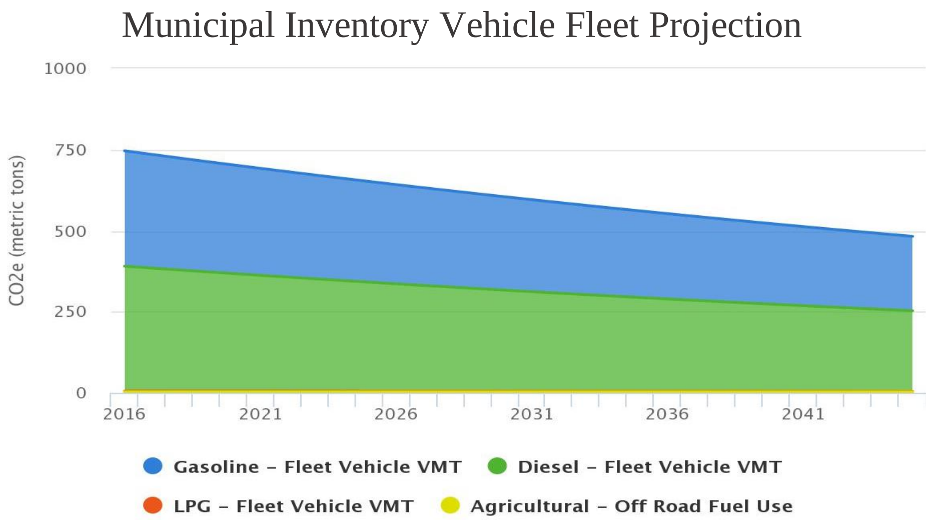


Figure 6. Municipal Inventory Vehicle Fleet Projection

Figure 6 shows the projection of the vehicle fleet sector, the second largest sector. Emissions decrease according to national fuel efficiency standards but at a very slow rate. This projection could change drastically, however, as fuel efficiency standards have in recent years been modified frequently. The only way for the town to reliably reduce these emissions would be to transition their fleet to be more environmentally friendly.

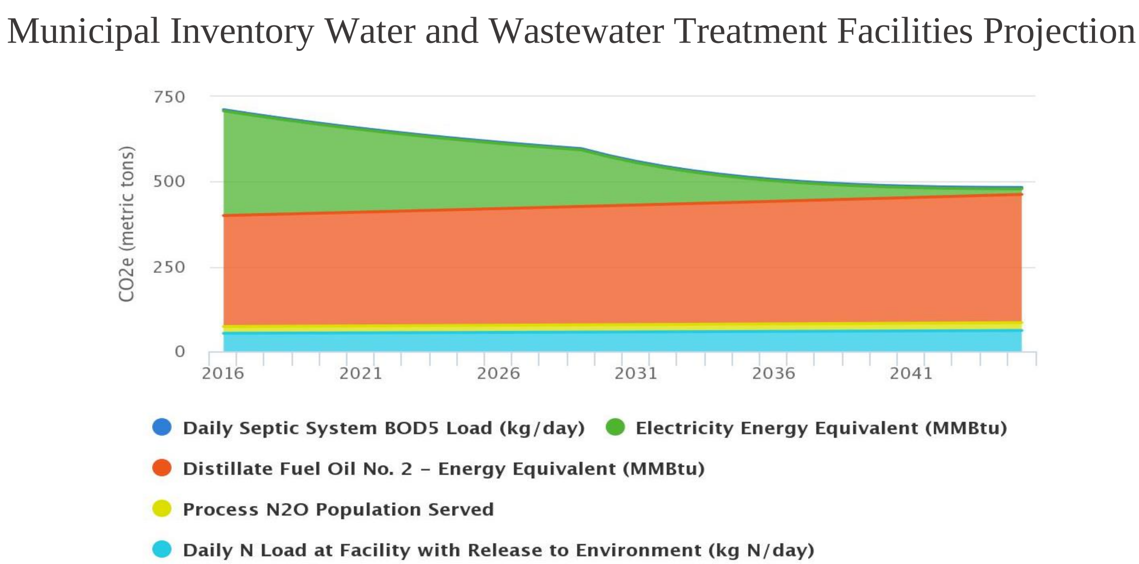


Figure 7. Municipal Inventory Water and Wastewater Treatment Facilities Projection

The projection of the water and wastewater treatment facilities sector is shown in Figure 7 above. The emissions from electricity usage in this sector are being reduced by Maine's RPS as it was in previous projections. Other sources of emissions, heating fuel and process emissions, are increasing as Kennebunk's population rises. To reduce this sector's emissions, these sources would have to be addressed through a combination of making the buildings more efficient, changing to a renewable heating source, and offsetting process emissions as much as possible.

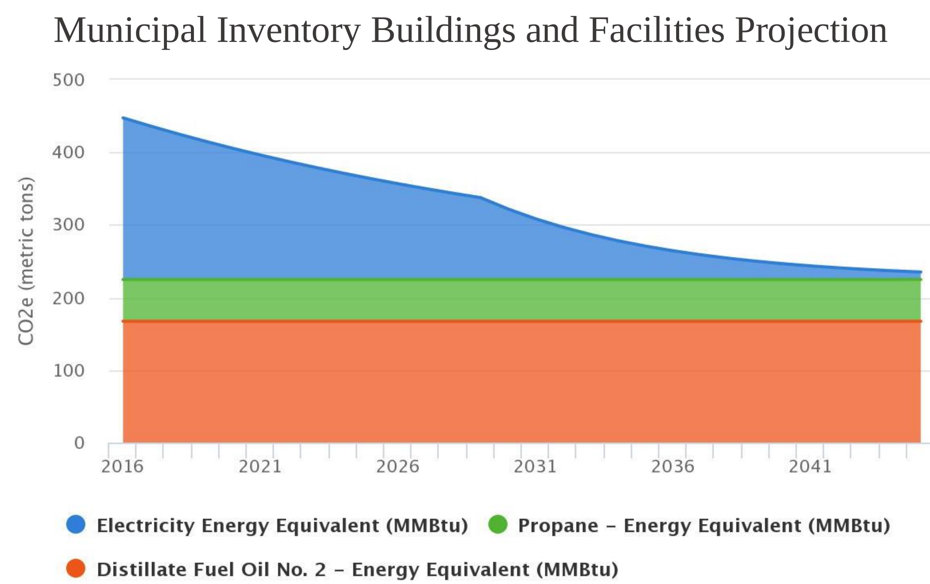


Figure 8. Municipal Inventory Buildings and Facilities Projection

Figure 8 depicts the building and facilities sector projection. Like other sectors, the electricity emissions will decrease according to Maine's RPS, but heating fuel emissions will remain constant. To reduce emissions in this sector, increasing building efficiency, especially in the winter, and switching to a renewable heating source may be necessary.

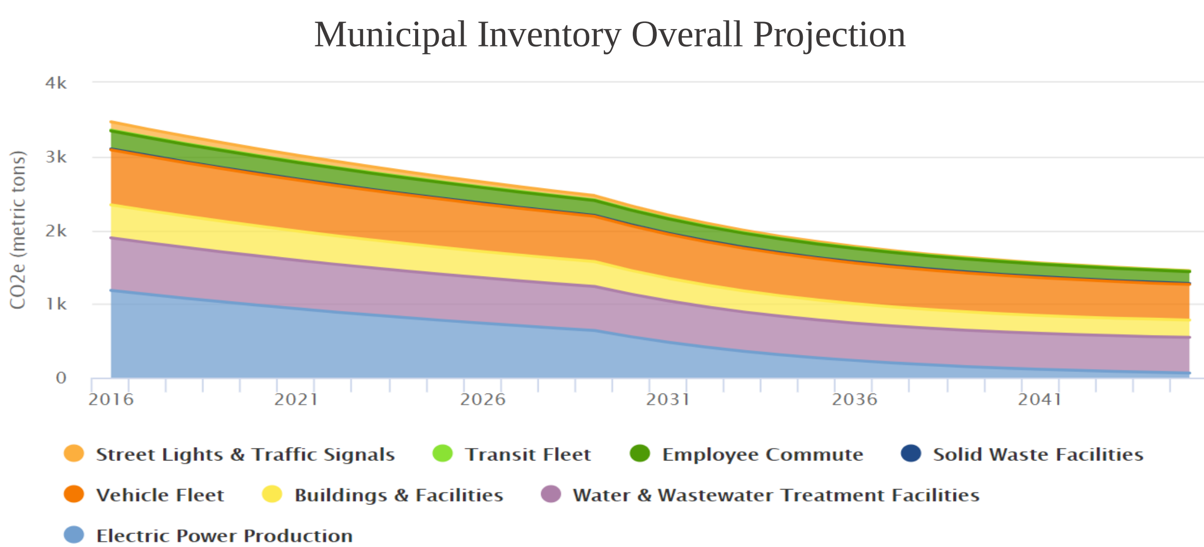


Figure 9. Municipal Inventory Overall Projection

Figure 9 above shows the overall projection of all sectors in the municipal inventory. If current projections remain in place, emissions will be reduced by 58% (compared to the baseline year) to 1,450 MT $CO_2e$ by 2045 due to Maine's RPS and national fuel efficiency standards. It is strongly recommended that the town work assiduously at the local level to further reduce emissions both before and beyond 2045.

## 2.5 Summary

Total emissions according to the 2016 municipal inventory were 3,472 MT $CO_2$e. The largest contributing sectors were electric power production (34%), vehicle fleet (22%), water and wastewater treatment facilities (21%), and buildings and facilities (13%). The inventory is very consistent across all three years.

Scope 2 comprised the largest portion of emissions, but projections show that Maine’s RPS will reduce these emissions to nearly zero by 2045 if its goals are successfully met. If not, purchased KLPD electricity will have to be independently transitioned to renewable electricity and the T&D system will need to be made more efficient.

Scope 1 emissions had the second largest impact. These emissions are predominantly from stationary combustion, or the usage of heating fuels, and vehicle usage. To reduce these emissions, buildings will have to be made more efficient in the winter, renewable heating sources will have to be considered, and the municipal fleet will have to be made more efficient and environmentally friendly. Scope 3 had a small impact on the total amount of emissions and significant reductions in this sector are difficult.

Overall, compared to the baseline year, municipal emissions will be reduced to 1,450 MT $CO_2$e, a 58% reduction, by 2045 as a result of Maine’s RPS and national fuel efficiency standards, if these standards are followed. However, the additional 42% of reductions must be made by the town if they are to achieve carbon neutrality by 2045, a goal set by the Maine State Governor. Since most of these emissions are from only two sources, it is not unrealistic for Kennebunk’s municipal operations to be carbon neutral within the next 25 years.

# 3. COMMUNITY INVENTORY

## 3.1 Overview

Like municipal inventories, community greenhouse gas emissions inventories allow towns and cities to identify major emissions sources within the jurisdiction as a basis for climate policy, create a baseline against which to set emissions reduction targets, and enable the demonstration of progress across future inventories. This inventory encompasses the 2016, 2017, and 2018 calendar years and the methods used to collect data were kept as consistent as possible across each year.

## 3.2 Methodology

This community inventory was created using ICLEI ClearPath and follows a combination of the guidelines set by the ICLEI U.S. Community and ICLEI Global Community Protocols. It uses a geographic control boundary when determining which emission sources to include. In other words, anything that falls within the town's geographic boundary is included in the inventory. This geographic boundary is shown outlined in red below in Figure 10.

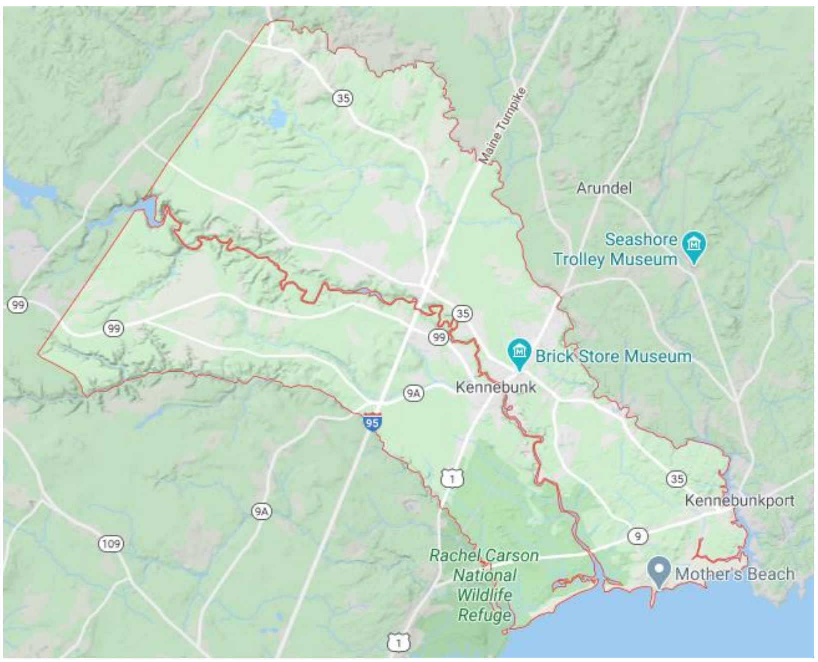


Figure 10. Kennebunk Geographic Boundary

The inventory uses 2016 as the baseline year against which 2017 and 2018 are compared. Details about emissions factor sets, a value used in calculations, can be found in Appendix G. IPCC 5th Assessment 100 Year Values were selected as the global warming potential, a value also used in calculations and projections. All results are expressed in metric tons of carbon dioxide equivalent (MT $CO_2e$).

### *3.2.1 Sectors, Sources, and Scopes*

This community inventory, like the municipal inventory, is broken down into emission sectors and the sources within each sector. The nine sectors included were taken directly from the ICLEI ClearPath Community Track program. These sectors and sources are shown in Table 7 below.

Table 7. Community Inventory Sectors and Emissions Sources

| Sector | Emission Sources |
|---|---|
| Residential Energy | Electricity Usage, Stationary Fuel Combustion |
| Commercial Energy | Electricity Usage, Stationary Fuel Combustion |
| Industrial Energy | Electricity Usage, Stationary Fuel Combustion |
| Transportation and Mobile Sources | Local Road Vehicles, Interstate-95 Vehicles |
| Solid Waste | Waste Generation, Waste Collection and Transportation |
| Water and Wastewater | Water and Sewer District Buildings and Facilities, Wastewater Treatment Process, Septic Systems |
| Process and Fugitive Emissions | Natural Gas Distribution |
| Upstream Impact of Activities | CMP and KLPD Transmission and Distribution Losses, Purchased Electricity, Stationary Fuel Combustion |
| Consumption-Based | Food, Goods, Services |

Community greenhouse gas emissions inventories are also broken down into three scopes, although they are slightly different than municipal scopes. These scopes distinguish between emissions that occur inside the town boundary from emissions that occur outside the town boundary. These scopes are shown in Table 8 below.

Table 8. Community Inventory Scopes

| Scope | Description |
|---|---|
| 1 | Emissions from sources located within the town boundary |
| 2 | Emissions occurring due to the use of electricity within the town boundary |
| 3 | Emissions that occur outside the town boundary as a result of activities taking place within the town boundary |

### *3.2.2 Data Collection*

Residential Energy

The residential energy sector is comprised of electricity usage and stationary fuel combustion, also known as heating fuel usage. Town electricity is supplied by both CMP and KLPD and data about electricity usage for this sector was provided by each utility. This residential electricity usage is categorized as scope 2. The other emissions source in this sector is stationary fuel combustion. Information about Kennebunk residential fuel use was extrapolated using information about statewide fuel usage by sector from the U.S. Energy Information Administration and estimated home fuel use percentages for Kennebunk from the American Community Survey. The stationary fuels included in this sector are natural gas, distillate fuel oil, wood, and hydrocarbon gas liquids

(HGL) which was estimated as propane. Emissions from all these stationary fuels are categorized as scope 1.

Commercial Energy

The data collected for the commercial energy sector is very similar to the residential energy sector. It is comprised of electricity usage, supplied by both CMP and KLPD, and stationary fuel combustion. The electricity usage is categorized as scope 2 and the stationary fuel combustion is categorized as scope 1. Commercial stationary fuel use was extrapolated using information about statewide fuel and electricity usage by sector from the U.S. Energy Information Administration. The stationary fuels included in this sector are natural gas, distillate fuel oil, kerosene, gasoline, residual fuel oil, wood, and HGL which was again estimated as propane. This method of stationary fuel use calculation is merely an estimation and it is recommended that in the future more accurate accounting is performed.

Industrial Energy

Industrial energy sector data was collected using an identical method as commercial energy data. Similarly, electricity usage in this sector is categorized as scope 2 and stationary fuel combustion is categorized as scope 1. The stationary fuels included in this sector are coal, natural gas, distillate fuel oil, gasoline, residual fuel oil, wood, HGL which was estimated as propane, and other petroleum fuel which was estimated as kerosene. As in the commercial energy sector, this method of stationary fuel use calculation is merely an estimation and it is recommended that in the future a more accurate accounting is performed.

Transportation and Mobile Sources

The transportation and mobile sources sector is composed of local road traffic and Interstate-95 traffic. Data about the annual vehicle miles traveled for each section of road was provided by the Maine Department of Transportation. Percentages of vehicle type and fuel type were also needed for this calculation. These values were taken from the EPA state inventory tool. All emissions from this sector are categorized as scope 1. In the future, it is recommended that a more accurate method that does not include travel directly through the town be used for this sector and that accounting be expanded to include water vessels, off road vehicles, and air travel.

Solid Waste

Emissions from the solid waste sector are a result of the trash generated within the town's boundaries. Most of the trash produced in Kennebunk is gathered through a curbside collection program by Casella Waste Systems and taken to a landfill outside of the town. There is also a transfer station in Kennebunk operated by CPRC Management, LLC that is used to collect trash and other waste that is not collected by the curbside program. After this waste is collected at the transfer station, it is also transported to a facility outside of the town. Data about the amount of waste collected at both locations was provided by the operator of each program. Beyond the direct emissions of the waste, there are also emissions that are caused by garbage trucks during the collection of the trash through the curbside program. Any emissions from the collection inside the town's boundary are already encompassed in the transportation and mobile sources sector so only emissions between the landfill and the town were included here. All emissions in this sector are categorized as scope 3 as they all occur outside of the town's geographical boundary but are a result of activities within the town.

Water and Wastewater

The water and wastewater sector is very similar to that of the municipal inventory. Potable water is supplied to the town by the Kennebunk, Kennebunkport, and Wells Water District and wastewater is treated by the Kennebunk Sewer District. Data about electricity usage, wastewater process emissions, and fugitive septic system emissions were all collected as they were for the municipal inventory. The electricity usage is categorized as scope 2 and the process and septic emissions are categorized as scope 1. Stationary fuel combustion is not included in this sector as it is already accounted for in the industrial energy sector. The other notable difference between the municipal and community inventory for this sector is that this inventory includes water district buildings and facilities even though the municipal inventory did not. Specifically, water district electric consumption is included in this sector but not stationary fuel usage as it is also already accounted for in the industrial energy sector. All water district facilities were included in the inventory because the data collected did not categorize which buildings and pumping facilities are used to provide water specifically to Kennebunk. The electricity used by the water district buildings and facilities within the town's geographical boundary is categorized as scope 2 and the electricity used by buildings and facilities outside the town's boundary is categorized as scope 3.

Process and Fugitive Emissions

The only emissions source in this sector is from the leakage of natural gas in the local distribution system. It was calculated using natural gas data from the residential, commercial, and industrial energy sectors. These emissions are categorized as scope 1. There is a high likelihood that other process and fugitive emissions are present within the town's boundary, so it is recommended that more data is collected for this sector in the future.

Upstream Impacts of Activities

Upstream impacts of activities refer to any emissions that occurred outside of the town's boundary as a result of the energy used in the town. The first emissions source in this sector is T&D losses of the electricity provided by both KLPD and CMP. This source is the same as T&D losses in the municipal inventory, but unlike the municipal inventory, this inventory includes CMP losses as well. The next source of emissions in this sector is from purchased KLPD electricity. As mentioned in the municipal inventory, KLPD purchases electricity from an external generation source. This purchased electricity must be transported from the external source to the KLPD facility which leads to further T&D losses. The final source of emissions in this sector is from the combustion of stationary heating fuels. Upstream impacts of these fuels are from the energy required to extract, process, and deliver the fuel to the buildings that utilize them. All stationary fuels that were used in the residential, commercial, and industrial energy sectors were included. Each emissions source in this sector is categorized as scope 3 and all calculations were performed using values and methods from ICLEI protocols.

Consumption-Based

Emissions in this sector are caused by the consumption of food, goods, and services. To calculate these emissions, information from the University of Berkeley's Cool Climate Network was used. This network provides an estimation of consumption-based emissions per household by zip code throughout the United States. The value for York County was multiplied by the number of households in Kennebunk to get a final value. The same value was used for 2016, 2017, and 2018 and emissions from this sector are categorized as scope 3. The underlying method used by Berkeley's network to estimate these emissions is unknown, and therefore the accuracy of the calculated emissions in this sector is also unknown. It is recommended that a more accurate accounting method be developed for this sector in the future.

## 3.3 Results

As with the municipal inventory, the baseline year must be examined before following years can be compared. Figure 11 below breaks down this baseline year by percentage for the community inventory.

### *3.3.1 Baseline in Detail*

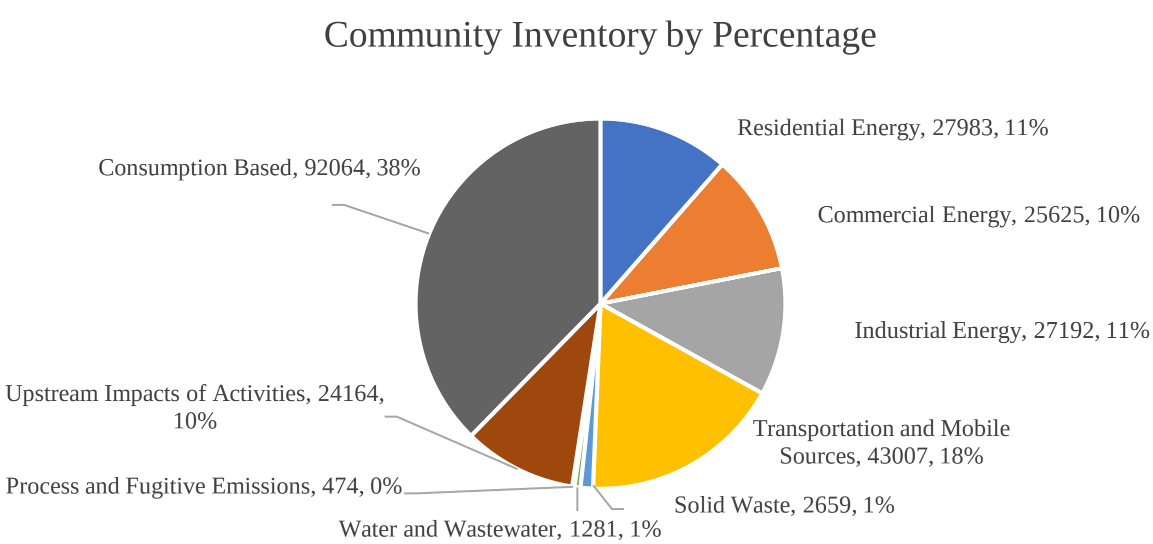


Figure 11. 2016 Community Inventory by Percentage

The total community emissions calculated in the 2016 inventory were 244,449 MT $CO_2$e. The biggest sectors were consumption-based (38%); transportation and mobile sources (18%); and residential energy, commercial energy, industrial energy, and upstream impacts of activities (each approximately 10%). Utilizing the scopes framework is also useful in this inventory to fully understand the significance of these results. The scopes descriptions for community inventories are shown in Table 8 in the methodology section. Figure 12 below shows the breakdown by sector and scope for 2016.

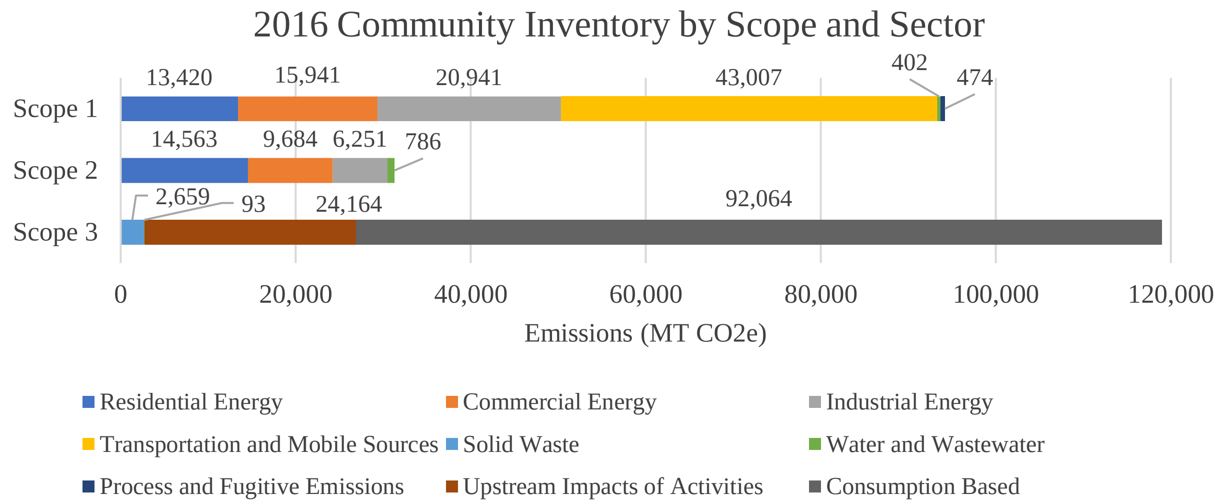


Figure 12. 2016 Community Inventory by Sector and Scope

In 2016, 38% of emissions were categorized as scope 1, or emissions from sources located within the town, 13% were categorized as scope 2, or emissions occurring due to the use of electricity within the town, and 49% were scope 3, or emissions that occur outside the town as a result of activities taking place within the town.

The largest single component of scope 1 emissions is vehicle use on roads within the town's boundary over which the town has very little control. It is important to note that the results above do not include miles traveled on Interstate-95 which bisects the town. If these miles were included, the total MT $CO_2e$ of this sector would be approximately twice as high. The other major contributor to this scope is the combustion of heating fuels in the residential, commercial, and industrial sectors. Just like scope 1 of the municipal inventory, these heating fuel emissions are the ones with the greatest potential for the town to control.

The scope 2 emissions are from the electricity used by the residential, commercial, and industrial sectors. Again, these emissions are often difficult to reduce, but since KLPD supplies most of the electricity to the town and the municipality operates the utility, there are ample options for emissions reduction in these sectors and scope.

A significant component of the scope 3 emissions is the upstream impacts of activities. Typically, scope 3 emissions are difficult to reduce but in this case they are not. Recall from section 3.2.1 that sources in this sector include CMP and KLPD T&D losses, KLPD purchased electricity, and stationary fuel combustion. Other than CMP T&D losses, Kennebunk can reduce these emissions through increasing efficiency of electricity distribution, purchasing electricity generated by renewable energy, and attempting to reduce the town-wide consumption of unsustainable heating fuels. The largest piece of the scope 3 emissions, and of the entire inventory, is the consumption-based sector which measures the impact of consumed food, goods, and services. These emissions are extremely difficult for a town to reduce as they are attributed to everyday choices made by residents. One of the few tactics a community can employ is an educational campaign that shows residents how a small adjustment to daily choices can greatly reduce their environmental impact.

A summary of the community baseline results is shown below in Table 9.

Table 9. 2016 Community Inventory Summary

| | Emissions (MT $CO_2$e) | | | | |
|---|---|---|---|---|---|
| | Scope 1 | Scope 2 | Scope 3 | Total | Percentage |
| Residential Energy | 13,420 | 14,563 | 0 | 27,983 | 11% |
| Commercial Energy | 15,941 | 9,684 | 0 | 25,625 | 10% |
| Industrial Energy | 20,941 | 6,251 | 0 | 27,192 | 11% |
| Transportation & Mobile Sources | 43,007 | 0 | 0 | 43,007 | 18% |
| Solid Waste | 0 | 0 | 2,659 | 2,659 | 1% |
| Water and Wastewater | 402 | 786 | 93 | 1,281 | 1% |
| Process and Fugitive Emissions | 474 | 0 | 0 | 474 | 0% |
| Upstream Impacts of Activities | 0 | 0 | 24,164 | 24,164 | 10% |
| Consumption-Based | 0 | 0 | 92,064 | 92,064 | 38% |
| Totals | 94,185 | 31,284 | 118,980 | 244,449 | 100% |
| Percentage of Total Emissions | 38% | 13% | 49% | | |

## *3.3.2 Comparison by Sector*

Figure 13 below shows the community inventory comparison by sector compared to the baseline year. It is easy to see that emissions are relatively consistent across all years both by sector and in totality. Beneath this graphic is Table 10, which shows a summary of the data as well as a percent change compared to the baseline year.

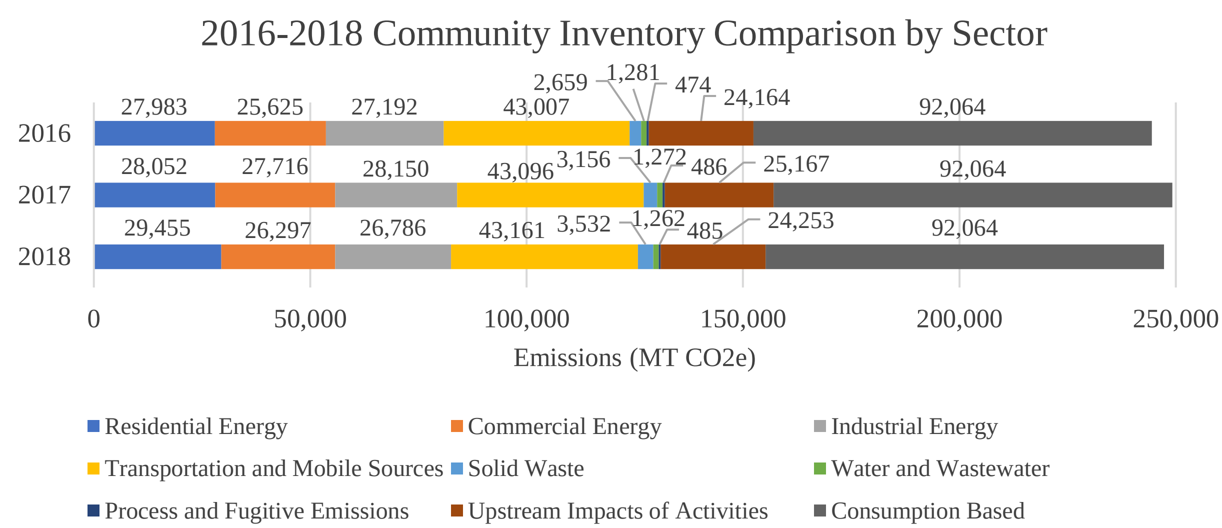


Figure 13. 2016-2018 Community Inventory Comparison by Sector

Table 10. 2016-2018 Community Inventory Comparison by Sector Summary

| | Emissions (MT $CO_2$e) | | | | |
|---|---|---|---|---|---|
| | 2016 (Baseline) | 2017 | % from Baseline | 2018 | % from Baseline |
| Residential Energy | 27,983 | 28,052 | +0.2% | 29,455 | +5.1% |

| | | | | | |
|---|---|---|---|---|---|
| Commercial Energy | 25,625 | 27,716 | +7.8% | 26,297 | +2.6% |
| Industrial Energy | 27,192 | 28,150 | +3.5% | 26,786 | -1.5% |
| Transportation & Mobile Sources | 43,007 | 43,096 | +0.2% | 43,161 | +0.4% |
| Solid Waste | 2,659 | 3,156 | +17.1% | 3,532 | +28.2% |
| Water and Wastewater | 1,281 | 1,272 | -0.7% | 1,262 | -1.5% |
| Process and Fugitive Emissions | 474 | 486 | +2.5% | 485 | +2.3% |
| Upstream Impacts of Activities | 24,164 | 25,167 | +4.1% | 24,253 | +0.4% |
| Consumption-Based | 92,064 | 92,064 | 0.0% | 92,064 | 0.0% |
| Totals | 244,449 | 249,159 | +1.9% | 247,295 | +1.2% |

The only noticeable differences are in the residential energy, commercial energy, and solid waste sectors. The residential energy and commercial energy inconsistencies can be explained as they were in the buildings and facilities sector of the municipal inventory. Differences in winter weather between years will skew the amount of heating fuel used. The difference in the solid waste sector is most likely just a slight increase in the amount of waste produced by town residents. Although this is a large increase in the sector, it makes a very small impact on the total emissions. Overall, the difference across the three inventory years is less than 2% and they are all very similar by sector, as was the municipal inventory.

### *3.3.3 Comparison by Scope*

Figure 14 below shows the analysis by scope that is needed to fully prove the similarity between years. It is clear from this graphic that emissions by scope are relatively consistent across all three years. Beneath is Table 11, which shows a summary of the data from the graph along with percent change compared to the baseline year.

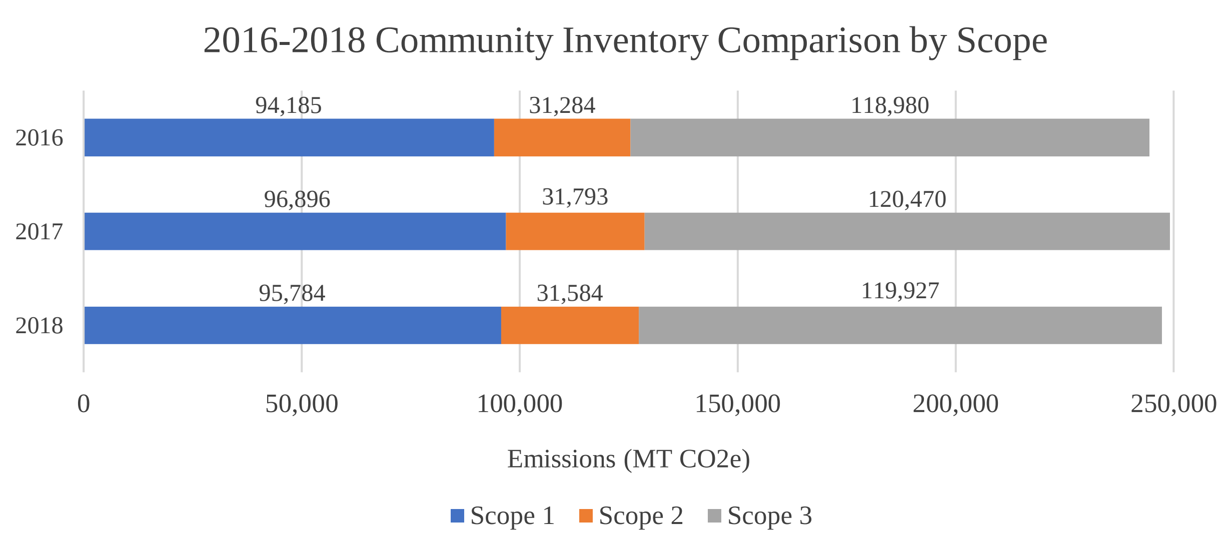


Figure 14. 2016-2018 Community Inventory Comparison by Scope

Table 11. 2016-2018 Community Inventory Comparison by Scope Summary

| | Emissions (MT $CO_2$e) | | | | |
|---|---|---|---|---|---|
| | 2016 (Baseline) | 2017 | % from Baseline | 2018 | % from Baseline |
| Scope 1 | 94,185 | 96,896 | +2.8% | 95,784 | +1.7% |
| Scope 2 | 31,284 | 31,793 | +1.6% | 31,584 | +1.0% |
| Scope 3 | 118,980 | 120,470 | +1.2% | 119,927 | +0.8% |
| Totals | 244,449 | 249,159 | +1.9% | 247,295 | +1.2% |

This table shows that the largest difference is less than 3%. This small difference shows that all three years of the community inventory are very similar by scope. Seeing that all the years of the community inventory are similar by both sector and scope, the detailed breakdown of the 2016 baseline year in section 3.3.1 is an accurate representation of the community emissions in 2017 and 2018.

## 3.4 Projections

Baseline year projections were also analyzed for the community inventory. All projections were done through the year 2045 in accordance with Maine's carbon neutrality deadline set by the state Governor. Growth indicators used for these projections include town population, number of households, community employment, Maine's renewable portfolio standard (RPS), and national vehicle fuel efficiency standard. Table 12 below shows the growth indicators used for each sector's projection according to ICLEI Forecasting Guide standards. More details about the growth indicators are included in Appendix G.

Table 12. Community Inventory Projection Growth Indicators

| Sector | Growth Indicator(s) |
|---|---|
| Residential Energy | Households, Maine RPS |
| Commercial Energy | Community Employment, Maine RPS |
| Industrial Energy | Community Employment, Maine RPS |
| Transportation and Mobile Sources | Population, Vehicle Fuel Efficiency |
| Solid Waste | Population, Vehicle Fuel Efficiency |
| Water & Wastewater | Population, Maine RPS |
| Process and Fugitive Emissions | Population |
| Upstream Impacts of Activities | Population, Maine RPS |
| Consumption-Based | Population |

The next six figures show the emissions projections of the largest community inventory sectors. The final figure in this section shows the overall projection of all combined community sectors.

Community Inventory Consumption-Based Projection

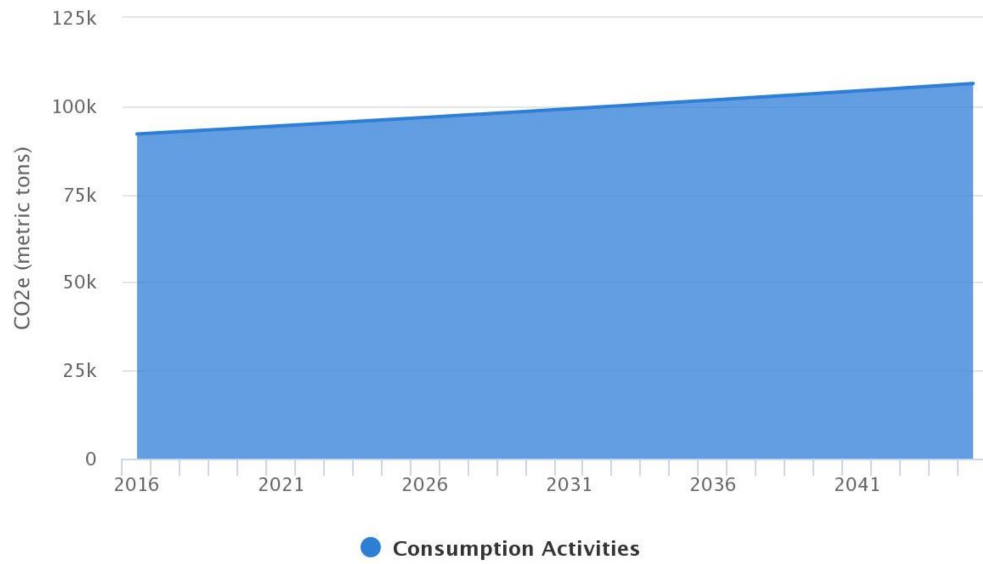


Figure 15. Community Inventory Consumption-Based Projection

Figure 15 above shows the projection for the largest sector of the inventory. Assuming consumption patterns of food, goods, and services remain the same, emissions will increase proportionally to the increase in population of Kennebunk. Knowing that these emissions will only continue to rise, actions to reduce them as much as possible should be taken.

Community Inventory Transportation and Mobile Sources Projection

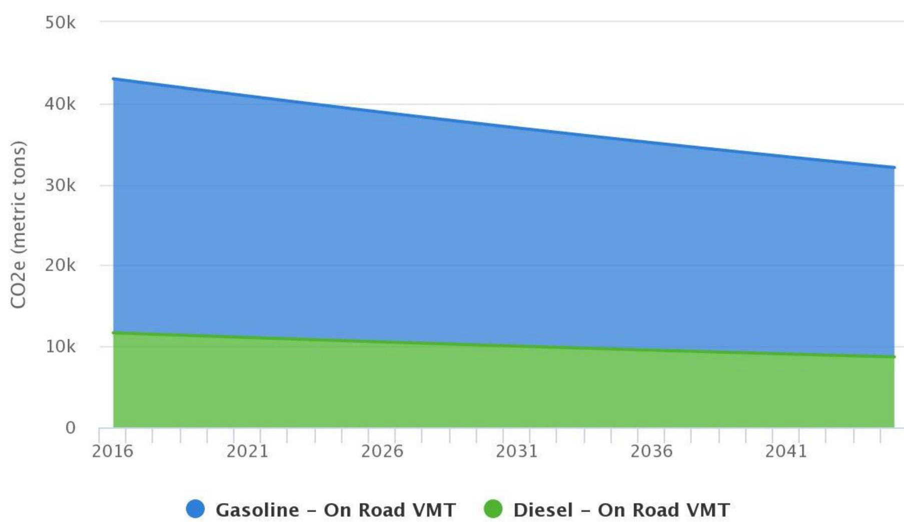


Figure 16. Community Inventory Transportation and Mobile Sources Projection

Figure 16 above shows the projection for the transportation and mobile sources sector. Emissions will slowly drop according to national fuel efficiency standards. However, as noted in the municipal inventory vehicle fleet projection, this trend could change drastically in the future as fuel efficiency standards have historically been changed often. If the town desired to decrease these emissions further, then public transportation or lower emission modes of travel would need to become more available and popular.

Community Inventory Residential Energy Projection

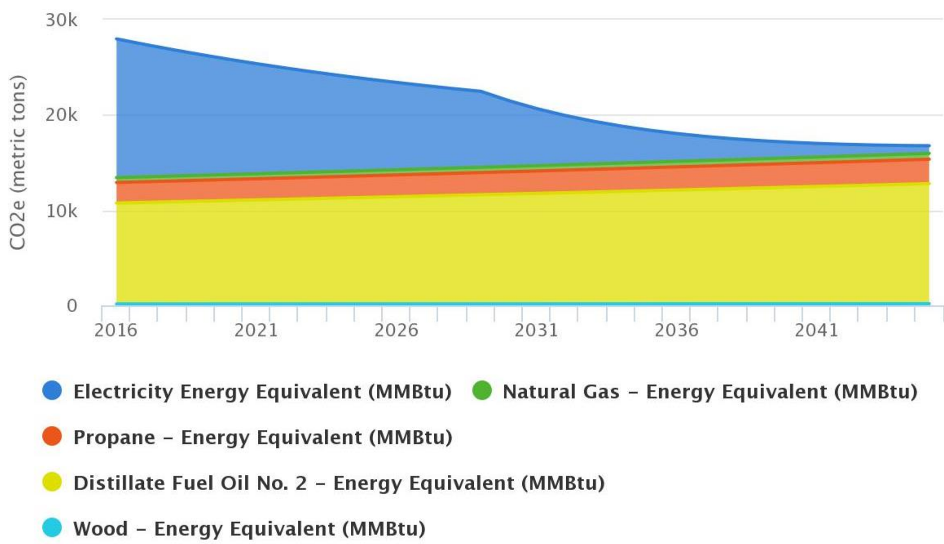


Figure 17. Community Inventory Residential Energy Projection

Community Inventory Commercial Energy Projection

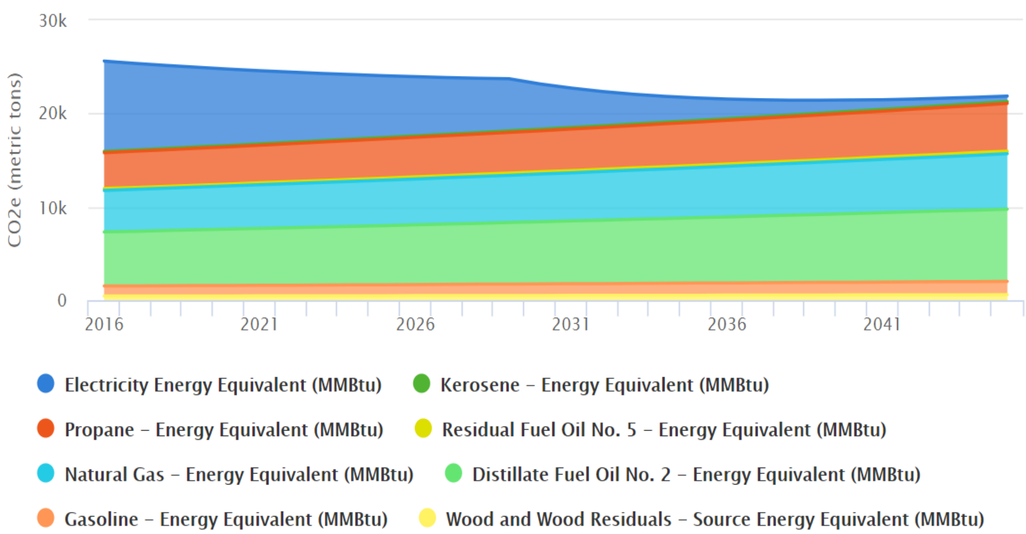


Figure 18. Community Inventory Commercial Energy Projection

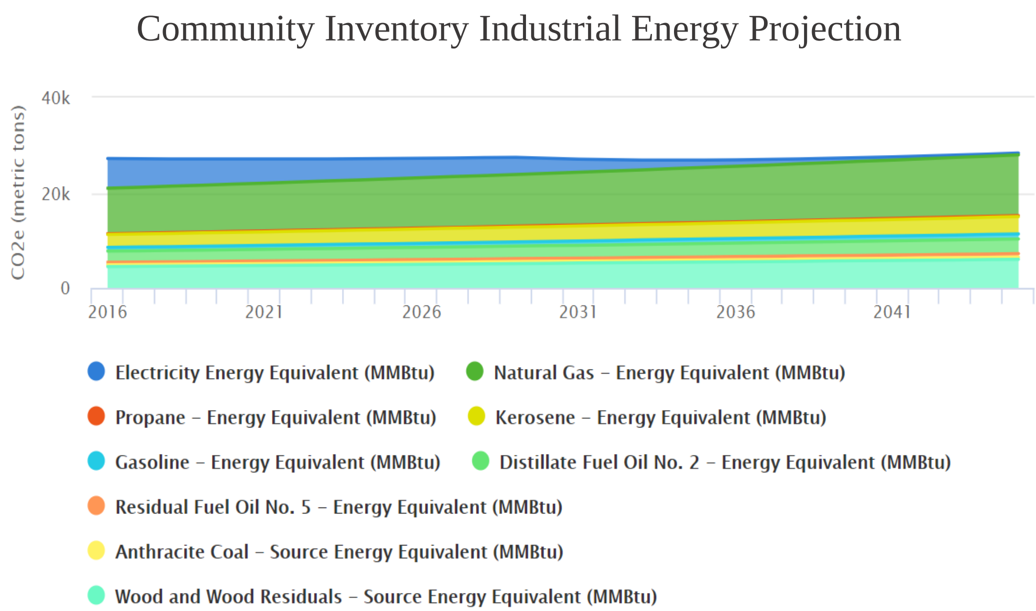


Figure 19. Community Inventory Industrial Energy Projection

Figures 17, 18, and 19 above show the projections for the three energy sectors of the community inventory. They all show that electricity emissions will decrease according to Maine's RPS, but all other emissions will increase as the number of households and community employment increases. To further decrease these emissions, community actions will have to be made such as increasing building energy efficiency and transitioning to renewable heating sources.

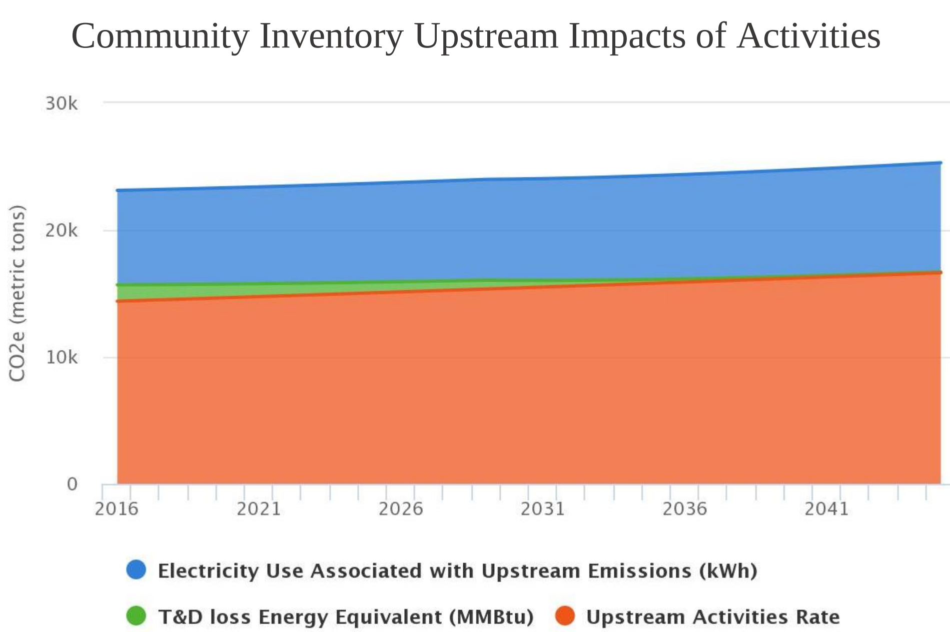


Figure 20. Community Inventory Upstream Impacts of Activities Projection

The final major sector of the community inventory, upstream impacts of activities, is shown above in Figure 20. Emissions in this sector will rise as population rises if no actions are taken. However, reducing emissions from this sector will happen as a result of action in other sectors. If renewable and other environmentally friendly fuels are used in Kennebunk, all sources of emissions in this sector will also be reduced.

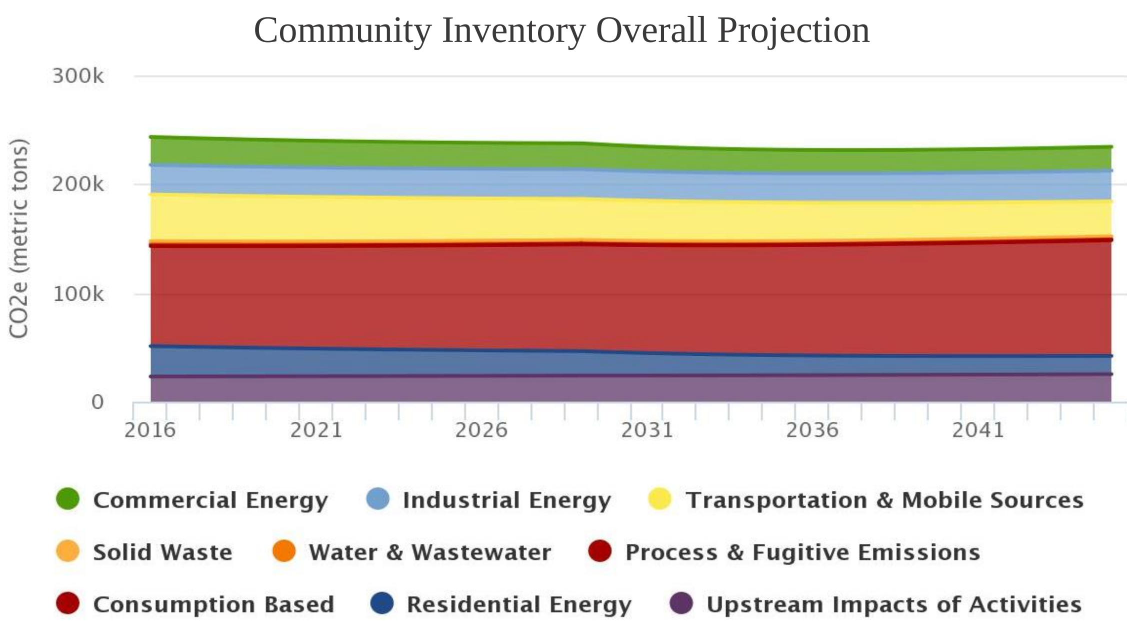


Figure 21. Community Inventory Overall Projection

Figure 21 above shows the overall projection of all sectors of the community inventory. If this projection remains in place, emissions will be reduced by only 4% (compared to the baseline year) to 234,357 MT $CO_2$e by 2045 due to Maine's RPS and national fuel efficiency standards. As with the municipal inventory, it is strongly recommended that further local actions are taken to reduce these emissions both before and beyond 2045.

## 3.5 Summary

The total emissions calculated by the 2016 community inventory were 244,449 MT $CO_2$e. The biggest sectors were consumption-based (38%); transportation and mobile sources (18%); and residential energy, commercial energy, industrial energy, and upstream impacts of activities (each approximately 10%). Like the municipal inventory, this inventory is very consistent across all three years.

Scope 3 had the largest impact on emissions. The biggest source of these emissions was from the consumption of food, goods, and services, and this source is projected to continue to increase in future years as population increases. The only way for the town to reduce these emissions is to set a good example and educate residents about the importance of making daily environmentally conscious choices. The other source from this scope, upstream impacts of activities, can be reduced by simply reducing emissions from other scopes and sectors.

Scope 1 had the second largest emissions impact. The largest source of these emissions was vehicle usage within the town's boundary. Reduction strategies besides enabling public and low emission transport are typically limited. The other scope 1 source was the usage of heating fuels. To reduce these emissions, buildings will have to be made more efficient, especially in the winter, and renewable heating sources will have to be considered.

Scope 2 emissions were the smallest portion of all emissions. Maine’s RPS should reduce these emissions to nearly zero by 2045 assuming its goals are successfully met. If not, the municipal strategy of transitioning purchased KLPD electricity to renewable electricity and upgrading the T&D system is also applicable here.

Overall, community emissions will not be reduced by state and national standards to the extent that emissions in the municipal inventory were. This is because in this inventory there is a much larger population that uses stationary fuels and vehicles than in the municipal inventory. Also, the consumption-based sector, which is by far the largest component in this inventory, is not part of the operational boundary of the municipal inventory. If the town of Kennebunk were to reduce community emissions, significant reduction programs would have to be adopted.

# 4. DIVERSITY, EQUITY, AND INCLUSION

When discussing any social issue, it is important to address the demographics of the area both in the past and present. By considering demographics, it is possible to analyze an area in terms of its diversity, equity, and inclusion (DEI). Maine as a whole was home to five distinct Native American tribes, known collectively as the Wabanaki, before the Europeans settled in the area. Kennebunk itself is rooted in the history of these tribes. The Eastern Abenaki tribe lived primarily in Southern Maine and in Kennebunk. The town's name is even derived from a Wabanaki word meaning "long cut bank". During the early eighteenth century, many battles between the French and Native Americans took place directly within Kennebunk's current borders. Due to this deep historical connection, there is much to consider when addressing DEI in Kennebunk.

DEI is still at the forefront of current events and issues in Kennebunk. In terms of diversity, Kennebunk is geographically within 30 miles of four of the top seven towns with the largest African American populations in Maine (Portland, South Portland, Biddeford, and Westbrook). Demographically, Kennebunk is very homogenous and there are 143 times more white (not Hispanic or Latino) residents than any other race or ethnicity. Many argue that these demographics dominate the culture in Kennebunk as well.

This lack of diversity can occasionally also cause Kennebunk to lack equity and inclusion. The most recent notable example of this is found at Kennebunk High School. In February 2019, a race-retaliation complaint was brought before the Maine Human Rights Commission following an incident involving a Confederate flag. This incident, along with other similar incidents, has caused the teacher that filed the complaint to leave the school district, a biracial family and another community member to move out of Kennebunk, and much continued criticism to come upon the school district for their handling of these situations. Since the filing of the complaint, many positive steps have been taken to address this lack of equity and inclusion in Kennebunk. Inclusivity training was held for staff of the school, a high school teacher has developed a Black American history class, the school district hired a woman of color as superintendent, and community discussions of race-related issues and inclusion were held by several groups. These actions are by no means a complete or permanent solution to these issues, but they are a good first step. Overall, these race-related events and subsequent actions to address them further show the significance of DEI in Kennebunk.

Beyond race-related issues, Kennebunk is home to other DEI struggles as well. There is a lack of reliable high-speed internet access in some parts of the town, a lack of affordable housing, a lack of public transportation, and, in some places, inequity in the supply of clean water. All these issues disproportionately affect lower-income and older populations. Another significant DEI issue in Kennebunk is the flooding risk of coastal and riverbank properties in the face of sea level rise. Throughout the world, lower-elevation properties are predominantly inhabited by lower-income and minority populations leading to equity issues. However, for various reasons in Kennebunk, including the desirability of these properties and the high costs associated with flood insurance and repairing damages after storms, seacoast and riverfront properties can be quite expensive. Even though some of these costs are reduced by federal funds, lower-income populations still cannot afford to live in these areas, which is a clear case of inequity. Furthermore, in the event of property damage from severe weather, the wealthier populations that can afford to live in these areas are benefitting from FEMA and town-wide taxpayer funds. These resources are contributed in part by those that are less economically secure than the owners of the properties, which is another source of inequity. Both of these facets of housing in Kennebunk are clear DEI issues that must be addressed in the future.

DEI issues may not seem like they are related to climate change and other environmental impacts, but the connection is substantial. First, the many impacts of climate change such as sea level rise, droughts, flooding, extreme weather events, and others have a disproportionate impact on communities of color and low-income communities in the United States and around the world. These impacts have been seen more often than ever in recent years in Kennebunk. Those groups experiencing a disproportionate impact in Kennebunk include those whose livelihoods rely on the coast, such as fishermen, and older populations. Second, many landfills, power generation, toxic facilities, and other large polluters are also mostly located outside of Kennebunk in communities of color and low-income areas. This can cause disproportionate health effects on these populations that can severely decrease quality of life. Not coincidentally, these areas are often the same as those impacted disproportionately by climate change. Finally, if the world stands a chance of successfully addressing climate change, people of color must be a part of that solution. Statistically, people of color are significantly more concerned about climate change than white people, however their priorities are often focused on primary DEI issues, and rightfully so. If the burden of addressing DEI issues is lessened, then the number of people advocating for climate change and the environment will increase exponentially.

The analysis in this section is in no way an indictment of Kennebunk, but rather a glimpse into why it is crucial that DEI and other related issues be included in emissions reduction strategies.

# 5. REDUCTION STRATEGIES

In previous sections, many general reduction strategies were recommended for potential emission reductions. However, detailed strategies are needed to successfully reduce emissions. The following are examples of some detailed reduction strategies that could be used in climate planning.

## 5.1 Municipal Strategies

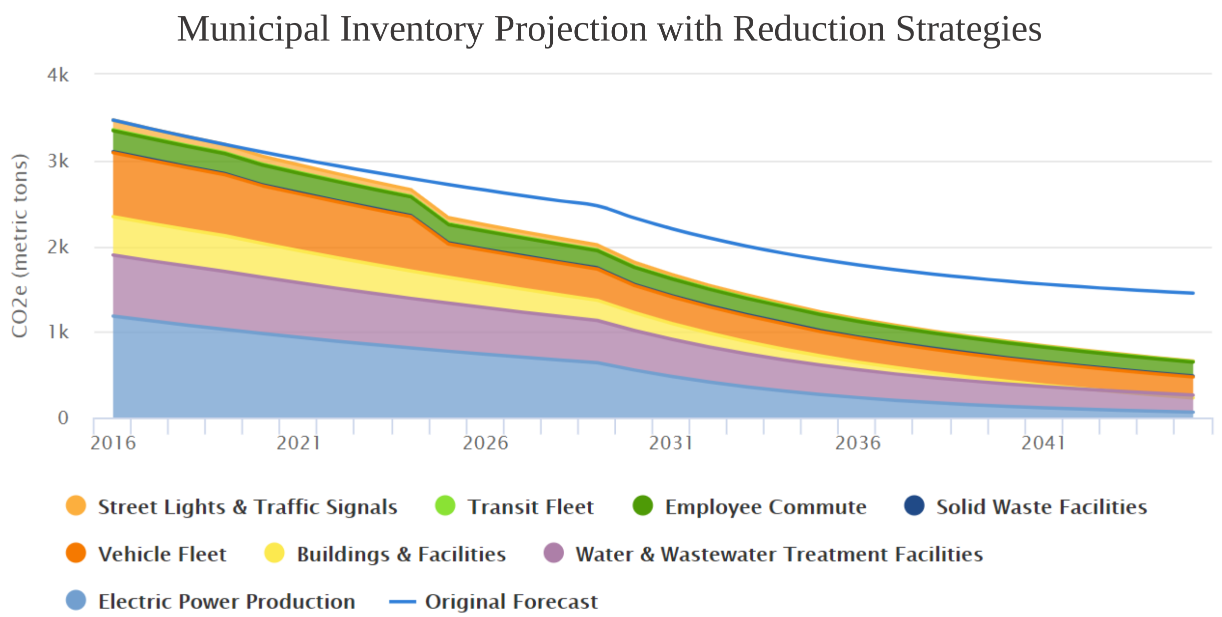


Figure 22. Municipal Inventory Projection with Reduction Strategies

Figure 22 above shows the municipal inventory projection with the following implemented reduction strategies taking place starting in 2020:

- Proper maintenance of all fleet vehicles (e.g. keeping tires inflated, changing oil, and replacing air filters)
- Gradual partial transition to a high efficiency vehicle fleet (e.g. town hall, KLPD, Sewer District, and half of police department gasoline vehicles to electric)
- Annual 1000-gallon decrease of distillate fuel oil No. 2 usage from buildings and facilities

Ensuring all municipal fleet vehicles are properly maintained is an easy and inexpensive strategy that can increase the efficiency of the vehicles. Assuming the vehicles had previously received an average level of maintenance, this reduction strategy will decrease vehicle fleet emissions by approximately 8 MT $CO_2e$ by 2045. While this is only a very small reduction in relation to the total emissions, this strategy is one of the easiest to implement.

The gradual transitioning of part of the municipal vehicle fleet to high efficiency vehicles would require a significant investment from the town but would cause a large projected decrease in emissions. If the vehicles listed above were to be transitioned from gasoline to electric vehicles, the municipality could reduce emissions from the initial projection by 219 MT $CO_2e$ by 2045. Electric vehicles would require town infrastructure to be updated with charging stations. However, these vehicles could instead be transitioned to hybrids. Using hybrids would not require charging stations but would decrease the potential of reduced emissions.

An annual decrease of 1000 gallons of distillate fuel oil No. 2 from any building or facility, including wastewater treatment facilities, is estimated to reduce the projected emissions by 533 MT $CO_2e$. To decrease usage of fuel oil, a renewable source will have to be used instead. Many options exist depending on the infrastructure of buildings and facilities in the affected sectors.

Combining all three of these reduction strategies will cause a decrease of 690 MT $CO_2e$ (48%) in projected 2045 emissions. These strategies are merely potential reduction strategies that the municipality could implement. Variations and additions can easily be made that could increase the effectiveness of emissions reductions. It is also important to note that this projection could change drastically if national and state efforts to reduce emissions change. Due to this uncertainty, the municipality must make additional emissions reduction efforts for them to be successful in reaching carbon neutrality.

In addition to the proposed strategies above, it is recommended that the municipality address any DEI issues considered in section 4. Examples of actions the municipality could take include mandating DEI training for all employees and establishing focus groups tasked with the creation of effective communication strategies for the results of the inventory and proposed reductions.

## 5.2 Community Strategies

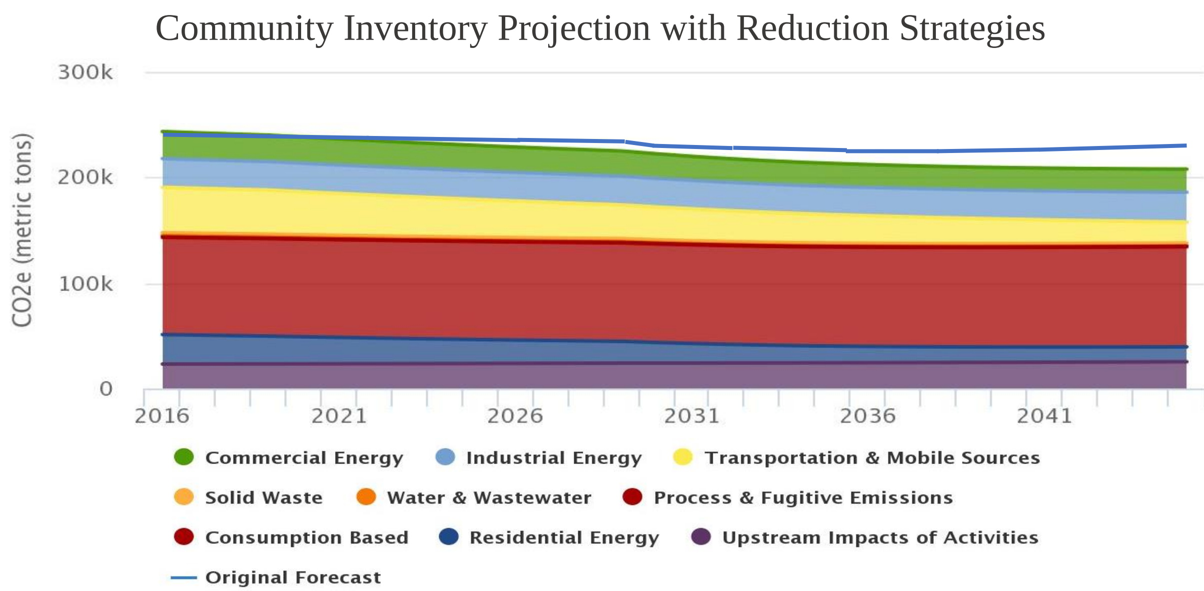

Figure 23. Community Inventory Projection with Reduction Strategies

Figure 23 above shows the community inventory projection with the following implemented reduction strategies taking place starting in 2020:

- Residential energy efficiency education (i.e. teaching residents simple measures to take in their homes to save energy)
- Increasing residential solar water heating
- Low-income weatherization program implementation (e.g. sealing cracks, weather stripping, and adding insulation in lower-income homes)
- Transportation target-planning (e.g. increasing walking, biking, telecommuting, and implementing a public transportation system)
- Electric vehicle promotion
- Educational programs to reduce consumption-based emissions by 10%

Educating residents to save energy often is very appealing because it is an opportunity for them to save money. Beyond saving residents money, it can be very effective in reducing residential energy emissions. The reduction strategy shown in the figure assumes that 5% of residents would participate in this program each year. Another strategy to reduce residential energy use is to increase solar water heating. Solar water heating is an environmentally friendly way to heat water that does not require the combustion of fuels. The projection above assumes that 30 systems are implemented per year. The final residential strategy is to implement a low-income weatherization program. Such a program can go a long way to decrease energy bills, increase the health of residents, increase property values, and increase community pride. It also addresses DEI by increasing the equity across economic classes in Kennebunk. All three of these programs when combined have the potential to decrease residential energy emissions by over 2,500 MT $CO_2e$ compared to the 2045 projection. Similar programs can most likely be implemented in the commercial and industrial sectors for similar reductions, but a more detailed accounting of these sectors must be done to know for sure.

The transportation target-planning reduction strategy refers to setting goals for the breakdown of future travel modes. Specifically, this strategy entails encouraging more walking, bike riding, and telecommuting and implements a public bus transportation network that replaces 10% of all in town travel. This transportation mode switch will greatly decrease emissions and has the potential to increase the health of those who switch to walking or bike riding. Also, a public transportation network addresses equity and inclusion issues in lower-income and older populations by providing a transportation option for those without a personal car. In addition to the target-planning strategy, electric vehicle promotion is also included. This reduction strategy entails providing incentives and infrastructure to increase electric vehicles to make up 10% of all miles traveled in the town’s boundary. When combined, these strategies have the potential to reduce transportation and mobile source emissions by almost 11,000 MT $CO_2e$, a substantial reduction in community emissions.

To reduce consumption-based emissions, Kennebunk could host educational programs that aim to reduce unsustainable consumption of food, goods, and services. Examples of such programs include food impact programs; food waste reduction programs; reduce, reuse, and repair programs; and many more. The projection above aims to reduce per capita consumption-based emissions by only 10% by 2045. This small reduction would decrease projected 2045 emissions by almost 12,000 MT $CO_2e$. This reduction essentially would offset the increase in consumption-based emissions that will be caused by population increase. Educational programs in Kennebunk related to DEI are also encouraged to be offered or combined with other programs to address concerns named in section 4. Possibilities for these programs include anti-racism training, DEI training, and educational programs about the disproportionate impacts of climate change. It is recommended that these programs be strategically targeted toward the groups that could create the largest possible positive impact.

Overall, combining all these reduction strategies will cause a decrease of approximately 25,500 MT $CO_2e$ (10%) in projected 2045 emissions. Also, any municipal reductions made would increase reductions from this estimation. It is important to reiterate that these strategies are merely potential reduction strategies that could be implemented in Kennebunk. Variations and additions can easily be made that could increase the effectiveness of emissions reductions especially because many of these recommended strategies are fairly conservative in their projected impact. This is by no means a comprehensive list of reduction strategies, but rather just a picture of the large impact a few strategies can accomplish.

# 6. CONCLUSION AND RECOMMENDATIONS

The completion of Kennebunk’s first municipal and community greenhouse gas emissions inventories is an important first step in becoming an environmental leader along the coast of Maine. By utilizing the data and analysis in this report, Kennebunk can credibly create detailed reduction strategies and a climate action plan to work toward carbon neutrality and to protect its key coastal region. However, continual work is necessary to make a notable impact. Specifically, annual inventories should be conducted, and efforts should be made to increase the accuracy and applicability of each successive inventory.

The following is a list of recommendations to improve the quality of future inventories:

- Hire a Kennebunk municipal employee to at least part-time status who is responsible for the completion of each annual inventory.
- Establish a formal municipal and community greenhouse gas emissions reduction target.
- Collaborate with other regional towns and the Southern Maine Planning & Development Commission to standardize the inventory process.
- Conduct a wetland and forest carbon sequestration study like the one conducted in Philipstown, NY, as the results could greatly shift projections.
- Include heating and cooling degree days and other weather-related information to normalize inventories across years.
- Improve community inventory accuracy by adding the agriculture, forestry, and other land use sector and including a more accurate accounting of commercial and industrial buildings and facilities, transportation and mobile sources, solid waste collection, process and fugitive emissions, and consumption-based emissions.
- Incorporate a nitrogen footprint analysis into inventories to give a broader picture of environmental impacts, especially when it comes to food production and consumption.
- Create more detailed reduction strategies with financial impact analysis using the ICLEI ClearPath planning module.
- Incorporate diversity, equity, and inclusion in all future inventories and reduction strategies.