City of New Bedford

Greenhouse Gas Inventory Methodology and Data Collection Report

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Contents

Introduction

Over the last several years New Bedford has been a model for climate action and resilience, demonstrating leadership on clean energy and energy efficiency and preparing its community for the impacts of climate change. Through the NB Resilient Plan, completed in 2019, the City created a roadmap to meet its climate related goals.

In 2023, the City completed an update to its existing municipal and community-wide greenhouse gas (GHG) inventories to determine where they stand in relation to their goals. As part of this process, the City completed an analysis on the specific pathways and indicators necessary to ensure they are on track to meet their GHG reduction targets of 35% below 2017 levels by 2030 and net-zero by 2050.

This report provides an overview of the data sources and methodologies used to complete the update to the municipal and community-wide inventories, as well as the data gaps and limitations and resulting recommendations for improved data collection, tracking, and reporting.

Community Inventory Methodology & Data Sources

The data used to generate community GHG emissions estimates were drawn from sources that capture activity data from multiple sectors across the City of New Bedford. This inventory uses 100-year horizon Global Warming Potential values from the IPCC 4th Assessment Report, aligning with the values used in previous inventories from New Bedford as well as the most recent State of Massachusetts GHG Inventory. Except where noted, this inventory follows methods and emissions factors sourced from the US Community Protocol and aligns with the reporting conventions defined by the Global Protocol for Community Scale Emissions Inventories (GPC).

Energy

Electricity

Data Sources

Data Provider	Year(s)	Data Type	Categorization
Mass Save	2019	Electricity Consumption	Community wide consumption. Residential and Commercial
eGRID emission factors New England region*	2020	Emission Factors	EPA eGRID: New England CO2, CH4, and N2O Factors

*The Emissions and Generation Resource Integrated Database (eGRID), published every two years by the EPA, uses data from electricity generating plants to portray the environmental impact of electricity generation. As new factors are published, they should be updated and used in future GHG accounting efforts. This will ensure the City can account for the increase in renewable sources of electric generation.

Methodology

- Collect electricity consumption data from the Mass Save Online database.
- Multiply electricity consumption by eGRID emission factors to estimate emissions.

Natural Gas

Data Sources

Data Provider	Year(s)	Data Type	Categorization
Mass Save	2019	Natural Gas Consumption	Community wide consumption. Residential and Commercial
U.S. EPA's Emission Factors for Greenhouse Gas Inventories	2021	Emission Factors	By fuel type

Methodology

- Collect natural gas consumption data from the Mass Save Online database.
- Multiply natural gas consumption by EPA emission factors.

Fugitive Natural Gas

Data Sources

Data Provider	Year(s)	Data Type	Categorization

Mass Save	2019	Natural Gas Consumption	Community wide consumption. Residential and Commercial
Applied Economics Clinic Policy Brief	2019	Natural Gas Lost in Transmission & Distribution	Massachusetts

Methodology

- Collect natural gas consumption data from the Mass Save Online database.
- Multiply Massachusetts' leakage rate (2.7%) by municipal natural gas consumption.
- Convert leaked gas to methane emissions and apply global warming potential factors.

Liquified Petroleum Gas (LPG) and Distillate Fuel Oil

Data Sources

Data Provider	Year(s)	Data Type	Categorization
American Community Survey, U.S. Census Bureau, 5-Year Estimates Data Profile, DP04 Selected Housing Characteristics	2019	Estimated number & percentage of homes in the City of New Bedford categorized by the primary home heating fuel type	Residential
US EIA Residential Energy Consumption Survey	2015	Heating fuel intensities for homes heated with fuel oil and bottled gas	Residential
ComStock Building Characteristics	2019	Distillate Fuel Oil #2 Usage	Commercial
New Bedford Assessor's Database	2018	Property type breakdown	Commercial
U.S. EPA's Emission Factors for Greenhouse Gas Inventories	2021	Emission Factors	By fuel type

Methodology

Residential

- Estimate total number of households using fuel oil and propane for heating from the ACS.
- Calculate heating energy per household based on the US EIA Residential Energy Consumption Survey.
- Multiply total heating energy per household by the number of homes heated by fuel oil and propane, respectively.
- Multiply consumption estimates by EPA emission factors.

Commercial

- Determine commercial square footage from the New Bedford Assessor database.
- Determine the energy use intensity (EUI) of Other Fuels from ComStock Building Characteristics Summary for Bristol County.
- Determine the percentage of buildings heated with fuel oil and propane, respectively, from the ComStock Building Characteristics Summary.
- Multiply the EUI, commercial square footage, and percent of commercial buildings heated with fuel oil and propane- respectively.
- Multiply consumption estimates by EPA emission factors.

On-Road Transportation

Passenger Vehicles

This assessment of On-Road Transportation activity leverages best available data to capture as many components of vehicle activity as possible distinct from each other. These methods combined are able to capture resident activity, inbound commuting from neighboring cities and towns, and activity by local commercial vehicles.

Data Sources

Data Provider	Year(s)	Data Type	Categorization
MAPC Vehicle Census*	2014	VMT	Residential and Commercial
US Community Protocol Appendix D	2013	Table TR.1.3 Vehicle Mix Breakout	National
U.S. Census Longitudinal Employer-Household Dynamics	2019	Commute Out	Commuters
Department of Energy (DOE) Alternative Fuels Data Center	2020	Average Fuel Economy by Major Vehicle Category	Gasoline passenger cars and light trucks
U.S. EPA's Emission Factors for Greenhouse Gas Inventories	2021	Emission Factors	By fuel type
eGRID emission factors New England region	2020	Emission Factors	EPA eGRID: New England CO2, CH4, and N2O Factors

*The MAPC Vehicle Census provides transportation data for all communities in the state. While the latest available data is for 2014, a linear VMT growth rate was used to estimate 2019 VMT. This method was utilized in order to align with data that will be made available by the State on an ongoing basis.

Methodology

Commuters – Induced Activity

- Calculate commute in and out with GIS using network analysis of shortest path of zip code centroids using distance data from the U.S. Census LEHD.
- Multiply the commute in VMT by the vehicle mix breakout (US Community Protocol) to determine VMT by fuel type and vehicle type.
- Multiply the commute out VMT by the vehicle mix breakout (US Community Protocol) to determine VMT by fuel type and vehicle type.
- Divide both commute in and out VMT by the average fuel economy by major vehicle category and fuel type (DOE Alternative Fuels Data Center) to determine fuel usage.
- Multiply fuel consumption by EPA emission factors per fuel type to estimate emissions.

Passenger – Resident Activity

- Obtain daily Passenger VMT in New Bedford for each quarter in 2014 using MAPC's Vehicle Census. Project the total 2019 VMT assuming a 3.27% linear rate of VMT growth from 2014.
- Determine the annual VMT commute out using data from the U.S. Census LEHD. Subtract the commute out VMT from the total projected passenger 2019 VMT.
- Multiply this new total 2019 VMT by the vehicle mix breakout (US Community Protocol) to determine VMT by fuel type and vehicle type.
- Gasoline/Diesel Vehicles

    - Divide VMT by the average fuel economy by major vehicle category and fuel type to determine fuel usage.
    - Multiply fuel consumption by EPA emission factors per fuel type to estimate emissions.
- Electric Vehicles
    - Divide VMT by the electric miles per gallon equivalent (MPGe), multiply MMBtu per gallon of gasoline, and convert to kWh.
    - Multiply electricity consumption by eGRID emission factors to estimate emissions.

Commercial – Resident Business Activity

- Obtain daily Commercial VMT in New Bedford for each quarter in 2014 using MAPC's Vehicle Census. Project the total 2019 VMT assuming a 3.27% linear rate of VMT growth from 2014.
- Multiply the total 2019 VMT by the vehicle mix breakout to determine VMT by fuel type and vehicle type.
- Gasoline/Diesel Vehicles
    - Divide VMT by the average fuel economy by major vehicle category and fuel type to determine fuel usage.
    - Multiply fuel consumption by EPA emission factors per fuel type to estimate emissions.
- Electric Vehicles
    - Divide VMT by the electric miles per gallon equivalent (MPGe), multiply MMBtu per gallon of gasoline, and convert to kWh.
    - Multiply electricity consumption by eGRID emission factors to estimate emissions.

Transit- Bus

Data Sources

Data Provider	Year(s)	Data Type	Categorization
SRTA Ridership	2017-2021	Passengers per Trip for New Bedford Routes	Community-wide
American Public Transportation Association 2021 Public Transportation Fact Book	2019	Average bus trip length	National
U.S. EPA's Emission Factors for Greenhouse Gas Inventories	2021	Emission Factors	By fuel type

Methodology

- Obtain SRTA Ridership data and calculate the total number of passengers per trip for New Bedford routes for one calendar year.
- Multiply average bus trip length (3.7 miles) by the total number of passenger trips for one calendar year to determine total passenger miles.
- Multiply passenger miles by EPA emission factors per fuel type to estimate emissions.

Off-Road Transportation

Aviation

Data Sources

Data Provider	Year(s)	Data Type	Categorization

FBO Jet and Aviation Gasoline Gallons and Cost	2019	Fuel usage	By fuel type
U.S. EPA's Emission Factors for Greenhouse Gas Inventories	2021	Emission Factors	By fuel type

Methodology

- Obtain both aviation gasoline usage and jet fuel usage data per month from the Client. Sum usage by calendar year.
- Multiply fuel use by EPA emission factors per fuel type to estimate emissions, respectively.

Solid Waste

Waste Landfilled- Methane Commitment

Data Sources

Data Provider	Year(s)	Data Type	Categorization
Geosyntec Waste Characterization, Table 1	2022	Estimated waste disposal in the district's watershed	Residential and Commercial
Geosyntec Waste Characterization, Table 6	2017-2021	Estimated composition of residential and ICI waste	By material type
2006 IPCC Guidelines for National Greenhouse Gas Inventories	2006	Biological treatment emission factors	By waste and treatment type
IPCC Climate Change 2014 Synthesis Report	2014	Global warming potentials	By greenhouse gas

Methodology

- Obtain tons of waste generated for both the commercial and residential sector.
- Multiply total residential tonnage by the Geosyntec waste characterization breakdown per material type.
- Multiply total commercial tonnage by the Geosyntec waste characterization breakdown per material type.
- Multiply tons landfilled by the IPCC solid waste emission factors per material type to determine the metric tons of methane (CH4) per material type.
- Multiply the metric tons of CH4 by the IPCC global warming potential (GWP) to estimate metric tons of CO2e.

Solid Waste Treated Biologically

Data Sources

Data Provider	Year(s)	Data Type	Categorization
Solid Waste and Recycling Survey	2019	Trash disposal and recycling tonnages	By material type
Global Protocol for Community Scale Emissions Inventories	N/A	Emission factors for biological treatment	By material type

IPCC Climate Change 2014 Synthesis Report	2014	Global warming potentials	By greenhouse gas

Methodology

- Obtain yard waste tonnages collected in the municipality.
- Multiply tons deposited by the Global Protocol waste emission factors for both CH4 and N2O.
- Multiply the metric tons of CH4 and N2O by the IPCC global warming potentials, respectively, to estimate metric tons of CO2e.

Water Treatment and Delivery

Data Sources

Data Provider	Year(s)	Data Type	Categorization
Mass Energy Insight	2019	Electricity and Natural Gas usage	By fuel type
U.S. EPA's Emission Factors for Greenhouse Gas Inventories	2021	Emission Factors	By fuel type

Methodology

- Obtain energy usage by fuel type in water treatment facilities from Mass Energy Insight.
- Multiply electricity (MWh) and natural gas (therm) consumption by EPA emission factors per fuel type to estimate emissions, respectively.

Wastewater

Data Sources

Data Provider	Year(s)	Data Type	Categorization
Mass Energy Insight	2019	Electricity and Natural Gas usage	By fuel type
U.S. EPA's Emission Factors for Greenhouse Gas Inventories	2021	Emission Factors	By fuel type
U.S. Census Bureau, Quickfacts	2019	Population	By City of Census Designated place
US Community Protocol for Accounting and Reporting of Greenhouse Gas: Appendix F	2013	Process and fugitive emissions equation	National

Methodology

Electricity and Natural Gas

- Obtain energy usage by fuel type in wastewater treatment facilities from Mass Energy Insight.
- Multiply electricity (MWh) and natural gas (therm) consumption by EPA emission factors per fuel type to estimate emissions, respectively.

Process and Fugitive Emissions

- Obtain total population served.

- Calculate N2O process emissions using Equation WW.8 from the US Community Protocol.
- Calculate N2O fugitive emissions using Equation WW.12 (alt) from the US Community Protocol.

Municipal Inventory Methodology & Data Sources

The data used to generate municipal GHG emissions estimates were drawn from sources that capture activity data from facilities, vehicles, and infrastructure used across City departments. This inventory uses 100-year horizon Global Warming Potential values from the IPCC 4th Assessment Report, aligning with the values used in previous inventories from New Bedford as well as the most recent State of Massachusetts GHG Inventory. Except where noted, this inventory follows methods and emissions factors sourced from the US Community Protocol and aligns with the reporting conventions defined by the Global Protocol for Community Scale Emissions Inventories (GPC).

Facilities

Electricity

Data Sources

Data Provider	Year(s)	Data Type	Categorization
Mass Energy Insight	2021	Electricity Consumption	By facility
eGRID emission factors	2021	Emission Factors	EPA eGRID: NEWE CH4 and N2O factors

Methodology

- Collect activity data from Mass Energy Insight.
- Multiply electricity consumption by eGRID emission factors to estimate emissions.

Natural Gas, Fuel Oil

Data Sources

Data Provider	Year(s)	Data Type	Categorization
Mass Energy Insight	2021	Fuel Consumption	By facility
U.S. EPA's Emission Factors for Greenhouse Gas Inventories	2021	Emission Factors	By fuel type for natural gas, fuel oil, diesel.

Methodology

- Collect activity data from Mass Energy Insight.
- Multiply consumption by EPA emission factors.

Streetlights

Data Sources

Data Provider	Year(s)	Data Type	Categorization
Mass Energy Insight	2021	Electricity Consumption	
eGRID emission factors	2021	Emission Factors	EPA eGRID: NEWE CH4 and N2O factors

Methodology

- Collect activity data from Mass Energy Insight.
- Multiply electricity consumption by eGRID emission factors to estimate emissions.

Vehicle Fleet

Data Sources

Data Provider	Year(s)	Data Type	Categorization
Mass Energy Insight	2021	Fuel Use	By fuel type
U.S. Department of Energy's Alternative Fuel Data, Average Fuel Economy of Major Vehicle Categories	2021	Average MPG (fuel efficiency) by Vehicle Type.	National
U.S. EPA's Emission Factors for Greenhouse Gas Inventories	2021	Emission factors by vehicle type and amount of fuel consumed.	National

Methodology

- Collect fuel use data from Mass Energy Insight.
- Estimates of CNG in terms of gallon gasoline equivalent were converted to standard cubic feet based on energy densities of fuel types.
- Calculate CO_2 on the basis of fuel volumes.
- Biogenic portions CO_2 was estimated by 15% of e85 ethanol and 5% of B5 biodiesel. These values are reported separate from fossil emissions.
- Fuel use data was not associated with specific vehicle types, for simplicity all gasoline was considered to be used by passenger vehicles and diesel by heavy trucks.
- Fuel use by equipment was identified by vehicles reporting operating hours rather than miles traveled.
- Calculate CH_4 and N_2O with VMT based emission factors for each fuel type combination.

Water Treatment & Delivery

Electricity

Data Sources

Data Provider	Year(s)	Data Type	Categorization
Mass Energy Insight	2021	Electricity Consumption	By facility
eGRID emission factors	2021	Emission Factors	EPA eGRID: NEWE CH4 and N2O factors

Methodology

- Collect activity data from Mass Energy Insight.
- Multiply electricity consumption by eGRID emission factors to estimate emissions.

Natural Gas & Fuel Oil

Data Sources

Data Provider	Year(s)	Data Type	Categorization
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U.S. EPA's Emission Factors for Greenhouse Gas Inventories	2021	Emission Factors	By fuel type for natural gas, fuel oil, diesel.

Methodology

- Collect activity data from Mass Energy Insight.
- Multiply consumption by EPA emission factors.

Wastewater

Electricity

Data Sources

Data Provider	Year(s)	Data Type	Categorization
Mass Energy Insight	2021	Electricity Consumption	By facility
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Natural Gas & Fuel Oil

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Data Provider	Year(s)	Data Type	Categorization
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Methodology

- Collect activity data from Mass Energy Insight.
- Multiply consumption by EPA emission factors.

Gaps and Limitations

Community Inventory

Fuel Used by Vessels

As the largest fishing port in the U.S., New Bedford sees a lot of activity from marine vessels coming in and out of the harbor. Although the electricity used by facilities at the port that support and service vessels is captured as part of overall electricity use, the fuel used by the vessels is not captured as part of the GHG inventory. Because the majority of vessels that travel in and out of New Bedford Harbor are commercial vessels, there is not currently a system in place to track fuel usage.

Non-Utility Fuel Use in Buildings (e.g., fuel oil, propane)

While utilities supply buildings with electricity and natural gas, other fuels—such as fuel oil and propane—are supplied by a myriad of companies, limiting access to usage data. Non-utility fuel use may be estimated based on the number of households (for residential usage) or commercial building area (for commercial usage) and usage estimates provided by the Energy Information Administration. This estimation methodology provides a general picture of the scale of transition needed, however, does not provide an accurate depiction of fuel usage.

Transportation by Non-Residents and Commercial Vehicles

The data sources used to estimate resident and commuter vehicle miles traveled (MAPC Vehicle Census and Census Employer-Household Dynamics Survey, respectively) do not include pass-through traffic.

Municipal Inventory

Vehicle Usage Patterns and Equipment Inventories

Emissions generated by the City's vehicle fleet were estimated by using the fuel usage data from major departments. While calculating emissions from fuel usage is straightforward and accurate, it cannot be used to help identify the best solutions for reducing GHGs. Understanding vehicle usage patterns, such as mileage by vehicle or vehicle type and age, through an equipment inventory, would position the City to identify which vehicles or use-cases would benefit most from an electric vehicle (EV) and to better prioritize how vehicles are used for different purposes.

Waste Generated at Municipal Facilities

It is common for municipalities to not have systems in place to track waste generation at the facility level. The waste generated at municipal facilities in New Bedford is aggregated to and incorporated in city-wide waste generation data. Some municipalities estimate this information based on the size of collection containers and frequency of pick up to provide a more regular stream of data between specific studies. Best practice supplements this with an assessment of the percentage each container is typically filled at collection time.

Recommendations for Improved Collection and Reporting

Improvements to data collection and maintenance will require a concerted effort. Ideally these are championed by an individual or department who can maintain a comprehensive view of needs at both the community and municipal operations scales. However, one person or department will not be able to accomplish this task alone. Departments throughout the City will need to cooperate in this effort and their level of participation will be critical to the success of efforts to reduce New Bedford's GHGs.

Community Inventory

Utility Data

Electricity and natural gas use by residents and commercial customers should continue to be available from the Mass Save data portal with a one to two year delay. This may become more predictable in the future but presently requires periodic monitoring of the site to collect newly published data; there is no notification system that could alert staff when new information is published. Currently, this data is provided without any context as to the number of customers represented in the dataset or firm definitions for what types of structures are included in each customer classification.

Recommendations:

- Advocate directly to the Executive Office of Energy and Environmental Affairs to improve the process and communication around publication of utility data.
- Advocate for the publication of a more descriptive dataset which would improve the ability to interpret trends among the number and type of customers using each type of data.

Fugitive Natural Gas

Currently, the volume of natural gas leaks is estimated as a percentage of gas usage that is lost to leaks throughout the local distribution system. This method provides an acceptable estimation of the magnitude of the issue without additional data collection. Maps maintained by HEET[1] can complement this calculation with the number and approximate size of the leaks in the community, though it is difficult to estimate leak volumes from this information. Ultimately a shift to this type of tracking may provide some additional benefits as the local gas distribution system is decommissioned.

Recommendations:

- Follow annual reports by HEET to monitor the rate at which significant leaks are addressed within the City of New Bedford.

Non-Utility Fuels

A perennial challenge to local GHG accounting is the lack of data on distributed fuel use. Fuel oil in particular, as well as bottled gas/propane, is always estimated. Traditionally, this information has come from a few different sources. The US Census American Community Survey includes a question on home heating fuels, which has been the most consistent source of data, however, there are significant

[1] The Gas Leaks Map - HEET

standard errors reported with those numbers, making it difficult to observe trends. The other potential source of data that includes the number of structures using different fuels for heating purposes is the City's property tax assessor records, which also contain fields for the overall heating delivery system and general property condition that are useful to understanding the energy savings potential that could be achieved through energy saving retrofits and fuel switching actions. While not the original intent of the assessor database, this resource has the potential to be a tremendous source of knowledge about the conditions of the community as a whole and the level of exposure residents have to changing fuel costs and other related topics.

Recommendations:

- Review City-wide processes and touchpoints for improving knowledge on the state of buildings and energy systems and identify opportunities to design workflows that would capture and update records continuously.
- Develop appropriate processes between permitting, inspectional services, and the assessor's office to ensure that changes made to a structure are captured in the database.
- Consider important 'meta-data' that should be included such as date stamps to indicate when a record was last updated to provide some means of indicating accuracy.
- Update permitting processes to ensure that data related to the energy transition within the built environment are easily reported on. Permit records should capture solar installations, battery storage, heat pump retrofits, EV chargers, and other key pieces of zero-carbon technologies. Processes should use structured data that can be easily queried, summarized, and related to other information about community needs to be able to assess whether the benefits of GHG reduction efforts are being distributed equitably across the city's residents.

These changes are not trivial to implement and will require concerted, coordinated, and ongoing collaboration across multiple departments to be successful. However, the data captured from these efforts will enable New Bedford to make compelling applications for funding support by providing solid articulation of the need and magnitude of benefits that can be delivered.

On-Road Transportation

The vehicle census, last published in 2014, has the best record of vehicle activity from cars registered in New Bedford. While dated, this information has some key superior qualities over other options for assessing transportation footprints. First, it is derived from a point of measurement (vehicle odometer readings) as opposed to modeled data. In addition, it is representative of resident travel behavior making it easier to relate directly to transportation cost burden facing community members. It can also be more clearly described than typical aggregate vehicle miles traveled (VMT) data developed from traffic counts, which provides little information on the purpose of trips or who is making them, both of which can support decision making. As stated in the 2022 Massachusetts Climate Bill, the state will be updating this source on an annual basis going forward, which should make monitoring for trends more easily applicable.

The vehicle census does include commercial vehicles that are registered within the City of New Bedford, however most commercial truck traffic, especially related to the Port, is missed by this method. Monitoring all truck traffic is not likely to yield actionable information and would be difficult to achieve. Future targeted assessments of truck traffic around the Port aimed at the potential of electrification of

freight vehicles could be a more manageable focal point where interventions could also deliver significant air quality improvements to neighboring residents.

Recommendations:

- Proactively monitor the State Department of Transportation, MAPC, and other channels for details on updates to the Vehicle Census records.
- Partner with neighboring communities and the Southeastern Regional Planning and Economic Development District to establish intra-community flows for daily commuting patterns to better understand where there might be potential for transportation demand reduction created by coordination to reduce jobs-housing imbalances throughout the region as a key climate strategy.

Transit Ridership (MBTA & SRTA)

Data on transit ridership is highly dependent on tracking mechanisms within the agencies that operate the service. Although using a fuel-use method allows for easier collection of consistent data, calculating GHGs from a ridership perspective helps to showcase the benefits of transit use relative to single occupancy vehicle travel to be showcase.

Recommendations:

- Proactively work with both SRTA and MBTA to assess to what degree regular ridership figures could be developed and reported on for riders traveling to and from New Bedford.
- Where feasible, support for transit operators to invest in payment systems that generate ridership data that can be easily disaggregated by location will help provide an understanding of how these systems contribute to the City's climate goals.

Vessel Fuel Use

Shipping, recreational boating, and fishing industries are a significant part of New Bedford's economy and identity; addressing emissions sources from these activities should be a key component of a comprehensive climate action plan. Even without the goal to include these sources in the climate action plan, there are significant investment opportunities to leverage federal grant funding for electrifying both port operations and vessels themselves. Getting specific data on these activities will require cooperation with private businesses operating in this area. Efforts for electrification or switching to low-carbon fuels will also need to be introduced as an opportunity to drive investment in the industry.
In the near future it is likely to remain a challenge to track this sector comprehensively. It may be most helpful to pivot towards addressing data challenges from a bottom-up perspective and finding champions within the sector that are looking to modernize equipment.

It should be noted that many attempts have been made to quantify this sector, including extensive searches and outreach to fuel providers to estimate total sales. In addition, looking at vessel tracking data maintained by the Federal Government was explored, but did not provide the resolution needed to assess the share of regional vessel traffic that comes in and out of New Bedford Harbor. Overall, a strategy to understand fuel switching opportunities among a smaller subset of vessels operating in the Port may be more productive than working to understand total fuel use.

Recommendations:

- Work with representatives of the fishing and shipping industries to identify candidate companies with needs for equipment modernization and interest in reducing GHGs and look for opportunities to characterize 'typical' fuel use profiles that could be scaled to better estimate the entire fleet of ships operating out of New Bedford.
- Support the acceleration of waterfront electrification through pilot projects for shore-side electrification and use of battery storage.

Municipal Inventory

The City of New Bedford maintains good records of the energy used in buildings. Fuel and electricity use, as well as the data on the performance of energy reduction actions, are well-established. However, other aspects of the City's operations are less understood in terms of data that can be used to both quantify existing emissions sources and illustrate the opportunities to address the emissions sources directly within the City's control. Energy data has the benefit of measurement for billing purposes that is directly tied to what we wish to measure for GHG assessment. The key to strengthening the ability to track additional sectors with as good of detail requires procedures that generate the needed data automatically in the course of daily operations.

Waste

Waste generation at municipal facilities is a data type that can be difficult to track precisely, fortunately data tracking does not need to be onerous to be useful for improved decision making. Using a combination of waste collection schedules and strategic sampling can provide adequate information.

If collection schedules are well-established for each facility, the maximum possible waste generation rate can be estimated simply from the volume of containers multiplied by how frequently they are emptied. It is likely that actual waste generation rates will be much lower and by recording an approximate percentage filled at each pick up interval, a more accurate picture of waste generation can be developed.

Waste characterization can be useful to understand particular opportunities for diversion of organic material, including paper products from the landfill. A full waste characterization study can be a large undertaking and the use of typical waste generation rates might be the most appropriate. However, as the City of New Bedford implements more diversion and waste reduction actions, tracking the specific materials that are reduced from those efforts can be used to calculate the GHG reductions achieved.

The less material the City uses in its operations, the less waste that will be generated to begin with. Procurement strategies that minimize the amount of single-use items and volume of paper can be an important waste strategy. Because purchasing processes already are designed to record data on the details of the transactions, those processes could be modified to supplement data on the materials used.

Recommendations:

- Establish a process for periodically gathering data on the percentage filled of containers prior to pick up. Ensure these cover the span of a full year to capture seasonality changes.
- Use procurement and contracts for waste collection to establish a comprehensive record of the frequency of waste pickups across New Bedford facilities.
- Empower individuals managing recycling, composting, or other waste diversion actions to record data to best showcase their accomplishments.
- Orient data collection within procurement processes to generate information on the quantities of materials purchased in addition to the financial aspects of the transactions. Begin with large volume products like paper to test and refine the process.

Fleet and Activity Tracking

The City of New Bedford maintains good records of total fuel purchased for its vehicle fleet and other equipment. What is less well-known is how that fuel is used for different functions, which would enable the ability to devise targeted strategies for maximizing fuel savings. During the most recent inventory, little data was available describing the type and age of vehicles operated by the City or how they are used. Recently, it was noted that the City is moving to improve tracking capabilities in this regard. As new systems are implemented, reporting should be oriented to inform vehicle electrification strategies.

Recommendations:

- Develop a comprehensive inventory of vehicles and equipment, including as much detail as can be reasonably collected for the department and use case for the vehicle.
- Collect odometer readings and maintain a record that would enable easy tracking of annual miles driven or equipment hours, as appropriate.
- To the extent possible, associate fuel purchases with the vehicles using them to gauge achieved fuel economy of different vehicles in use.
- Implement measures to reduce idling time. In order to obtain idling data, a GPS fleet tracking software would need to be implemented. Alternatively, guidelines for engine idling should be part of the City's training program.
- Utilize records to identify which departments and use cases will maximize the benefits of EV purchases with vehicles that travel regular and predictably high miles like inspections.
- As electric vehicles are added to the fleet, ensure that their electricity use can be metered separately from buildings from either the charger or vehicle on-board diagnostics. This will help distinguish rising electricity use from activities within buildings.