Exeter, NH Municipal Operations Greenhouse Gas Emissions Inventory Report

University of New Hampshire Sustainability Institute

Prepared By: Rachel Nadolny, UNH Sustainability Fellow

Contributions: Dave Sharples, Town Planner

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Executive Summary

The town of Exeter, NH is already experiencing impacts from the global crisis of climate change. Exeter intends to continue on the path of being a leading in becoming a more sustainable and resilient community against climate change. One way to measure the progress of a town's actions towards reducing its impact on climate change is by conducting a greenhouse gas emissions inventory. This report summarizes the results of the greenhouse gas emissions inventory for Exeter's municipal operations. The inventory was conducted using the EPA Local Greenhouse Gas (GHG) Inventory Tool: Government Operations Module. The categories included in this inventory are stationary combustion, mobile combustion, wastewater treatment process, electricity, employee commute, and agriculture & land management.

From the results of the inventory the total GHG emissions from Exeter's municipal operations are 2,729. MT CO_2e, displayed in Table 1. Exeter should set a goal to achieve net zero emissions from municipal operations by 2050, with an interim goal of a 30% reduction of emissions by 2030 based on the 2019 levels. Two strategies that can be implemented to work towards the 2030 goal include adding a solar array system to the Cross Road landfill and switching some municipal fleet vehicles to hybrid vehicles. The roadmap to achieve net zero by 2050 will require a more in-depth analysis of what emission reduction strategies are feasible for the town and on the status of emissions reduction technology/strategies. Although there is not a determined roadmap to achieve net zero by 2050, it will require collective action across Exeter's departments.

Introduction

Climate change is a global crisis that is impacting everyone everywhere around the world including Exeter, NH. Exeter is already experiencing impacts from climate change, such as flooding from sea level rise and storm surges. These changes will only continue to become worse as the Earth's atmosphere becomes warmer. Exeter intends to continue on the path of being a leading in becoming a more sustainable and resilient community against climate change. The Master Plan highlights that it is a part of Exeter's long-term planning to mitigate and adapt to climate change.[1] Exeter has been taking steps towards reducing its impact on climate change. For example, in 2017 the Energy Committee was created and in 2019 the Sustainability Advisory Committee was created to work towards this goal.

Greenhouse gases contribute to climate change, which is why it is beneficial to measure how much and where these emissions are coming from. In order to reduce emissions, it is necessary to first understand the sources of emissions. Conducting a greenhouse gas emissions inventory works on mitigating the causes of climate change. This GHG inventory included only the emissions coming from Exeter's municipal operations. Focusing on just the municipal operations allows for the municipality to address their direct impact towards climate change before including the impact from the rest of the community. This inventory will enable Exeter to take ownership and responsibility of its contributions to climate change. This report summarizes the results of the municipal operations greenhouse gas emissions inventory and recommends emission reduction targets as well as strategies to reach these targets.

Methodology

The EPA Local Greenhouse Gas (GHG) Inventory Tool: Government Operations Module was used to conduct the municipal operations greenhouse gas emissions inventory. This tool calculates the carbon dioxide equivalent for the total greenhouse gas emissions. The three main greenhouse gases accounted for are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The tool was designed to calculate emissions for scope 1, scope 2 and scope 3 emissions.

Fig. 1: Logo for Local GHG Inventory tool

- Scope 1 – direct emissions .[2]
- Scope 2 – indirect emissions from purchased or acquired electricity, steam, heating or cooling .[2]
- Scope 3 – all other indirect emissions .[2]

The categories included in this inventory include stationary combustion, mobile combustion, wastewater treatment, electricity, employee commute, and agriculture & land management. It should be noted that solid waste was not included in this inventory. To more accurately measure the municipal operations inventory solid waste management should be included. Approximate data were used when necessary and are explained below. This inventory was conducted with 2019 data.

Stationary Combustion (Scope 1)

The natural gas usage data was obtained from the Exeter's natural gas provider, Unitil. The data was downloaded from the website and entered into the inventory tool by meter. All of the data entered in this category was natural gas usage provided by Unitil except for one data point which was an estimate of diesel usage from a generator in the wastewater treatment plant.

Mobile Combustion (Scope 1)

Mobile combustion accounts for the emissions coming from municipal owned vehicles. In order to calculate the emissions coming from mobile combustion the fuel type, the amount of fuel consumed, and the vehicle miles traveled for each vehicle is needed. Fuel usage data and an estimated miler per gallon was used to approximate the vehicle miles traveled.

Wastewater Treatment (Scope 1)

The wastewater treatment process releases methane and nitrous oxide gases. Specific information on the wastewater treatment process was used to calculate the total emissions. The data was gathered from town staff.

Electricity (Scope 2)

Electricity usage data was obtained from Exeter's electricity provider, Unitil. The data was downloaded from the website and entered into the inventory tool by meter number.

Employee Commute (Scope 3)

Employee commuting data was calculated via a survey and an estimation based off of an employee survey. The information needed from employees was commute distance (miles), mode of transportation, number of employees, days worked per year, and the average one-way commute.

Agriculture & Land Management (Scope 3)

This category required information on the type of fertilizer and the quantity used. The data was obtained from Exeter staff.

Results

The full calculations and results of the inventory are portrayed in the GHG inventory spreadsheet. From the results of the inventory the total GHG emissions from Exeter's municipal operations is 2,729. MT CO_2e, displayed. The breakdown of emission by category are portrayed in Table 1.

Emissions by Category (MT CO2e)					
Category	**CO2**	**CH4**	**N2O**	**Total**	**Percent of Total**
Stationary Combustion	388.62	0.04	0.00	388.66	14%
Mobile Combustion	612.42	2.14	28.61	643.16	24%
Wastewater Treatment	-	653.33	31.29	684.62	25%
Electricity	552.62	2.17	3.47	558.26	20%
Employee Commute	454.19	-	-	454.19	17%
Ag & Land Management	-	-	0.67	0.67	0%
Total (Gross Emissions)	2007.86	657.68	64.04	2729.57	100%

Table 1: Total greenhouse gas emissions broken down by category.

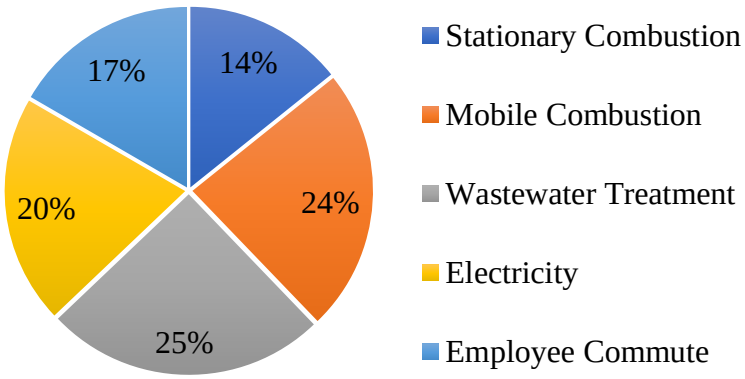

Figure 2: Percentage of total greenhouse gas emissions by category. The agriculture and land management category produced such a small amount of GHGs, it is not included in the pie chart.

As portrayed in Figure 2, the wastewater treatment process accounts for the largest portion of the total GHG emissions. It is important to note that the wastewater treatment category includes the entire town not just the wastewater that is produced from municipal operations. Vehicle combustion, which includes vehicle fleet combined with employee commuting, produced the largest source of emissions.

Stationary combustion primarily consisted of natural gas usage in buildings. The breakdown of building energy and natural gas usage are displayed in Figure 3 and Figure 4. These figures are not representative of the total stationary combustion and electricity usage. Portrayed in Figure 4, the wastewater treatment plant uses significantly more electricity than the other buildings. The Safety Complex uses the second largest amount of electricity usage. Figure 4 displays the electricity and natural gas usage by buildings except for the wastewater treatment plant and the safety complex.

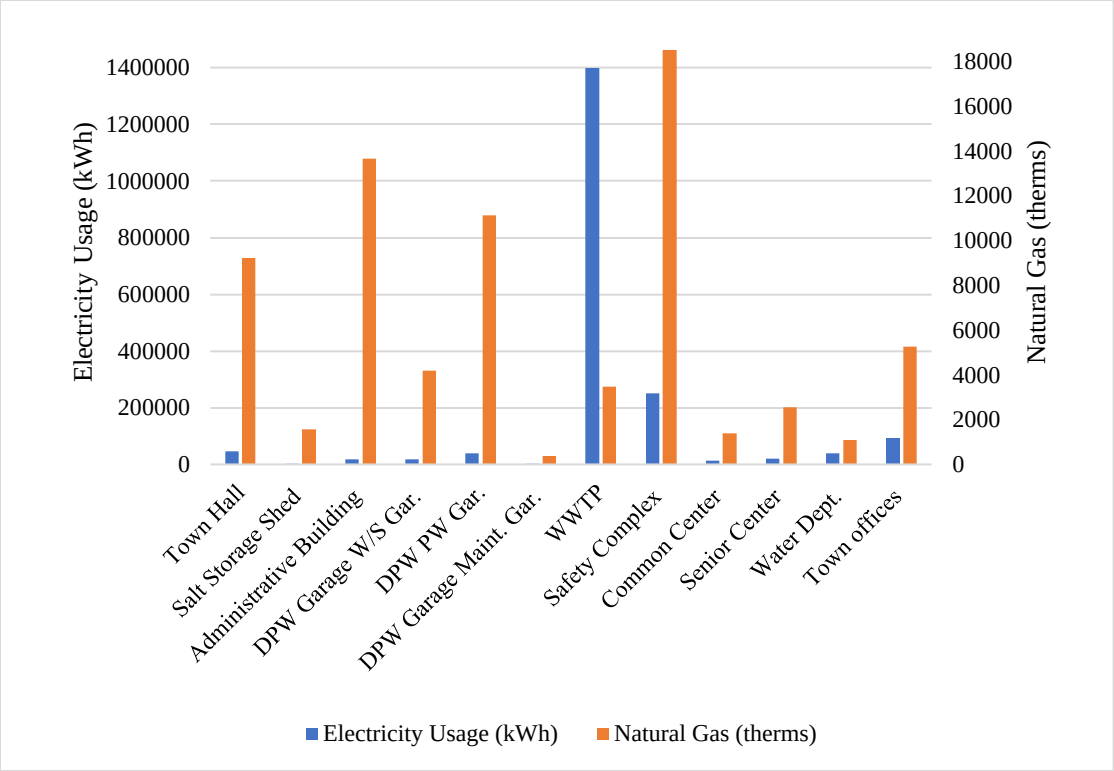

Figure 3: Building electricity and natural gas usage

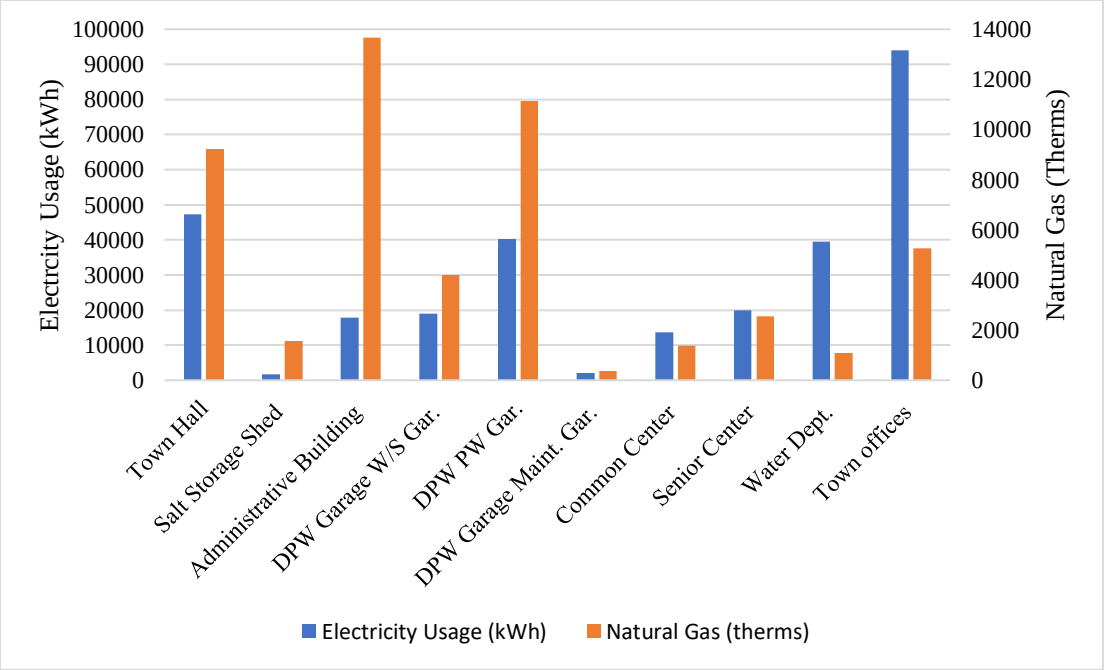

Figure 4: Building electricity and natural gas usage except for the top two electricity users (WWTP and Safety Complex).

Vehicle miles traveled from municipal fleet vehicles broken down by department is portrayed in Figure 5. The greater the vehicle miles traveled equates to the more emissions produced. The police department accrued the highest vehicles miles traveled out of all the departments.

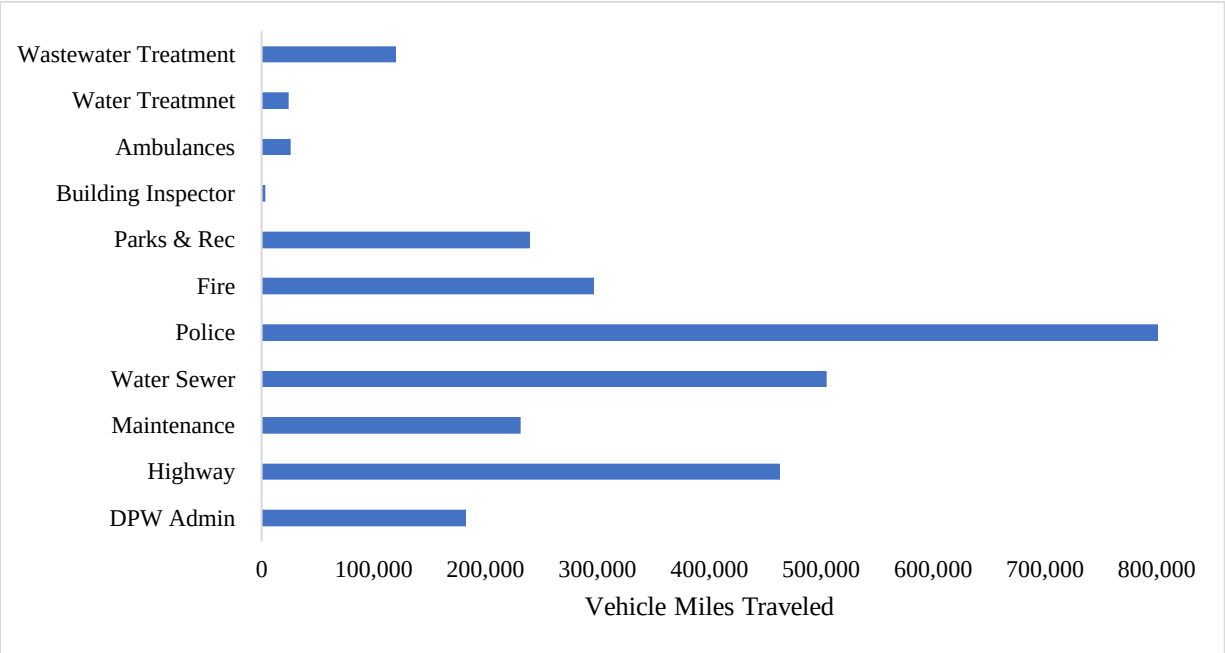

Figure 5: Vehicle miles traveled broken down by department.

Emission Reduction Targets & Strategies

According to the Intergovernmental Panel on Climate Change, limiting the warming of Earth's atmosphere to 1.5 ºC above the pre-industrial levels requires achieving net zero emissions by 2050.[3] Exeter should set a goal to achieve net zero emissions from municipal operations by 2050, with an interim goal of a 30% reduction of emissions by 2030 based on the 2019 levels. Net zero emissions can be achieved by an 80% emissions reduction with a 20% offset of emissions. This is in align with the New Hampshire Climate Action Plan to reduce NH emissions 80% below by 1990 levels by 2050.[4]

Achieving 30% Emissions Reduction by 2030

The town can achieve a 30% reduction in emissions by 2030 by implementing numerous emission reduction strategies. When researching for emission reduction strategies it was taken into consideration that the strategy will not negatively impact any one group of people more than another. Two strategies that can be implemented to work towards the 2030 goal include adding a solar array system to the Cross Road landfill and switching some municipal fleet vehicles to hybrid vehicles. These two strategies are explained in more detail below. The remaining 8% of emission reductions can be achieved from implementing the Community Power Purchase program that the town is already working on, switching from natural gas to heat pumps as the heat source for buildings as well as implementing a program the increases employees walking and biking to work as a mode of commuting.

Solar on Landfill Property

There is potential to put a 1.75 MW solar array system on the Cross Road landfill property. A 1.75 MW solar array system would produce about 2,192,522 kWh of energy per year. Based off of the 2019 electricity usage, this solar array system could reduce emissions associated with electricity usage by 92% (Table 2). There needs to be a more in-depth feasibility study to determine the possibility to install a solar array system on the landfill property. In addition to putting solar panels on the landfill property, the town should install them to any municipally owned property where practical.

	kWh	**Emissions (MT CO2e)**
Electricity Usage Municipal Operations	2,382,984	454.19
Solar Energy Output	2,192,522	0
Electricity Usage after Solar Energy (kWh)	190,462	36.30
% Emissions Reduction from Electricity Usage		**92%**

Table 2: Estimated emissions reduction after solar panel installation. Solar energy output was estimated using PV Watts Calculator (https://pvwatts.nrel.gov/pvwatts.php) .

Switching to Hybrid Vehicles

The state of New Hampshire recognizes that transitioning to electric vehicles is "one of the most effective ways to reduce transportation related emissions" and is preparing for this transition.[5] In the stages of transitioning to electrifying the transportation sector, hybrid vehicles can act as an intermediate stage. The long-term goal should be to electrify all municipal fleet vehicles, but for now switching some vehicles to hybrid is a good first step. Since the police department accrued the greatest vehicle miles traveled, it is used in this example. If the police department replaced 10 of their Ford Explorer vehicles with the 2020 Ford Escape SE Sport Hybrid, it would reduce total municipal operations emissions by approximately 7% (see Table 3). The emission reduction calculations are included in the appendix. An adoption rate of 1 hybrid vehicle every year for the next 10 years would enable Exeter to achieve this goal. Furthermore, a vehicle audit would be beneficial in order to determine which vehicles in the municipal fleet need to be replaced first.

Emission Reduction Strategy	**Amount of Emissions Reduced (MT CO2e)**	**% Reduction from Municipal Operations**
Switching to Hybrid Vehicles	183.27	7%
Solar Panels on Landfill Property	417.89	15%
Other	217.71	8%
Total Emissions Reduced	818.87	30%

Table 3: Estimated emissions reduction to get to a 30% emissions reduction by 2030.

Net Zero by 2050

The roadmap to get to net zero to get to 2050 has not yet been determined. This will require a more in-depth analysis of what emission reduction strategies are feasible for the town and on the status of emissions reduction technology/strategies. Although the strategies themselves have not been identified for the roadmap to achieve net zero, it will require collaboration across Exeter's departments. The Further Recommendations/Next Steps section after the Conclusion section describes actions that can be a part of the roadway to achieve net zero by 2050. It would be beneficial for a sustainability staff member to work on the details for the roadmap to get to net zero by 2050.

Conclusion

The results of the inventory portray that there is no one building, department, or process that is responsible for all of the GHG emissions. For this reason, Exeter's departments will need to take collective action towards the goal of achieving net zero by 2050. Setting and achieving this goal is one step in the right direction towards a sustainable future. In order for Exeter to become a sustainable and resilient community, it is necessary to view this from a holistic perspective. It is important to recognize that doing a GHG inventory and reducing emissions is just one part of sustainability. It is important to make sure to include all aspects of sustainability such as environmental justice and individual behavior change.

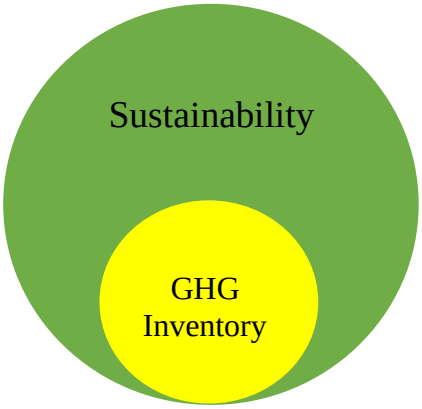

Figure 6: Graphic portraying that a GHG inventory is just one part of sustainability.

Future Recommendations/Next Steps

- Adopt emission reduction targets recommended in this report or similar ones
- Promote biking/walking to work when feasible & add bike lanes throughout the town in order to aid in this recommendation
- Community analysis – community wide greenhouse gas emissions inventory or some other type of analysis such as a consumption-based inventory.
- Electrify the municipal fleet
    - Do a vehicle audit – see what vehicles will need to be replaced soon
- Idle reducing technology in existing municipal fleet vehicles.
- Anaerobic digestor installed at the WWTP - would reduce both electricity usage of the WWTP and the effluent GHG emissions from the wastewater sludge
- Heat pumps – reduce natural gas usage for heating buildings
- Exeter should conduct a community wide analysis and then adopt emission reduction targets for town wide

References

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5. NH Department of Environmental Services. (2020). *NHDES Comments on Staff Recommendations.* https://www.puc.state.nh.us/Regulatory/Docketbk/2020/20-004/LETTERS-MEMOS-TARIFFS/20-004_2020-02-20_DES_COMMENTS.PDF

Appendix

Account Number (Electricity)	Address	Building	Meter numbers	Electriicity usage (kWh)	Account Number (Natural Gas)	Natural Gas (Therms)
210.2378	1 Front St	Town Hall	155630	47219	408.11005	9229
211.4251	13 Newsfield Rd	Salt storage shed	451687	1742	408.08135	1563.13
211.4247	13 Newsfield Rd	Administrative building	453598	17918	408.13105	13660.67
211.3696	13 Newsfield Rd	DPW Garage #2 - W/S Gara	451658	18978	408.11965	4199
211.3695	13 Newsfield Rd	DPW PW Garage	155615	40286	408.11005	11144.45
211.4482	13 Newsfield Rd	DPW Garage #3 - Maint Ga	410938	2087	408.05925	376.62
215.0116	13 Newsfield Rd	WWTP	155950	1398369	408.2008	3468
210.3116	20 Court St Safety Complex	Fire/Police	156738	250141	408.17475	18527.21
210.301	32 Court St	Common CNTR	150079	13611	408.13265	1390.92
210.3011	30 Court St	Senior Center		20000	408.07095	2540
211.4522	87 Epping Rd	Water Dept	153821	39543	407.06355	1078.27
210.2313	10 Front st	Town offices	153215	93947	408.09645	5271
210.4471	66 Lincoln St	Railroad Station	153469	34555		

Table 4: Electricity usage of each municipal building. This is not inclusive of the total electricity usage of Exeter's municipal operations.

Department	Current vehicle	Mileage (2019)	MPG	Gallons gasoline	mmBTU	MT CO2	MT CO2e (CH4)	MT CO2e (N2O)	Total MT CO2e
Police	Ford Explorer	4,773	18	265	33.15	2.3268375	0.0025	0.0059	2.3352
Police	Ford Explorer	84,558	18	4,698	587.21	41.222025	0.0440	0.1050	41.3711
Police	Ford Explorer	70,006	18	3,889	486.15	34.127925	0.0365	0.0869	34.2513
Police	Ford Explorer	117,464	18	6,526	815.72	57.2637	0.0612	0.1459	57.4707
Police	Ford Explorer	19,404	18	1,078	134.75	9.45945	0.0101	0.0241	9.4936
Police	Ford Explorer	107,728	18	5,985	748.11	52.5174	0.0561	0.1338	52.7073
Police	Ford Explorer	149,499	18	8,306	1038.19	72.8807625	0.0779	0.1856	73.1443
Police	Ford Explorer	94,741	18	5,263	657.92	46.1862375	0.0493	0.1176	46.3532
Police	Ford Explorer	158,575	18	8,810	1101.22	77.3053125	0.0826	0.1969	77.5848
Police	Ford Explorer	129,711	18	7,206	900.77	63.2341125	0.0676	0.1611	63.4627
								Total	**458.1743**
Department	**New vehicle**	**Mileage (2019)**	**MPG**	**Gallons gasoline**	**mmBTU**	**MT CO2**	**MT CO2e (CH4)**	**MT CO2e (N2O)**	**Total MT CO2e**
Police	Ford Escape SE Sport Hybrid 2020	4,773	30	159	19.89	1.3961	0.0015	0.0036	1.4011
Police	Ford Escape SE Sport Hybrid 2020	84,558	30	2819	352.33	24.7332	0.0264	0.0630	24.8226
Police	Ford Escape SE Sport Hybrid 2020	70,006	30	2334	291.69	20.4768	0.0219	0.0522	20.5508
Police	Ford Escape SE Sport Hybrid 2020	117,464	30	3915	489.43	34.3582	0.0367	0.0875	34.4824
Police	Ford Escape SE Sport Hybrid 2020	19,404	30	647	80.85	5.6757	0.0061	0.0145	5.6962
Police	Ford Escape SE Sport Hybrid 2020	107,728	30	3591	448.87	31.5104	0.0337	0.0803	31.6244
Police	Ford Escape SE Sport Hybrid 2020	149,499	30	4983	622.91	43.7285	0.0467	0.1114	43.8866
Police	Ford Escape SE Sport Hybrid 2020	94,741	30	3158	394.75	27.7117	0.0296	0.0706	27.8119
Police	Ford Escape SE Sport Hybrid 2020	158,575	30	5286	660.73	46.3832	0.0496	0.1181	46.5509
Police	Ford Escape SE Sport Hybrid 2020	129,711	30	4324	540.46	37.9405	0.0405	0.0966	38.0776
								Total	**274.9046**
								Emissions reduction	**183.2697**
								% emissions reducion	**40%**

Table 5: Calculations for the emission reductions from switching to hybrid vehicles.