Direct Annual CO2 Emissions from Mobile Combustion Sources

Prince George's County Department of Parks and Recreation
Division of Maintenance and Development

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Research Questions

What are the annual emissions produced by the Division of Maintenance and Development's fleet vehicles and equipment, and what is the most effective way of reducing these emissions by 50% over the next ten years?

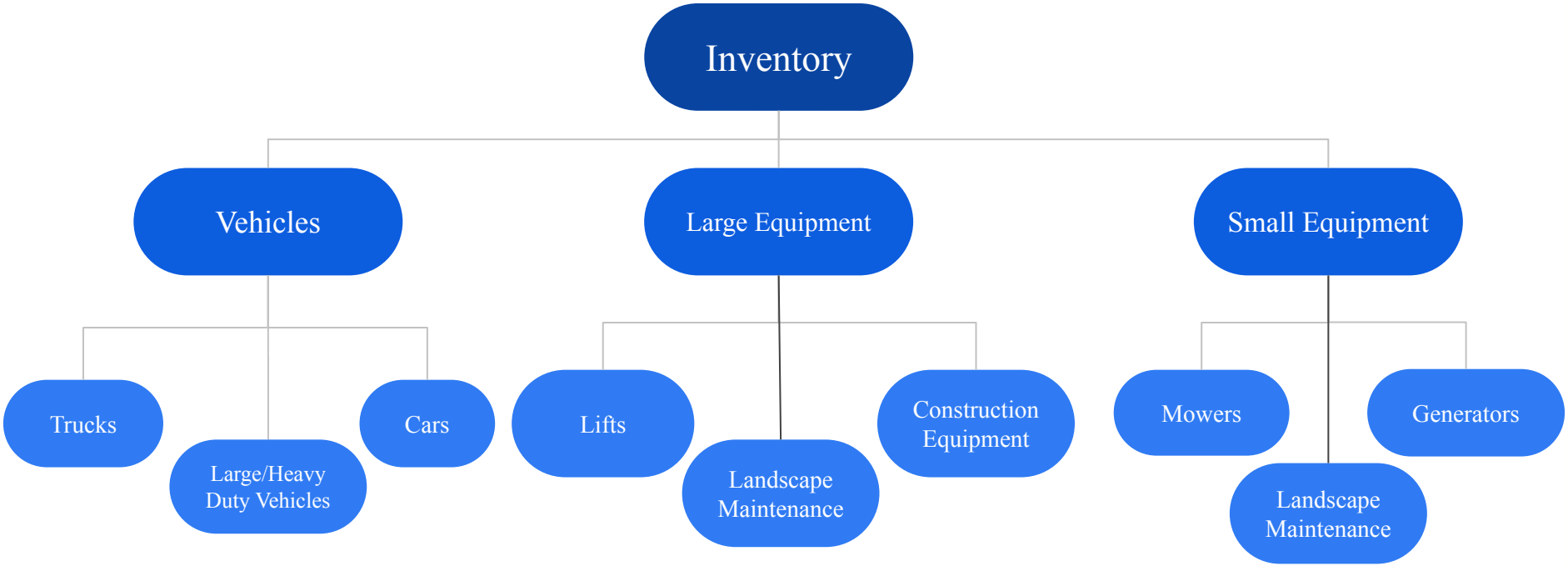
Project Goal

To provide the Division of Maintenance and Development with a report that includes a baseline measurement of carbon dioxide (CO2) emissions produced by fleet vehicles and equipment in 2019 and options that will help achieve a 50% reduction in the Division's CO2 emissions by 2030.

Objectives

1. Use equipment and vehicle inventory, fuel consumption rates, and use data to calculate the fleet's baseline annual emissions.
2. Provide recommendations for reaching a 50% reduction in CO2 emissions.

Methods


Inventory
Vehicles
Large Equipment
Small Equipment
Trucks
Large/Heavy Duty Vehicles
Cars
Lifts
Landscape Maintenance
Construction Equipment
Mowers
Landscape Maintenance
Generators

Methods - Obtaining Fuel Quantities

Step 1

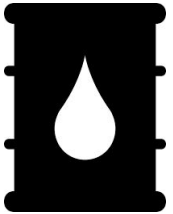
Organize each item into subcategories→ use fuel usage quantity and fuel type data for 2019 → CO2 coefficient from EIA for each fuel type → calculate emissions

Step 2 (Items w/out Fuel Quantity Data)

Research (manufacturer websites, manuals, contacting manufacturer, equipment-specific forums/websites) → based on reported standard usage, calculate fuel consumption

Step 3 (Remaining items with missing information)

Obtain 3150 Equipment History list (fuel quantities) → questionnaire for fuel consumption



Methods - Calculations

Method A - Direct Calculation of CO2 Emissions

CO2 Emissions = (fuel quantity used) x (fuel type CO2 emissions coefficient)

Method B - Estimated Calculation of CO2 Emissions

CO2 Emissions = (estimated fuel quantity used) x (fuel Type CO2 emissions coefficient)

(hours of usage) x (fuel consumption rate)

Methods - Calculations

Method C: Remaining Diesel Fuel Consumption Calculations

The fuel consumption rate of diesel vehicles was calculated using a calculation table.

The calculated fuel consumption was then multiplied by usage hours to get the fuel quantity.

Finally, the following equation was used:

CO2 Emissions = (fuel quantity used) x **(fuel type CO2 emissions coefficient)**

Power Unit			Fuel Consumption per hour			
hp	**kW**	**kVA**	**lb**	**kg**	**liter**	**US gal**
1	0.75	0.93	0.40	0.18	0.21	0.06
1.07	0.8	1	0.43	0.19	0.23	0.06
1.34	1	1.25	0.54	0.24	0.29	0.08
5	3.73	4.66	2.00	0.90	1.07	0.28
7	5.22	6.52	2.80	1.30	1.49	0.39

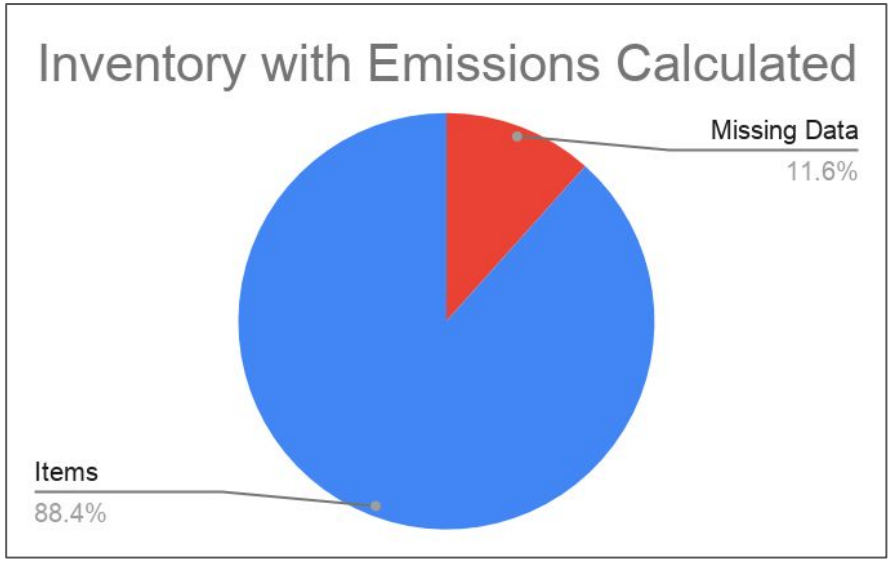
hp	**kW**	**kVA**	**lb**	**kg**	**liter**	**US gal**
10	7.46	9.32	4.00	1.80	2.13	0.56
12	9	11	4.80	2.20	2.56	0.68
15	11	14	6.00	2.70	3.20	0.85
18	13	17	7.20	3.25	3.84	1.01
20	15	19	8.00	3.50	4.26	1.13
22	16	21	8.80	4.00	4.69	1.24
25	19	23	10	4.5	5.33	1.41
35	26	33	14	6.4	7.46	1.97
50	37	47	20	9.1	10.66	2.82

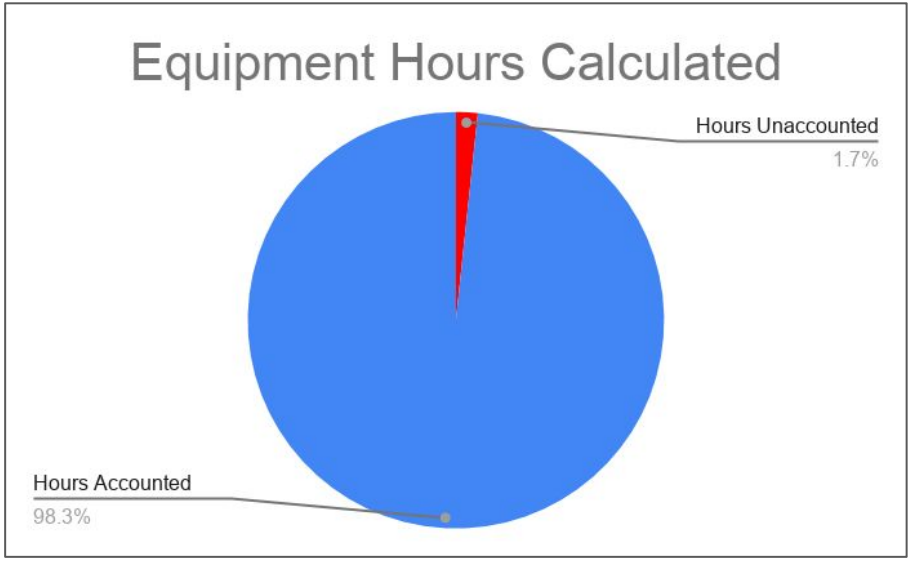
Barrington Diesel Club

Assumptions and Limitations

- Age of vehicles and equipment
- Condition of vehicles and equipment
- Equipment used in dry conditions, on relatively flat landscapes

Results - Percentage of Inventory Accounted For



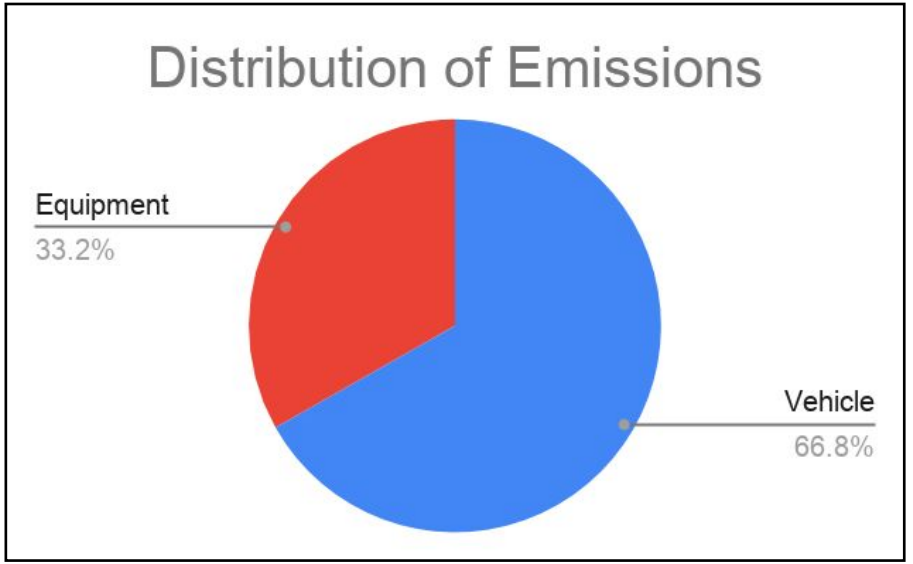


Results - Emissions by Inventory Category

Total of **909.3 metric tons** (MT) of CO2 produced by the Division in 2019

Vehicles produced **607.4 MT** of CO2, 66.8% of total emissions

Equipment produced **301.9 MT** of CO2, 33.2% of total emissions

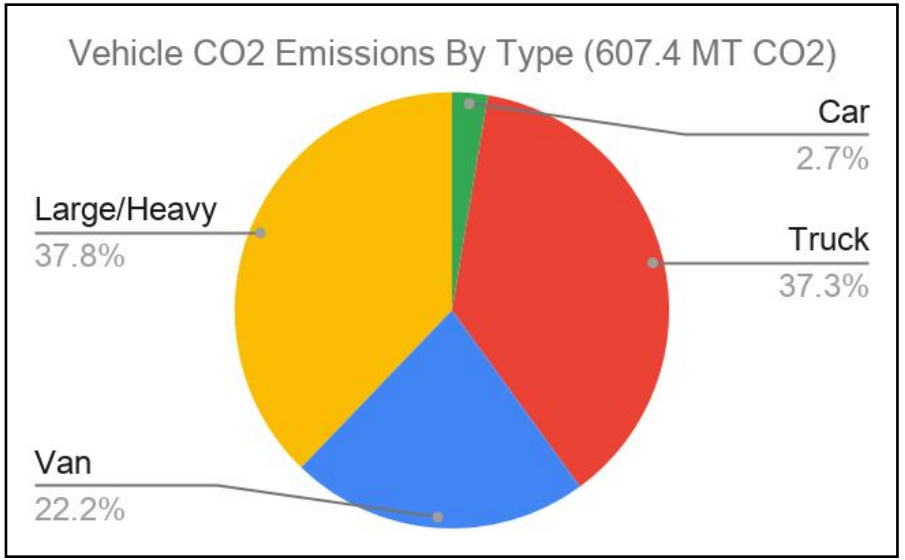


Results - Vehicle Emissions

Most vehicle emissions came from large/heavy duty vehicles and trucks, with each subcategory accounting for 37% of CO2 emissions

Vans produced 22.2% of CO2 emissions in 2019, with most coming from cargo vans

Cars accounted for only 2.7% of emissions



Results - Vehicle Emissions

Five vehicles account for **10%** of the inventory's CO2 emissions

- **91.4 metric tons** of CO2 from:
  - 3 Freightliner 114SD trucks
  - 1 Freightliner 114SD truck
  - 1 Ford F-350

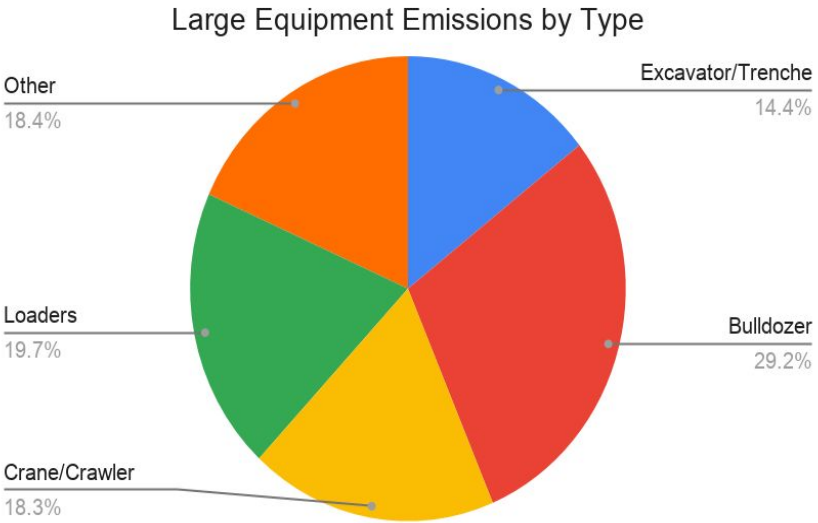
Ten highest emissions vehicles produce 16.3% of the 2019 emissions

Most highest emission vehicles are heavy duty vehicles more than 6 years old

Results - Large Equipment

Large Equipment Total:
278.74 MT of CO2

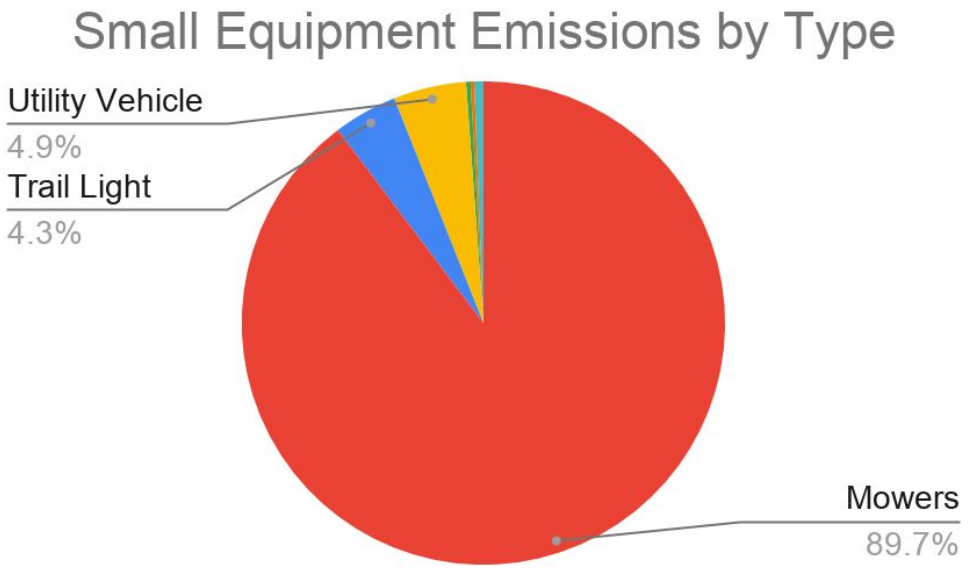
- Excavator/Trencher - 40.18 MT
- Bulldozer - 81.42 MT
- Crane/Crawler - 51.13 MT
- Loader - 54.83 MT
- Other - 51.15 MT



Results - Small Equipment

Small Equipment Total:
23.2 MT CO2

- Mowers - 20.6 MT CO2 (89.70%)
- Non-mowers - 2.5 MT CO2 (10.30%)



Strategies to Reduce Emissions by 50%

Estimations for all Vehicles and Equipment

- Work Scheduling - ~5% Overall Reduction
- Vehicle/Equipment Selection - ~9-12% Overall Reduction
- Telematic Equipment and Idle Reductions - ~44% reduction in total emissions

Strategies to Reduce Emissions by 50%

Estimations by Type of Vehicle/Equipment

Heavy duty vehicles

- Electric Vehicles for top emitters - 16.3% Overall reduction in CO2 emissions

Light duty vehicles

- Driver Training and Aerodynamics - 4-7% reduction

Large equipment

- Biodiesel - ~43% reduction for Diesel Equipment

Small equipment

- Electric mowers and utility vehicles - ~91.18% overall in CO2 emissions

50% Reduction Strategies - Option 1

Efficient Work Planning and Selection

- Optimize when equipment and vehicles are used at a worksite
- Choose efficient equipment and vehicles for specific tasks

Reduce Idling

- Decrease when the engine is on and not being used for equipment and vehicles

Biodiesel for all/most heavy equipment and vehicles

- Biodiesel (derived from plants and animals) produces less emissions, is cheaper than standard diesel fuel, and many diesel engines can switch to biodiesel fuel

50% Reduction Strategies - Option 2

Efficient Work Planning and Selection

- Optimize when equipment and vehicles are used at a worksite
- Choose efficient equipment and vehicles for specific tasks

Reduce Idling

- Decrease when the engine is on and not being used for equipment and vehicles

Install Telematic Equipment

- Install monitoring systems on all engines to analyze real-time data for fuel efficiency and to reduce emissions from each individual vehicle

Invest in Electric and Hydrogen Heavy Vehicles, Mowers, and Utility Vehicles

- Phase out old/inefficient heavy-duty vehicles and replace with electric alternatives

Conclusion/Recommendations

Estimated 2019 baseline of CO2 emissions - **909.3 metric tons** (includes 100% of vehicle fuel usage and 98.3% of equipment hours logged included)

About two-thirds of emissions come from vehicles, one-third from equipment

Prince George's County produced 4.39 million MT of CO2 emissions in 2014 from vehicles

Option 1 is a short-term, cost-effective approach to reducing emissions

Option 2 is a more effective, long-term approach to reach the reduction goal and build capacity for reducing CO2 emissions even further, beyond 2030

Future Work

Maintain more extensive records of vehicle and equipment use to calculate more accurate baseline CO2 emissions and to track reduction progress

Explore the continuing research on alternative fuel types for vehicles and equipment

Examine emissions from all of the Division's electricity consumption, buildings, etc. as indirect emissions sources

Determine a best plan for reaching carbon neutrality in the Division

Prince George's County Goal: Reduce County-wide greenhouse gas (GHG) or carbon emissions by 80% below 2008 levels by 2050