GHG and Fuel Cost Calculation Methods

Transit Buses

1) Step 1: Bus Inventory

Massachusetts

For the MBTA, we used the most current inventory (updated July 2019) available online at http://www.transithistory.org/roster/ to determine how many diesel (500), compressed natural gas, CNG (175) and hybrid buses (285) the MBTA is operating. The 60 trolley buses – which run in dual diesel & electric mode - were not included because their average fuel efficiency was not known.

For RTAs, we used the inventories from the most recent 2017 RTA audit, available at Mass.gov (only the revenue vehicles were included)

Rhode Island

For RIPTA, the inventory was obtained from the website https://www.ripta.com/about/, which lists a "fleet of 221 fixed-route buses, 95 paratransit vans, 17 flex vans." The active fleet was double checked here https://en.wikipedia.org/wiki/Rhode_Island_Public_Transit_Authority#Active_fleet. Emissions were calculated for 160 diesel buses, 62 diesel-hybrids and 112 vans (334 total).

2) Step 2: Fuel Consumption

For MBTA diesel buses, annual fuel consumption was obtained by using a fuel efficiency of 4 miles per gallon (mpg) and average yearly mileage of 35,000 miles per bus as suggested by the Department of Energy, DoER (https://afdc.energy.gov/data/widgets/10309).

For MBTA diesel hybrids, we used a fuel efficiency of 5 mpg, and 35,000 miles / bus / year.

For MBTA CNG buses, we used the annual fuel usage (2.1 million therms) from the FY18 Energy Consumption report presented at the Fiscal Board Control Management on 6/10/2019 (slides are available here)

For RIPTA, we obtained fuel consumption using 4 mpg for diesel buses, 5 mpg diesel hybrids, and 7 mpg for vans. We used an average 35,000 miles/year/bus in all cases. Using those parameters, we obtained a fuel consumption of 2,354,000 gallons of diesel, which is consistent with the statement on the RIPTA's webpage that the agency 'utilizes over 2.3 million gallons of fuel per year'. This was a very useful validation check for our calculations, meaning that fuel efficiency and average annual mileage numbers are generally correct.

Fuel economies were also checked against the 2018 U.S. PIRG report on Electric Buses: Clean Transportation for Healthier Neighborhoods and Cleaner Air (https://uspirg.org/reports/usp/electric-buses-clean-transportation-healthier-neighborhoods-and-cleaner-air)

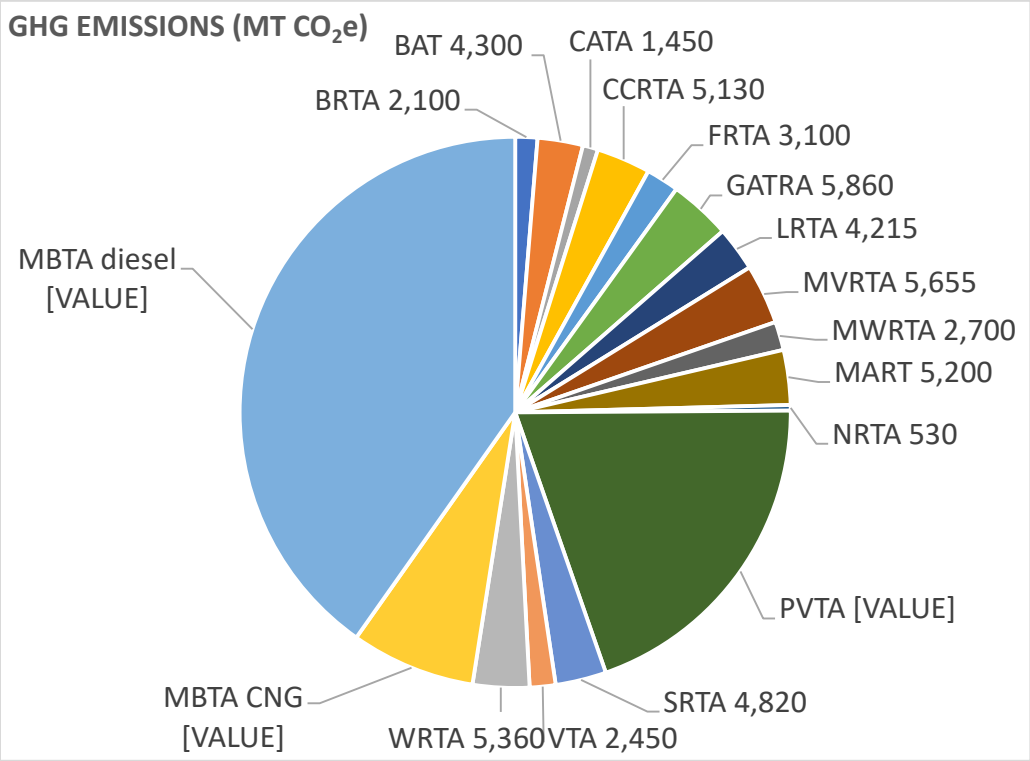
3) Step 3: GHG Emissions

The final piece is the calculation of GHG emissions, which is very easy to do once fuel usage (in gallons or therms) is known.

We used the EPA's Simplified GHG Emissions Calculator, version 5 (Center for Corporate Climate Leadership Simplified GHG Emissions Calculator, 2018) to calculate GHG in metric tons of CO_2 equivalent (MT CO_2e). The EPA Calculator v5 is available here https://www.epa.gov/climateleadership/center-corporate-climate-leadership-simplified-ghg-emissions-calculator

Below is the summary of the Massachusetts and Rhode Island GHG emissions for transit buses and the exact GHG emissions in Massachusetts for each Regional Transit Agency (RTA). The MBTA emissions in the pie chart are reported separately for diesel and CNG buses

	MBTA	RTAs	RIPTA
GHG (MT CO2e)	~77,000	~85,000	~24,000



School Buses

1) Step 1: Bus Inventory

There are 9,000 yellow buses in Massachusetts and 1690 yellow buses in Rhode Island, according to the 2016-17 Pupil Transportation Statistics https://files.schoolbusfleet.com/stats/SBFFB18StateByState.pdf

2) Step 2: Fuel Consumption

The average yearly mileage of a school bus 12,000 miles, as indicated by the by the Department of Energy, DoER (https://afdc.energy.gov/data/widgets/10309).

Assuming an average fuel economy of 7 mpg (taken from the 2018 U.S. PIRG report on Electric Buses mentioned above), we estimated that each school buses uses 1,700 gallons of fuel per year. This is consistent with the numbers reported by the American School Bus Council (1,697 gallons/year).

3) Step 3: GHG Emissions

Using the EPA's Simplified GHG Emissions Calculator, version 5, we calculated that each school bus emits 17 metric tons of CO_2 annually. When multiplied by the estimated number of school buses in Massachusetts and Rhode Island, we obtain 153,000 MT CO_2e for the MA school fleet (more than 2 times higher than the entire MBTA fleet) and 28,700 MT CO_2e for the Rhode Island school fleet.

4) Fuel Costs

Fuel costs were estimated based on fuel consumption (from Step 2) and the average price of diesel fuel and of CNG; we used $2/gallon for diesel (the price that the MBTA says it is paying for diesel fuel) and $0.7/therm for CNG. Numbers are approximated to the nearest integer, and are based on the latest available inventory, indicated in the Table.

	Bus Units	Annual GHG (MT CO_2e)	Annual Fuel Costs
MBTA diesel *(FY19 inventory)*	500 (diesel) + 285 (hybrids)	~ 65,000	~ $12.7 million
MBTA CNG *(FY18 fuel use)*	175	~ 12,000	~ $1.5 million
RTAs *(FY17 inventory)*	1611	~ 85,000	~ $16.8 million
RIPTA *(FY19 inventory)*	160 (diesel), 62 (hybrids) 112 (vans)	~ 24,000	~ $4.5 million
MA school buses *(FY17 inventory)*	9000	~ 153,000	~ $30 million
RI school buses *(FY17 inventory)*	1690	~ 29,000	~ $6 million