CTDOT:

The Connecticut Department of Transportation (CTDOT) is responsible for the development and operation of highways, railroads, mass transit systems, ports, waterways in the U.S. state of Connecticut (Wikipedia, 2017). James P. Redeker is the current Commissioner of CTDOT. Its headquarters is located in Newington. CTDOT owns the local bus systems in eight different metropolitan area and operates under the brand name of CTtransit. They also own all the bus storage and maintenance facility in Hartford, New Haven and Stamford.

CTDOT also has contracts with other private providers for services in New Britain, Bristol, Waterbury, Meriden and Wallingford. In all of these service areas the state is fully responsible for all operating deficits and capital costs. Additionally, CTDOT contracts with CTTransit and four private companies for the operation of express bus services to Hartford. Current fleet size for which CTDOT is responsible is 550.

CTtransit:

CTtransit began operations in 1976. CTTransit-branded services carry about 80% of the annual statewide bus ridership. Table 1 consists of the metropolitan areas and number of routes that are serviced in the respected areas.

Table 1: Route information

Metro Area	No of Routes
Hartford Local	48
CTfastrak	8
Hartford Express	20
Waterbury	32
New Haven	20
Stamford	19
New Britain	10
Bristol	5
Meriden	4
Wallingford	1

The following figures show all the stops and routes that are serviced by CTTransit (Figure 1 & Figure 2)

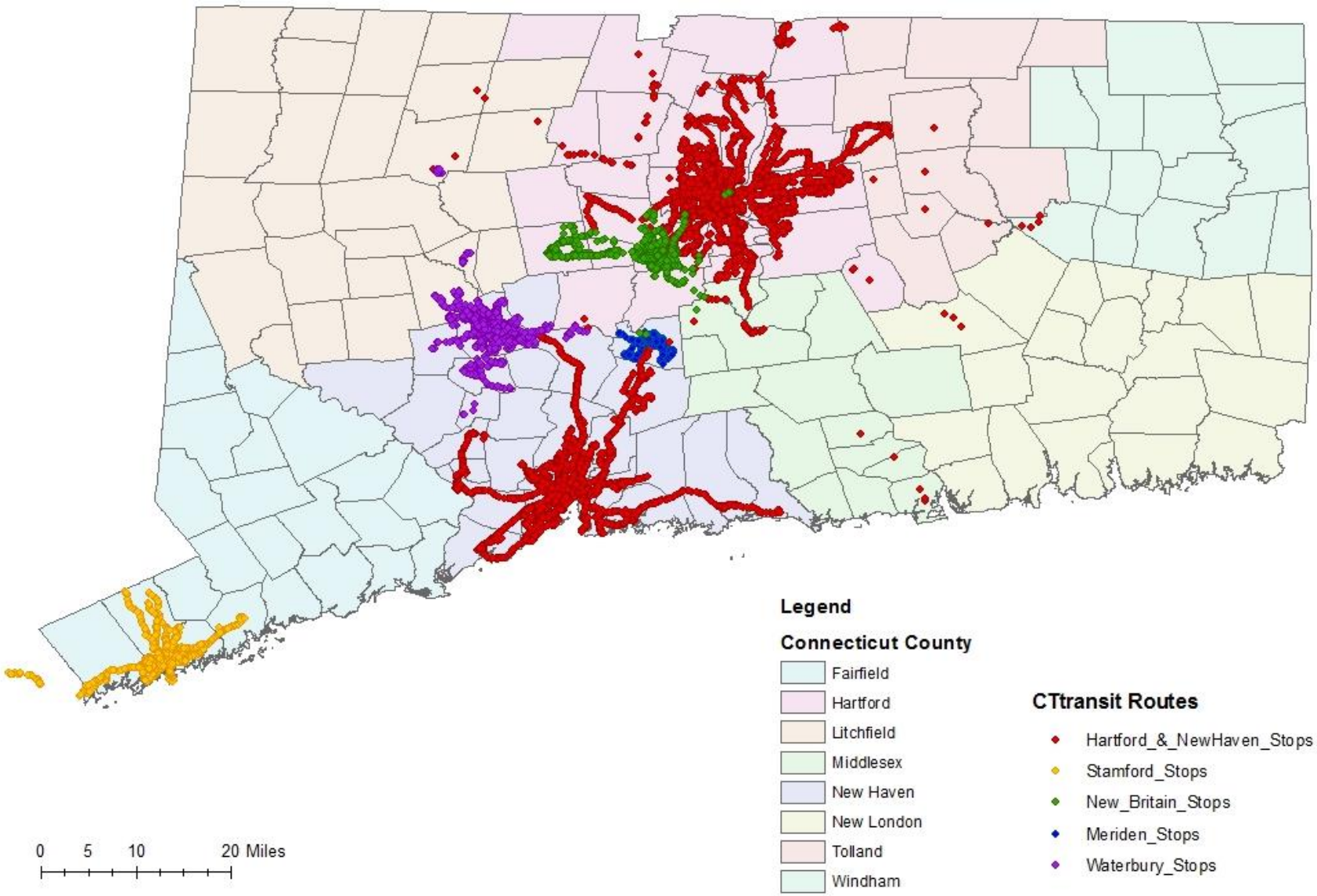

Figure 1: All stops in CTtransit service area

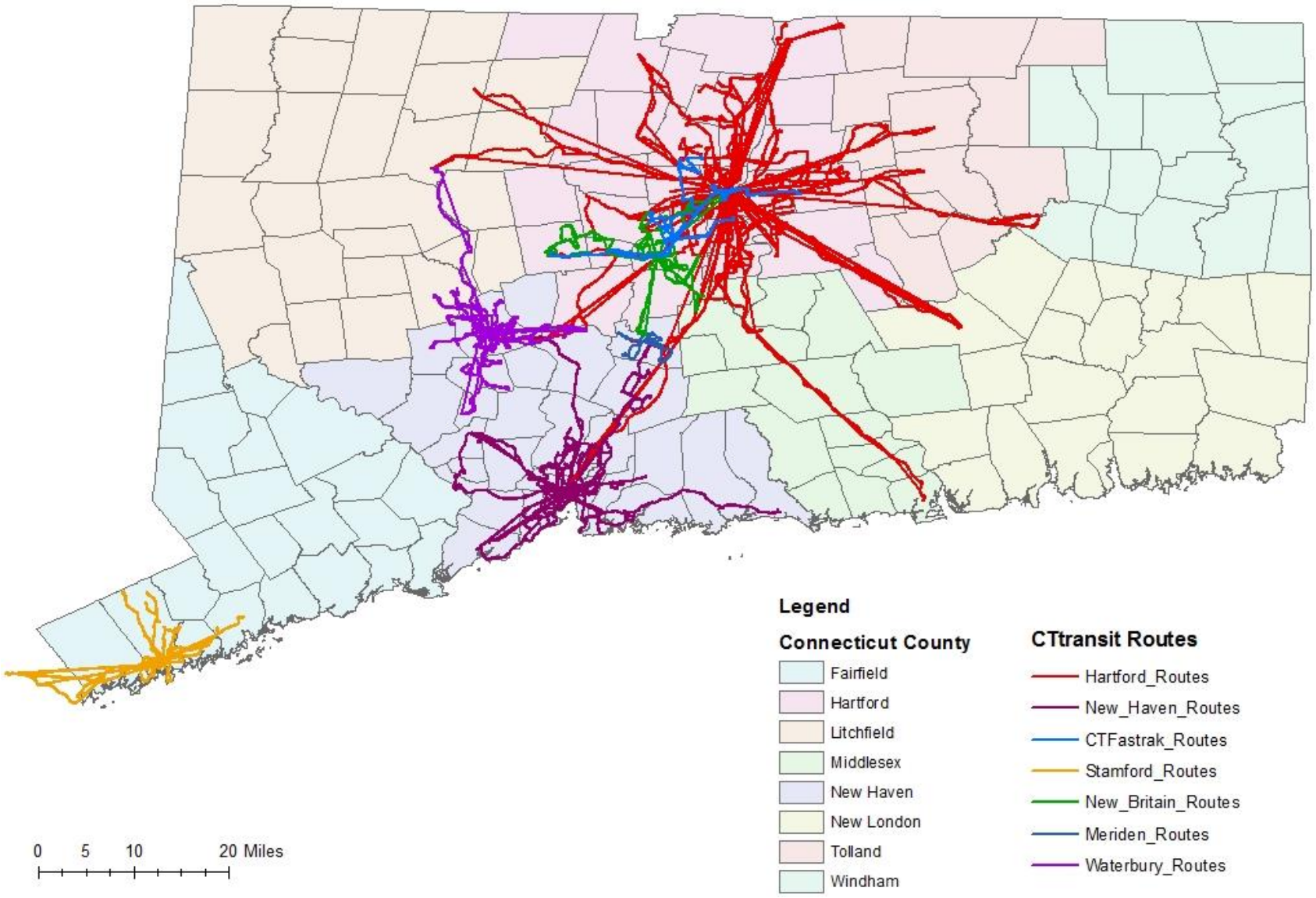

Figure 2: All routes in CTTransit service area

CTfastrak is Connecticut's first bus rapid transit system that has been operating between downtown Hartford and downtown New Britain since March 28, 2015. It has both 40ft and 60ft buses operating on the 9.4 mile dedicated busway.

The service area of CTFastrak is shown in the map below (Figure 3).

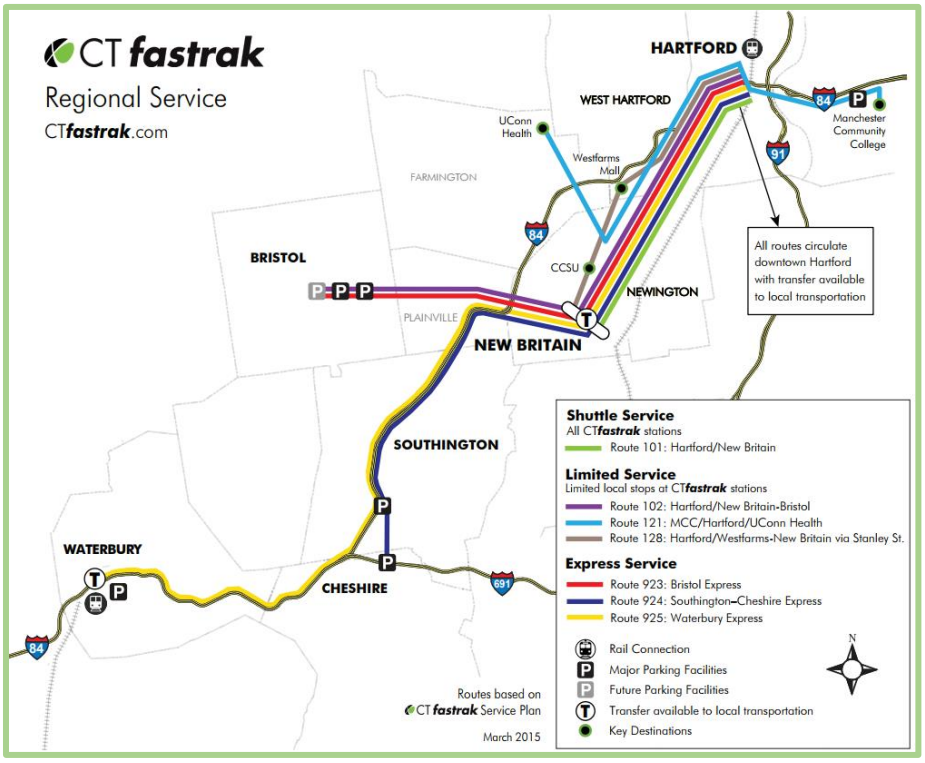

Figure 3: CTfastrak service map

Fleets:

Total number of buses operated by CTtransit is 477 (2016). Most of these buses are Diesel buses. Some of these are Hybrid Diesel Electric buses. All the metro areas that are served by CTtransit, can be categorized into three, Hartford, New Haven and Stamford. Of the three major divisions, Hartford has the highest number of buses (298). It also has the highest VMT and fuel usage in a year (2016). Total fleet size, VMT and fuel usage of three major divisions are listed below in table 2. Table 3 consists of detailed description of all the buses owned and operated by CTtransit in these three divisions.

Table 2: VMT and Diesel usage of fleet managed by CTtransit

Area	Fleet Size	Total VMT	Diesel usage (Thousand Gallons)
Hartford Division	298	10342365	2581.485
New Haven Division	129	4167289	1168.637
Stamford Division	59	1604373	370.7974

Some of the buses are shown in the following figures (Figure 2 & 3).

Figure 4: Bus in Downtown Hartford

Figure 5: CTfastrak Bus

A detail of the buses in operation can be found in Appendix X.

Facility:

Hartford, New Haven and Stamford divisions have large facilities for bus storage and maintenance which are under the operation of CTDOT. They also have buildings for administrative works. The total area of facility in Hartford division is about 17.5 acres. The facilities use electricity, gas, fire suppressors, heating & cooling systems, refrigerators etc. that are important for greenhouse gas emissions. Following data was collected from the facilities of CTtransit.

Table 3: CTTransit Facility Inventory

Division	Electricity	Refrigeration and AC		Purchased Gases		Fire Suppressant	
	(kWh)	Type	(lb)	Type	(CCF)	Type	(lb)
Hartford	3,694,459	CO2 R-22 R-234a (Propylene) R290 (Propane) R-1270	11348	CH4	578112	A-B-C (Non CO2 producing)	5 10 20
New Haven	3,761,715	CO2 (Propane) R-1270	2743		543269		
Stamford	1,256,640	(Propane) R-1270	165		278536		

Other fleet operators:

Except CTtransit, 4 other private agencies operate under CTDOT. Their fleet description is given below.

Table 4: VMT and Diesel usage of fleet

Area	Fleet Size	Total VMT	Diesel usage (Thousand Gallons)
The New Britain Transportation Company (NBT)	16	867649	219.7284
Collin Bus	6	224595	46.151
Dattco Inc.	26	1284190	291.376
Nason Partners LLC	4	79360	20.334
Peter Pan	21	737176.3	189.3202

Carbon Footprint of CTDOT:

An inventory was done to collect information regarding bus operation in various bus operators including CTtransit. A greenhouse gas emission calculator tool was developed for calculating the carbon footprint of CTDOT. The calculator was developed from EPA Simplified GHG Emissions Calculator (SGEC) where some modifications were done using the more specific APTA GHG Calculator for Transit. In all the calculations, the base year was considered 2016. Only the major three major gases were considered in this analysis. These are Carbon di oxide (CO_2), Methane (CH_4), and Nitrogen Di Oxide or NOX (NO_2). All the emission factors and global warming potentials (GWPs) were used from the calculators mentioned above.

The calculator used the information collected from the transit operators. Non-revenue vehicles were not considered in the analysis. The major inputs for calculating GHG emission from buses are the following:

1. No of vehicles operated
2. Type of vehicles operated (Diesel or Diesel Hybrid)
3. Vehicle age
4. Fuel mix (Ethanol percentage if any)
5. Fuel usage (Gallons of fuel used in the year 2016)
6. Vehicle miles travelled (in the year 2016)

For the emission calculation for facilities, only the facilities that are owned by CTtransit are considered. The input of the facility GHG calculations are mentioned in Table 4.

From the analysis, GHG emission by buses consist of almost 70% of the total emission. The other 30% of the emission is by facility, which is consistent with the calculations that has been done by other agencies such as NYC metro. The following table shows the summery of buses and facility emission by CTDOT.

Table 5: GHG emission by CTDOT

Division	MT CO_2 equivalent from Buses	MT CO_2 equivalent from Facility		
		Electricity	Refrigeration and AC	Purchased Gases
Hartford Division	26373.074	1077.378	2446.845442	5506.742
New Haven Division	11938.273	1096.991	2.486841648	5174.849
Stamford Division	3788.341	366.4614	0.1496847	2653.164
NBT	2245.079			
Collin Bus	472.002			
Dattco Inc.	2977.999			
Nason Partners LLC	54.451			
Peter Pan	1934.658			
Total (MT CO2 equivalent)	49938.109	2540.831	2,449.563	13,335.049
	68263.57			

APPENDIX

Table 6: Detailed Bus Inventory for CTTransit

	Bus	# Buses	# Seats	Model	Year
Hartford	101, 114-117, 120-122, 135	9	36	NF DL 40	2001
	201-240	40	38	NF DL 40	2002
	H302**	10	38	NF HDL 40	2003
	303-309*	7	57	MCI D4500	2003
	312-322	11	38	NF DL 40	2003
	401-442	42	38	NF DL 40	2004
	501-548	48	38	NF DL 40	2005
	711-714, 716-753	42	38	NF DL 40	2007
	761-782*	22	38	NF DL 40	2007
	801-802	2	38	NF DL 40	2008
	1011-1018*	8	57	MCI D4500	2010
	1101-1110**	10	57	Nova Artic	2011
	1201-1203**	3	30	NF XDE 35	2012
	1430-1438**	9	26	Gilling 30	2014
	1501-1503**	3	26	Gilling 30	2015
	1211-1212**	2	38	NF XDE 40	2012
	1441-1458**	18	35	NF XDE 40	2014
	1462-1473**	12	55	Nova Artic	2014
Total		298			
New Haven	106-112	7	36	NF DL 40	2001
	310, 311, 323, 330-336, 338-371	44	38	NF DL 40	2003
	451-492	42	38	NF DL 40	2004
	1023-1036**	14	38	NF XDE 40	2010
	1041-1052	12	57	Nova Artic	2010
	1204**	1	30	NF XDE 40	2012
	1426-1429**	4	57	Nova Artic	2014
	1489-1493**	5	40	NF XDE 40	2014
Total		129			
Stamford	1225	1	36	NF DL 40	2001
	127-132*	6	36	NF DL 40	2001
	1019-1022*	4	57	MCI D4500	2010
	1061-1073	13	57	Nova Artic	2010
	1213-1014**	2	38	NF XDE 40	2012
	1401-1425**	25	40	NF XDE 40	2014
	1481-1488**	8	40	NF XDE 40	2014
Total		59			

*High back commuter seat bus configuration

**Hybrid Buses