MassDEP GHG Reporting Program Summary Report
For Retail Sellers of Electricity
Emissions Year 2017

November 2019

The information below summarizes the 2017 greenhouse gas (GHG) emissions and megawatt hours (MWh) of electricity sales reported to the Massachusetts Department of Environmental Protection (MassDEP) by 110 of the 112[1] retail sellers that sold electricity in Massachusetts during that year, as required by MassDEP regulation 310 CMR 7.71. Additional information about MassDEP's GHG reporting program is available at https://www.mass.gov/guides/massdep-greenhouse-gas-emissions-reporting-program; see particularly *Retail Seller of Electricity Reporting*. MassDEP uses this information in considering measures to reduce emissions from the electric sector. This was the ninth[2] year of reporting under 310 CMR 7.71. The initial reporting year was 2008. Annual reporting began with the 2010 reporting year. Comparisons of the nine reporting years are provided in this summary.

MassDEP requires retail sellers to report emissions that occur from the generation of the electricity that they sell. The GHGs emitted from power plants during combustion of fuels to generate electricity are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Biogenic and non-biogenic GHG emissions are reported separately. Biogenic GHG emissions are emissions of CO_2 that result from the combustion of biogenic (plant or animal) material, excluding fossil fuels. Non-biogenic GHG emissions include CO_2 released from the combustion of non-biogenic fuel, plus CH_4 and N_2O released from the combustion of any fuel.

For 2017, the retail seller reporting process consisted of 4 steps:

Step 1. Some retail sellers chose to report use of MWh from particular generating units, and any associated emissions.

Step 2. MassDEP developed initial GHG emission factors in terms of pounds of non-biogenic and biogenic GHGs in carbon dioxide equivalents per megawatt hour (lb CO_2e/MWh) based on all of the electricity consumed in Massachusetts.

Step 3. MassDEP developed final GHG emission factors for the electricity consumed in Massachusetts that was not reported in Step 1, by removing the MWh and emissions reported in Step 1 from the initial emission factors developed in Step 2.

Step 4. Retail sellers determined their GHG emissions by multiplying the final emission factors in Step 3 by the energy they sold that they did not report in Step 1, and then adding any emissions reported in Step 1.

The purpose of Step 1 is to allow retail sellers to document the use of clean energy. Because MWh associated with this clean energy are included in Step 2 but excluded in Step 3, the final emission factors are greater than the initial emission factors. For more details on the reporting process and development of GHG emission factors for electricity consumed in Massachusetts, see *Draft 2017 Greenhouse Gas (GHG) Emission Factors to be used by Retail Sellers of Electricity Reporting under 310 CMR 7.71(9)*

[1] Sixty-eight competitive suppliers sold retail electricity in Massachusetts in 2017. Two of these competitive suppliers (BPCC/Great Eastern Energy and Utility Expense Reduction) failed to report their 2017 GHG emissions. It is MassDEP's understanding that these two competitive suppliers no longer operate in MA.

[2] 2017 was the final reporting year under 310 CMR 7.71. Beginning with 2018 calendar year emissions, retail sellers will reporting under 310 CMR 7.75(9).

"Reporting Requirements for Retail Sellers of Electricity" (https://www.mass.gov/doc/technical-support-document-draft-2017-ghg-emission-factors/download).

GHG Emission Factors

Table 1 shows the initial (Step 2) and final (Step 3) emission factors upon which retail seller GHG emissions are based. The combined non-biogenic and biogenic emission factors have been included in this summary report for informational purposes. (Please note that Table 1 presents wholesale emission factors. MassDEP recommends that consumers of electricity that want to use Massachusetts-specific emission factors to report their GHG emissions from electricity use see Appendix 3 for appropriate values.)

For an explanation of the "Massachusetts-based" and "Regional-based" approaches used to calculate the emission factors in Table 1, see *Draft 2017 Greenhouse Gas (GHG) Emission Factors to be used by Retail Sellers of Electricity Reporting under 310 CMR 7.71(9) "Reporting Requirements for Retail Sellers of Electricity"* (https://www.mass.gov/doc/technical-support-document-draft-2017-ghg-emission-factors/download).[3]

Table 1. GHG Emission Factors for Electricity Consumed in Massachusetts, prior to and after accounting for particular generating units (lb CO_2e/MWh)

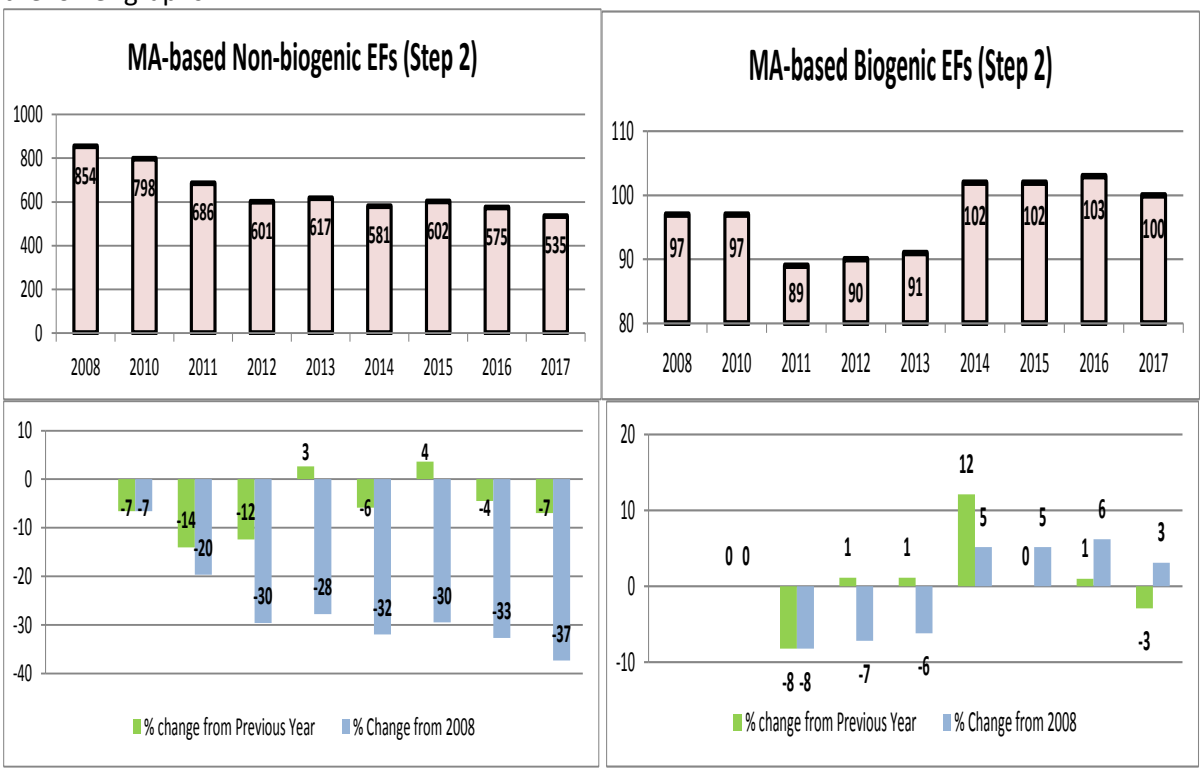
	Massachusetts-based approach			**Regional-based approach**		
	Non-Biogenic	**Biogenic**	**Combined**	**Non-Biogenic**	**Biogenic**	**Combined**
Initial Emission Factors: **prior to** accounting for particular generating units (Step 2)						
2008	854	97	951	700	139	839
2010	798	97	896	662	136	798
2011	686	89	775	584	122	706
2012	601	90	691	535	120	685
2013 corrected[4]	617	91	708	515	118	632
2014	581	102	683	527	132	659
2015	602	102	704	536	139	675
2016	575	103	678	503	141	644
2017	535	100	636	469	138	607
Final Emission Factors: **after** accounting for particular generating units (Step 3)						
2008	871	98	970	708	141	849
2010	824	101	925	672	138	810
2011	712	93	805	595	124	719
2012	628	94	722	546	123	669
2013 corrected	654	97	751	528	121	650
2014	617	108	725	541	136	677
2015	640	109	749	552	143	695
2016	611	109	721	518	145	663
2017	580	109	688	486	143	630

For 2017, all initial and most final emission factors decreased from the previous year. Figure 1 shows the MA-Based EFs prior to accounting for particular generating units (Step 2). The percent changes from the year prior and from the first reporting year are shown in the lower graphs.

[3] MassDEP updated global warming potentials (GWPs) from the Intergovernmental Panel on Climate Change's (IPCC's) Second Assessment Report (SAR) to the IPCC's Fourth Assessment Report (AR4) starting with the 2014 EFs, similar to most other reporting programs.

[4] See the MassDEP GHG Reporting Program Summary Report For Retail Sellers of Electricity Emissions Year 2013 (https://www.mass.gov/files/documents/2016/08/tb/13rsesum.pdf).

Figure 1: MA-Based Non-Biogenic and Biogenic Emission Factors (CO_2e lb/MWh) prior to adjusting for MWh from particular generating units (Step 2), showing the annual and cumulative percent changes in the lower graphs



MWh Sold by Retail Sellers and Reported from Particular Generating Units

For 2017, three electric utilities, two competitive suppliers, and all 40 municipal electric departments (MEDs)[5] or light boards chose to report MWh from particular generating units in Step 1. All MWh reported from particular generating units in the first nine reporting years have been from non-emitting units. The number of optional reporters, the amount of non-emitting MWh reported, and the percent of non-emitting MWh to total retail sales all continued to increase from 2008 to 2017.

Tables 2 and 3 show the number of retail sellers reporting in 2008, and 2010 through 2017. Figure 2 shows their total retail sales.[6] Figure 3 shows the amount of non-emitting MWh from particular generating units that they chose to report and Figure 4 shows the ratio of non-emitting MWh to total retail sales. Figures 5 and 6 show this non-emitting power by fuel type (as MWh and as a percent) and Figures 7 and 8 show the locations of these particular generating units (again as MWh and as a percent).

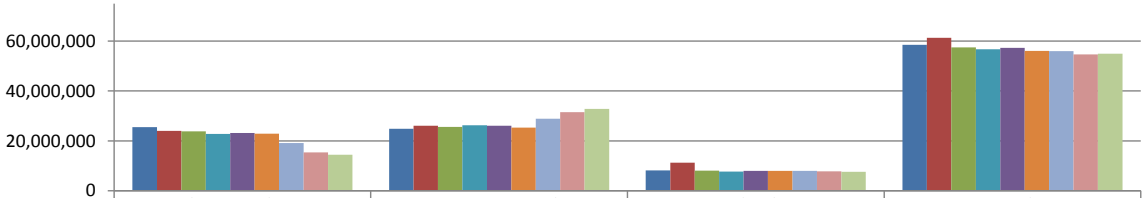
[5] In this document, Municipal Electric Departments and Municipal Light Boards are collectively referred to as municipal electric departments (MEDs).

[6] The total retail sales reported by competitive suppliers for 2017 differs by 1,355,909 MWh from the total reported in the Department of Energy Resources's (DOER) *Massachusetts RPS & APS Annual Compliance Report for 2017* due primarily to the two competitive suppliers that failed to report, as noted in footnote 1 on page 1 of this document and also due to some minor reporting differences.

Table 2. Number of Retail Sellers Reporting GHG Emissions

Mandatory Reporting:	Electric Utilities	Competitive Suppliers	Municipal Electric Departments	Total Retail Sellers
2008	4	22	40	66
2010	4	31	40	75
2011	4	33	40	77
2012	4	43	40	87
2013	4	44 of 47	40	88 of 91
2014	4	47 of 52	40	91 of 96
2015	4	54 of 56[7]	40	98 of 100
2016	4	62	40	106
2017	4	66 of 68	40	110 of 112

Figure 2. Total MWh of Retail Sales of Electricity Reported



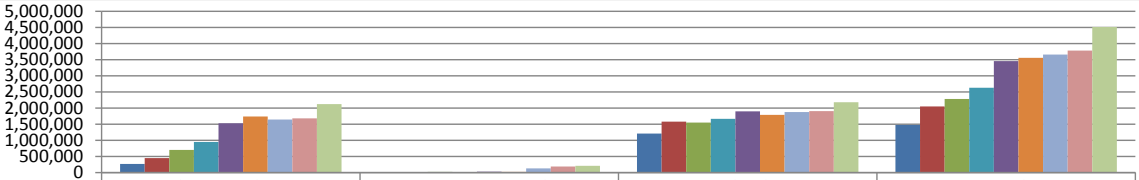
	Electric Utilities	Competitive Suppliers	Municipal Light Depts.	Total
2008	25,514,875	24,806,760	8,154,220	58,475,855
2010	23,997,222	26,028,871	11,297,116	61,323,209
2011	23,775,874	25,610,294	8,086,980	57,473,148
2012	22,736,900	26,255,523	7,708,611	56,701,034
2013	23,167,213	26,085,716	8,018,581	57,271,510
2014	22,828,147	25,301,147	7,946,541	56,077,849
2015	19,140,524	28,869,199	7,947,326	55,957,049
2016	15,336,547	31,527,882	7,811,587	54,676,016
2017	14,485,374	32,824,790	7,614,025	54,924,189

Table 3. Number of Retail Sellers Reporting Optional MWh from particular generating units

Optional Reporting (Step 1): Number of Reporters	Electric Utilities	Competitive Suppliers	Municipal Electric Departments	Total Retail Sellers
2008	2	0	17	19
2010	2	1	24	27
2011	3	1	25	29
2012	3	1	31	35
2013	3	1	33	37
2014	3	1	31	35
2015	3	2	36	41
2016	3	3	37	43
2017	3	2	40	45

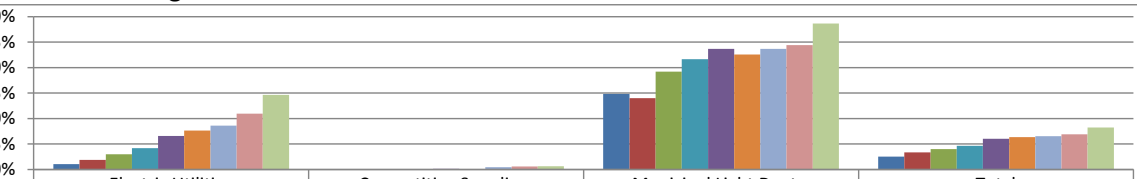
[7] Sixty-eight competitive suppliers sold retail electricity in Massachusetts in 2017. Two of these competitive suppliers that no longer operate in Massachusetts (BBPC/Great Eastern and Utility Expense Reduction) failed to report their 2017 GHG emissions.

Figure 3. Optional MWh reported from particular generating units



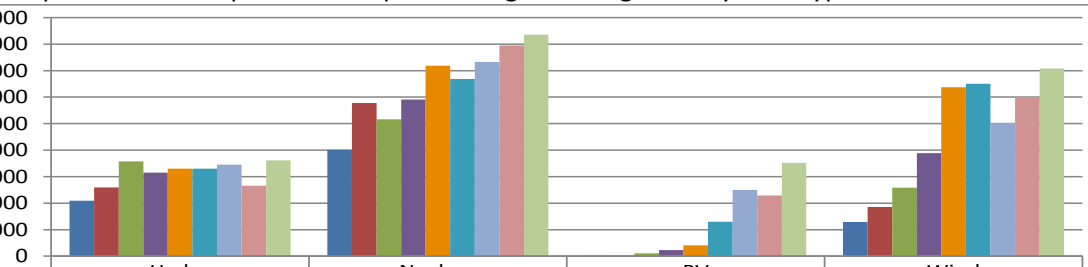
	Electric Utilities	Competitive Suppliers	Municipal Light Depts.	Total
2008	267,806	0	1,209,698	1,477,504
2010	450,034	18,213	1,581,612	2,049,859
2011	707,893	22,876	1,554,539	2,285,308
2012	947,525	18,772	1,667,919	2,634,216
2013	1,527,172	28,085	1,898,690	3,453,947
2014	1,739,524	21,473	1,794,509	3,555,506
2015	1,647,720	131,372	1,880,545	3,659,637
2016	1,682,577	191,605	1,906,916	3,781,098
2017	2,121,872	211,012	2,180,359	4,513,243

Figure 4. Non-emitting MWh as % of Total MWh of Retail Sales



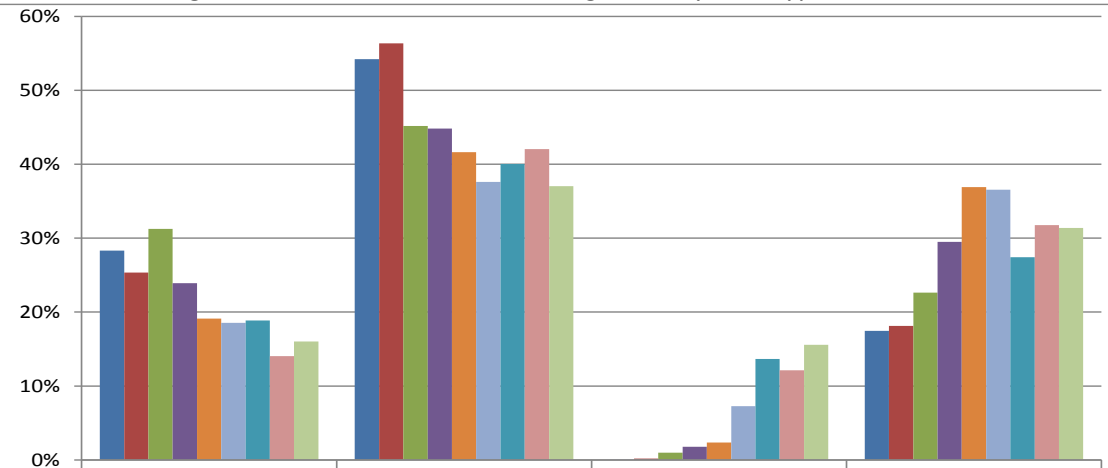
	Electric Utilities	Competitive Suppliers	Municipal Light Depts.	Total
2008	1.0%	0.0%	14.8%	2.5%
2010	1.9%	0.1%	14.0%	3.3%
2011	3.0%	0.1%	19.2%	4.0%
2012	4.2%	0.1%	21.6%	4.6%
2013	6.6%	0.1%	23.7%	6.0%
2014	7.6%	0.1%	22.6%	6.3%
2015	8.6%	0.5%	23.7%	6.5%
2016	11.0%	0.6%	24.4%	6.9%
2017	14.6%	0.6%	28.6%	8.2%

Figure 5. Optional MWh reported from particular generating units by Fuel Type



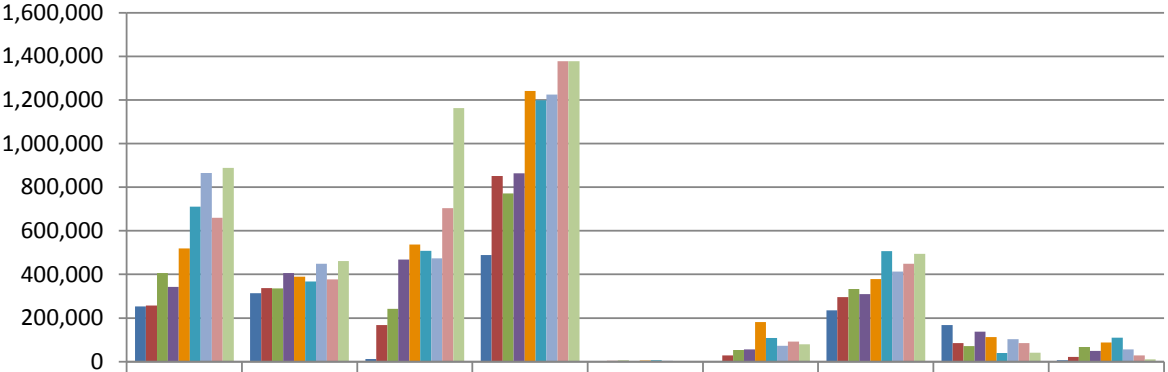
	Hydro	Nuclear	PV	Wind
2008	418238	801,263	94	257,909
2010	519,266	1,155,435	3,590	371,568
2011	714,116	1,032,183	22,117	516,891
2012	629,829	1,180,856	46,664	776,865
2013	659,640	1,437,681	81,518	1,273,843
2014	659,576	1,336,781	258,993	1,300,160
2015	690,356	1,465,285	500,291	1,003,706
2016	531,401	1,589,986	458,418	1,201,293
2017	722,577	1,670,892	702,966	1,416,807

Figure 6. Non-Emitting MWh as % of Total Non-Emitting MWh by Fuel Type



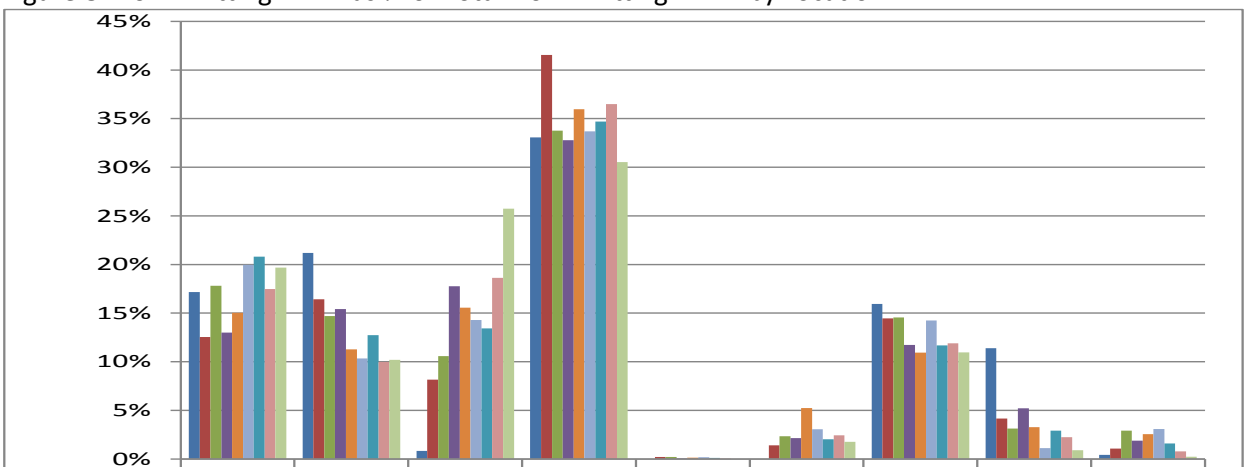
	HYDRO	NUCLEAR	PV	WIND
2008	28.3%	54.2%	0.01%	17.5%
2010	25.3%	56.4%	0.2%	18.1%
2011	31.2%	45.2%	1.0%	22.6%
2012	23.9%	44.8%	1.8%	29.5%
2013	19.1%	41.6%	2.4%	36.9%
2014	18.6%	37.6%	7.3%	36.6%
2015	18.9%	40.0%	13.7%	27.4%
2016	14.1%	42.1%	12.1%	31.8%
2017	16.0%	37.0%	15.6%	31.4%

Figure 7. Optional MWh reported from particular generating units by Location



	MA	CT	ME	NH	RI	VT	NY	Q	PEI
2008	253,532	313,238	12,192	488,558	0	0	235,427	168,185	6,372
2010	257,262	336,674	167,106	851,812	4,222	28,837	296,417	85,537	21,992
2011	406,842	336,041	241,564	771,460	4,745	53,448	332,825	71,594	66,788
2012	342,423	405,995	467,702	863,859	1,448	56,681	309,087	137,150	49,869
2013	519,216	389,070	537,274	1,241,587	4,645	181,267	378,063	113,174	88,386
2014	710,136	367,938	508,091	1,198,089	6,260	108,832	506,797	40,048	109,319
2015	864,667	449,148	473,996	1,224,297	3,811	71,973	412,566	103,028	56,152
2016	660,230	377,212	703,630	1,378,214	1,189	91,938	449,120	84,871	29,173
2017	888,030	460,677	1,162,251	1,377,857	0	79,281	494,251	40,895	10,000

Figure 8. Non-Emitting MWh as % of Total Non-Emitting MWh by Location



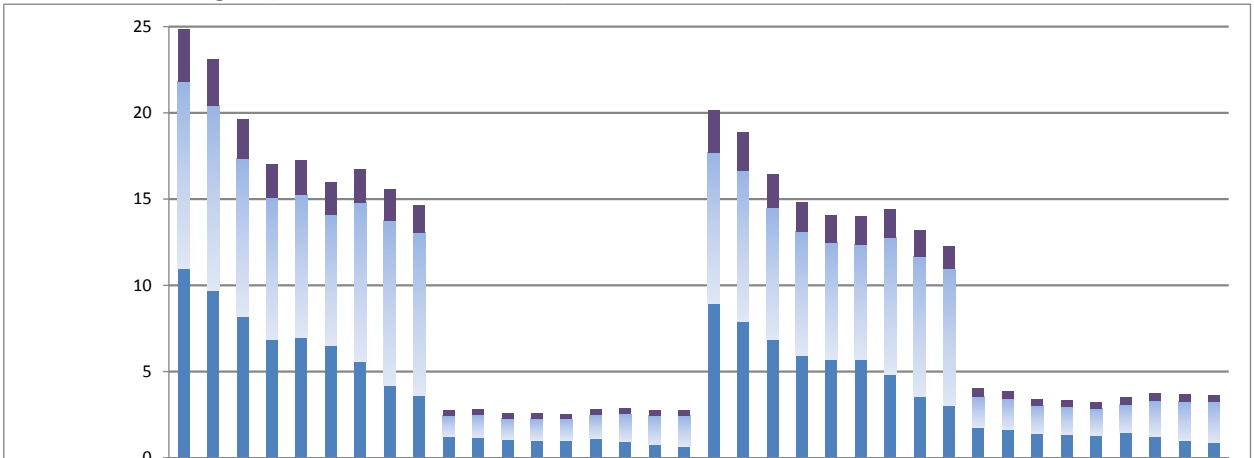
	MA	CT	ME	NH	RI	VT	NY	Q	PEI
2008	17.2%	21.2%	0.8%	33.1%	0.00%	0.00%	15.9%	11.4%	0.4%
2010	12.6%	16.4%	8.2%	41.6%	0.21%	1.41%	14.5%	4.2%	1.1%
2011	17.8%	14.7%	10.6%	33.8%	0.21%	2.34%	14.6%	3.1%	2.9%
2012	13.0%	15.4%	17.8%	32.8%	0.1%	2.2%	11.7%	5.2%	1.9%
2013	15.0%	11.3%	15.6%	36.0%	0.1%	5.3%	10.9%	3.3%	2.6%
2014	20.0%	10.3%	14.3%	33.7%	0.2%	3.1%	14.3%	1.1%	3.1%
2015	20.8%	12.7%	13.4%	34.7%	0.1%	2.0%	11.7%	2.9%	1.6%
2016	17.5%	10.0%	18.6%	36.5%	0.0%	2.4%	11.9%	2.2%	0.8%
2017	19.7%	10.2%	25.8%	30.5%	0.0%	1.8%	11.0%	0.9%	0.2%

GHG Emissions Reported by Retail Sellers

For 2017, MA-based and Regional-based non-biogenic GHG emissions decreased to their lowest level due to the decrease in the EFs, as seen in Figure 1. Biogenic emissions continue to fluctuate somewhat from year to year. The differences in GHG emissions between each reporting year within each retail seller type are caused by the changes in total MWh sales and percent of MWh reported from particular generating units in Step 1 by each type of retail seller. There has been a shift in load served, resulting in decreasing electric utility load and increasing competitive supplier load (see Figure 2). Thus there has been a corresponding decrease in electric utility emissions and an increase in competitive supplier emissions (see Figure 9).

Figure 9 shows the total GHG emissions reported by the three types of retail sellers. GHG emissions were calculated by each retail seller using the reporting process shown on page 1 of this summary. The GHG emissions reported by each retail seller can be found in Appendix 1.

Figure 9. GHG Emissions Reported by Retail Seller Type and Year using the MA-Based and Regional-Based methodologies (Million Short Tons CO_2e)



	MA nonbiogenic									MA biogenic									REGION nonbiogenic									REGION biogenic								
	8	10	11	12	13	14	15	16	17	8	10	11	12	13	14	15	16	17	8	10	11	12	13	14	15	16	17	8	10	11	12	13	14	15	16	17
Municipalities	3.0	2.7	2.3	2.0	2.0	1.9	1.9	1.8	1.6	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.5	2.2	1.9	1.7	1.6	1.7	1.7	1.5	1.3	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Competitive Suppliers	10.	10.	9.1	8.2	8.3	7.6	9.2	9.6	9.5	1.2	1.3	1.2	1.2	1.2	1.3	1.6	1.7	1.8	8.8	8.7	7.6	7.2	6.8	6.7	7.9	8.1	7.9	1.7	1.8	1.6	1.6	1.5	1.7	2.1	2.3	2.3
Electric Utilities	11.	9.7	8.2	6.8	7.0	6.5	5.6	4.2	3.6	1.2	1.2	1.1	1.0	1.0	1.1	1.0	0.7	0.7	8.9	7.9	6.9	5.9	5.7	5.7	4.8	3.5	3.0	1.8	1.6	1.4	1.3	1.3	1.4	1.3	1.0	0.9

Individual Retail Seller Reporting for 2017

For each retail seller that chose to submit MWh from particular generating units in 2017, "individual" GHG emission factors were determined. These factors represent individual GHG emission rates for each retail seller based on their reported GHG emissions and MWh of electricity sales. The greater the percentage of total MWh electricity sales reported as non-emitting MWh, the lower a retail seller's individual emission factors.[8]

Figures 10A and 10B show the non-emitting MWh reported, and the ratio of those MWh to the retail seller's 2017 electricity MWh sales, for each retail seller that chose to report use of particular generating units. To illustrate trends, the figures present the retail sellers in order of increasing percentage of reported non-emitting power. Figure 10A compares optional MWh reported as a percentage of total retail sales. Figure 10B shows the variation in total MWh sales. Figures 11A and 11B show similar information specifically for MEDs. See Appendix 2 for individual retail seller values used in these figures.

[8] In 2011, one MED reported a greater amount of MWh from particular generating units than its retail sales, resulting in apparently negative total retail sales, negative GHG emissions, and a negative GHG emission rate. The regulation at 310 CMR 7.71(9)(d)5. does not allow a retail seller to claim more generation from particular generating units than it sold to its retail customers. To prevent this situation from occurring again, MassDEP now requires MEDs to submit page 57 of their *Annual Return*, showing their total retail sales, with their optional "Step 1" report on MWh from particular generating units.

Figure 10A. 2017 Electricity Sales Reported as Non-Emitting by Retail Seller (MWh and % of sales)
(retail sellers not shown chose not to report MWh from particular generating units)

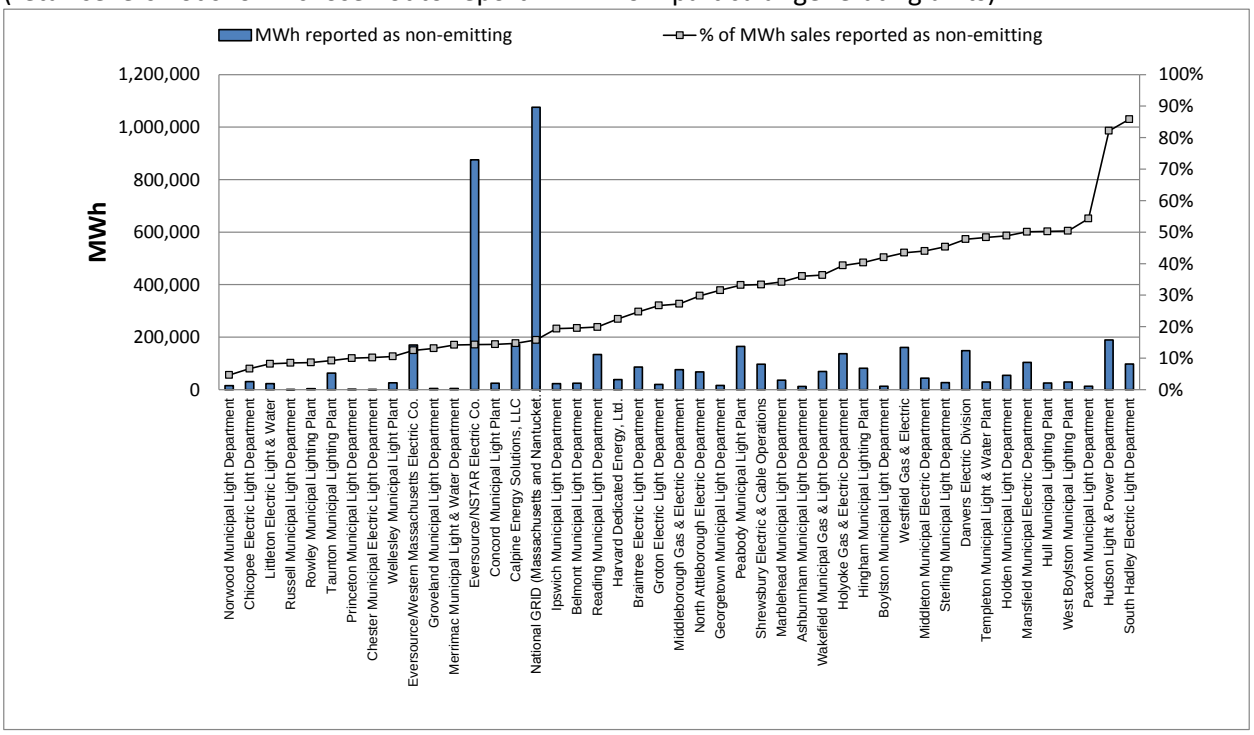


Figure 10B. 2017 Electricity Sales by Retail Seller: Non-Emitting vs. All Other MWh Sales Reported
(retail sellers not shown chose not to report MWh from particular generating units)

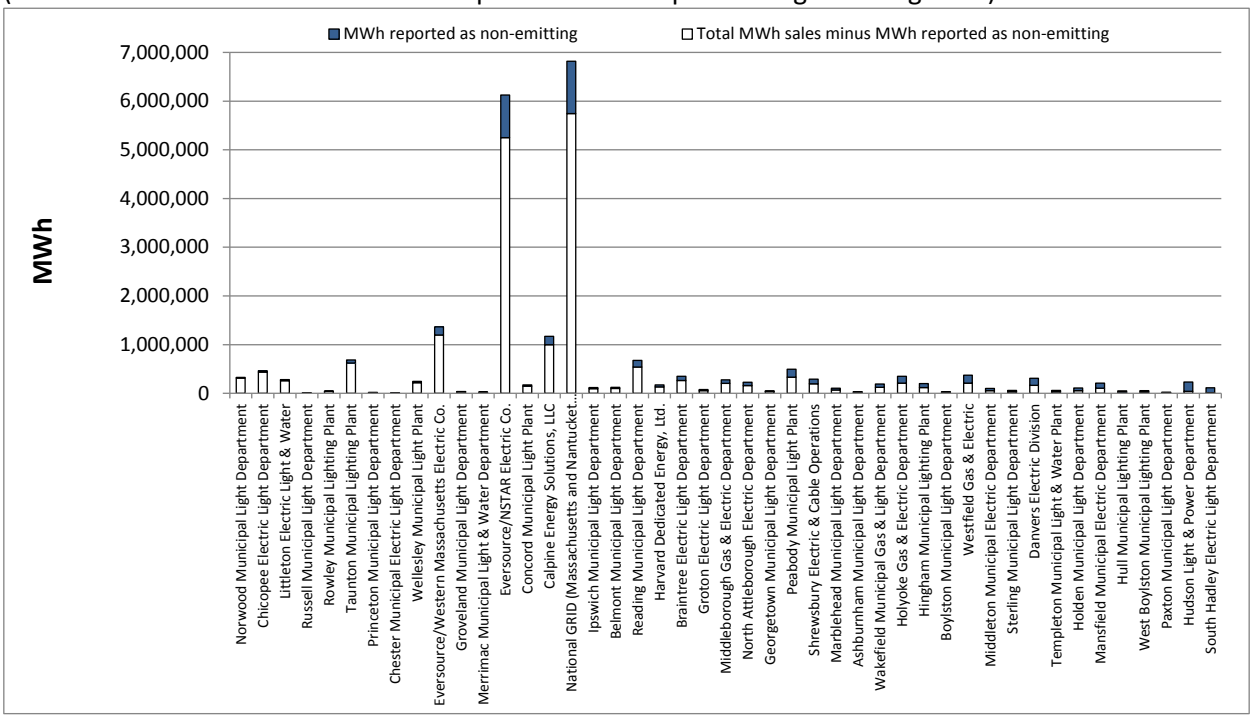


Figure 11A. 2017 Electricity Sales Reported as Non-Emitting by MEDs (MWh and % of sales)

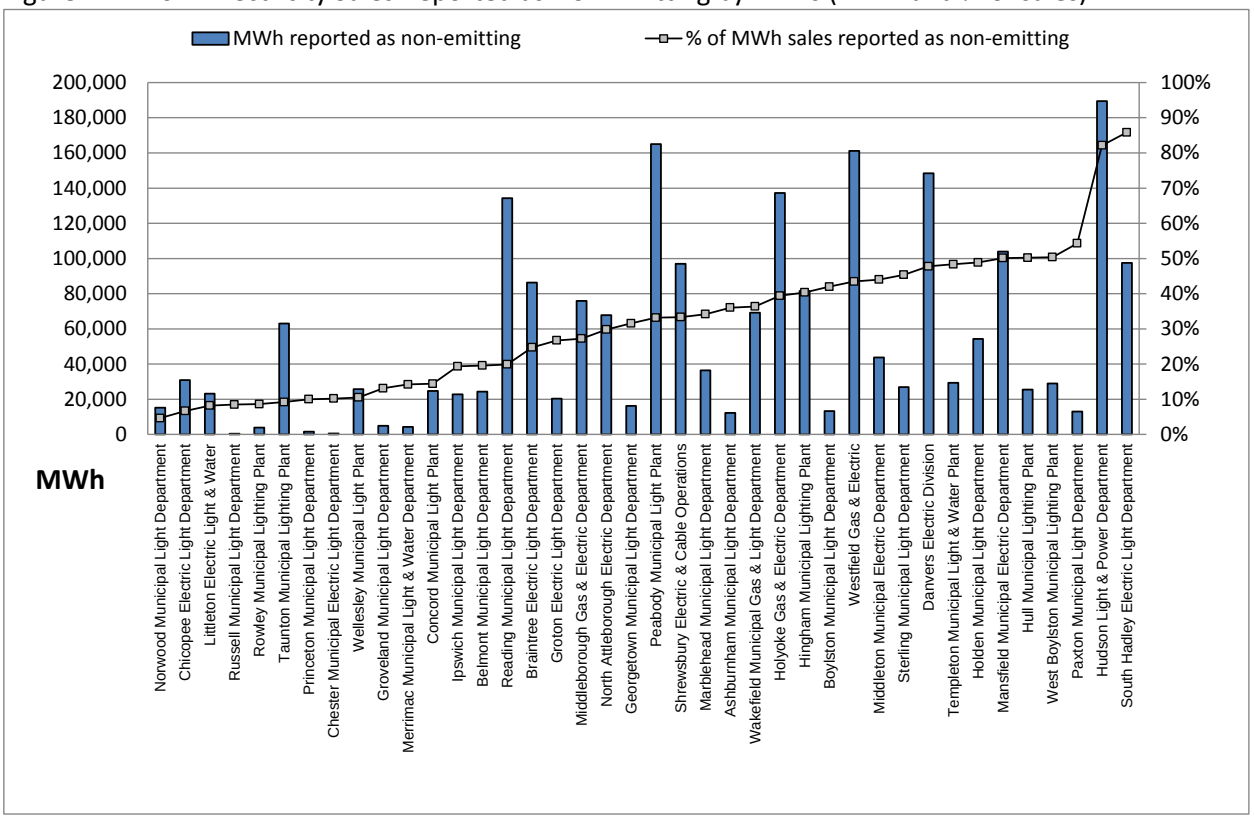
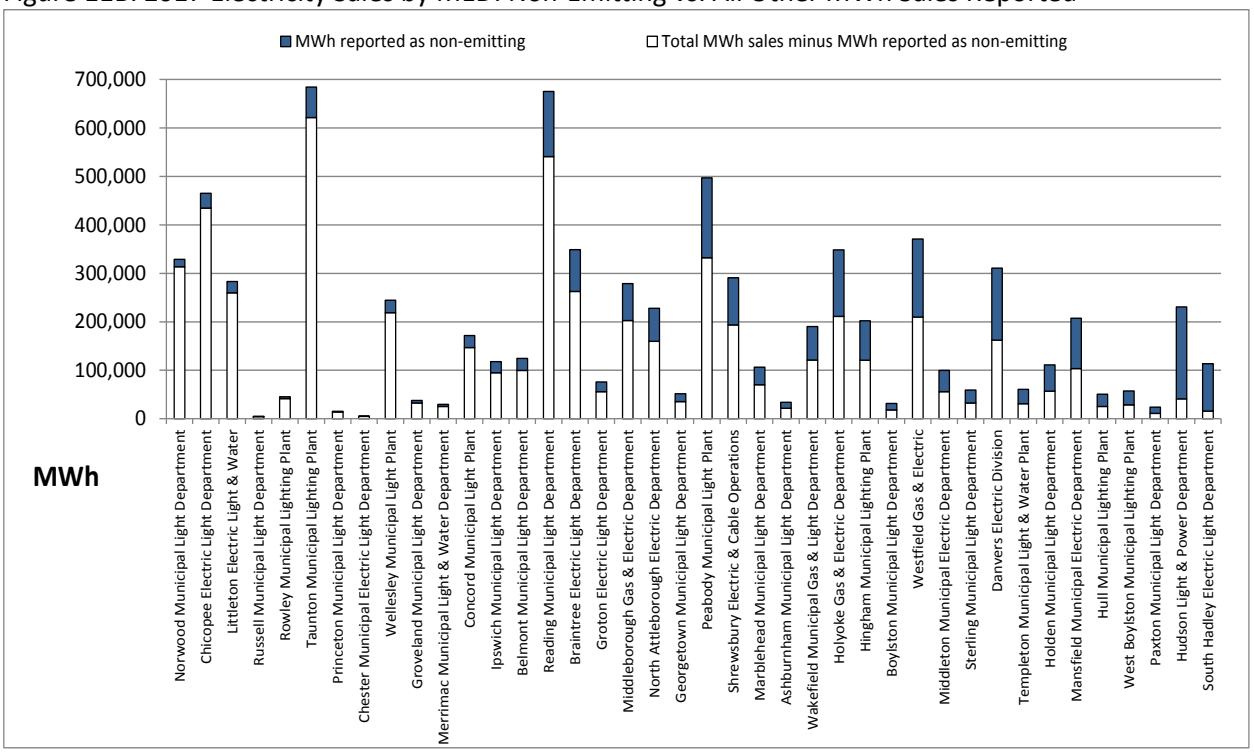


Figure 11B. 2017 Electricity Sales by MED: Non-Emitting vs. All Other MWh Sales Reported



Appendix 1: 2017 Individual Retail Seller GHG Emissions

Below are 2017 GHG emissions for each retail seller calculated by MassDEP based on:

- the final GHG emission factors from Step 3 above, and
- MWh reported to Department of Energy Resources (DOER) by electric utilities and competitive suppliers and to the Department of Public Utilities (DPU) by MEDs, less MWh from any particular generating units that a retail seller reported in Step 1. See footnotes 6 and 7 regarding the retail sales and emissions of competitive suppliers.

Table 4. 2017 MA Retail Seller GHG Emissions (Short Tons CO_2e)

	Massachusetts-based approach			Regional-based approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
Electric Utilities						
Unitil (Fitchburg Gas & Electric Co.)	49,986	9,394	59,379	41,884	12,324	54,208
NGRID (Mass. and Nantucket Elec.)	1,665,890	313,072	1,978,963	1,395,901	410,728	1,806,629
Eversource/NSTAR Electric Co.	1,522,264	286,081	1,808,345	1,275,552	375,317	1,650,869
Eversource/Western MA Electric Co.	347,276	65,264	412,539	290,993	85,621	376,614
Competitive Suppliers						
Abest Power & Gas, LLC	678	127	805	568	167	735
Agera Energy LLC	313,821	58,977	372,797	262,960	77,373	340,333
Ambit Northeast, LLC	56,870	10,688	67,558	47,653	14,021	61,675
Atlantic Energy LLC	11,799	2,217	14,016	9,886	2,909	12,795
Blue Rock Energy LLC	2,083	392	2,475	1,746	514	2,259
Calpine Energy Solutions LLC	289,621	54,429	344,050	242,682	71,407	314,089
Champion Energy Services	130,276	24,483	154,758	109,162	32,120	141,282
Clean Choice	16,053	3,017	19,070	13,451	3,958	17,409
Clearview Electric, Inc.	27,127	5,098	32,226	22,731	6,688	29,419
Connecticut Municipal Electric Energy Cooperative	25,742	4,838	30,580	21,570	6,347	27,917
Consolidated Edison Solutions, Inc.	562,917	105,790	668,707	471,686	138,788	610,474
Constellation Energy Power Choice	635	119	755	532	157	689
Constellation Energy Services, Inc.	110,300	20,729	92,424	27,195	131,029	119,619

	Massachusetts-based approach			Regional-based approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
Constellation NewEnergy, Inc.	2,036,759	382,770	2,419,529	1,706,663	502,166	2,208,830
Devonshire Energy, LLC	21,902	4,116	26,018	18,353	5,400	23,753
Direct Energy Business LLC	1,287,378	241,938	1,529,316	1,078,734	317,405	1,396,139
Direct Energy Services, LLC	34,199	6,427	40,626	28,656	8,432	37,088
Direct Energy Business Marketing, LLC	0	0	0	0	0	0
Discount Power, Inc.	13,773	2,588	16,362	11,541	3,396	14,937
Dynegy Energy Services (East), LLC	70,531	13,255	83,786	59,100	17,389	76,489
East Avenue Energy, LLC	233	44	276	195	57	252
EDF Energy Services, LLC	56,872	10,688	67,560	47,655	14,022	61,677
Eligio Energy MA LLC	18,263	3,432	21,696	15,303	4,503	19,806
Energy Plus Holdings	9,791	1,840	11,631	8,204	2,414	10,618
ENGIE Resources, LLC	611,073	114,840	725,912	512,037	150,661	662,698
ENGIE Retail, LLC (dba Think Energy)	54,271	10,199	64,470	45,475	13,381	58,856
Everyday Energy LLC	3	1	4	3	1	4
First Point Power	181,802	34,166	215,968	152,337	44,823	197,161
Green Mountain Energy Company	4,976	935	5,911	4,169	1,227	5,396
Hampshire Council of Governments	123,229	23,159	146,388	103,258	30,382	133,640
Harborside Energy of Massachusetts LLC	3,381	635	4,017	2,833	834	3,667
Harvard Dedicated Energy, Ltd.	38,828	7,297	46,124	32,535	9,573	42,108
Hudson Energy Services	106,162	19,951	126,114	88,957	26,175	115,131
Interstate Gas Supply, Inc. (dba IGS Energy)	2,844	534	3,379	2,383	701	3,084
Inspire Energy Holdings, LLC	20,622	3,875	24,497	17,280	5,084	22,364
Just Energy Mass. Corp.	53,105	9,980	63,085	44,498	13,093	57,591
Liberty Power Holdings	108,316	20,356	128,672	90,761	26,706	117,467

	Massachusetts-based approach			Regional-based approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
Major Energy Electric Service, LLCs	324	61	384	271	80	351
Massachusetts Gas & Electric Co.	49,169	9,240	58,409	41,200	12,123	53,323
Mega Energy Holdings, LLC	64,030	12,033	76,064	53,653	15,787	69,440
Messer Energy Services	14,626	2,749	17,374	12,255	3,606	15,861
Mint Energy, LLC	148,079	27,829	175,908	124,080	36,509	160,589
NextEra Energy	564,770	106,138	670,908	473,238	139,245	612,483
National Gas & Electric, Inc.	21	4	25	18	5	23
Nordic Energy Services	705	132	837	590	174	764
Oasis Power, LLC	22,457	4,220	26,677	18,817	5,537	24,354
Palmco Power MA, LLC	20,272	3,810	24,081	16,986	4,998	21,984
Perigee Energy, LLC	1,618	304	1,922	1,356	399	1,755
Provider Power MASS, LLC	36,061	6,777	42,838	30,217	8,891	39,107
Public Power, LLC	76,180	14,317	90,497	63,834	18,782	82,616
Reliant Energy Northeast	141,733	26,636	168,369	118,762	34,944	153,707
Residents Energy, LLC	175	33	207	146	43	189
SFE Energy Massachusetts	88,882	16,704	105,586	74,477	21,914	96,391
SmartEnergy Holdings, LLC	14,902	2,800	17,702	12,487	3,674	16,161
South Jersey Energy	36,733	6,903	43,636	30,780	9,057	39,836
Spark Energy, LLC	32,701	6,146	38,847	27,401	8,062	35,464
Starion Energy, Inc.	81,946	15,400	97,346	68,665	20,204	88,869
Summer Energy	9,781	1,838	11,619	8,195	2,411	10,607
Sunwave Gas & Power Massachusetts, Inc.	14,993	2,818	17,811	12,563	3,697	16,260
Texas Retail Energy	29,066	5,462	34,529	24,355	7,166	31,522
Town Square Energy, LLC	19,827	3,726	23,553	16,614	4,888	21,502

	Massachusetts-based approach			Regional-based approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
TransCanada Power Marketing Ltd.	545,828	102,578	648,407	457,367	134,575	591,942
Union Atlantic Electricity LLC	6,706	1,260	7,967	5,619	1,653	7,273
Verde Energy USA Massachusetts, LLC	68,948	12,957	81,905	57,773	16,999	74,773
Viridian	159,489	29,973	189,462	133,641	39,322	172,963
Xoom Energy Massachusetts LLC	26,914	5,058	31,972	22,552	6,636	29,187
Great Eastern Energy (aka BBPC, LLC) and Utility Expense Reduction	387,414	72,807	460,221	324,626	95,517	420,143
Municipal Electric Departments						
Ashburnham Muni. Light Dept.	6,322	1,188	7,510	5,297	1,559	6,856
Belmont Municipal Light Dept.	28,990	5,448	34,439	24,292	7,148	31,440
Boylston Municipal Light Dept.	5,322	1,000	6,322	4,460	1,312	5,772
Braintree Electric Light Dept.	76,207	14,322	90,529	63,856	18,789	82,645
Chester Muni. Electric Light Dept.	1,461	275	1,735	1,224	360	1,584
Chicopee Electric Light Dept.	125,998	23,679	149,677	105,577	31,065	136,642
Concord Municipal Light Plant	42,640	8,013	50,654	35,730	10,513	46,243
Danvers Electric Division	47,060	8,844	55,904	39,433	11,603	51,036
Georgetown Municipal Light Dept.	10,214	1,920	12,134	8,559	2,518	11,077
Groton Electric Light Dept.	16,141	3,033	19,175	13,525	3,980	17,505
Groveland Municipal Light Dept.	9,479	1,781	11,261	7,943	2,337	10,280
Hingham Municipal Lighting Plant	34,945	6,567	41,512	29,281	8,616	37,897
Holden Municipal Light Dept.	16,474	3,096	19,570	13,804	4,062	17,866
Holyoke Gas & Electric Dept.	61,206	11,503	72,709	51,287	15,091	66,377
Hudson Light & Power Dept.	11,942	2,244	14,186	10,006	2,944	12,951
Hull Municipal Lighting Plant	7,335	1,378	8,713	6,146	1,808	7,955
Ipswich Municipal Light Dept.	27,554	5,178	32,733	23,089	6,794	29,882

	Massachusetts-based approach			Regional-based approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
Littleton Electric Light & Water	75,370	14,164	89,534	63,155	18,583	81,737
Mansfield Municipal Electric Dept.	30,016	5,641	35,656	25,151	7,400	32,551
Marblehead Municipal Light Dept.	20,330	3,821	24,151	17,036	5,013	22,048
Merrimac Muni. Light & Water	7,410	1,393	8,803	6,209	1,827	8,036
Middleborough Gas & Elec. Dept.	58,831	11,056	69,887	49,296	14,505	63,801
Middleton Muni. Electric Dept.	16,153	3,036	19,188	13,535	3,982	17,517
North Attleboro Electric Dept.	46,381	8,716	55,097	38,864	11,435	50,299
Norwood Municipal Light Dept.	90,927	17,088	108,015	76,191	22,418	98,609
Paxton Municipal Light Dept.	3,190	599	3,789	2,673	786	3,459
Peabody Municipal Light Plant	96,350	18,107	114,458	80,735	23,755	104,490
Princeton Municipal Light Dept.	4,024	756	4,781	3,372	992	4,364
Reading Municipal Light Dept.	156,903	29,487	186,390	131,474	38,685	170,158
Rowley Municipal Lighting Plant	12,027	2,260	14,287	10,078	2,965	13,043
Russell Municipal Light Dept.	1,311	246	1,557	1,099	323	1,422
Shrewsbury Electric & Cable Ops.	56,205	10,563	66,768	47,096	13,857	60,954
South Hadley Electric Light Dept.	4,663	876	5,540	3,908	1,150	5,057
Sterling Municipal Light Dept.	9,381	1,763	11,144	7,860	2,313	10,173
Taunton Municipal Lighting Plant	182,444	34,287	216,731	152,875	44,982	197,857
Templeton Muni. Light & Water	9,082	1,707	10,788	7,610	2,239	9,849
Wakefield Muni. Gas & Light	35,142	6,604	41,746	29,446	8,664	38,110
Wellesley Municipal Light Plant	63,509	11,935	75,444	53,216	15,658	68,874
West Boylston Muni. Light. Plant	8,276	1,555	9,831	6,934	2,040	8,975
Westfield Gas & Electric	60,785	11,423	72,208	50,934	14,987	65,920
2017 distribution company total	3,585,416	673,811	4,259,226	3,004,331	883,990	3,888,321

	Massachusetts-based approach			Regional-based approach		
	Non-Biogenic	**Biogenic**	**Combined**	**Non-Biogenic**	**Biogenic**	**Combined**
2017 competitive supplier total	9,070,582	1,704,644	10,775,226	7,600,522	2,236,368	9,836,890
2017 MED total	1,578,000	296,555	1,874,555	1,322,255	389,059	1,711,314
2017 RETAIL SELLER TOTAL GHGs	**14,621,411**	**2,747,817**	**17,369,228**	**12,251,734**	**3,604,934**	**15,856,669**

Appendix 2: Individual 2017 Retail Seller Emission Factors

Below are the 2017 GHG emission factors for each retail seller that chose to report use of non-emitting MWh from particular generating units. These factors represent individual GHG emission rates for each retail seller based on their reported GHG emissions and MWh of electricity sales, and are based on the final EFs in Table 1.

Table 5. Individual 2017 Retail Seller Emission Factors

	MWh reported as non-emitting	Massachusetts-based emission factors (lb CO_2e/MWh)		Regional-based emission factors (lb CO_2e/MWh)		% of sales reported as non-emitting MWh
		Non-Biogenic	Biogenic	Non-Biogenic	Biogenic	
Electric Utilities						
NGRID (Mass. and Nantucket Elec.)	1,075,926	489	92	409	120	15.8%
Eversource/NSTAR	875,697	497	93	417	123	14.3%
Eversource/WMECO	170,249	508	95	426	125	12.4%
Competitive Suppliers						
Calpine/Noble Americas Energy Solutions	172,302	495	93	414	122	14.7%
Harvard Dedicated Energy	38,710	450	85	377	111	22.4%
Municipal Electric Departments						
Ashburnham Muni. Light Dept.	12,275	371	70	311	91	36.0%
Belmont Municipal Light Department	24,314	467	88	391	115	19.6%
Boylston Municipal Light Dept.	13,276	337	63	282	83	42.0%
Braintree Electric Light Dept.	86,293	437	82	366	108	24.7%
Chester Municipal Electric Light Dept.	571	521	98	437	128	10.2%
Chicopee Electric Light Dept.	30,896	541	102	454	134	6.6%
Concord Municipal Light Plant	24,715	497	93	416	122	14.4%
Danvers Electric Division	148,366	303	57	254	75	47.8%
Georgetown Municipal Light Department	16,240	397	75	333	98	31.6%
Groton Electric Light Dept.	20,291	425	80	356	105	26.7%
Groveland Municipal Light Dept.	4,928	504	95	422	124	13.1%

	MWh reported as non-emitting	Massachusetts-based emission factors (lb CO_2e/MWh)		Regional-based emission factors (lb CO_2e/MWh)		% of sales reported as non-emitting MWh
		Non-Biogenic	Biogenic	Non-Biogenic	Biogenic	
Hingham Municipal Lighting Plant	81,499	346	65	290	85	40.3%
Holden Municipal Light Dept.	54,256	297	56	249	73	48.9%
Holyoke Gas & Electric Dept.	137,283	351	66	294	87	39.4%
Hudson Light & Power Dept.	189,504	104	19	87	26	82.1%
Hull Municipal Lighting Plant	25,510	289	54	242	71	50.2%
Ipswich Municipal Light Department	22,797	468	88	392	115	19.4%
Littleton Electric Light & Water	23,210	532	100	446	131	8.2%
Mansfield Municipal Electric Dept.	103,944	289	54	242	71	50.1%
Marblehead Municipal Light Dept.	36,412	382	72	320	94	34.2%
Merrimac Municipal Light & Water Dept.	4,228	498	94	417	123	14.2%
Middleborough Gas & Electric Dept.	75,846	422	79	354	104	27.2%
Middleton Municipal Electric Dept.	43,783	325	61	272	80	44.0%
North Attleboro Electric Dept.	67,852	407	77	341	100	29.8%
Norwood Municipal Light Dept.	15,207	553	104	464	136	4.6%
Paxton Municipal Light Dept.	13,068	265	50	222	65	54.3%
Peabody Municipal Light Plant	164,967	388	73	325	96	33.2%
Princeton Municipal Light Dept.	1,542	522	98	437	129	10.0%
Reading Municipal Light Dept.	134,278	465	87	389	115	19.9%
Rowley Municipal Lighting Plant	3,908	530	100	444	131	8.6%
Russell Municipal Light Department	419	531	100	445	131	8.5%
Shrewsbury Electric & Cable Ops.	96,935	387	73	324	95	33.3%
South Hadley Electric Light Dept.	97,461	82	15	69	20	85.8%
Sterling Municipal Light Dept.	26,855	317	60	266	78	45.4%

	MWh reported as non-emitting	Massachusetts-based emission factors (lb CO_2e/MWh)		Regional-based emission factors (lb CO_2e/MWh)		% of sales reported as non-emitting MWh
		Non-Biogenic	Biogenic	Non-Biogenic	Biogenic	
Taunton Municipal Lighting Plant	62,994	527	99	441	130	9.2%
Templeton Municipal Light & Water	29,300	300	56	251	74	48.3%
Wakefield Municipal Gas & Light Dept.	69,245	369	69	309	91	36.4%
Wellesley Municipal Light Plant	25,746	519	98	435	128	10.5%
West Boylston Municipal Lighting Plant	28,980	288	54	241	71	50.4%
Westfield Gas & Electric	161,165	328	62	275	81	43.5%
All Other Retail Sellers	**0**	**580**	**109**	**486**	**143**	**0%**

Appendix 3: 2017 Retail Level Emission Factors For Use by Consumers of Electricity to Report Greenhouse Gas Emissions (MA-Based EFs)

Some electricity consumers have expressed interest in using MA-specific greenhouse gas (GHG) emission factors (EFs) to report their GHG emissions from use of electricity. The EFs shown earlier in this document are often not appropriate for use by electricity consumers for two reasons: first, the EFs earlier in this document are for the combination of CO_2, CH_4 and N_2O when many electricity consumers seek EFs for the individual gases and, second, the EFs earlier in this document are per wholesale MWh, rather than per retail meter MWh (or kWh) that electricity consumers see on their electric bill. In order to assist electricity consumers in reporting GHGs, this appendix presents the 2017 EFs that consumers of electricity would use to report their GHG emissions at a retail electricity level.

Combined, Biogenic and Non-Biogenic EFs: Progress on achieving the *Massachusetts Clean Energy and Climate Plan for 2020* limit of a 25% reduction in GHG emissions from 1990 by 2020 is determined using MA-based emission calculations. Thus, it is MA-Based EFs that consumers of electricity should use to determine GHG emissions. The MA-based EFs include all CO_2, CH_4 and N_2O emissions from non-biogenic (fossil) and biogenic (non-fossil) fuels combusted to generate the electricity sold by retail sellers of electricity in Massachusetts. The Combined EF can be determined by adding the Non-Biogenic and Biogenic EFs together.

2017 RS Wholesale Non-Biogenic MA-Based EF	535 lb	Non-Biogenic CO_2e/Wholesale MWh
+ 2017 RS Wholesale Biogenic MA-Based EF	+100 lb	Biogenic CO_2e/Wholesale MWh
2017 RS Wholesale Combined MA-Based EF	636 lb	Combined CO_2e/Wholesale MWh

Wholesale v. Retail EFs (line losses): Power lines lose 5.7%[9] (on average) of the electricity they carry. The amount of wholesale MWh needed to deliver a particular amount of electricity at the retail level is, therefore, 5.7% greater than the amount shown on a retail meter. The emissions released to produce the electricity can be spread out over either the larger number of wholesale MWh or the smaller number of retail MWh, such that the retail lb/MWh EF will always be higher than the wholesale lb/MWh EF:

Wholesale Combined EF / (100% of MWh – 5.7% of MWh due to line losses) = Retail Combined EF

Specifically: 636 lb CO_2e/Wholesale MWh / (1 - 0.057) = 674 lb CO_2e/Retail MWh

Table 6. 2017 MA-Based CO_2e GHG Emission Factors

	Retail Seller Wholesale Level (lb CO_2e/Wholesale MWh)	Electricity Consumer Retail Level (lb CO_2e/Retail MWh)
Non-Biogenic	535	567
Biogenic	100	106
Combined	636	674

Individual CO_2, CH_4, and N_2O EFs: If a consumer wants to use EFs by individual gas, then the lb CO_2e/MWh value needs to be separated into the individual components: lb CO_2/MWh, lb CH_4/MWh, and lb N_2O/MWh. MassDEP has separated the three gases by alternately zeroing out the other two gases on the 'Calculating CO2e' tab of the retail seller EF spreadsheet at https://www.mass.gov/lists/massachusetts-greenhouse-gas-ghg-reporting-program-data#massdep-

[9] This value was updated from the previously used value of 7% to reflect new data and to align with the line loss value used in the updated Massachusetts Clean Energy and Climate Plan for 2020, dated December 2015.

emission-factor-calculations-. For the 2017 retail level Combined EF, this results in 670 lb of CO_2e from CO_2, 1 lb of CO_2e from CH_4, and 3 lb of CO_2e from N_2O. The global warming potential (GWP) of each gas must then be taken into account to determine the EF for each gas. The GWPs used through 2017 by MassDEP are: 1 for CO_2, 25 for CH_4, and 298 for N_2O.[10]

lb CO_2e/MWh = ((lb CO_2 *1) + (lb CH_4 * 25) + (lb N_2O * 298)) / MWh

Specifically: 1.4 lb CO_2e from CH_4 / 25 = 0.058 lb CH_4 *and* 2.5 lb CO_2e from N_2O / 298 = 0.008 lb N_2O, *therefore*

674 lb CO_2e/Retail MWh = (670 lb CO_2 + (0.058 lb CH_4 * 25) + (0.008 lb N_2O * 298)) / Retail MWh

The breakdown of the 674 lb CO_2e/Retail MWh value from Table 6 into individual gases, at various scales of electricity, is shown in Table 7.

Table 7. 2017 Electricity Consumers Retail-level MA-Based CO_2e GHG Emission Factors by Individual Gas

	CO_2e		
	CO_2	**CH_4**	**N_2O**
lb/Retail kWh	0.670	0.000058	0.000008
lb/Retail MWh	670	0.058	0.008
lb/Retail GWh	670,000	58	8

The lb/Retail kWh values in the upper row of Table 7 may be the values most likely to be used by electricity consumers since most electric bills show kWh use. The CO_2, CH_4, and N_2O EFs in lb/Retail GWh shown in the bottom row in Table 7 are used by MassDEP when voluntarily reporting emissions from its operations to The Climate Registry.

The breakdown of the 670 lb CO_2/Retail MWh value from Table 7 into its non-biogenic and biogenic components is shown in Table 8. All CH_4 and N_2O emissions are considered non-biogenic and thus cannot be further broken down.

Table 8. 2017 Electricity Consumers Retail-level MA-Based Non-Biogenic and Biogenic CO_2 Emission Factors

	CO_2	
	Non-Biogenic CO_2	**Biogenic CO_2**
lb/Retail kWh	0.564	0.107
lb/Retail MWh	564	107
lb/Retail GWh	564,000	107,000

[10] Beginning with the 2014 EFs, MassDEP updated the global warming potentials (GWPs) it uses based on the Intergovernmental Panel on Climate Change's (IPCC's) Fourth Assessment Report (AR4), published in 2007, similar to most other reporting programs. The global GWPs used with earlier EFs were from IPCC's Second Assessment Report (SAR) published in 1996.