MassDEP GHG Reporting Program Summary Report
For Retail Sellers of Electricity
Emissions Year 2015

February 2018

The information below summarizes the 2015 greenhouse gas (GHG) emissions and megawatt hours (MWh) of electricity sales reported to the Massachusetts Department of Environmental Protection (MassDEP) by 98 of the 100[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 will use the information presented here in considering future measures to reduce emissions from the electric sector. This was the seventh year of reporting under the regulation. 2008 was the initial reporting year. Annual reporting began with the 2010 reporting year. Comparisons of the first seven 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 plant smokestacks 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 2015, 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 2014 and 2015 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/files/documents/2017/05/zw/rsef1415tsd.pdf).

[1] Fifty-six competitive suppliers sold retail electricity in Massachusetts in 2015. Two of these competitive suppliers (Glacial Energy and Gulf Oil) failed to report their 2015 GHG emissions. It is MassDEP's understanding that these two competitive suppliers no longer operate in MA.

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 year's summary report for information purposes.[2] (Please note that Table 1 presents wholesale emission factors. MassDEP recommends that consumers of electricity wishing to use Massachusetts-specific emission factors to report their GHG emissions from use of electricity should see Appendix 3 to this document 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 2014 and 2015 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/files/documents/2017/05/zw/rsef1415tsd.pdf).[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
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

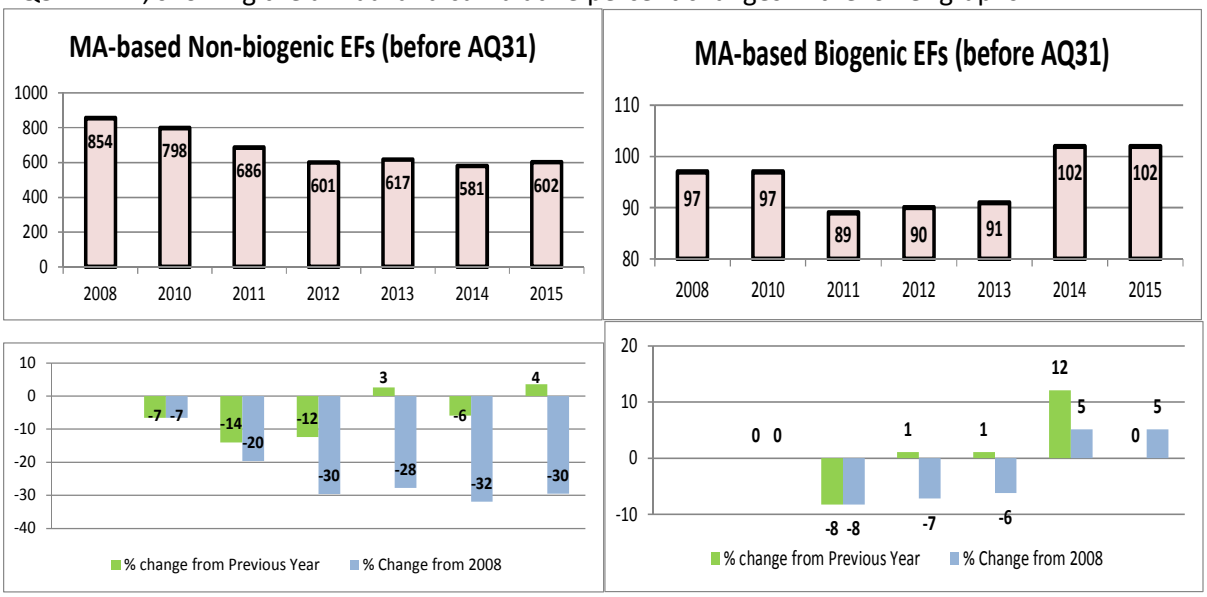
For 2015, all emission factors increased from the previous year, except the Massachusetts-based biogenic emission factor which remained about the same. Figure 1 shows the MA-Based EFs (before accounting for AQ31 MWh). The percent changes from the year prior and from the first reporting year are shown in the lower graphs.

[2] The inclusion of the combined non-biogenic and biogenic EFs was requested during the public comment period required by 310 CMR 7.71(9)(b)3.a. Also requested were the combined non-biogenic and biogenic emissions of each retail seller, which have been added to Appendix 1 of this report.

[3] The Department 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 AQ31 MWh, showing the annual and cumulative percent changes in the lower graphs



MWh Sold by Retail Sellers and Reported from Particular Generating Units

For 2015, 3 electric utilities, 2 competitive suppliers, and 36 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 seven 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 2015.

Tables 2 and 3 show the number of retail sellers reporting in 2008, and 2010 through 2015. 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).

Table 2. Number of Retail Sellers Reporting GHG Emissions

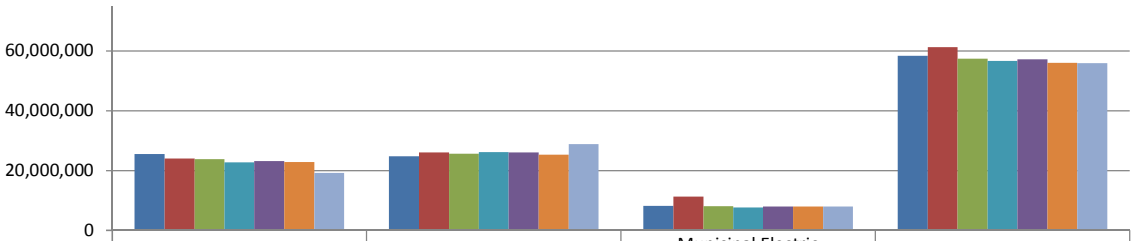
Mandatory Reporting:	Electric Utilities	Competitive Suppliers	Municipal Electric Departments	Total Retail Sellers
2008	4	22	40	66
2010	4	31	40	75
2011	4	33	40	77
2012	4	43	40	87
2013	4	44 of 47	40	88 of 91
2014	4	47 of 52	40	91 of 96
2015	4	54 of 56*	40	98 of 100

*See Footnote 1 on page 1 of this document.

[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 2015 differs by 217,205 MWh from the total reported in DOER's *Massachusetts RPS & APS Annual Compliance Report for 2015* due primarily to the two competitive suppliers that failed to report, as noted in footnote 1 on page 1 of this document and also to some minor reporting differences.

Figure 2. Total MWh of Retail Sales of Electricity Reported

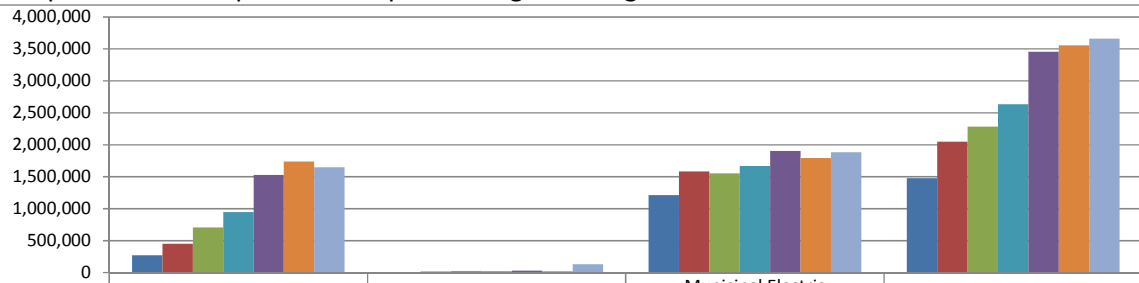


	Electric Utilities	Competitive Suppliers	Municipal Electric Departments	Total
2008	25,514,875	24,806,760	8,154,220	58,475,855
2010	23,997,222	26,028,871	11,297,116	61,323,209
2011	23,775,874	25,610,294	8,086,980	57,473,148
2012	22,736,900	26,255,523	7,708,611	56,701,034
2013	23,167,213	26,085,716	8,018,581	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

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

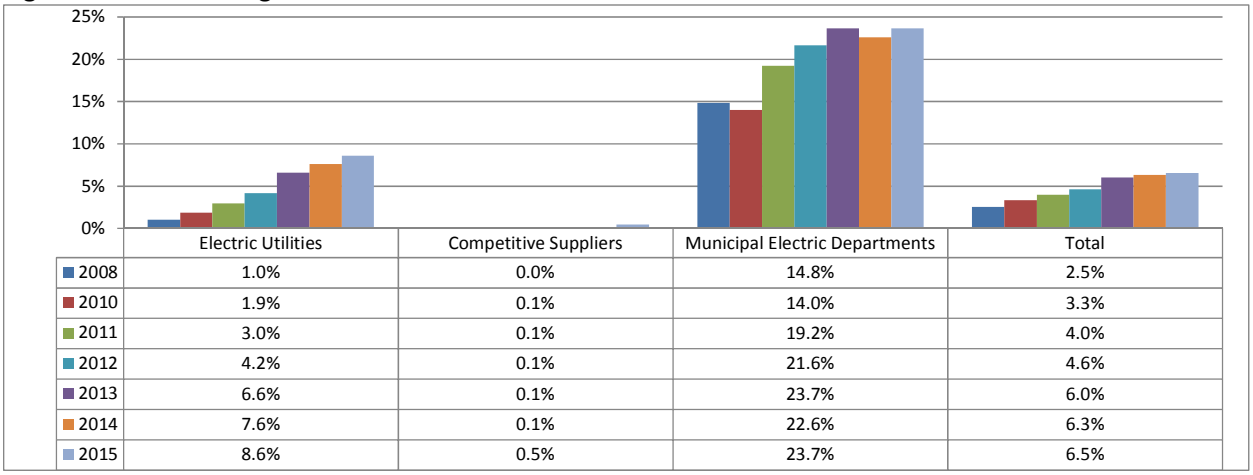
Optional Reporting (Step 1): Number of Reporters	Electric Utilities	Competitive Suppliers	Municipal Electric Departments	Total Retail Sellers
2008	2	0	17	19
2010	2	1	24	27
2011	3	1	25	29
2012	3	1	31	35
2013	3	1	33	37
2014	3	1	31	35
2015	3	2	36	41

Figure 3. Optional MWh reported from particular generating units



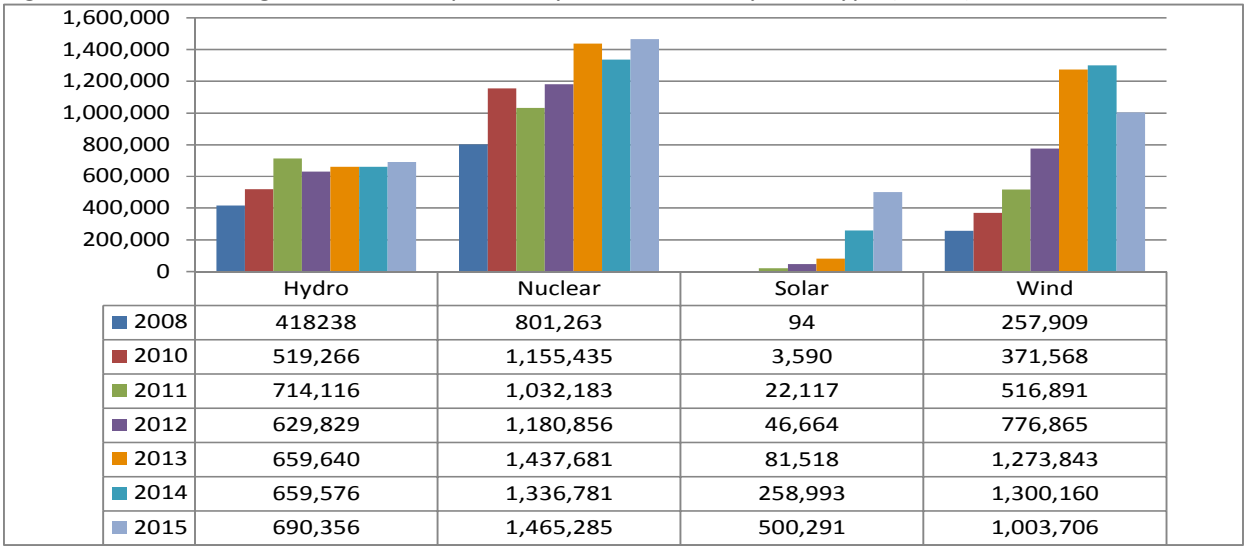
	Electric Utilities	Competitive Suppliers	Municipal Electric Departments	Total
2008	267,806	0	1,209,698	1,477,504
2010	450,034	18,213	1,581,612	2,049,859
2011	707,893	22,876	1,554,539	2,285,308
2012	947,525	18,772	1,667,919	2,634,216
2013	1,527,172	28,085	1,898,690	3,453,947
2014	1,739,524	21,473	1,794,509	3,555,506
2015	1,647,720	131,372	1,880,545	3,659,637

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



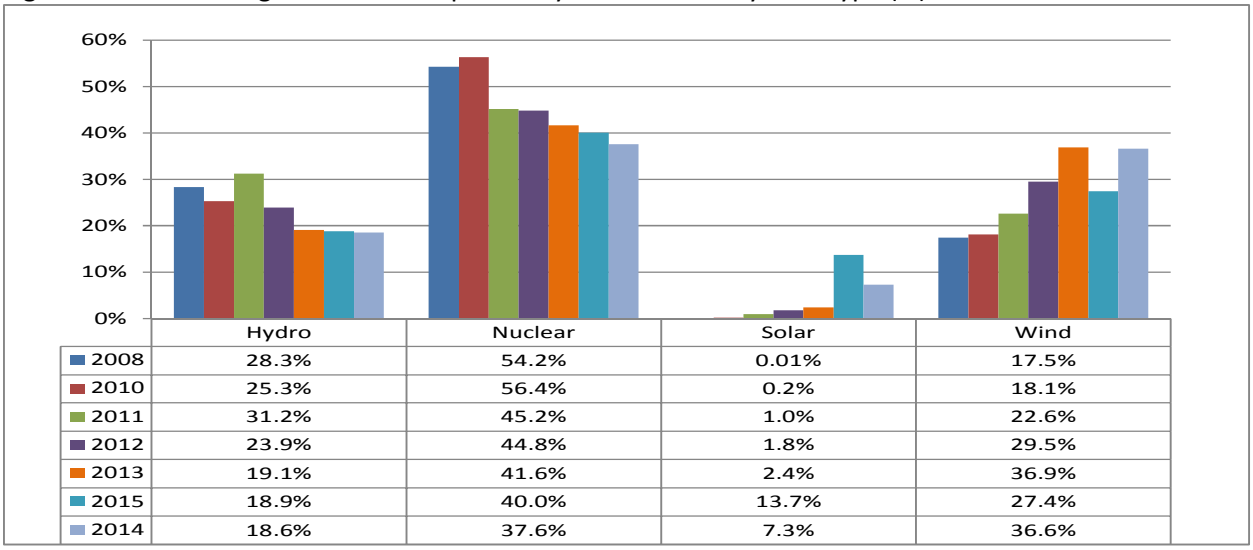
	Electric Utilities	Competitive Suppliers	Municipal Electric Departments	Total
2008	1.0%	0.0%	14.8%	2.5%
2010	1.9%	0.1%	14.0%	3.3%
2011	3.0%	0.1%	19.2%	4.0%
2012	4.2%	0.1%	21.6%	4.6%
2013	6.6%	0.1%	23.7%	6.0%
2014	7.6%	0.1%	22.6%	6.3%
2015	8.6%	0.5%	23.7%	6.5%

Figure 5. Non-Emitting Generation Reported by Retail Sellers by Fuel Type (MWh)



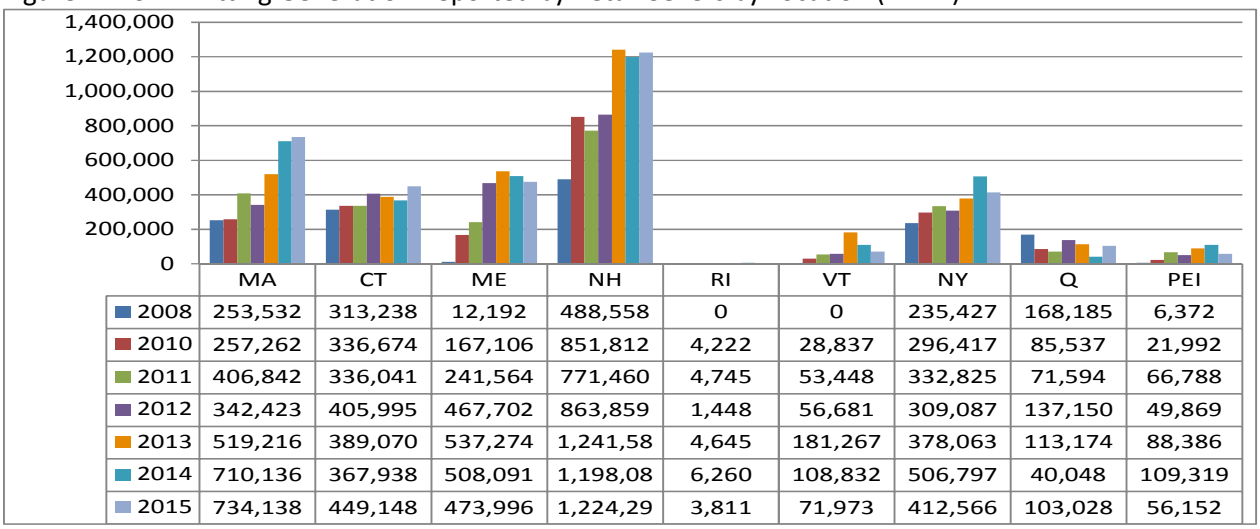
	Hydro	Nuclear	Solar	Wind
2008	418238	801,263	94	257,909
2010	519,266	1,155,435	3,590	371,568
2011	714,116	1,032,183	22,117	516,891
2012	629,829	1,180,856	46,664	776,865
2013	659,640	1,437,681	81,518	1,273,843
2014	659,576	1,336,781	258,993	1,300,160
2015	690,356	1,465,285	500,291	1,003,706

Figure 6. Non-Emitting Generation Reported by Retail Sellers by Fuel Type (%)



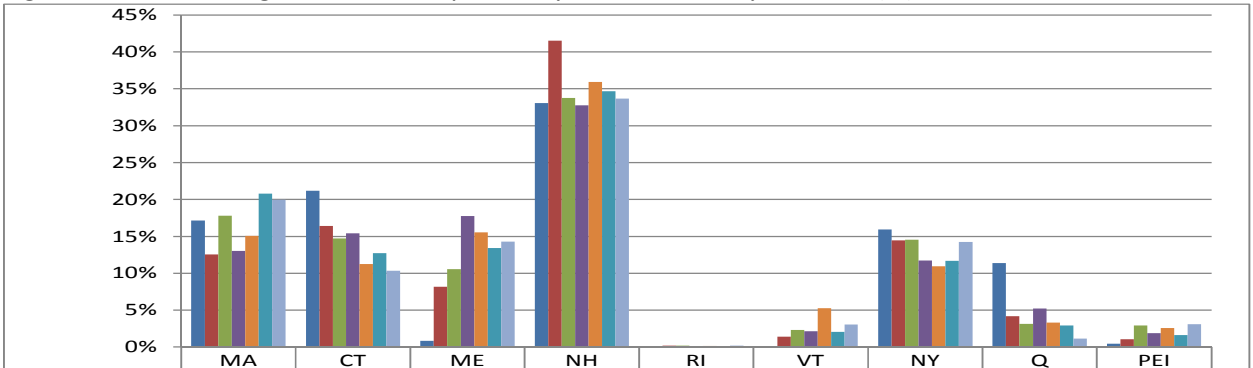
	Hydro	Nuclear	Solar	Wind
2008	28.3%	54.2%	0.01%	17.5%
2010	25.3%	56.4%	0.2%	18.1%
2011	31.2%	45.2%	1.0%	22.6%
2012	23.9%	44.8%	1.8%	29.5%
2013	19.1%	41.6%	2.4%	36.9%
2015	18.9%	40.0%	13.7%	27.4%
2014	18.6%	37.6%	7.3%	36.6%

Figure 7. Non-Emitting Generation Reported by Retail Sellers by Location (MWh)



	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	1,241,58	4,645	181,267	378,063	113,174	88,386
2014	710,136	367,938	508,091	1,198,08	6,260	108,832	506,797	40,048	109,319
2015	734,138	449,148	473,996	1,224,29	3,811	71,973	412,566	103,028	56,152

Figure 8. Non-Emitting Generation Reported by Retail Sellers by Location (%)



	MA	CT	ME	NH	RI	VT	NY	Q	PEI
2008	17.2%	21.2%	0.8%	33.1%	0.0%	0.0%	15.9%	11.4%	0.4%
2010	12.6%	16.4%	8.2%	41.6%	0.2%	1.4%	14.5%	4.2%	1.1%
2011	17.8%	14.7%	10.6%	33.8%	0.2%	2.3%	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%
2015	20.8%	12.7%	13.4%	34.7%	0.1%	2.0%	11.7%	2.9%	1.6%
2014	20.0%	10.3%	14.3%	33.7%	0.2%	3.1%	14.3%	1.1%	3.1%

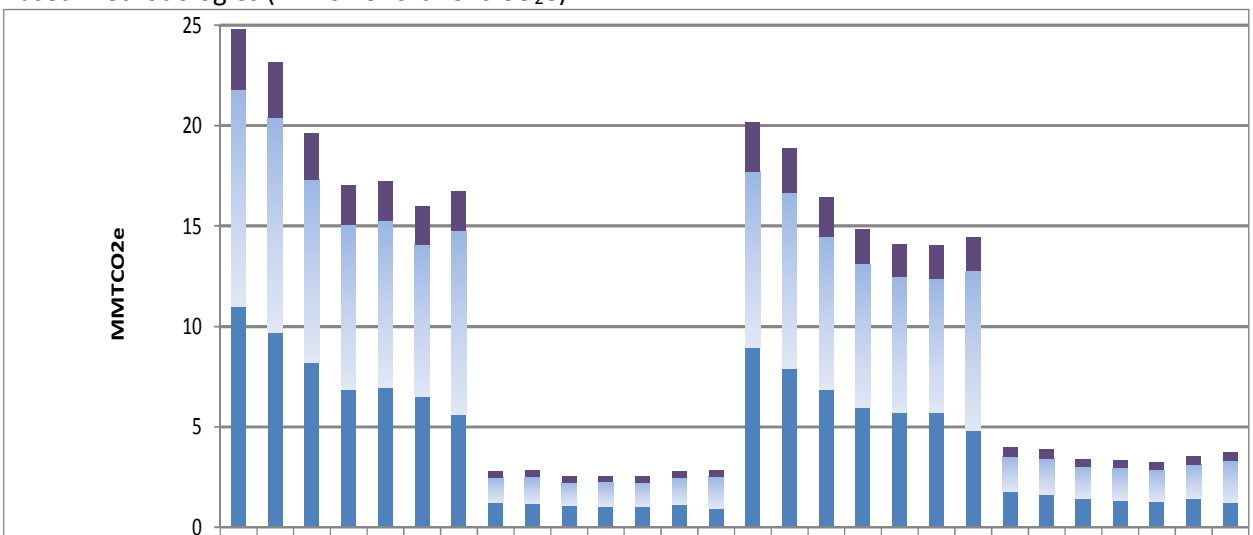
GHG Emissions Reported by Retail Sellers

For 2015, GHG emissions increased in all four categories from 2014 due to the increase in the EFs.[7] 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; 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.

[7] The full MWh value of retail sales of electricity from MA DOER for competitive suppliers was used to determine GHG emissions in this report. Therefore GHG emissions from all 56 competitive suppliers are included in Figure 8 and Appendix 1, including the two companies that failed to submit their 2015 reports.

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



Year 2008-2015	MA-based non-biogenic							MA-based biogenic							Regional-based non-biogenic							Regional-based biogenic						
	8	10	11	12	13	14	15	8	10	11	12	13	14	15	8	10	11	12	13	14	15	8	10	11	12	13	14	15
Municipal Electric Departments	3.0	2.7	2.3	2.0	2.0	1.9	1.9	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	0.5	0.5	0.4	0.4	0.4	0.4	0.4
Competitive Suppliers	10.8	10.7	9.1	8.2	8.3	7.6	9.2	1.2	1.3	1.2	1.2	1.2	1.3	1.6	8.8	8.7	7.6	7.2	6.8	6.7	7.9	1.7	1.8	1.6	1.6	1.5	1.7	2.1
Electric Utilities	11.0	9.7	8.2	6.8	7.0	6.5	5.6	1.2	1.2	1.1	1.0	1.0	1.1	1.0	8.9	7.9	6.9	5.9	5.7	5.7	4.8	1.8	1.6	1.4	1.3	1.3	1.4	1.3

Individual Retail Seller Reporting for 2015

For each retail seller that chose to submit MWh from particular generating units in 2015, "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 2015 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.[9] See Appendix 2 below 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.

[9] The inclusion of separate figures for MEDs, at an appropriate scale, was requested during the public comment period as a way to make the data easier to read and understand.

Figure 10A. 2015 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)

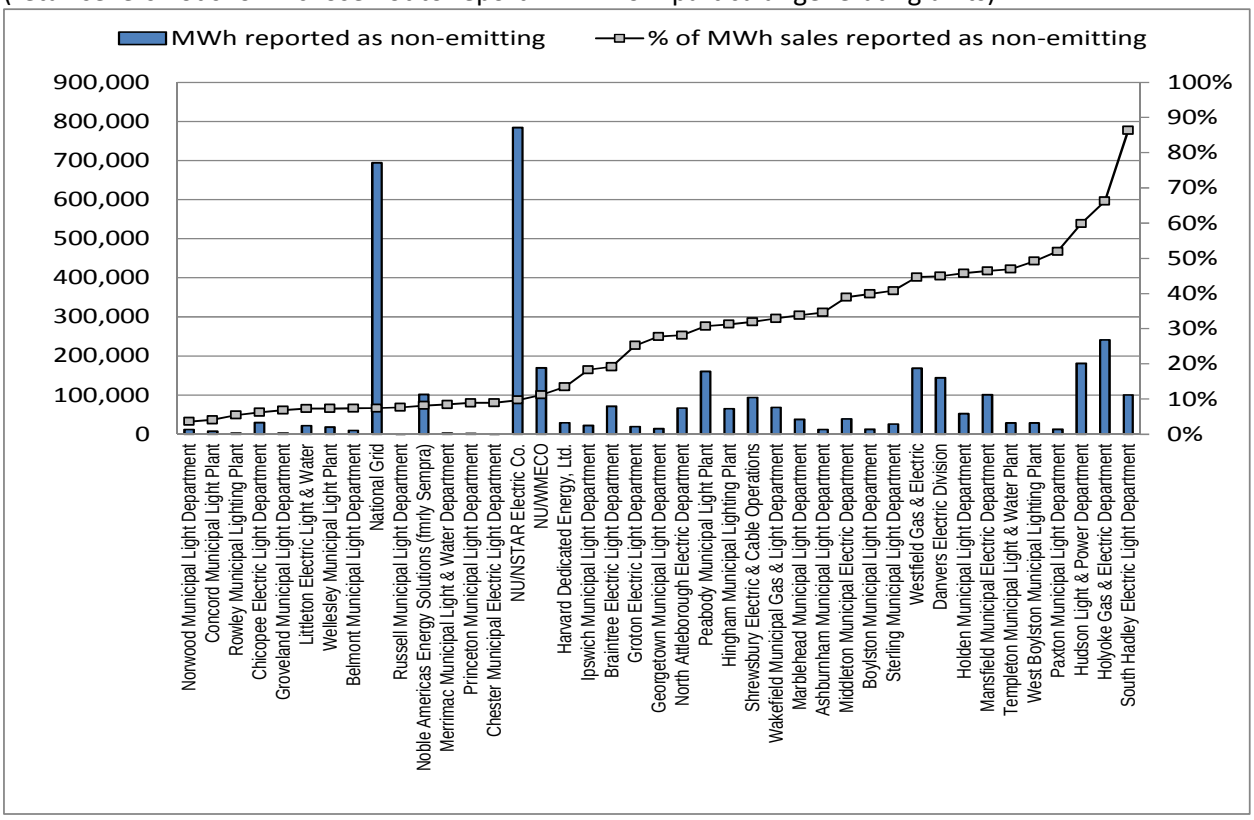


Figure 10B. 2015 Electricity Sales by Retail Seller: Non-Emitting vs. All Other MWh Sales Reported
(retail sellers not shown chose not to report MWh from particular generating units)

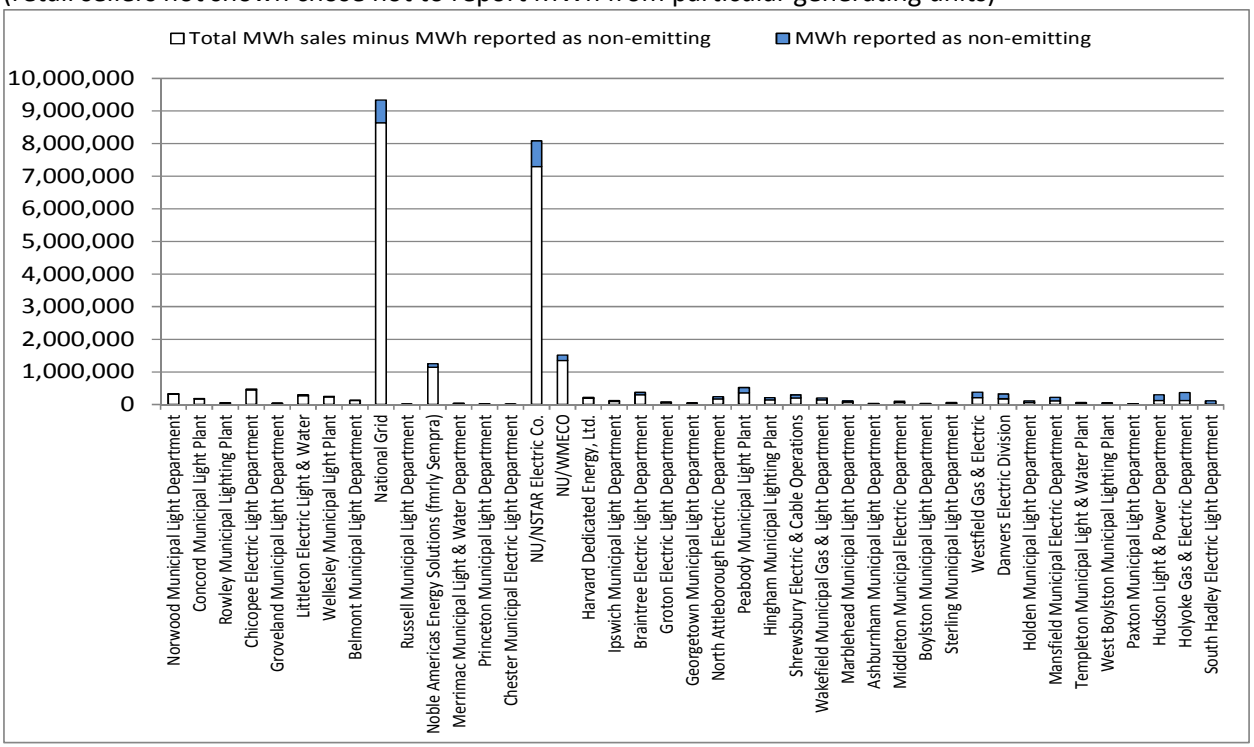


Figure 11A. 2015 Electricity Sales Reported as Non-Emitting by MEDs (MWh and % of sales) (MEDs not shown chose not to report MWh from particular generating units)

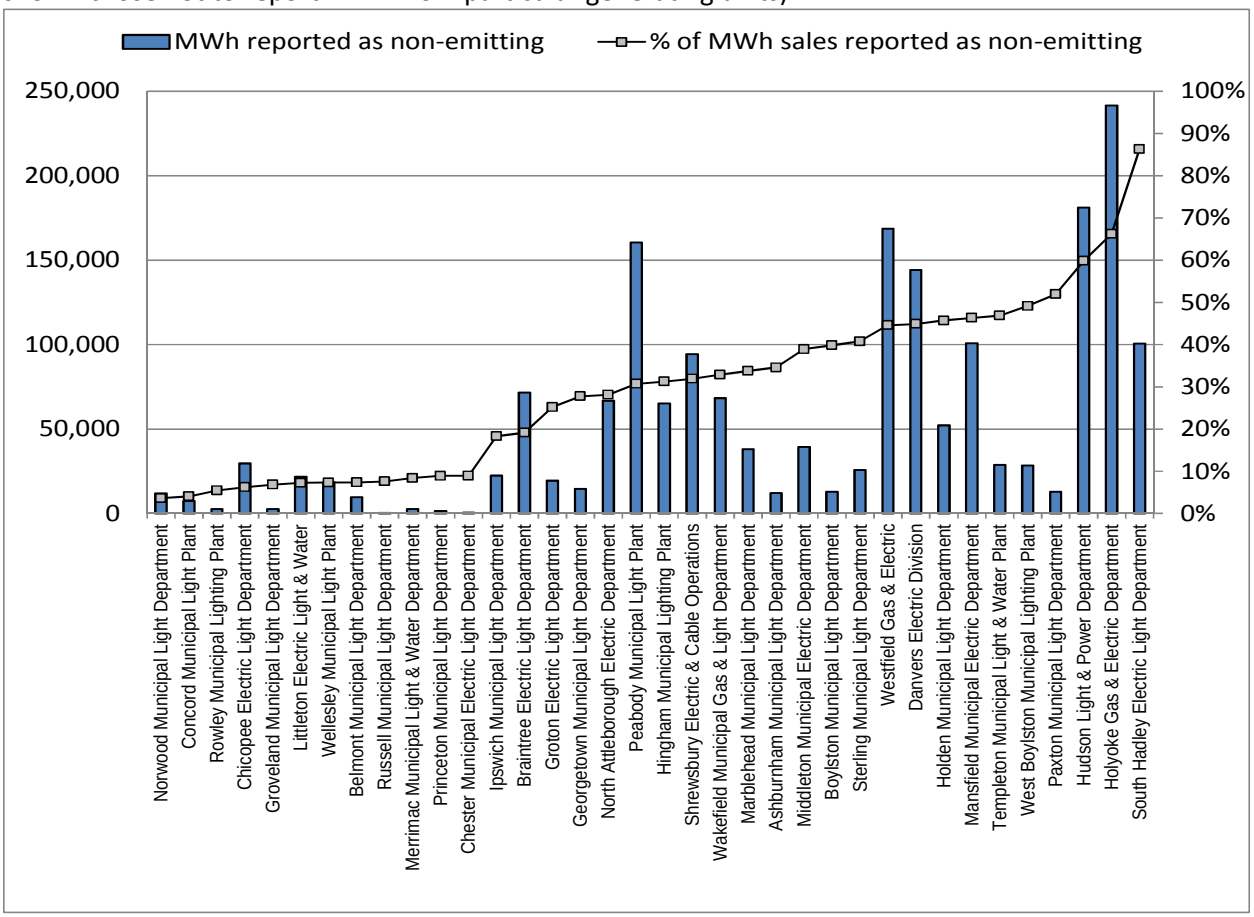
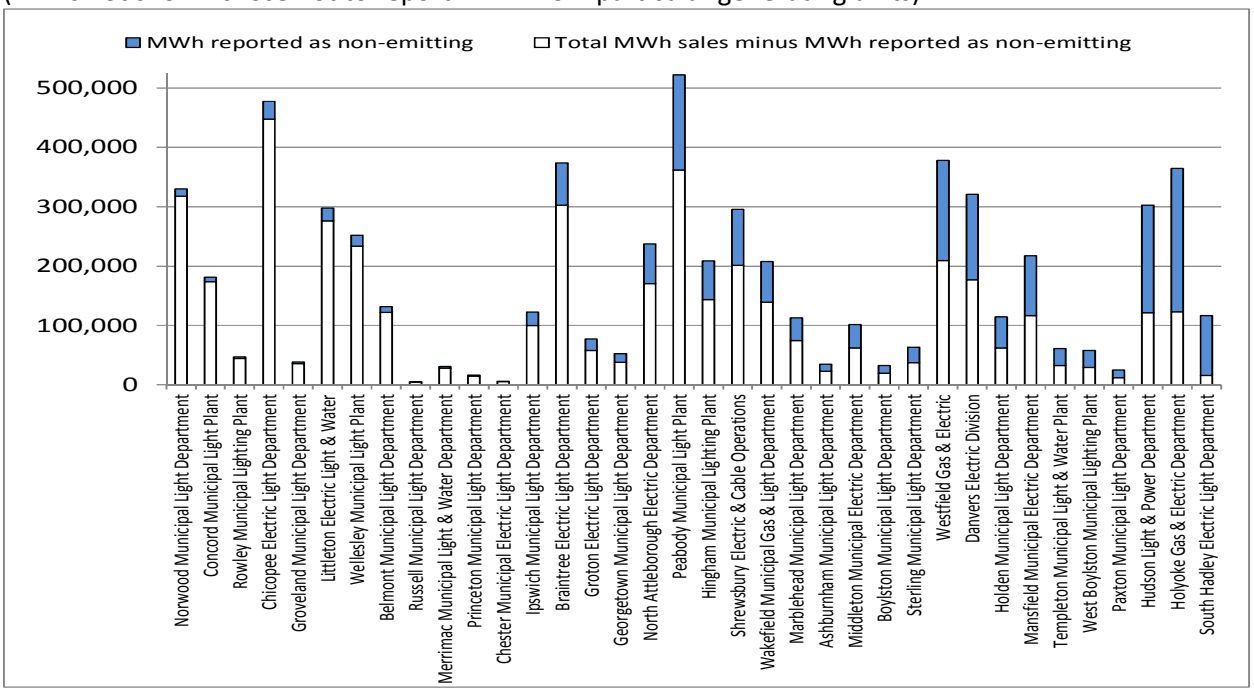


Figure 11B. 2015 Electricity Sales by MED: Non-Emitting vs. All Other MWh Sales Reported (MEDs not shown chose not to report MWh from particular generating units)



Appendix 1: 2015 Individual Retail Seller GHG Emissions

Below are 2015 GHG emissions for each retail seller calculated by MassDEP based on:

- the final GHG emission factors from Step 3 above,
- MWh reported to Department of Energy Resources by electric utilities and competitive suppliers and to DPU by MEDs, less MWh from any particular generating units that a retail seller reported in Step 1. See footnotes 1, 6, 7 and 8 regarding the retail sales and emissions of competitive suppliers and MEDs, and
- an aggregate of 2015 GHG emissions for the two competitive suppliers that failed to report 2015 emissions (shown in the last row of the Competitive Suppliers section of Table 4).

Table 4. 2015 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						
NGRID (Mass. and Nantucket Elec.)	2,765,854	471,060	3,236,914	2,385,549	617,996	3,003,545
Eversource/NSTAR Electric Co.	2,335,289	397,729	2,733,018	2,014,187	521,791	2,535,978
Eversource/Western MA Electric Co.	431,546	73,498	505,044	372,208	96,424	468,632
Unitil (Fitchburg Gas & Electric Co.)	65,008	11,072	76,080	56,070	14,525	70,595
Competitive Suppliers						
Abest Power & Gas, LLC	15,558	2,650	18,208	13,419	3,476	16,895
Agera Energy LLC	38,501	6,557	45,058	33,207	8,603	41,810
Ambit Northeast, LLC	10,625	1,810	12,435	9,164	2,374	11,538
Champion Energy Services	6,620	1,127	7,747	5,710	1,479	7,189
Clearview Electric, Inc.	23,620	4,023	27,642	20,372	5,277	25,649
Consolidated Edison Solutions, Inc.	935,901	159,396	1,095,297	807,215	209,115	1,016,330
Constellation Energy Power Choice (frmrly MxEnergy Electric)	63,839	10,873	74,711	55,061	14,264	69,325
Constellation Energy Services, Inc. (frmrly Integrys)	363,582	61,923	425,505	313,590	81,238	394,827
Constellation NewEnergy, Inc.	1,384,433	235,786	1,620,220	1,194,074	309,334	1,503,408
Devonshire Energy, LLC	27,200	4,633	31,833	23,460	6,078	29,538
Direct Energy Business LLC	1,036,410	176,514	1,212,923	893,903	231,573	1,125,476

	Massachusetts-based approach			Regional-based approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
Direct Energy Business Marketing, LLC	106,490	18,137	124,626	91,848	23,794	115,641
Direct Energy Services, LLC	106,490	18,137	124,626	91,848	23,794	115,641
Discount Power, Inc.	9,298	1,583	10,881	8,019	2,077	10,097
East Avenue Energy	264	45	309	228	59	287
Energy Plus Holdings	21,212	3,613	24,825	18,296	4,740	23,035
ENGIE Resources, LLC	633,357	107,869	741,226	546,271	141,516	687,787
ENGIE Retail, LLC (dba Think Energy)	33,828	5,761	39,590	29,177	7,558	36,735
Ethical Electric, Inc. (Clean Choice)	1	0	1	1	0	1
First Point Power	94,717	16,131	110,848	81,693	21,163	102,857
Great Eastern Energy (aka BBPC LLC)	444,539	75,710	520,249	383,415	99,327	482,741
Green Mountain Energy Company	6,356	1,082	7,438	5,482	1,420	6,902
Hampshire Council of Governments	189,615	32,294	221,908	163,543	42,367	205,910
Harvard Dedicated Energy, Ltd.	60,941	10,379	71,320	52,562	13,617	66,178
Hudson Energy Services	269,651	45,925	315,576	232,574	60,250	292,824
Interstate Gas Supply, Inc. (dba IGS Energy)	5	1	6	4	1	6
Inspire Energy Holdings, LLC	4,449	758	5,206	3,837	994	4,831
Just Energy Mass.	125,496	21,374	146,870	108,241	28,041	136,281
Liberty Power Holdings	354,173	60,320	414,493	305,474	79,136	384,610
Major Energy Electric Service, LLCs	55,477	9,449	64,926	47,849	12,396	60,245
Massachusetts Gas & Electric Co.	62,180	10,590	72,770	53,630	13,893	67,523
Mega Energy Holdings, LLC	13,196	2,248	15,444	11,382	2,949	14,331
Mint Energy, LLC	60,199	10,253	70,451	51,921	13,451	65,372
NextEra Energy	230,839	39,315	270,154	199,099	51,578	250,677

	Massachusetts-based approach			Regional-based approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
Noble Americas Energy Solutions (frmrly Sempra)	367,397	62,572	429,969	316,880	82,090	398,970
Oasis Power, LLC	8,093	1,378	9,472	6,981	1,808	8,789
Palmco Power MA, LLC	30,012	5,112	35,124	25,886	6,706	32,592
Perigee Energy, LLC	4,957	844	5,801	4,276	1,108	5,383
Provider Power MASS, LLC	13,964	2,378	16,342	12,044	3,120	15,164
Public Power, LLC	3,378	575	3,954	2,914	755	3,669
Reliant Energy Northeast	314,094	53,494	367,588	270,906	70,180	341,086
REP Energy	27,179	4,629	31,807	23,442	6,073	29,514
SFE Energy Massachusetts	4,321	736	5,057	3,727	966	4,693
SmartEnergy Holdings, LLC	292	50	342	252	65	318
South Jersey Energy	47,990	8,173	56,164	41,392	10,723	52,115
Spark Energy, LP	44,484	7,576	52,060	38,367	9,939	48,306
Starion Energy, Inc.	70,614	12,027	82,641	60,905	15,778	76,683
Sunwave Gas & Power Massachusetts, Inc.	1,534	261	1,795	1,323	343	1,666
Texas Retail Energy	33,237	5,661	38,897	28,667	7,426	36,093
Town Square Energy, LLC	1,287	219	1,507	1,110	288	1,398
TransCanada Power Marketing Ltd.	766,617	130,564	897,181	661,207	171,291	832,498
Verde Energy USA Massachusetts, LLC	63,744	10,856	74,600	54,979	14,243	69,222
Viridian	252,366	42,981	295,348	217,666	56,388	274,054
Xoom Energy Massachusetts LLC	28,386	4,834	33,220	24,483	6,342	30,825
Glacial Energy and Gulf Oil (combined)	69,513	11,839	81,352	59,955	15,532	75,486
Municipal Electric Departments						
Ashburnham Muni. Light Dept.	7,288	1,241	8,529	6,286	1,628	7,914
Belmont Municipal Light Dept.	38,998	6,642	45,640	33,636	8,714	42,349

	Massachusetts-based approach			Regional-based approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
Boylston Municipal Light Dept.	6,239	1,063	7,302	5,381	1,394	6,775
Braintree Electric Light Dept.	96,760	16,479	113,239	83,456	21,620	105,075
Chester Muni. Electric Light Dept.	1,735	295	2,031	1,496	388	1,884
Chicopee Electric Light Dept.	143,332	24,411	167,743	123,624	32,026	155,649
Concord Municipal Light Plant	55,626	9,474	65,100	47,978	12,429	60,407
Danvers Electric Division	56,596	9,639	66,236	48,814	12,646	61,460
Georgetown Municipal Light Dept.	12,166	2,072	14,238	10,493	2,718	13,212
Groton Electric Light Dept.	18,497	3,150	21,648	15,954	4,133	20,087
Groveland Municipal Light Dept.	11,430	1,947	13,377	9,859	2,554	12,413
Hingham Municipal Lighting Plant	45,903	7,818	53,721	39,591	10,256	49,847
Holden Municipal Light Dept.	19,868	3,384	23,251	17,136	4,439	21,575
Holyoke Gas & Electric Dept.	39,398	6,710	46,108	33,981	8,803	42,784
Hudson Light & Power Dept.	38,898	6,625	45,522	33,549	8,691	42,240
Hull Municipal Lighting Plant	17,080	2,909	19,989	14,732	3,816	18,548
Ipswich Municipal Light Dept.	31,999	5,450	37,449	27,599	7,150	34,749
Littleton Electric Light & Water	88,340	15,045	103,386	76,193	19,739	95,932
Mansfield Municipal Electric Dept.	37,310	6,354	43,664	32,180	8,336	40,516
Marblehead Municipal Light Dept.	23,861	4,064	27,925	20,580	5,331	25,911
Merrimac Muni. Light & Water	8,987	1,531	10,517	7,751	2,008	9,759
Middleborough Gas & Elec. Dept.	90,128	15,350	105,478	77,735	20,138	97,873
Middleton Muni. Electric Dept.	19,820	3,376	23,196	17,095	4,429	21,524
North Attleboro Electric Dept.	54,576	9,295	63,871	47,072	12,194	59,266
Norwood Municipal Light Dept.	101,746	17,329	119,075	87,756	22,734	110,490
Paxton Municipal Light Dept.	3,800	647	4,447	3,277	849	4,126

	Massachusetts-based approach			Regional-based approach		
	Non-Biogenic	**Biogenic**	**Combined**	**Non-Biogenic**	**Biogenic**	**Combined**
Peabody Municipal Light Plant	115,780	19,719	135,499	99,861	25,870	125,730
Princeton Municipal Light Dept.	6,328	1,078	7,406	5,458	1,414	6,872
Reading Municipal Light Dept.	228,726	38,955	267,681	197,277	51,106	248,383
Rowley Municipal Lighting Plant	14,170	2,413	16,584	12,222	3,166	15,388
Russell Municipal Light Dept.	1,511	257	1,768	1,303	338	1,641
Shrewsbury Electric & Cable Ops.	64,379	10,965	75,344	55,527	14,385	69,912
South Hadley Electric Light Dept.	5,110	870	5,980	4,407	1,142	5,549
Sterling Municipal Light Dept.	12,000	2,044	14,044	10,350	2,681	13,032
Taunton Municipal Lighting Plant	218,338	37,186	255,523	188,316	48,785	237,101
Templeton Muni. Light & Water	10,424	1,775	12,199	8,990	2,329	11,319
Wakefield Muni. Gas & Light	44,612	7,598	52,209	38,477	9,968	48,445
Wellesley Municipal Light Plant	74,765	12,733	87,499	64,485	16,705	81,190
West Boylston Muni. Light. Plant	9,452	1,610	11,062	8,153	2,112	10,265
Westfield Gas & Electric	66,961	11,404	78,365	57,754	14,962	72,715
2015 distribution company total	5,597,697	953,358	6,551,055	4,828,014	1,250,735	6,078,749
2015 competitive supplier total	9,196,112	1,566,213	10,762,324	7,931,646	2,054,756	9,986,403
2015 MED total	1,942,937	330,907	2,273,844	1,675,783	434,125	2,109,908
2015 RETAIL SELLER TOTAL GHGs	16,736,746	2,850,477	19,587,223	14,435,444	3,739,617	18,175,060

Appendix 2: Individual 2015 Retail Seller Emission Factors

Below are the 2015 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 EFs in Table 1.

Table 5. Individual 2015 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.)	693,903	592	101	511	133	7.4%
Eversource/NSTAR	784,050	578	98	498	130	9.7%
Eversource/WMECO	169,767	568	97	490	128	11.2%
Competitive Suppliers						
Harvard Dedicated Energy	29,555	554	94	478	125	13.4%
Noble Americas Energy Solutions	101,817	588	100	507	132	8.1%
Municipal Electric Departments						
Ashburnham Muni. Light Dept.	12,043	419	71	361	94	34.6%
Belmont Municipal Light Department	9,703	593	101	511	133	7.4%
Boylston Municipal Light Dept.	12,923	385	66	332	87	39.9%
Braintree Electric Light Dept.	71,659	517	88	446	116	19.2%
Chester Municipal Electric Light Dept.	532	583	99	503	131	8.9%
Chicopee Electric Light Dept.	29,736	600	102	518	135	6.2%
Concord Municipal Light Plant	7,412	614	105	529	138	4.1%
Danvers Electric Division	144,297	352	60	304	79	44.9%
Georgetown Municipal Light Department	14,617	462	79	399	104	27.8%
Groton Electric Light Dept.	19,504	479	82	413	108	25.2%
Groveland Municipal Light Dept.	2,627	596	102	514	134	6.9%
Hingham Municipal Lighting Plant	65,218	440	75	379	99	31.3%
Holden Municipal Light Dept.	52,287	347	59	300	78	45.7%

	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	
Holyoke Gas & Electric Dept.	241,496	216	37	186	49	66.2%
Hudson Light & Power Dept.	181,163	257	44	222	58	59.8%
Ipswich Municipal Light Department	22,438	523	89	451	118	18.3%
Littleton Electric Light & Water	21,756	593	101	512	133	7.3%
Mansfield Municipal Electric Dept.	100,802	343	58	296	77	46.4%
Marblehead Municipal Light Dept.	38,062	424	72	365	95	33.8%
Merrimac Municipal Light & Water Dept.	2,591	586	100	505	132	8.4%
Middleton Municipal Electric Dept.	39,489	391	67	337	88	38.9%
North Attleboro Electric Dept.	66,785	460	78	397	103	28.1%
Norwood Municipal Light Dept.	11,912	617	105	532	139	3.6%
Paxton Municipal Light Dept.	12,840	307	52	265	69	52.0%
Peabody Municipal Light Plant	160,515	443	76	382	100	30.7%
Princeton Municipal Light Dept.	1,455	583	99	503	131	8.9%
Rowley Municipal Lighting Plant	2,556	605	103	522	136	5.5%
Russell Municipal Light Department	390	591	101	510	133	7.6%
Shrewsbury Electric & Cable Ops.	94,349	436	74	376	98	31.9%
South Hadley Electric Light Dept.	100,664	88	15	76	20	86.3%
Sterling Municipal Light Dept.	25,852	379	65	327	85	40.8%
Templeton Municipal Light & Water	28,775	340	58	293	76	46.9%
Wakefield Municipal Gas & Light Dept.	68,396	429	73	370	97	32.9%
Wellesley Municipal Light Plant	18,510	593	101	511	133	7.3%
West Boylston Municipal Lighting Plant	28,551	325	55	281	73	49.1%

	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	
Westfield Gas & Electric	168,640	354	60	306	80	44.6%
All Other Retail Sellers	**0**	**640**	**109**	**552**	**144**	**0%**

Appendix 3: 2015 Retail Level Emission Factors to be Used 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 2015 EFs that consumers of electricity would use to report their GHG emissions at a retail electricity level.

Combined, Biogenic & 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.

2015 RS Wholesale Non-Biogenic MA-Based EF	602 lb	Non-Biogenic CO_2e/Wholesale MWh
+ 2015 RS Wholesale Biogenic MA-Based EF	+102 lb	Biogenic CO_2e/Wholesale MWh
2015 RS Wholesale Combined MA-Based EF	704 lb	Combined CO_2e/Wholesale MWh

Wholesale v. Retail EFs (line losses): Power lines lose 5.7%[10] (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: 704 lb CO_2e/Wholesale MWh / (1 - 0.057) = 747 lb CO_2e/Retail MWh

Table 6. 2015 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	602	638
Biogenic	102	108
Combined	704	747

Individual CO_2, CH_4, and N_2O EFs: If the entity to which you are reporting requires 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. For the 2015

[10] This value was updated from 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.

retail level Combined EF, this results in 742 lb of CO_2e from CO_2, 2 lb 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 2015 by MassDEP are: 1 for CO_2, 25 for CH_4, and 298 for N_2O.[11]

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

Specifically: 1.6 lb CO_2e from CH_4 / 25 = 0.064 lb CH_4 *and* 2.8 lb CO_2e from N_2O / 298 = 0.010 lb N_2O,

therefore

747 lb CO_2e/Retail MWh = (742 lb CO_2 + (0.064 lb CH_4 * 25) + (0.010 lb N_2O * 298)) / Retail MWh

The breakdown of the 747 lb CO_2e/Retail MWh value from Table 6 into individual gases, at various scales of electricity, is shown in Table 7.

Table 7. 2015 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	0.742	0.000064	0.000010
lb/Retail MWh	742	0.064	0.010
lb/Retail GWh	742,000	64	10

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 742 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. 2015 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	0.634	0.108
lb/Retail MWh	634	108
lb/Retail GWh	634,000	108,000

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