MassDEP GHG Reporting Program Summary Report
For Retail Sellers of Electricity
Emissions Year 2014

February 2018

The information below summarizes the 2014 greenhouse gas (GHG) emissions and megawatt hours (MWh) of electricity sales reported to the Massachusetts Department of Environmental Protection (MassDEP) by 91 of the 96[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 sixth year of reporting under the regulation. 2008 was the initial reporting year. Annual reporting began with the 2010 reporting year. Comparisons of the first six 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 2014, 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-two competitive suppliers sold retail electricity in Massachusetts in 2014. Five of these competitive suppliers (Glacial Energy, Gulf Oil, HOP Energy, OBE Electric and Open Book) failed to report their 2014 GHG emissions. It is MassDEP's understanding that these five 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
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

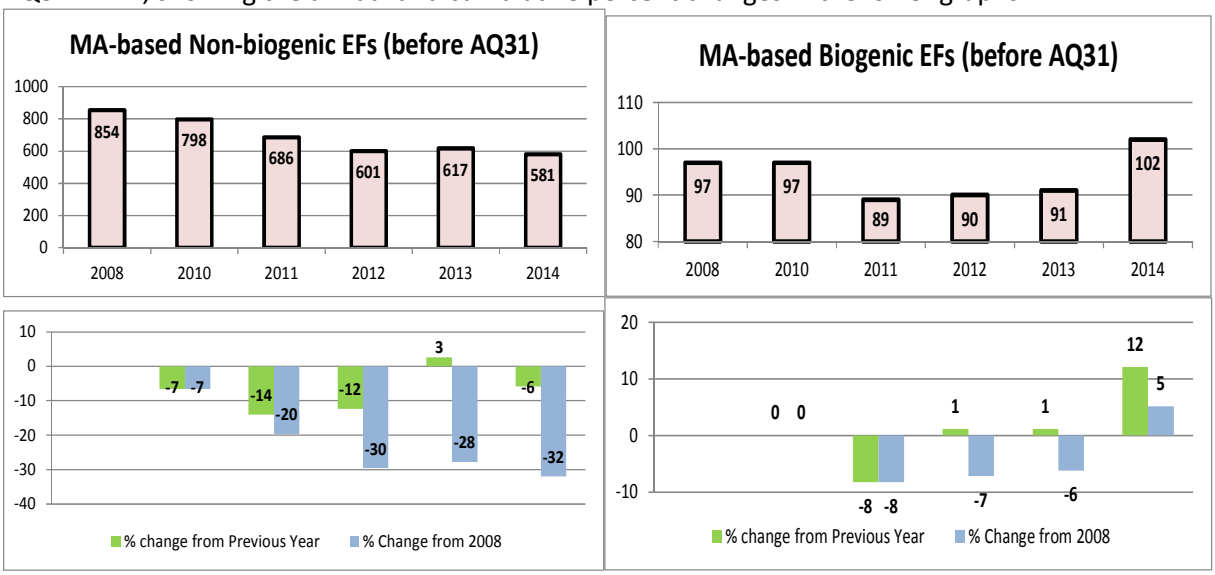
For 2014, the Massachusetts-based non-biogenic emission factor decreased from the previous year (and brought down the combined Massachusetts-based emission factor shown above in Table 1), while all other emission factors increased. Figure 1 shows the MA-Based EFs (before accounting for AQ31 MWh). The percent changes from the year prior and from the first reporting year are shown in the lower graphs. The MA-based and Regional-based non-biogenic EFs show a similar downward trend while the MA-based and Regional-based biogenic EFs do not show a particular trend.

[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 2014, 3 electric utilities, 1 competitive supplier, and 31 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 six reporting years have been from non-emitting units. 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 2014.

Tables 2 and 3 show the number of retail sellers reporting in 2008, and 2010 through 2014. 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

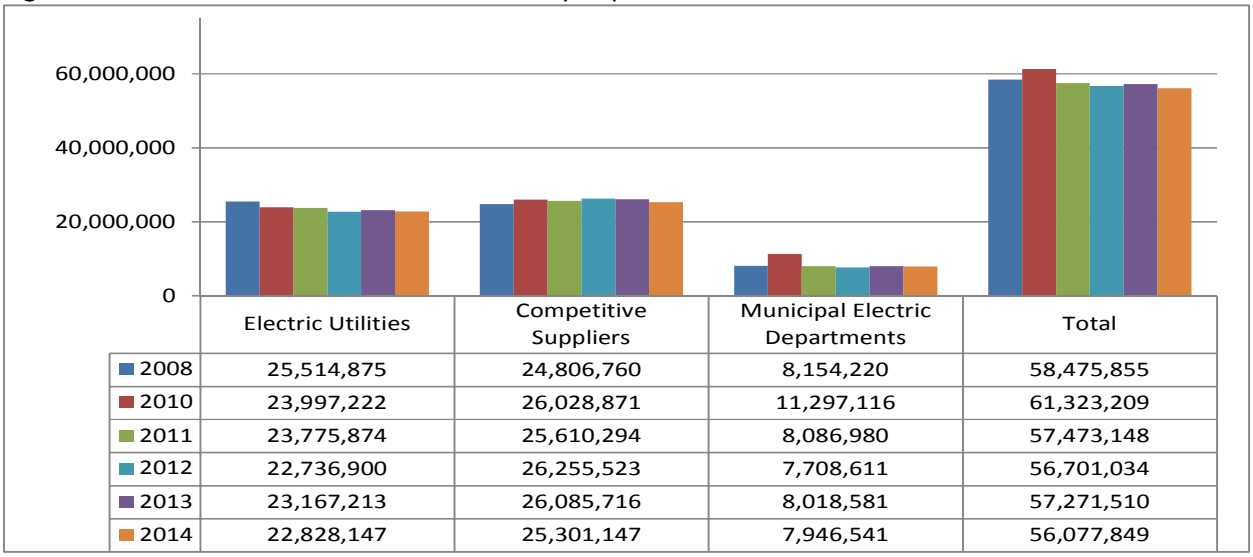
Mandatory Reporting: Number of Retail Sellers	Electric Utilities	Competitive Suppliers	Municipal Electric Departments	Total Retail Sellers
2008	4	22	40	66
2010	4	31	40	75
2011	4	33	40	77
2012	4	43	40	87
2013	4	44 of 47	40	88 of 91
2014	4	47 of 52*	40	91 of 96

*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 2014 differs by 267,574 MWh from the total reported in DOER's *Massachusetts RPS & APS Annual Compliance Report for 2014* due to the five competitive suppliers that failed to report, as noted in footnote 1 on page 1 of this document. One MED failed to subtract their Sales from Resale (line 18) from the TOTAL (line 15) from page 57 their *Annual Return* to DPU, as instructed. The *Annual Return* TOTAL from line 15 is used throughout this document, with Sales from Resale subtracted, as necessary.

Figure 2. Total MWh of Retail Sales of Electricity Reported

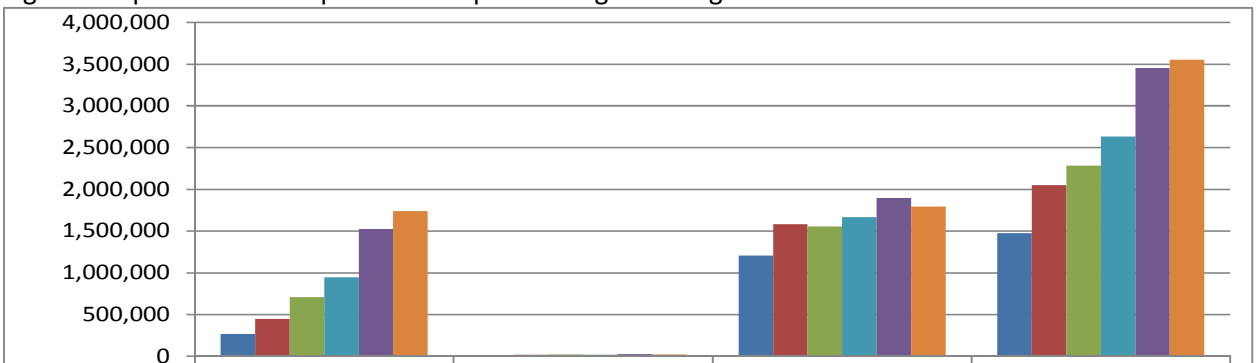


	Electric Utilities	Competitive Suppliers	Municipal Electric Departments	Total
2008	25,514,875	24,806,760	8,154,220	58,475,855
2010	23,997,222	26,028,871	11,297,116	61,323,209
2011	23,775,874	25,610,294	8,086,980	57,473,148
2012	22,736,900	26,255,523	7,708,611	56,701,034
2013	23,167,213	26,085,716	8,018,581	57,271,510
2014	22,828,147	25,301,147	7,946,541	56,077,849

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

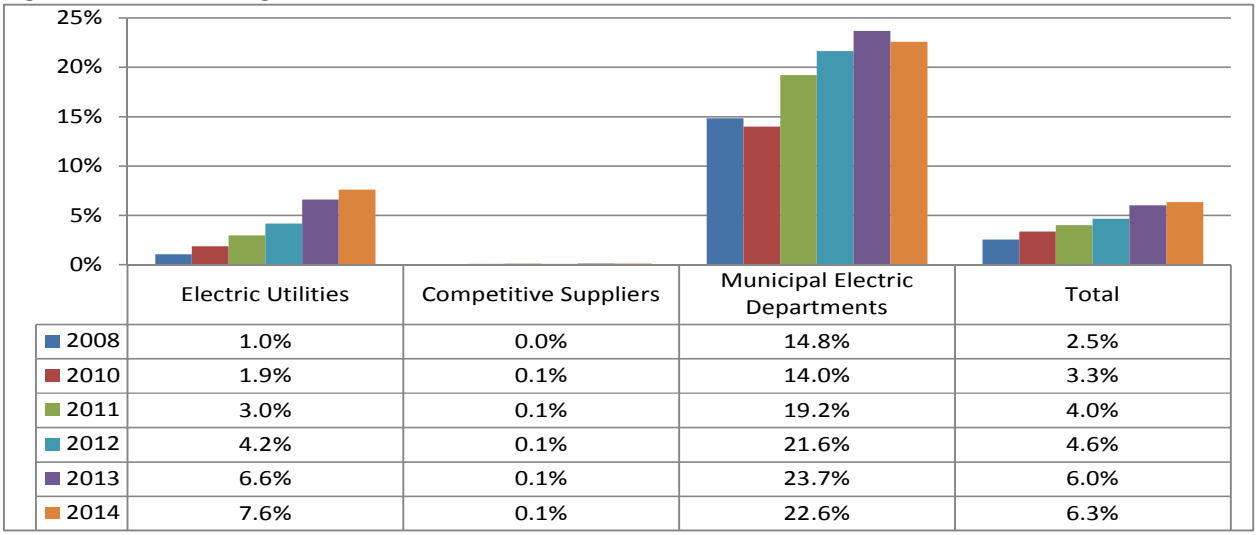
Optional Reporting (Step 1): Number of Reporters	Electric Utilities	Competitive Suppliers	Municipal Electric Departments	Total Retail Sellers
2008	2	0	17	19
2010	2	1	24	27
2011	3	1	25	29
2012	3	1	31	35
2013	3	1	33	37
2014	3	1	31	35

Figure 3. Optional MWh reported from particular generating units



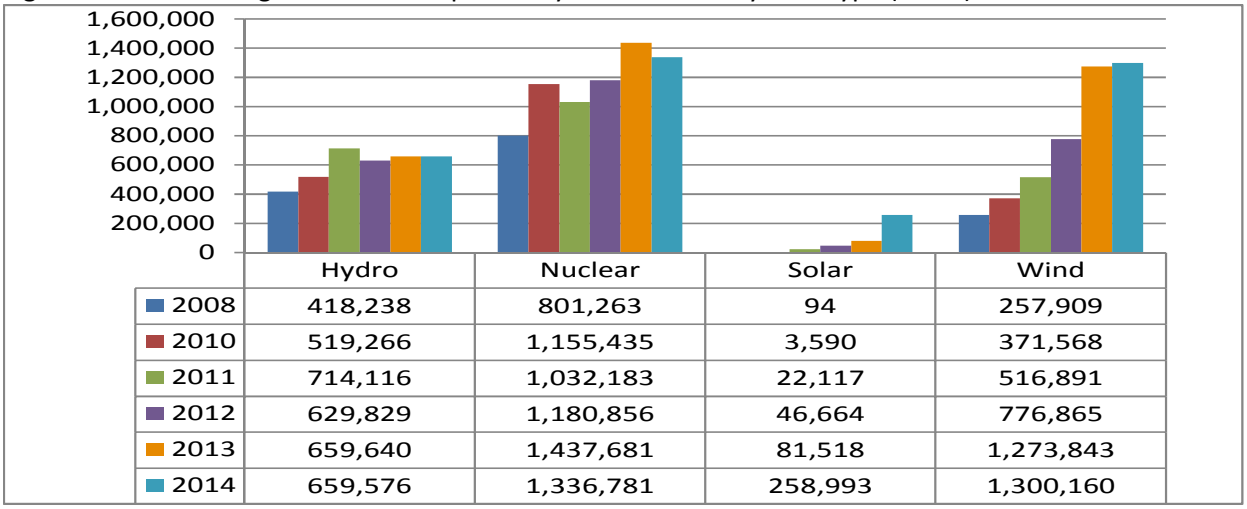
	Electric Utilities	Competitive Suppliers	Municipal Electric Departments	Total
2008	267,806	0	1,209,698	1,477,504
2010	450,034	18,213	1,581,612	2,049,859
2011	707,893	22,876	1,554,539	2,285,308
2012	947,525	18,772	1,667,919	2,634,216
2013	1,527,172	28,085	1,898,690	3,453,947
2014	1,739,524	21,473	1,794,509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

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



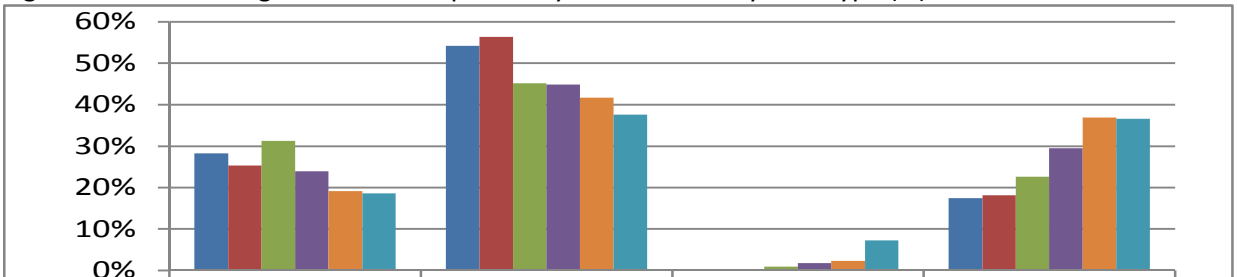
	Electric Utilities	Competitive Suppliers	Municipal Electric Departments	Total
2008	1.0%	0.0%	14.8%	2.5%
2010	1.9%	0.1%	14.0%	3.3%
2011	3.0%	0.1%	19.2%	4.0%
2012	4.2%	0.1%	21.6%	4.6%
2013	6.6%	0.1%	23.7%	6.0%
2014	7.6%	0.1%	22.6%	6.3%

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



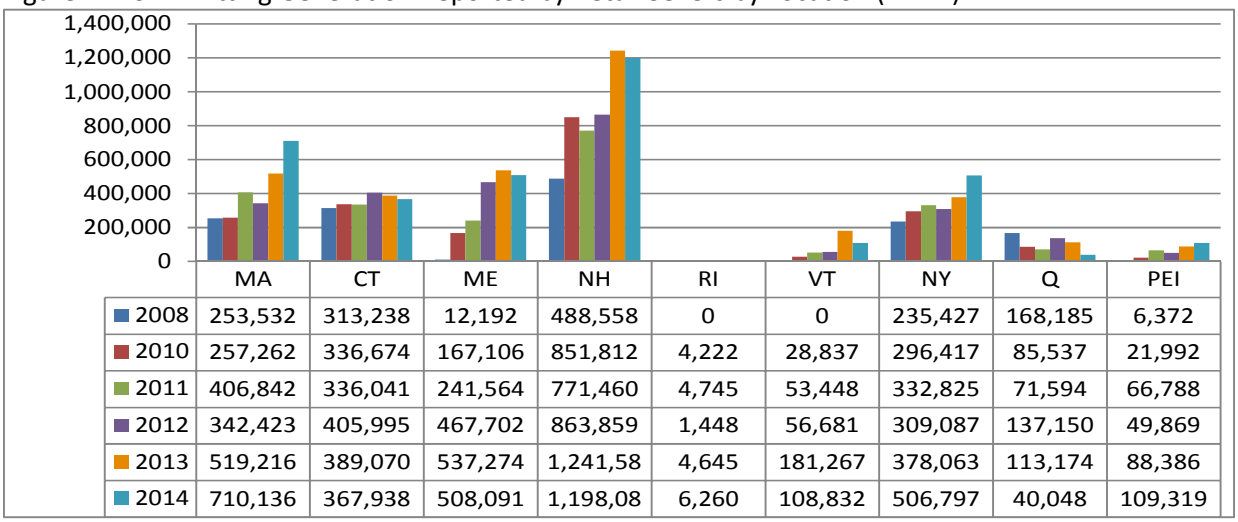
	Hydro	Nuclear	Solar	Wind
2008	418,238	801,263	94	257,909
2010	519,266	1,155,435	3,590	371,568
2011	714,116	1,032,183	22,117	516,891
2012	629,829	1,180,856	46,664	776,865
2013	659,640	1,437,681	81,518	1,273,843
2014	659,576	1,336,781	258,993	1,300,160

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



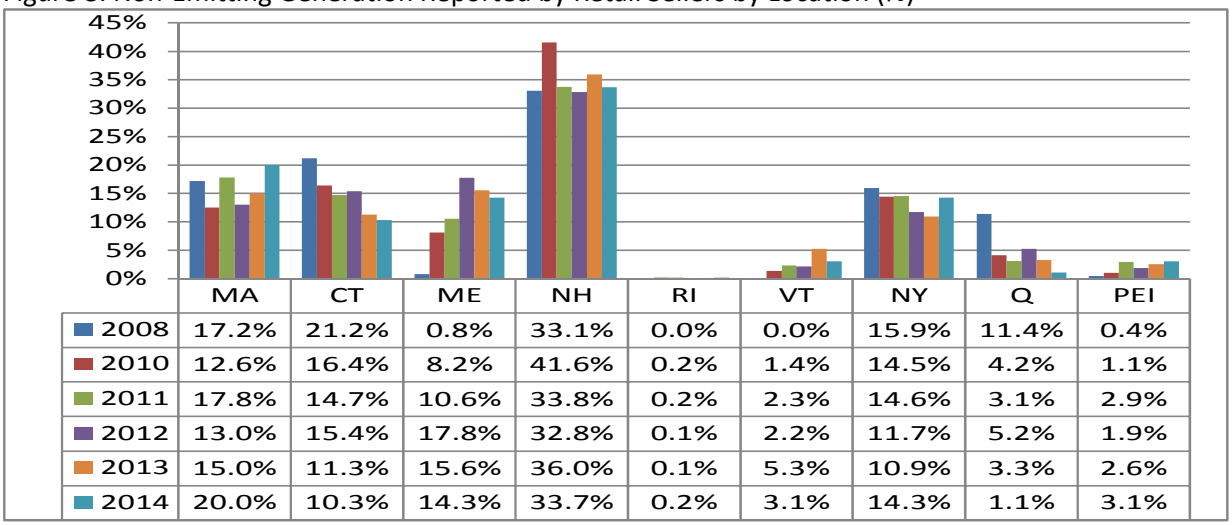
	Hydo	Nuclear	Solar	Wind
2008	28.3%	54.2%	0.01%	17.5%
2010	25.3%	56.4%	0.2%	18.1%
2011	31.2%	45.2%	1.0%	22.6%
2012	23.9%	44.8%	1.8%	29.5%
2013	19.1%	41.6%	2.4%	36.9%
2014	18.6%	37.6%	7.3%	36.6%

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

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%
2014	20.0%	10.3%	14.3%	33.7%	0.2%	3.1%	14.3%	1.1%	3.1%

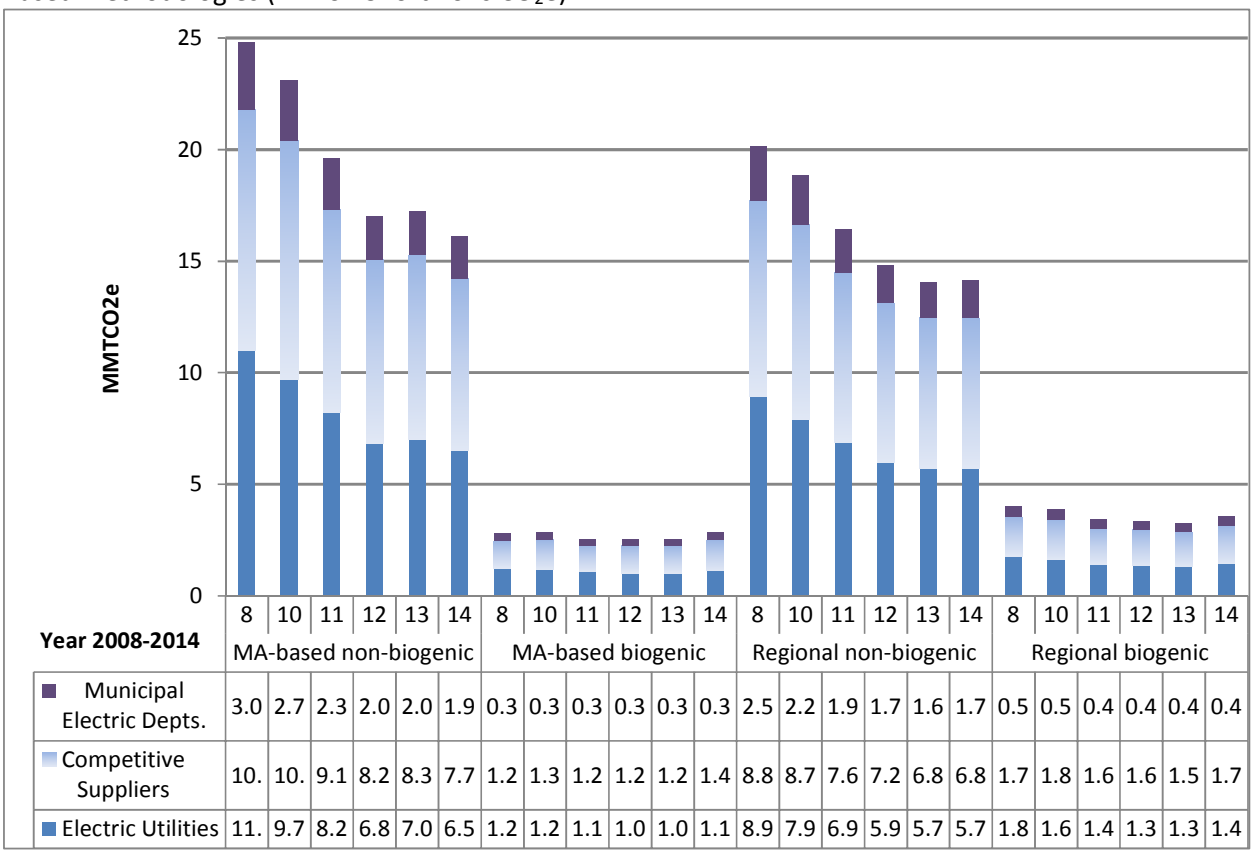
GHG Emissions Reported by Retail Sellers

For 2014, the total reported Massachusetts-based non-biogenic GHG emissions decreased from 2013 for all three categories of retail sellers, due to the decrease in the Massachusetts-based non-biogenic EF (reported non-emitting MWh as % of total retail sales again increased in 2014 while actual MWh retail sales decreased).[7] GHG emissions in the remaining three categories increased from earlier years. 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.

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 52 competitive suppliers are included in Figure 8 and Appendix 1, including the five companies that failed to submit their 2014 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 2008-2014	MA-based non-biogenic						MA-based biogenic						Regional non-biogenic						Regional biogenic					
	8	10	11	12	13	14	8	10	11	12	13	14	8	10	11	12	13	14	8	10	11	12	13	14
Municipal Electric Depts.	3.0	2.7	2.3	2.0	2.0	1.9	0.3	0.3	0.3	0.3	0.3	0.3	2.5	2.2	1.9	1.7	1.6	1.7	0.5	0.5	0.4	0.4	0.4	0.4
Competitive Suppliers	10.	10.	9.1	8.2	8.3	7.7	1.2	1.3	1.2	1.2	1.2	1.4	8.8	8.7	7.6	7.2	6.8	6.8	1.7	1.8	1.6	1.6	1.5	1.7
Electric Utilities	11.	9.7	8.2	6.8	7.0	6.5	1.2	1.2	1.1	1.0	1.0	1.1	8.9	7.9	6.9	5.9	5.7	5.7	1.8	1.6	1.4	1.3	1.3	1.4

Individual Retail Seller Reporting for 2014

For each retail seller that chose to submit MWh from particular generating units in 2014, "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 2014 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. 2014 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)

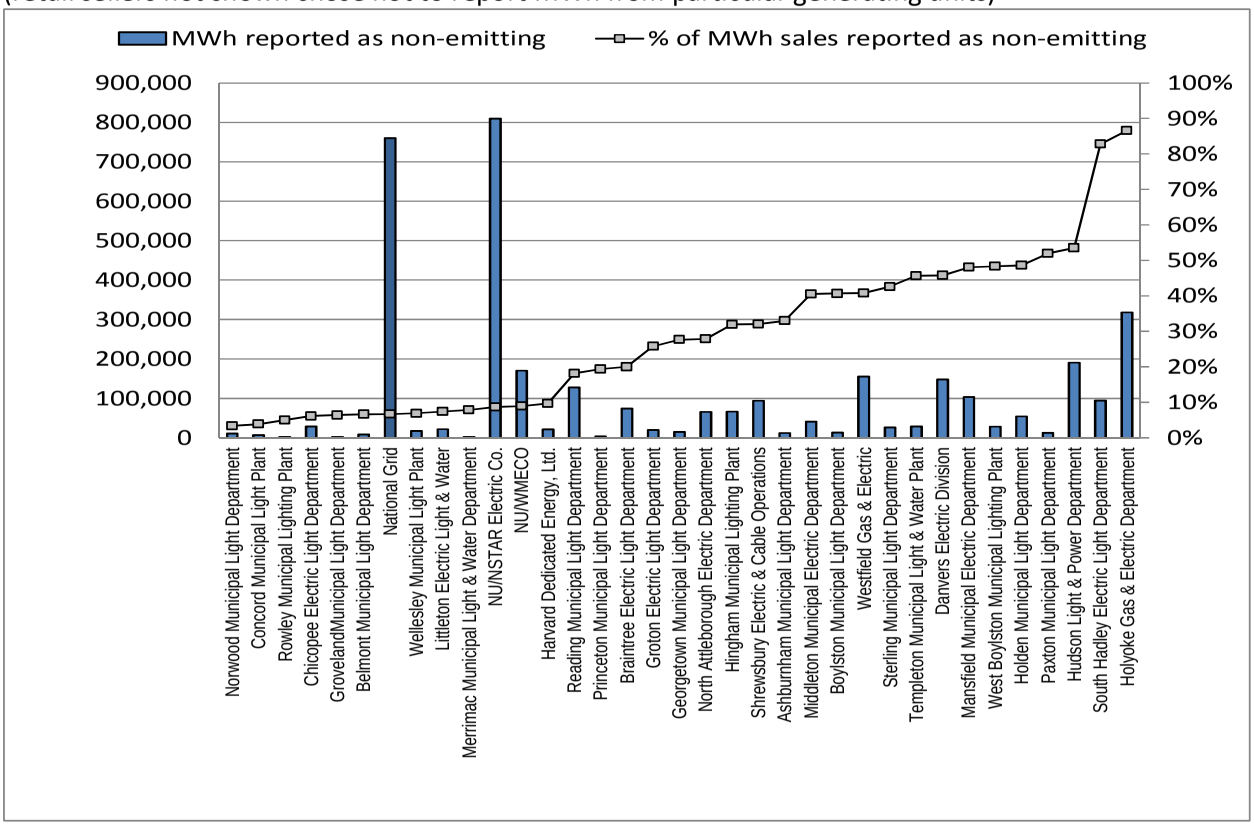


Figure 10B. 2014 Electricity Sales by Retail Seller: Non-Emitting vs. All Other MWh Sales Reported
(retail sellers not shown chose not to report MWh from particular generating units)

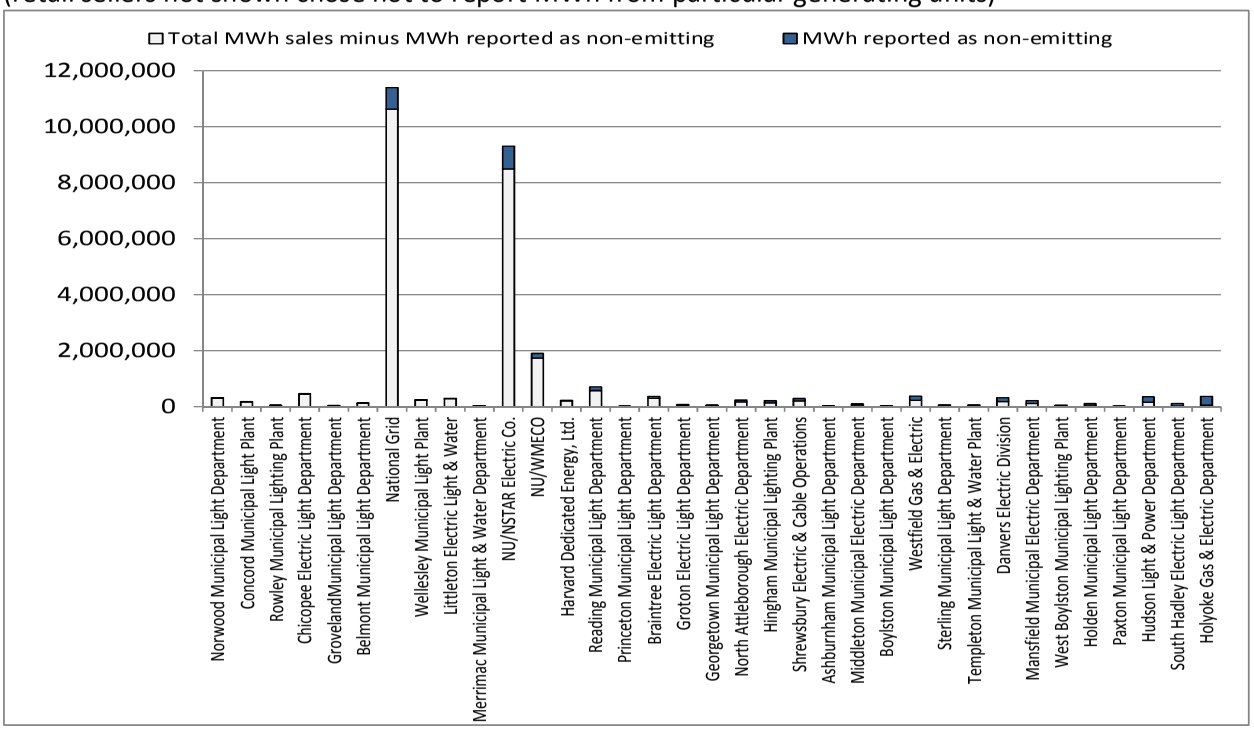


Figure 11A. 2014 Electricity Sales Reported as Non-Emitting by MEDs (MWh and % of sales) (MEDs not shown chose not to report MWh from particular generating units)

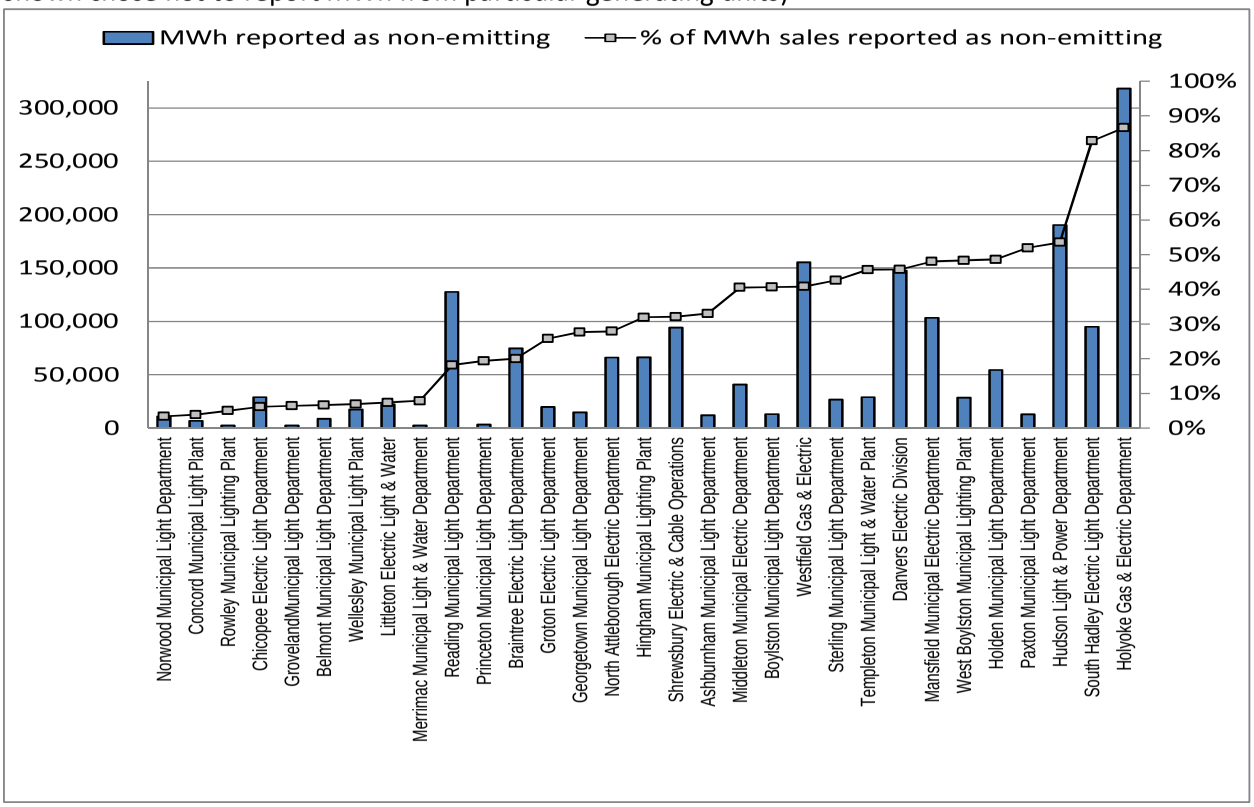
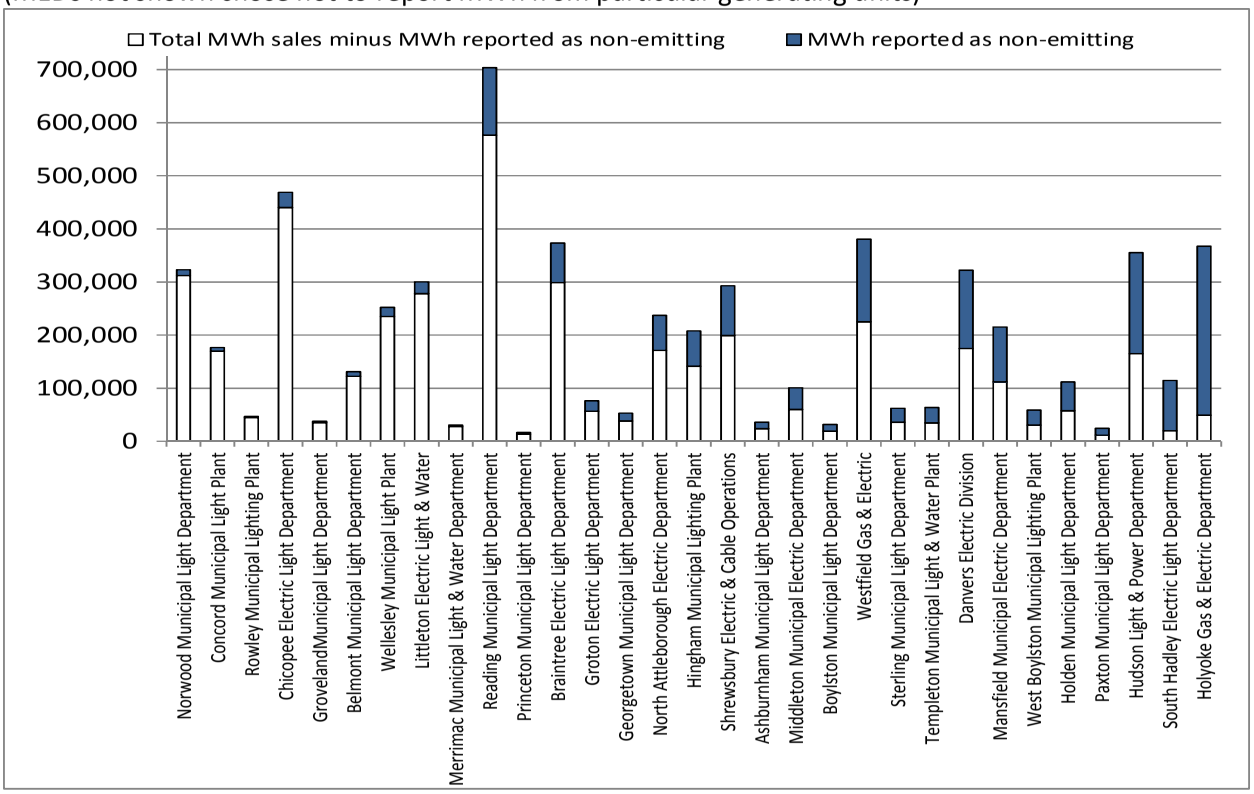


Figure 11B. 2014 Electricity Sales by MED: Non-Emitting vs. All Other MWh Sales Reported (MEDs not shown chose not to report MWh from particular generating units)



Appendix 1: 2014 Individual Retail Seller GHG Emissions

Below are 2014 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 2014 GHG emissions for the five competitive suppliers that failed to report 2014 emissions (shown in the last row of the Competitive Suppliers section of Table 4).

Table 4. 2014 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.)	68,540	11,997	80,537	60,097	15,108	75,205
Eversource/NSTAR Electric Co.	3,281,236	574,349	3,855,585	2,877,064	723,255	3,600,319
Eversource/Western MA Electric Co.	2,614,410	457,628	3,072,038	2,292,376	576,272	2,868,648
Unitil (Fitchburg Gas & Electric Co.)	535,237	93,688	628,925	469,308	117,978	587,286
Competitive Suppliers						
Abest Power & Gas, LLC	1,191	209	1,400	1,045	263	1,307
Cianbro Energy	7	1	8	6	2	8
Clearview Electric, Inc.	5,137	899	6,036	4,504	1,132	5,636
Consolidated Edison Solutions, Inc.	738,025	129,184	867,209	647,118	162,677	809,794
Constellation Energy Power Choice (frmrly MxEnergy Electric)	38,691	6,773	45,464	33,925	8,528	42,454
Constellation Energy Services, Inc. (frmrly Integrys)	252,987	44,283	297,270	221,825	55,764	277,589
Constellation NewEnergy, Inc.	1,003,054	175,575	1,178,630	879,502	221,095	1,100,596
Devonshire Energy, LLC	27,601	4,831	32,433	24,202	6,084	30,286
Direct Energy Business, LLC	1,112,060	194,655	1,306,715	975,080	245,122	1,220,201
Direct Energy Business Marketing, LLC	498,636	87,282	585,918	437,216	109,910	547,126
Direct Energy Services, LLC	79,622	13,937	93,559	69,814	17,550	87,364

	Massachusetts-based approach			Regional-based approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
Dominion Retail, Inc.	98,629	17,264	115,893	86,480	21,740	108,220
East Avenue Energy	285	50	335	250	63	313
Energy Plus Holdings	23,517	4,116	27,634	20,620	5,184	25,804
First Point Power	29,192	5,110	34,302	25,596	6,435	32,031
GDF Suez Energy Resources	656,559	114,924	771,483	575,686	144,720	720,406
GDF Suez Retail Energy Solutions (dba Think Energy)	7,266	1,272	8,538	6,371	1,602	7,972
Great Eastern Energy (aka BBPC LLC)	206,372	36,123	242,495	180,952	45,489	226,440
Hampshire Council of Governments	36,603	6,407	43,010	32,094	8,068	40,162
Hannaford Energy	71	12	84	62	16	78
Harvard Dedicated Energy, Ltd.	62,008	10,854	72,861	54,370	13,668	68,037
Hudson Energy Services	311,993	54,611	366,604	273,562	68,770	342,332
Just Energy Mass.	173,220	30,321	203,541	151,884	38,181	190,065
Liberty Power Holdings	290,213	50,799	341,012	254,466	63,969	318,435
Major Energy Electric Service, LLCs	10,261	1,796	12,057	8,997	2,262	11,259
Massachusetts Gas & Electric Co.	10,044	1,758	11,803	8,807	2,214	11,021
Mega Energy Holdings, LLC	6,847	1,198	8,045	6,003	1,509	7,512
Mint Energy, LLC	36,885	6,456	43,342	32,342	8,130	40,472
NextEra Energy	157,358	27,544	184,902	137,975	34,685	172,660
Noble Americas Energy Solutions (frmrly Sempra)	371,363	65,004	436,366	325,620	81,856	407,476
Oasis Power, LLC	1,211	212	1,424	1,062	267	1,329
Palmco Power MA, LLC	1,301	228	1,529	1,141	287	1,428
Perigee Energy, LLC	4,123	722	4,845	3,615	909	4,524
Provider Power MASS, LLC	6,327	1,107	7,434	5,547	1,395	6,942

	Massachusetts-based approach			Regional-based approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
Public Power, LLC	6,271	1,098	7,368	5,498	1,382	6,880
Reliant Energy Northeast	433,431	75,868	509,299	380,042	95,537	475,580
REP Energy	17,445	3,054	20,499	15,297	3,845	19,142
South Jersey Energy	41,221	7,215	48,437	36,144	9,086	45,230
Spark Energy, LP	4,065	712	4,776	3,564	896	4,460
Starion Energy, Inc.	9,858	1,725	11,583	8,643	2,173	10,816
Sunwave Gas & Power Massachusetts, Inc.	174	30	204	153	38	191
Texas Retail Energy	31,580	5,528	37,108	27,690	6,961	34,651
Town Square Energy, LLC	2	0	2	1	0	2
TransCanada Power Marketing Ltd.	732,456	128,209	860,665	642,234	161,449	803,683
Verde Energy USA Massachusetts, LLC	37,716	6,602	44,318	33,071	8,313	41,384
Viridian	128,641	22,517	151,158	112,795	28,355	141,150
Xoom Energy Massachusetts LLC	14,714	2,576	17,290	12,902	3,243	16,145
Glacial Energy, Gulf Oil, HOP Energy, OBE Energy and Open Book (combined)	82,547	14,449	96,996	72,379	18,195	90,574
Municipal Electric Departments						
Ashburnham Muni. Light Dept.	7,431	1,301	8,732	6,516	1,638	8,154
Belmont Municipal Light Dept.	37,787	6,614	44,401	33,132	8,329	41,462
Boylston Municipal Light Dept.	5,847	1,023	6,870	5,127	1,289	6,415
Braintree Electric Light Dept.	92,158	16,131	108,290	80,806	20,314	101,120
Chester Muni. Electric Light Dept.	1,791	313	2,104	1,570	395	1,965
Chicopee Electric Light Dept.	135,846	23,778	159,624	119,113	29,943	149,056
Concord Municipal Light Plant	52,360	9,165	61,525	45,910	11,541	57,452
Danvers Electric Division	53,942	9,442	63,383	47,297	11,890	59,187
Georgetown Municipal Light Dept.	11,879	2,079	13,958	10,416	2,618	13,034

	Massachusetts-based approach			Regional-based approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
Groton Electric Light Dept.	17,449	3,054	20,503	15,299	3,846	19,146
Groveland Municipal Light Dept.	10,867	1,902	12,769	9,528	2,395	11,924
Hingham Municipal Lighting Plant	43,596	7,631	51,227	38,226	9,609	47,835
Holden Municipal Light Dept.	17,757	3,108	20,865	15,570	3,914	19,484
Holyoke Gas & Electric Dept.	15,235	2,667	17,902	13,359	3,358	16,717
Hudson Light & Power Dept.	50,960	8,920	59,881	44,683	11,233	55,916
Hull Municipal Lighting Plant	17,381	3,042	20,423	15,240	3,831	19,071
Ipswich Municipal Light Dept.	37,372	6,542	43,914	32,769	8,238	41,006
Littleton Electric Light & Water	85,782	15,015	100,797	75,215	18,908	94,123
Mansfield Municipal Electric Dept.	34,453	6,031	40,484	30,209	7,594	37,803
Marblehead Municipal Light Dept.	34,307	6,005	40,312	30,081	7,562	37,643
Merrimac Muni. Light & Water	8,600	1,505	10,105	7,540	1,896	9,436
Middleborough Gas & Elec. Dept.	84,423	14,778	99,201	74,024	18,609	92,633
Middleton Muni. Electric Dept.	18,467	3,232	21,699	16,192	4,070	20,262
North Attleboro Electric Dept.	52,763	9,236	61,999	46,264	11,630	57,894
Norwood Municipal Light Dept.	96,288	16,854	113,143	84,428	21,224	105,652
Paxton Municipal Light Dept.	3,659	640	4,299	3,208	806	4,015
Peabody Municipal Light Plant	159,947	27,997	187,945	140,246	35,256	175,501
Princeton Municipal Light Dept.	4,112	720	4,832	3,605	906	4,512
Reading Municipal Light Dept.	177,773	31,118	208,891	155,876	39,185	195,061
Rowley Municipal Lighting Plant	13,761	2,409	16,169	12,066	3,033	15,099
Russell Municipal Light Dept.	1,590	278	1,868	1,394	350	1,745
Shrewsbury Electric & Cable Ops.	61,418	10,751	72,169	53,853	13,538	67,391
South Hadley Electric Light Dept.	6,084	1,065	7,149	5,334	1,341	6,675

	Massachusetts-based approach			Regional-based approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
Sterling Municipal Light Dept.	11,054	1,935	12,988	9,692	2,436	12,128
Taunton Municipal Lighting Plant	209,756	36,716	246,472	183,919	46,235	230,154
Templeton Muni. Light & Water	10,620	1,859	12,479	9,312	2,341	11,653
Wakefield Muni. Gas & Light	62,054	10,862	72,915	54,410	13,678	68,088
Wellesley Municipal Light Plant	72,439	12,680	85,118	63,516	15,967	79,483
West Boylston Muni. Light. Plant	9,397	1,645	11,042	8,240	2,071	10,311
Westfield Gas & Electric	69,500	12,165	81,665	60,939	15,319	76,258
2014 distribution company total	6,499,423	1,137,662	7,637,085	5,698,846	1,432,612	7,131,457
2014 competitive supplier total	7,798,779	1,365,102	9,163,882	6,838,152	1,719,018	8,557,170
2014 MED total	1,897,902	332,210	2,230,112	1,664,125	418,338	2,082,463
2014 RETAIL SELLER TOTAL GHGs	16,196,104	2,834,974	19,031,079	14,201,122	3,569,968	17,771,090

Appendix 2: Individual 2014 Retail Seller Emission Factors

Below are the 2014 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 2014 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.)	759,874	576	101	505	127	6.7%
Eversource/NSTAR	809,615	563	99	494	124	8.7%
Eversource/WMECO	170,035	562	98	493	124	8.9%
Competitive Suppliers						
Harvard Dedicated Energy	21,473	557	98	489	123	9.7%
Municipal Electric Departments						
Ashburnham Muni. Light Dept.	11,869	413	72	362	91	33.0%
Belmont Municipal Light Department	8,686	576	101	505	127	6.6%
Boylston Municipal Light Dept.	12,985	366	64	321	81	40.7%
Braintree Electric Light Dept.	74,729	494	86	433	109	20.0%
Chicopee Electric Light Dept.	28,802	579	101	508	128	6.1%
Concord Municipal Light Plant	6,793	593	104	520	131	3.8%
Danvers Electric Division	147,522	335	59	293	74	45.8%
Georgetown Municipal Light Department	14,720	446	78	391	98	27.7%
Groton Electric Light Dept.	19,668	458	80	401	101	25.8%
Groveland Municipal Light Dept.	2,407	578	101	506	127	6.4%
Hingham Municipal Lighting Plant	66,345	420	73	368	93	31.9%
Holden Municipal Light Dept.	54,406	317	56	278	70	48.6%
Holyoke Gas & Electric Dept.	318,124	83	15	73	18	86.6%

	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	
Hudson Light & Power Dept.	190,300	287	50	251	63	53.5%
Littleton Electric Light & Water	22,136	572	100	501	126	7.4%
Mansfield Municipal Electric Dept.	103,376	320	56	281	71	48.1%
Merrimac Municipal Light & Water Dept.	2,375	569	100	499	125	7.9%
Middleton Municipal Electric Dept.	40,824	367	64	322	81	40.5%
North Attleboro Electric Dept.	66,048	445	78	390	98	27.9%
Norwood Municipal Light Dept.	10,931	596	104	523	131	3.4%
Paxton Municipal Light Dept.	12,822	296	52	260	65	51.9%
Princeton Municipal Light Dept.	3,200	498	87	436	110	19.4%
Reading Municipal Light Dept.	127,559	505	88	443	111	18.1%
Rowley Municipal Lighting Plant	2,342	586	103	514	129	5.0%
Shrewsbury Electric & Cable Ops.	93,979	419	73	368	92	32.1%
South Hadley Electric Light Dept.	94,852	106	19	93	23	82.8%
Sterling Municipal Light Dept.	26,585	354	62	311	78	42.6%
Templeton Municipal Light & Water	28,919	335	59	294	74	45.7%
Wellesley Municipal Light Plant	17,467	574	101	504	127	6.9%
West Boylston Municipal Lighting Plant	28,508	319	56	279	70	48.3%
Westfield Gas & Electric	155,230	365	64	320	81	40.8%
All Other Retail Sellers	**0**	**617**	**108**	**541**	**136**	**0%**

Appendix 3: 2014 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 2014 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.

2014 RS Wholesale Non-Biogenic MA-Based EF	581 lb	Non-Biogenic CO_2e/Wholesale MWh
+ 2014 RS Wholesale Biogenic MA-Based EF	+102 lb	Biogenic CO_2e/Wholesale MWh
2014 RS Wholesale Combined MA-Based EF	683 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: 683 lb CO_2e/Wholesale MWh / (1 - 0.057) = 724 lb CO_2e/Retail MWh

Table 6. 2014 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	581	616
Biogenic	102	108
Combined	683	724

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 2014

[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 719 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 2014 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 = 0.065 lb CH_4 *and* 2.9 lb CO_2e from N_2O / 298 = 0.010 lb N_2O, *therefore*

724 lb CO_2e/Retail MWh = (719 lb CO_2 + (0.065 lb CH_4 * 25) + (0.010 lb N_2O * 298)) / Retail MWh

The breakdown of the 724 lb CO_2e/Retail MWh value from Table 6 into individual gases, at various scales of electricity, is shown in Table 7.

Table 7. 2014 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	0.719	0.000065	0.000010
lb/Retail MWh	719	0.065	0.010
lb/Retail GWh	719,000	65	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 719 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. 2014 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	0.611	0.108
lb/Retail MWh	611	108
lb/Retail GWh	611,000	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.