MassDEP GHG Reporting Program Summary Report
For Retail Sellers of Electricity
Emissions Year 2013

June 2016

The information below summarizes the 2013 greenhouse gas (GHG) emissions and megawatt hours (MWh) of electricity sales reported to the Massachusetts Department of Environmental Protection (MassDEP) by 88 of the 91[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 program is available at http://www.mass.gov/eea/agencies/massdep/climate-energy/climate/approvals/ma-greenhouse-gas-emissions-reporting-program.html; 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 fifth year of reporting under the regulation. 2008 was the initial reporting year. Annual reporting began with the 2010 reporting year. Comparisons of the first five 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 2013, 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 2013 Greenhouse Gas (GHG) Emission Factors to be used by Retail Sellers of Electricity Reporting under 310 CMR 7.71(9)*

[1] Forty-seven competitive suppliers sold retail electricity in Massachusetts in 2013. Three of these competitive suppliers failed to report (People's Power & Gas), completely report (Easy Energy), or accurately report (Glacial Energy) their 2013 GHG emissions. It is MassDEP's understanding that these three competitive suppliers no longer operate in MA.

"Reporting Requirements for Retail Sellers of Electricity" (http://www.mass.gov/eea/docs/dep/air/climate/rse13tsd.pdf).

GHG Emission Factors

Table 1 shows the initial (Step 2) and final (Step 3) emission factors upon which retail seller GHG emissions are based. (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 2013 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"* (http://www.mass.gov/eea/docs/dep/air/climate/rse13tsd.pdf).[2]

After the 2013 GHG EFs were final and retail sellers 2013 GHG reports were submitted it was discovered that the 2013 GHG EFs had been developed using the 2014 ISO generation for each New England state, instead of 2013 values. The EFs were subsequently corrected although retail sellers were not asked to resubmit their reports. Table 1 shows both the published and the corrected EFs. This calculation error affected the 2013 Massachusetts-based GHG EFs. (Regional-based EFs, which were using the 2013 total ISO generation value in their calculations, were not affected.)

For 2013, the Massachusetts-based emission factors increased from the previous year. The Regional-based emission factors continued to decrease.

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**	**Non-Biogenic**	**Biogenic**
Initial Emission Factors: **prior to** accounting for particular generating units (Step 2)				
2008	854	97	700	139
2010	798	97	662	136
2011	686	89	584	122
2012	601	90	535	120
2013 published	610	90	515	118
2013 corrected	617	91		
Final Emission Factors: **after** accounting for particular generating units (Step 3)				
2008	871	98	708	141
2010	824	101	672	138
2011	712	93	595	124
2012	628	94	546	123
2013 published	646	95	528	121
2013 corrected	654	97		

[2] The 2013 Retail Seller EFs continue to use the global warming potentials (GWPs) from Intergovernmental Panel on Climate Change's (IPCC's) Second Assessment Report (SAR) published in 1996. The Department anticipates updating to GWPs from the IPCC's Fourth Assessment Report (AR4) with the 2014 EFs, similar to most other reporting programs.

MWh Sold by Retail Sellers and Reported from Particular Generating Units

For 2013, 3 electric utilities, 1 competitive supplier, and 33 municipal electric departments or light boards chose to report MWh from particular generating units in Step 1. All MWh reported from particular generating units in the first five reporting years have been from non-emitting units. The number of optional reporters, the amount of non-emitting MWh they reported, and the percent of non-emitting MWh to total retail sales all continued to increase from 2008 to 2013.

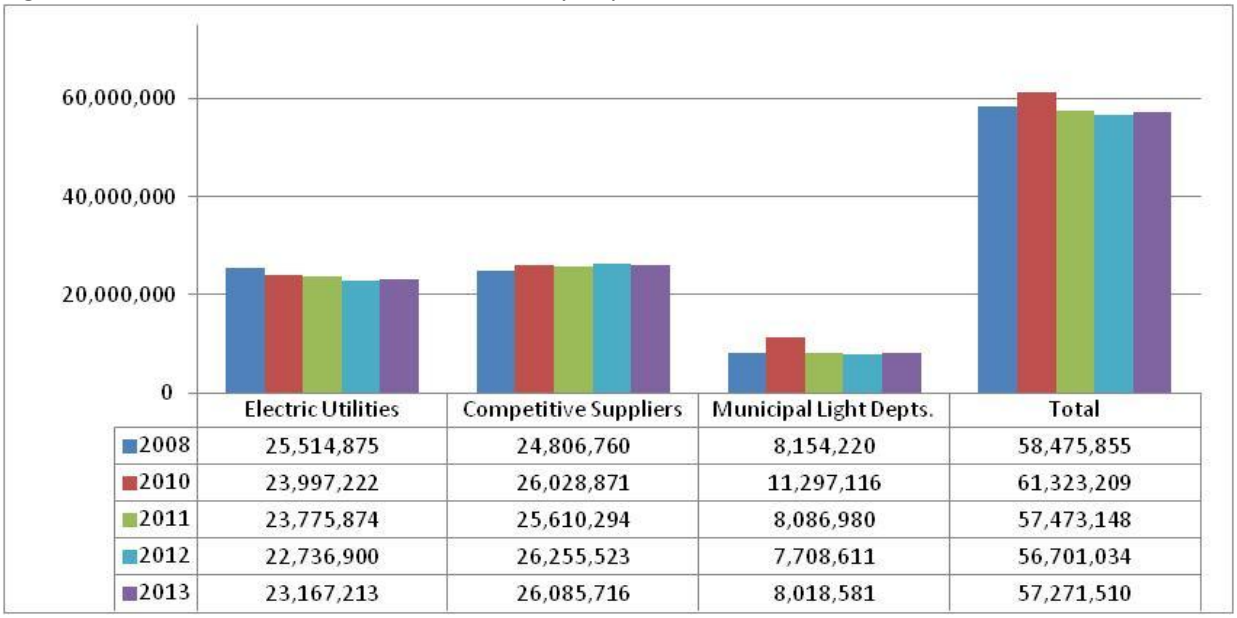
Tables 2 and 3 show the number of retail sellers reporting in 2008, and 2010 through 2013. Figure 1 shows their total retail sales.[3] Figure 2 shows the amount of non-emitting MWh from particular generating units that they chose to report and Figure 3 shows the ratio of non-emitting MWh to total retail sales. Figures 4 and 5 show this non-emitting power by fuel type (as MWh and as a percent) and Figures 6 and 7 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 Light Depts.	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

*See Footnote 1 on page 1 of this document.

Figure 1. Total MWh of Retail Sales of Electricity Reported



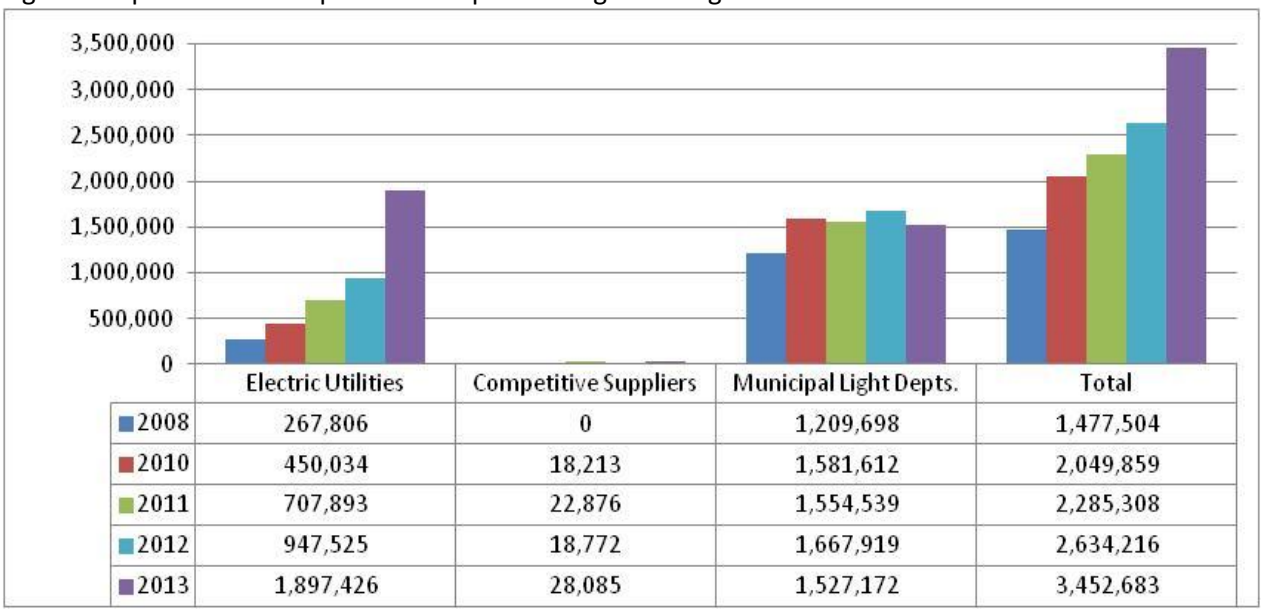
	Electric Utilities	Competitive Suppliers	Municipal Light Depts.	Total
2008	25,514,875	24,806,760	8,154,220	58,475,855
2010	23,997,222	26,028,871	11,297,116	61,323,209
2011	23,775,874	25,610,294	8,086,980	57,473,148
2012	22,736,900	26,255,523	7,708,611	56,701,034
2013	23,167,213	26,085,716	8,018,581	57,271,510

[3] The total retail sales reported by competitive suppliers for 2013 differs by 179,820 MWh from the total reported in DOER's *Massachusetts RPS & APS Annual Compliance Report for 2013* due to the three competitive suppliers that either failed to report or failed to correct their reports, as noted in footnote 1 on page 1 of this document. Several municipalities reported their total retail sales value from a line other than the TOTAL (line 15) from page 57 their *Annual Return* to DPU, or failed to subtract their Sales from Resale (line 18) from the TOTAL, as instructed. In addition, several municipalities had minor rounding or reporting errors resulting in a 1 to 4 MWh difference between what the municipalities reported to MassDEP and to DPU. The *Annual Return* TOTAL from line 15 is used throughout this document, with Sales from Resale subtracted, as necessary.

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

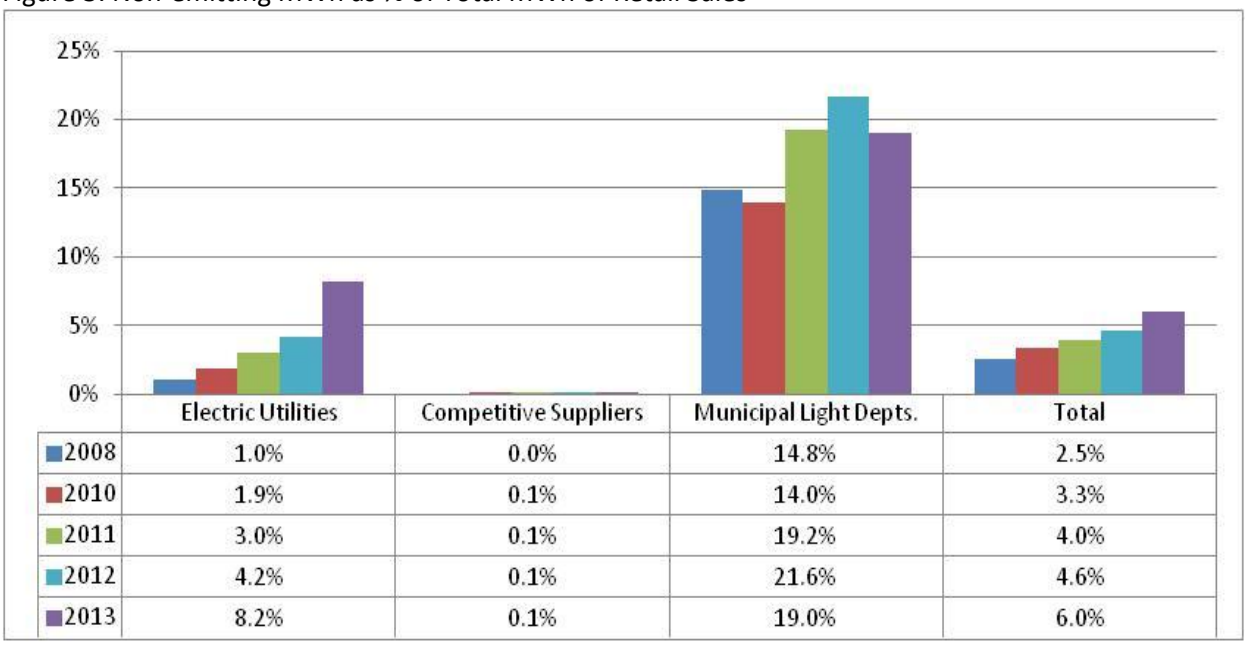
Optional Reporting (Step 1): Number of Reporters	Electric Utilities	Competitive Suppliers	Municipal Light Depts.	Total Retail Sellers
2008	2	0	17	19
2010	2	1	24	27
2011	3	1	25	29
2012	3	1	31	35
2013	3	1	33	37

Figure 2. Optional MWh reported from particular generating units



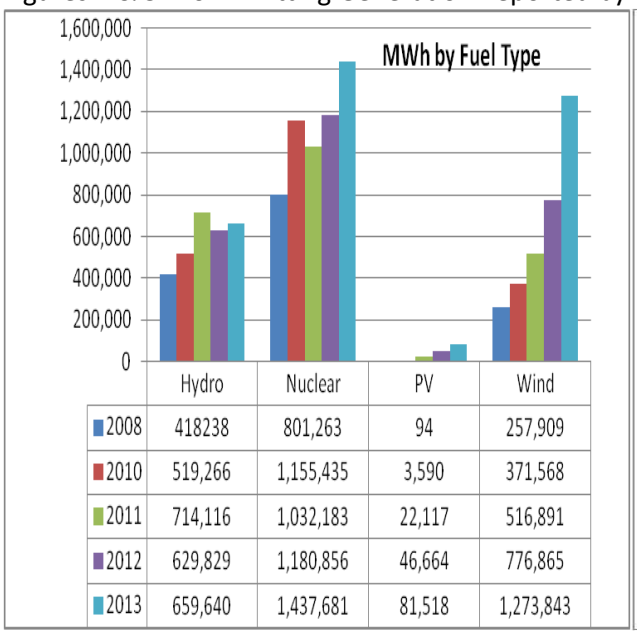
	Electric Utilities	Competitive Suppliers	Municipal Light Depts.	Total
2008	267,806	0	1,209,698	1,477,504
2010	450,034	18,213	1,581,612	2,049,859
2011	707,893	22,876	1,554,539	2,285,308
2012	947,525	18,772	1,667,919	2,634,216
2013	1,897,426	28,085	1,527,172	3,452,683

Figure 3. Non-emitting MWh as % of Total MWh of Retail Sales

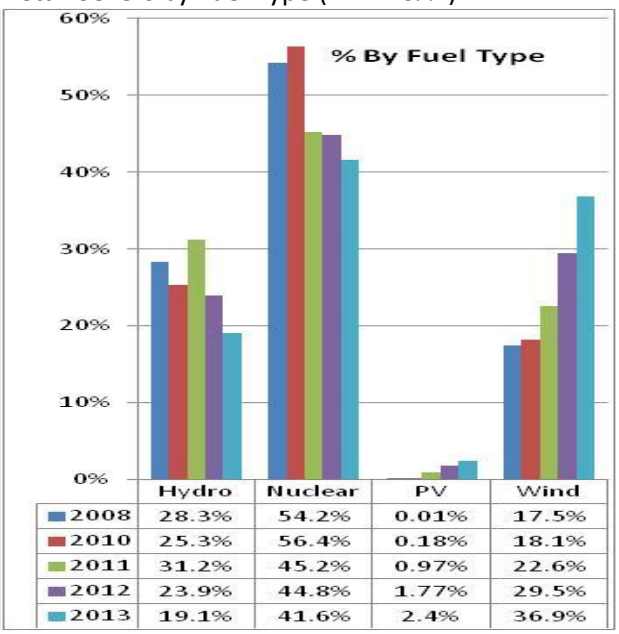


	Electric Utilities	Competitive Suppliers	Municipal Light Depts.	Total
2008	1.0%	0.0%	14.8%	2.5%
2010	1.9%	0.1%	14.0%	3.3%
2011	3.0%	0.1%	19.2%	4.0%
2012	4.2%	0.1%	21.6%	4.6%
2013	8.2%	0.1%	19.0%	6.0%

Figures 4 & 5. Non-Emitting Generation Reported by Retail Sellers by Fuel Type (MWh & %)

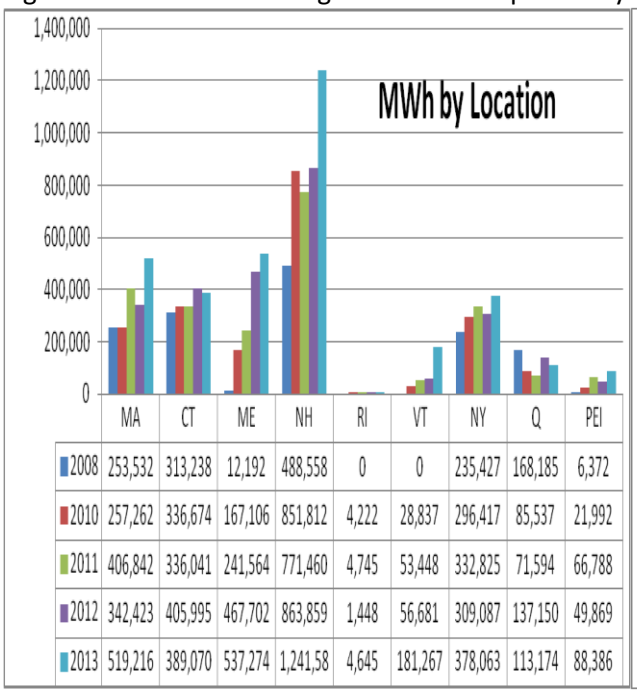


	Hydro	Nuclear	PV	Wind
2008	418238	801,263	94	257,909
2010	519,266	1,155,435	3,590	371,568
2011	714,116	1,032,183	22,117	516,891
2012	629,829	1,180,856	46,664	776,865
2013	659,640	1,437,681	81,518	1,273,843

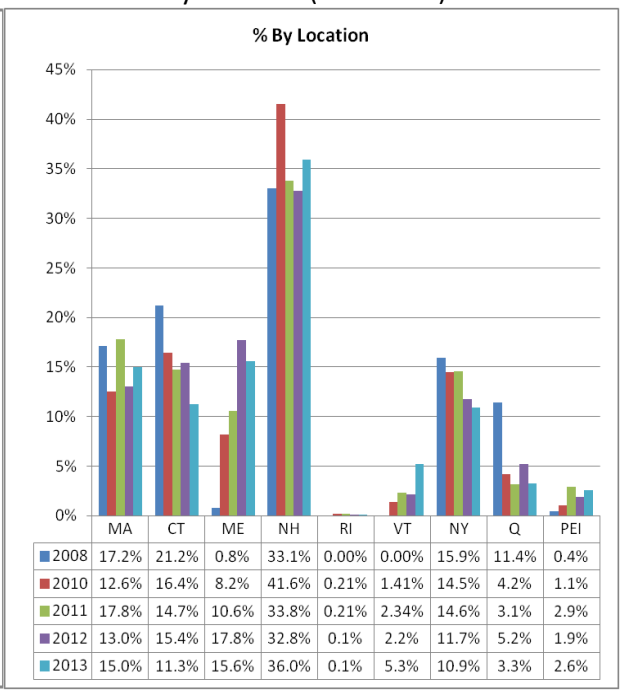


	Hydro	Nuclear	PV	Wind
2008	28.3%	54.2%	0.01%	17.5%
2010	25.3%	56.4%	0.18%	18.1%
2011	31.2%	45.2%	0.97%	22.6%
2012	23.9%	44.8%	1.77%	29.5%
2013	19.1%	41.6%	2.4%	36.9%

Figures 6 & 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



	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%

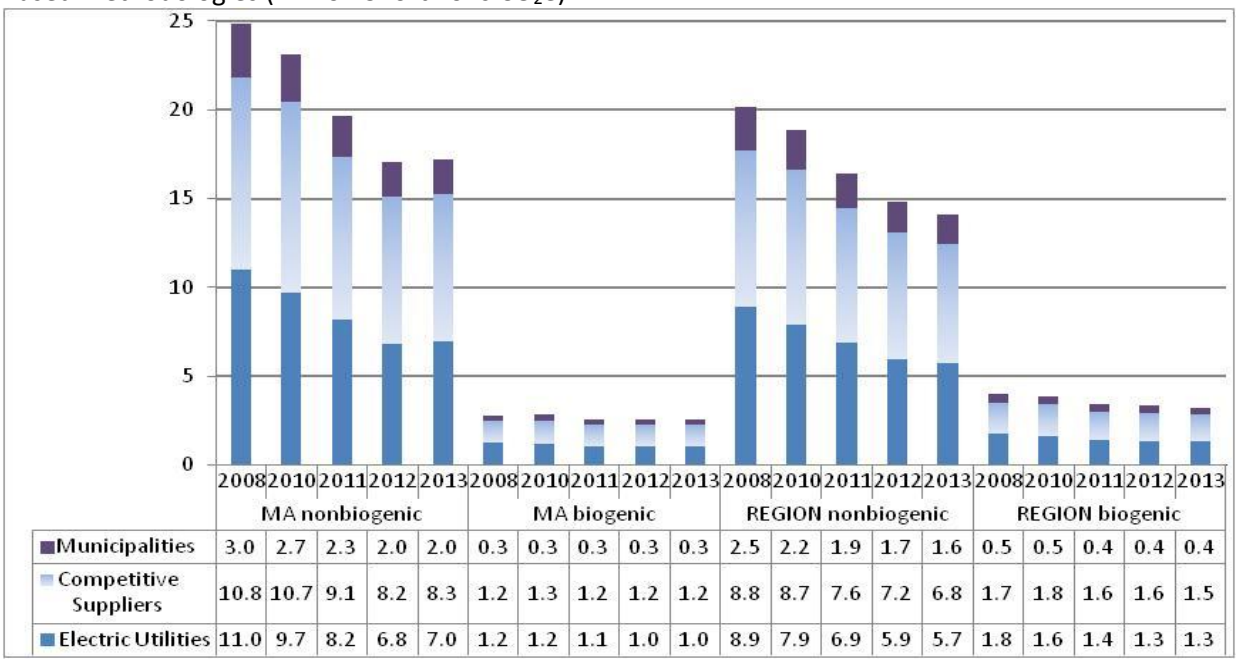
GHG Emissions Reported by Retail Sellers

For 2013, the total reported Massachusetts-based GHG emissions increased slightly from 2012 for competitive suppliers and distribution companies, due in large part to 2012 having been a very mild

weather year, with lower energy use.[4] GHG emissions in the remaining three categories decreased from earlier years, following the trend from previous years. The differences in GHG emissions between each reporting year within each retail seller type would be 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 8 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 8. 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				
	2008	2010	2011	2012	2013	2008	2010	2011	2012	2013	2008	2010	2011	2012	2013	2008	2010	2011	2012	2013
Municipalities	3.0	2.7	2.3	2.0	2.0	0.3	0.3	0.3	0.3	0.3	2.5	2.2	1.9	1.7	1.6	0.5	0.5	0.4	0.4	0.4
Competitive Suppliers	10.8	10.7	9.1	8.2	8.3	1.2	1.3	1.2	1.2	1.2	8.8	8.7	7.6	7.2	6.8	1.7	1.8	1.6	1.6	1.5
Electric Utilities	11.0	9.7	8.2	6.8	7.0	1.2	1.2	1.1	1.0	1.0	8.9	7.9	6.9	5.9	5.7	1.8	1.6	1.4	1.3	1.3

Individual Retail Seller Reporting for 2013

For each retail seller that chose to submit MWh from particular generating units in 2013, "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. [5]

Figures 9 and 10 show the MWh reported, and the ratio of those MWh to the retail seller's 2013 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 9 compares optional MWh reported as a percentage of total retail sales. Figure

[4] 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 47 competitive suppliers are included in Figure 8 and Appendix 1, including the three companies that failed to submit their 2013 reports.

[5] In 2011, one municipality 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 municipalities 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.

10 shows the variation in total MWh sales. See Appendix 2 below for individual retail seller values used in these two figures.

Figure 9. 2013 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)

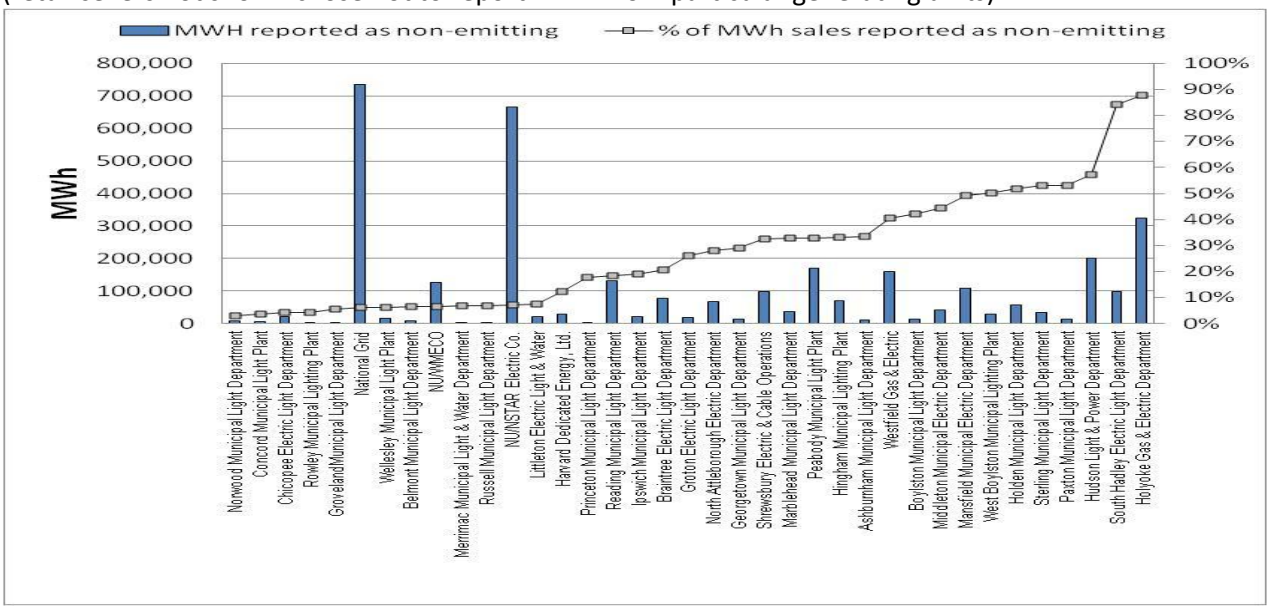
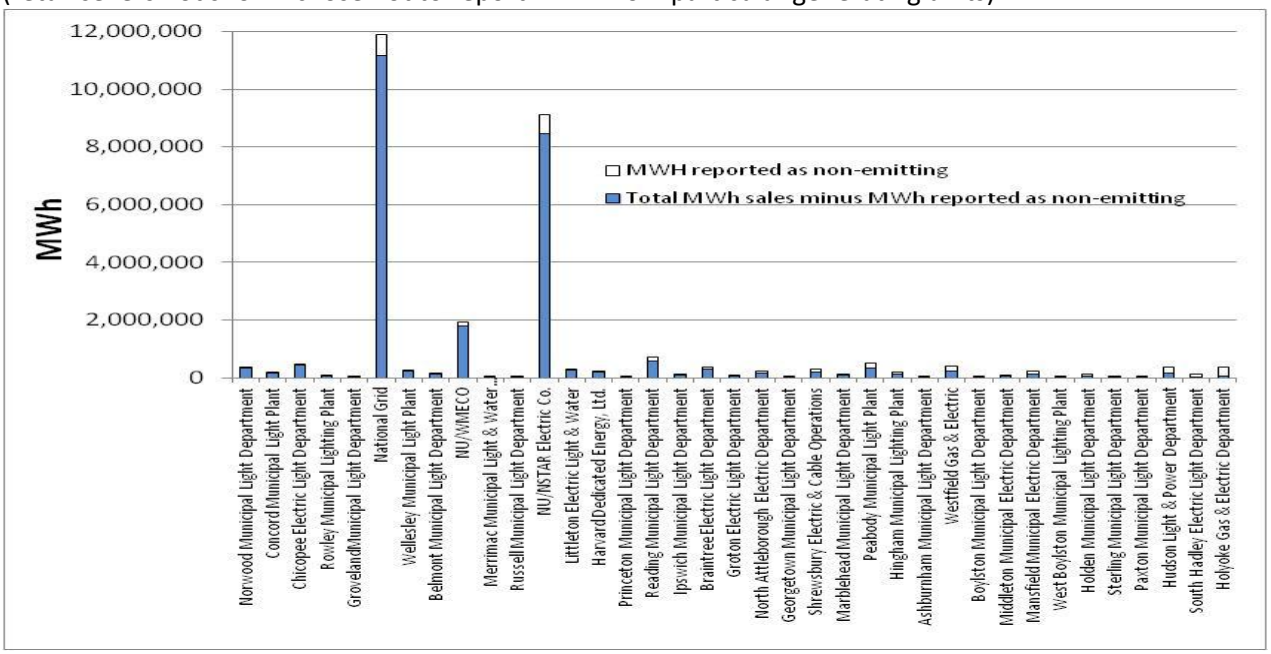


Figure 10. 2013 Electricity Sales by Retail Seller: Non-Emitting vs. All Other MWh Sales Reported
(retail sellers not shown chose not to report MWh from particular generating units)



Appendix 1: 2013 Individual Retail Seller GHG Emissions

Below are 2013 GHG emissions for each retail seller calculated by MassDEP based on:

- the final corrected GHG emission factors from Step 3 above,
- MWh reported to Department of Energy Resources by electric utilities and competitive suppliers and to DPU by municipal electric departments and light boards, less MWh from any particular generating units that a retail seller reported in Step 1. See footnotes 1, 3, and 4 regarding the retail sales and emissions of competitive suppliers and municipalities, and
- an aggregate of 2013 GHG emissions for the three competitive suppliers that failed to report 2013 emissions shown in the last row of the Competitive Suppliers section of Table 4.

Table 4. 2013 MA Retail Seller GHG Emissions (Short Tons CO_2e)

	Massachusetts-based approach		Regional-based approach	
	Non-Biogenic	**Biogenic**	**Non-Biogenic**	**Biogenic**
Electric Utilities				
NGRID (Mass. and Nantucket Elec.)	3,655,699	542,206	2,951,390	676,360
NU/NSTAR Electric Co.	2,761,554	409,588	2,229,512	510,930
NU/Western Mass. Electric Co.	584,071	86,628	471,544	108,062
Unitil (Fitchburg Gas & Electric Co.)	74,969	11,119	60,525	13,870
Competitive Suppliers				
Cianbro Energy, LLC	81	12	65	15
Clearview Electric, Inc.	9,361	1,388	7,558	1,732
Consolidated Edison Solutions, Inc.	771,300	114,398	622,701	142,702
Constellation Energy Power Choice.	47,571	7,056	38,406	8,801
Constellation NewEnergy, Inc.	1,339,636	198,692	1,081,541	247,853
Devonshire Energy	30,383	4,506	24,530	5,621
Direct Energy Business, LLC	1,200,127	178,000	968,910	222,042
Direct Energy Services, LLC	97,926	14,524	79,060	18,118
Dominion Retail, Inc.	425,225	63,069	343,301	78,673
East Avenue Energy, LLC	305	45	246	56
Easy Energy of MA	(see below)	(see below)	(see below)	(see below)
Energy Plus	28,582	4,239	23,075	5,288
First Point Power	20,607	3,056	16,637	3,813
GDF Suez Energy Resources	756,699	112,232	610,913	140,001
GDF Suez Retail Energy of MA, Inc. (dba Think Energy)	9,002	1,335	7,267	1,665
Glacial Energy of Massachusetts	(see below)	(see below)	(see below)	(see below)
Great Eastern Energy (BBPC, LLC)	21,930	3,253	17,705	4,057
Gulf Oil LP	4,276	634	3,452	791
Hampshire Council of Governments	14,121	2,097	11,400	2,613
Hannaford Energy	12,340	1,830	9,963	2,283
Harvard Dedicated Energy, Ltd.	65,874	9,770	53,183	12,188
Hess Corporation	712,974	105,747	575,612	131,911
HOP Energy	116	17	94	22
Hudson Energy Services	303,474	45,011	245,007	56,147
Integrys Energy Services, Inc.	197,172	29,244	159,184	36,480
Just Energy Massachusetts	213,879	31,722	172,673	39,571
Liberty Power Holdings	175,454	26,023	141,651	32,462
Massachusetts Gas & Electric Co.	13,075	1,939	10,556	2,419
Mega Energy Holdings, LLC	14	2	11	1

	Massachusetts-based approach		Regional-based approach	
	Non-Biogenic	Biogenic	Non-Biogenic	Biogenic
Mint Energy, LLC.	30,120	4,467	24,317	5,573
NextEra Energy	227,105	33,684	183,351	42,018
Noble Americas Energy Solutions	400,796	59,445	323,578	74,153
OBE Electric	8,946	1,327	7,223	1,655
Open Book (ECM Energy Management)	2,896	429,2,338	536	
Peoples Power & Gas	(see below)	(see below)	(see below)	(see below)
Pepco Energy Services, Inc.	3,054	453	2,465	565
Perigee Energy, Inc.	2,676	397	2,160	495
Public Power & Utility, Inc.	12,121	1,798	9,786	2,243
Reliant Energy Northeast	178,365	26,455	144,001	33,000
REP Energy	20,463	3,035	16,521	3,786
South Jersey Energy	21,635	3,209	17,467	4,003
Spark Energy, LP	2,362	350	1,907	437
Texas Retail Energy	31,050	4,605	25,068	5,745
TransCanada Power Marketing Ltd.	847,808	125,745	684,469	156,858
Verde Energy USA MA LLC	17,283	2,563	13,953	3,198
Viridian	82,602	12,251	66,688	15,283
Xoom Energy Massachusetts LLC	14,773	2,191	11,927	2,733
Easy Energy of MA, Glacial Energy of Massachusetts, Inc and Peoples Power & Gas (combined)	58,801	8,721	47,472	10,879
Municipalities				
Ashburnham Muni. Light Dept.	7,870	1,167	6,353	1,456
Belmont Municipal Light Dept.	40,111	5,949	32,384	7,421
Boylston Municipal Light Dept.	6,086	903	4,913	1,126
Braintree Electric Light Dept.	111,377	16,519	89,919	20,606
Chester Muni. Electric Light Dept.	1,910	283	1,542	353
Chicopee Electric Light Dept.	147,217	21,835	118,854	27,237
Concord Municipal Light Plant	56,264	8,345	45,424	10,410
Danvers Electric Division	108,357	16,071	87,481	20,048
Georgetown Municipal Light Dept.	11,990	1,778	9,680	2,218
Groton Electric Light Dept.	18,779	2,785	15,161	3,474
Groveland Municipal Light Dept.	11,861	1,759	9,576	2,194
Hingham Municipal Lighting Plant	45,668	6,773	36,869	8,449
Holden Municipal Light Dept.	17,327	2,570	13,989	3,206
Holyoke Gas & Electric Dept.	14,933	2,215	12,056	2,763
Hudson Light & Power Dept.	49,139	7,288	39,672	9,091
Hull Municipal Lighting Plant	17,200	2,551	13,886	3,182
Ipswich Municipal Light Dept.	31,563	4,681	25,482	5,840
Littleton Electric Light & Water	90,363	13,402	72,953	16,719
Mansfield Municipal Electric Dept.	36,599	5,428	29,548	6,771
Marblehead Municipal Light Dept.	25,119	3,726	20,280	4,647
Merrimac Muni. Light & Water	9,445	1,401	7,625	1,747
Middleborough Gas & Elec. Dept.	90,172	13,374	72,799	16,683
Middleton Muni. Electric Dept.	19,384	2,875	15,649	3,586
North Attleboro Electric Dept.	54,458	8,077	43,966	10,076
Norwood Municipal Light Dept.	104,664	15,523	84,499	19,364
Paxton Municipal Light Dept.	3,866	573	3,122	715

	Massachusetts-based approach		Regional-based approach	
	Non-Biogenic	**Biogenic**	**Non-Biogenic**	**Biogenic**
Peabody Municipal Light Plant	113,193	16,789	91,385	20,942
Princeton Municipal Light Dept.	4,772	708	3,853	883
Reading Municipal Light Dept.	191,517	28,405	154,619	35,434
Rowley Municipal Lighting Plant	14,524	2,154	11,726	2,687
Russell Municipal Light Dept.	1,591	236	1,284	294
Shrewsbury Electric & Cable Ops.	65,779	9,756	53,106	12,170
South Hadley Electric Light Dept.	6,013	892	4,855	1,113
Sterling Municipal Light Dept.	10,060	1,492	8,122	1,861
Taunton Municipal Lighting Plant	222,193	32,955	179,385	41,109
Templeton Muni. Light & Water	20,330	3,015	16,413	3,761
Wakefield Muni. Gas & Light	67,700	10,041	54,657	12,526
Wellesley Municipal Light Plant	78,693	11,672	63,532	14,559
West Boylston Muni. Light. Plant	9,710	1,440	7,839	1,796
Westfield Gas & Electric	75,842	11,249	61,230	14,032
2013 RETAIL SELLER TOTAL GHGs	**17,524,292**	**2,599,169**	**14,148,052**	**3,242,262**

Appendix 2: Individual 2013 Retail Seller Emission Factors

Below are the 2013 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 corrected EFs in Table 1.

Table 5. Individual 2013 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.)	734,042	614	91	495	114	6.2%
NU/NSTAR	665,630	606	90	489	112	7.3%
NU/WMECO	127,500	610	91	493	113	6.7%
Competitive Suppliers						
Harvard Dedicated Energy	28,085	574	85	463	106	12.2%
Municipalities						
Ashburnham Muni. Light Dept.	12,189	434	64	350	80	33.6%
Belmont Municipal Light Department	8,409	612	91	494	113	6.4%
Boylston Municipal Light Dept.	13,514	379	56	306	70	42.1%
Braintree Electric Light Dept.	78,533	519	77	419	96	20.7%
Chicopee Electric Light Dept.	20,219	626	93	505	116	4.3%
Concord Municipal Light Plant	6,395	631	94	509	117	3.6%
Georgetown Municipal Light Department	15,035	464	69	374	86	29.1%
Groton Electric Light Dept.	20,199	484	72	391	90	26.0%
Groveland Municipal Light Dept.	2,100	618	92	499	114	5.5%
Hingham Municipal Lighting Plant	69,437	437	65	353	81	33.2%
Holden Municipal Light Dept.	56,879	315	47	255	58	51.8%
Holyoke Gas & Electric Dept.	325,394	80	12	65	15	87.7%
Hudson Light & Power Dept.	202,157	279	41	225	52	57.4%
Ipswich Municipal Light Dept.	22,512	530	79	428	98	18.9%

	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	
Littleton Electric Light & Water	22,561	605	90	488	112	7.5%
Mansfield Municipal Electric Dept.	108,777	332	49	268	61	49.3%
Marblehead Municipal Light Department	37,307	440	65	355	81	32.7%
Merrimac Municipal Light & Water Dept.	2,114	609	90	492	113	6.8%
Middleton Municipal Electric Dept.	42,758	364	54	294	67	44.3%
North Attleboro Electric Dept.	68,137	471	70	380	87	28.0%
Norwood Municipal Light Dept.	9,926	634	94	512	117	3.0%
Paxton Municipal Light Dept.	13,386	307	45	248	57	53.1%
Peabody Municipal Light Plant	170,274	438	65	354	81	33.0%
Princeton Municipal Light Dept.	2,997	538	80	434	100	17.8%
Reading Municipal Light Dept.	130,806	535	79	432	99	18.3%
Rowley Municipal Lighting Plant	2,037	625	93	505	116	4.4%
Russell Municipal Light Dept.	360	609	90	492	113	6.9%
Shrewsbury Electric & Cable Ops.	97,227	441	65	356	82	32.6%
South Hadley Electric Light Dept.	98,415	103	15	83	19	84.3%
Sterling Municipal Light Dept.	33,282	308	46	248	57	53.0%
Wellesley Municipal Light Plant	16,271	613	91	495	113	6.3%
West Boylston Municipal Lighting Plant	29,804	326	48	264	60	50.1%
Westfield Gas & Electric	159,229	388	58	313	72	40.7%
All Other Retail Sellers	0	654	97	528	131	**0%**

Appendix 3: 2013 Retail Level Emission Factors to be Used by Consumers of Electricity to Report Greenhouse Gas Emissions (corrected 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 2013 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.

2013 RS Wholesale Non-Biogenic MA-Based EF	617 lb Non-Biogenic CO_2e/Wholesale MWh
+ 2013 RS Wholesale Biogenic MA-Based EF	+ 91 lb Biogenic CO_2e/Wholesale MWh
2013 RS Wholesale Combined MA-Based EF	708 lb Combined CO_2e/Wholesale MWh

Wholesale v. Retail EFs (line losses): Power lines lose 5.7%[6] (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, 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: 708 lb CO_2e/Wholesale MWh / (1 - 0.057) = 751 lb CO_2e/Retail MWh

Table 6. 2013 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	617	654
Biogenic	91	97
Combined	708	751

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 http://www.mass.gov/eea/docs/dep/air/climate/rse13calc.xls. For the 2013 retail level Combined EF, this results in 748 lb of CO_2e from CO_2, 1 lb CO_2e from CH_4, and 2 lb of CO_2e from N_2O. The global

[6] 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.

warming potential (GWP) of each gas must then be taken into account to determine the EF for each gas. The GWPs used through 2013 by MassDEP are: 1 for CO_2, 21 for CH_4, and 310 for N_2O.[7]

lb CO_2e/MWh = ((lb CO_2 *1) + (lb CH_4 * 21) + (lb N_2O * 310)) / MWh

Specifically: 1.4 lb CO_2e from CH_4 / 21 = 0.067 lb CH_4 *and* 2.3 lb CO_2e from N_2O / 310 = 0.007 lb N_2O,

therefore

751 lb CO_2e/Retail MWh = (748 lb CO_2 + (0.067 lb CH_4 * 21) + (0.007 lb N_2O * 310)) / Retail MWh

The breakdown of the 751 lb CO_2e/Retail MWh value from Table 6 into individual gases, at various scales of electricity, is shown in Table 7.

Table 7. 2013 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	0.748	0.000067	0.000007
lb/Retail MWh	748	0.067	0.007
lb/Retail GWh	748,000	67	7

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 748 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. 2013 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	0.651	0.097
lb/Retail MWh	651	97
lb/Retail GWh	651,000	97,000

[7] The global warming potentials (GWPs) are from Intergovernmental Panel on Climate Change's (IPCC's) Second Assessment Report (SAR) published in 1996. The Department anticipates updating to GWPs from the IPCC's Fourth Assessment Report (AR4) with the 2014 EFs, similar to most other reporting programs.