MassDEP GHG Reporting Program Summary Report
For Retail Sellers of Electricity
Emissions Year 2021

JANUARY 2024

The information below summarizes the 2021 greenhouse gas (GHG) emissions and megawatt hours (MWh) of electricity sales in Massachusetts by the 102 retail sellers that sold electricity in Massachusetts during that year. Retail sellers of electricity in Massachusetts are required to report this information to the Massachusetts Department of Environmental Protection (MassDEP) under regulation 310 CMR 7.75.[1] MassDEP uses this information in considering measures to reduce emissions from the electric sector. This was the thirteenth[2] year of emissions reporting by retail sellers of electricity, and the fourth year of reporting under regulation 310 CMR 7.75. Data and comparisons from the first nine reporting years under 310 CMR 7.71 are provided in the summary reports for 2008 and 2010-2017.[3] Changes to the regulation and the methodology for calculating emission factors make data from before 2018 not comparable with data since 2018; therefore, this summary only includes data beginning with 2018.

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

The retail seller reporting process consists of 4 steps:

Step 1. Unit-Specific Generation: Retail sellers report the use of MWh from unit-specific generation and any associated emissions.

Step 2. Initial GHG Emission Factors: MassDEP develops 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 the electricity consumed in Massachusetts.

Step 3. Final GHG Emission Factors: MassDEP develops 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. GHG Emissions: Retail sellers report their GHG emissions by multiplying the final emission factors in Step 3 by their electricity sold and not reported in Step 1, and then adding emissions reported in Step 1.

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[1] 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*.

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

[3] The summary reports may be found at: https://www.mass.gov/lists/massachusetts-greenhouse-gas-ghg-reporting-program-data#retail-seller-ghg-emissions-reports-.

This summary document reports data as calculated and/or corrected by MassDEP, and not necessarily as reported by retail sellers (as discussed further below).

Step 1: Unit-Specific Generation Reported by Retail Sellers

The purpose of reporting unit-specific generation is to assign to each retail seller the MWh and associated emissions from the unit-specific electricity claimed by each through ownership of the unit, contract for the power, or the purchase of certificates. Under 310 CMR 7.75, this report is mandatory for electric utilities and competitive suppliers and optional for municipal electric departments and light boards (MEDs).[4] Table 1 shows the number of retail sellers reporting MWh from specific generating units from 2018 through 2021.

Table 1. Number of Retail Sellers Reporting MWh from Unit-Specific Generation

	Electric Utilities	Competitive Suppliers	Municipal Electric Departments	Total Retail Sellers
2018	all 3	62 of 65	all 40	105 of 108
2019	all 3	56 of 61	all 40	99 of 104
2020	all 3	60 of 61	all 40	103 of 104
2021	all 3	56 of 59[5]	all 40	99 of 102

MWh and emissions from specific electricity generating units retired by electric utilities and competitive suppliers are reported through their annual 'Renewable Portfolio Standard/Alternative Portfolio Standard/Clean Energy Standard (RPS/APS/CES) Workbook' to the Massachusetts Department of Energy Resources (DOER).[6, 7] Retail sellers are then required to include these MWh and emissions in the mandatory GHG Emissions report. The reporting of MWh from specific electricity generating units by MEDs is still done through the submittal of an optional unit-specific generation report to MassDEP.

Figures 1 through 3 show the total retail sales and unit-specific generation by retail seller type for 2018 through 2021: Figure 1 shows the total retail sales; Figure 2 shows the total MWh from unit-specific generation; and Figure 3 shows the ratio of unit-specific generation to total retail sales. Figures 4 and 5 show the amount of emitting and non-emitting unit-specific generation retired by retail seller type for 2021 in MWh and as a percent of total. The increase in unit-specific generation in 2021 for electric utilities and competitive suppliers seen in Figures 2 and 3 is due to the first year of compliance with MassDEP's CES-E (clean existing generation) requirement.

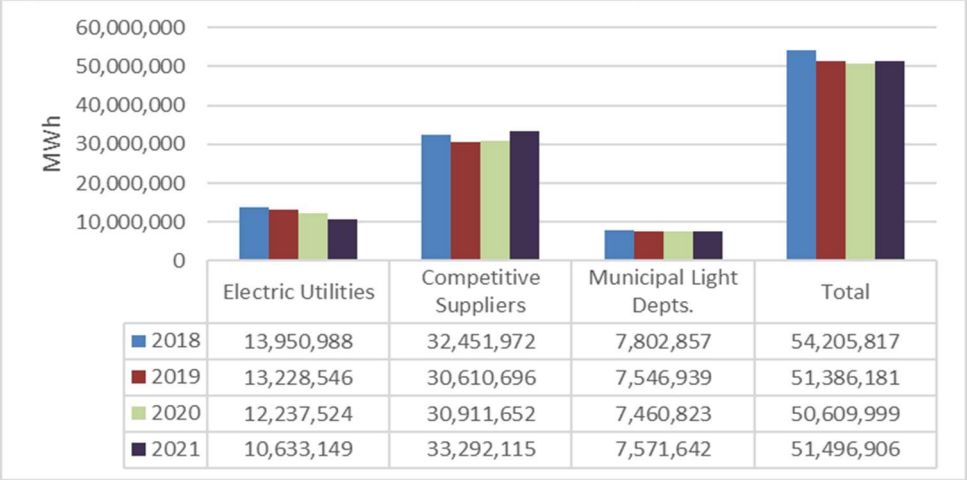
[4] In this document, Municipal Electric Departments and Municipal Light Boards are collectively referred to as municipal electric departments (MEDs).

[5] Fifty-nine competitive suppliers sold retail electricity in Massachusetts in 2021. Three competitive suppliers (Agera, Liberty and Sunwave) failed to report their 2021 unit-specific generation. It is MassDEP's understanding that these competitive suppliers no longer operate in MA.

[6] Certificates are required for compliance with DOER's Renewable Energy Portfolio Standard (RPS) https://www.mass.gov/renewable-energy-portfolio-standard and Alternative Energy Portfolio Standard (APS) https://www.mass.gov/alternative-energy-portfolio-standard programs, and MassDEP's Clean Energy Standard (CES) program https://www.mass.gov/guides/clean-energy-standard-310-cmr-775.

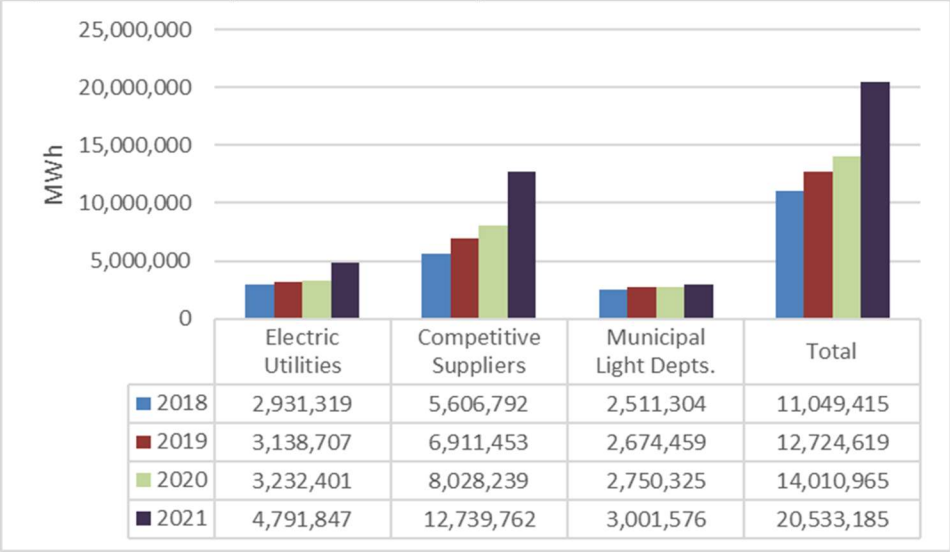
[7] For more details on Step 1 of the GHG reporting process in Massachusetts, see https://www.mass.gov/how-to/aq-31-32-retail-seller-of-electricity-greenhouse-gas-emissions-reporting.

Figure 1. Total MWh of Retail Sales of Electricity



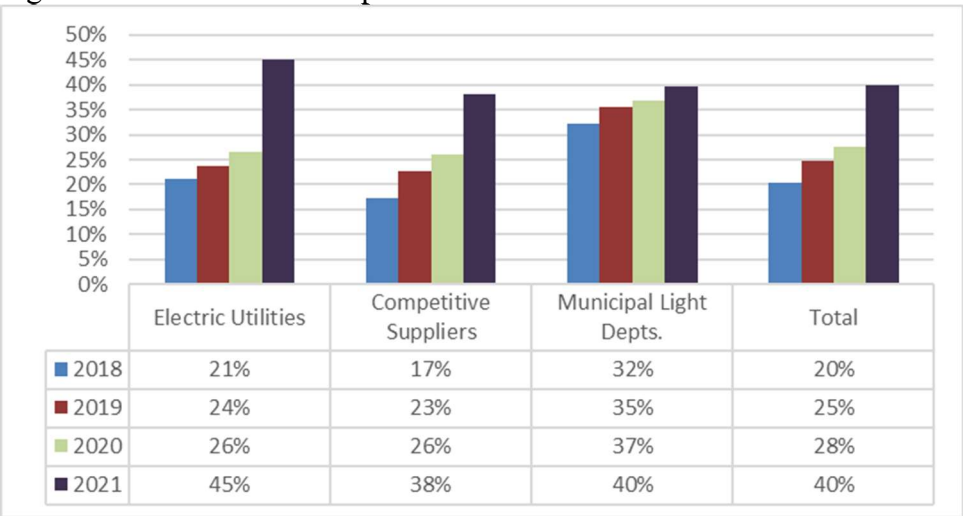
	Electric Utilities	Competitive Suppliers	Municipal Light Depts.	Total
2018	13,950,988	32,451,972	7,802,857	54,205,817
2019	13,228,546	30,610,696	7,546,939	51,386,181
2020	12,237,524	30,911,652	7,460,823	50,609,999
2021	10,633,149	33,292,115	7,571,642	51,496,906

Figure 2. MWh reported from Unit-Specific Generation



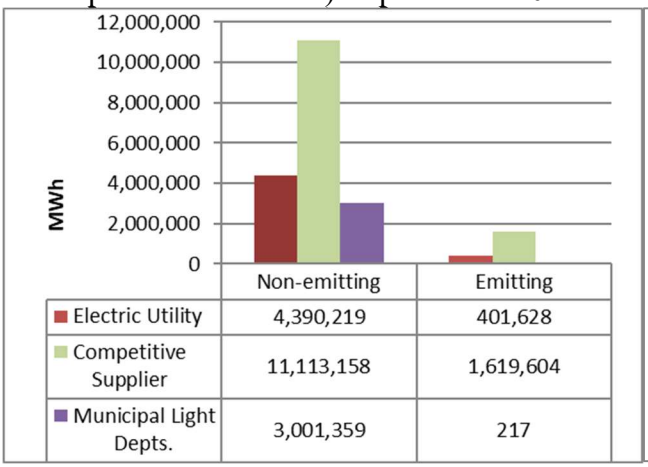
	Electric Utilities	Competitive Suppliers	Municipal Light Depts.	Total
2018	2,931,319	5,606,792	2,511,304	11,049,415
2019	3,138,707	6,911,453	2,674,459	12,724,619
2020	3,232,401	8,028,239	2,750,325	14,010,965
2021	4,791,847	12,739,762	3,001,576	20,533,185

Figure 3. MWh from Unit-Specific Generation as % of Total Retail Sales

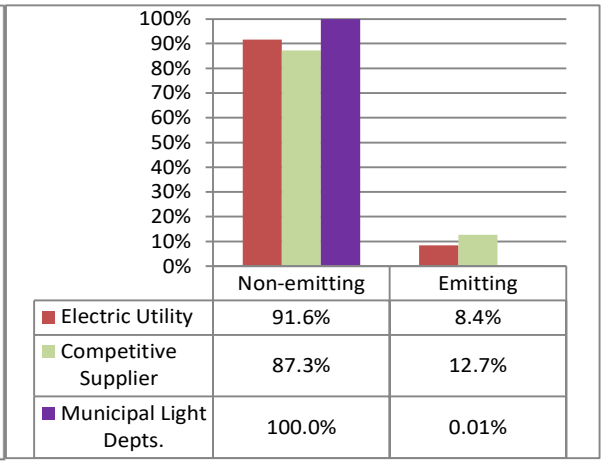


	Electric Utilities	Competitive Suppliers	Municipal Light Depts.	Total
2018	21%	17%	32%	20%
2019	24%	23%	35%	25%
2020	26%	26%	37%	28%
2021	45%	38%	40%	40%

Figures 4 and 5. Unit-Specific Non-emitting and Emitting Generation (as MWh and as Percent of Unit-Specific Generation) Reported for 2021



	Non-emitting	Emitting
Electric Utility	4,390,219	401,628
Competitive Supplier	11,113,158	1,619,604
Municipal Light Depts.	3,001,359	217



	Non-emitting	Emitting
Electric Utility	91.6%	8.4%
Competitive Supplier	87.3%	12.7%
Municipal Light Depts.	100.0%	0.01%

Details on the MWh reported by retail sellers from specific generating units can be found in Appendix 2A: *Optional Unit-Specific Generation Reported by MEDs for 2021* and Appendix 2B: *Unit-Specific Generation from GIS Certificates*[8] *Reported by Electric Utilities and Competitive Suppliers for 2021.*

Steps 2 and 3: GHG Emission Factors

Table 2 shows the initial (Step 2) and final (Step 3) emission factors upon which retail seller GHG emissions are based. The combined non-biogenic and biogenic emission factors have been included in this summary report for informational purposes. (Please note that Table 2 presents wholesale emission factors. Consumers of electricity that want to use Massachusetts-specific emission factors to report their GHG emissions from electricity use should see Appendix 3: *2021 Retail Level Emission Factors for Use by Consumers of Electricity to Report Greenhouse Gas Emissions (Massachusetts-based Emission Factors)* for appropriate values.)

For an explanation of the methodology used to calculate the initial emission factors, and of the "Massachusetts-based" and "Regional" approaches used to calculate the emission factors in Table 2, see *Draft 2021 Greenhouse Gas (GHG) Emission Factors to be used by Retail Sellers of Electricity Reporting under 310 CMR 7.75(9)(c) "Greenhouse Gas Emissions Reporting."*[9]

The RPS regulation requires electric utilities and competitive suppliers to retire certificates from emitting unit-specific generation, including municipal solid waste (MSW).[10] Therefore, electric utilities and competitive suppliers are required to claim these certificates in their unit-specific generation reports. Because MSW emissions make up the major portion of biogenic emissions, particularly in Massachusetts, the result is a decrease from the initial biogenic emission factors to

[8] Certificates are created and retired through the New England Power Pool Generation Information System (NEPOOL GIS). NEPOOL GIS "issues and tracks certificates for all MWh of generation and load produced in the ISO New England control area, as well as imported MWh from adjacent control areas." One certificate is generated for each MWh. See https://www.nepoolgis.com/.

[9] https://www.mass.gov/doc/technical-support-document-draft-2021-ghg-emission-factors/download

[10] Massachusetts retail sellers retired approximately 97% of the MWh generated in Massachusetts by MSW in 2021.

the final biogenic emission factors that are applied to non-unit-specific generation, as shown in Table 2.

Table 2. GHG Emission Factors for Electricity Consumed in Massachusetts, prior to and after accounting for Unit-Specific Generation (lb CO_2e/MWh)

	Massachusetts-based approach			Regional approach		
	Non-Biogenic	**Biogenic**	**Combined**	**Non-Biogenic**	**Biogenic**	**Combined**
Initial Emission Factors: **prior to** accounting for unit-specific generation (Step 2)						
2018	445	72	517	430	134	564
2019	416	62	478	402	119	521
2020	509	68	577	407	108	515
2021	466	71	537	426	12	552
Final Emission Factors: **after** accounting for unit-specific generation (Step 3)						
2018	486	18	504	445	118	563
2019	468	8	476	421	104	525
2020	605	2	607	431	87	518
2021	634	15	650	478	117	595

Step 4: GHG Emissions Reported by Retail Sellers

Most of the 102 retail sellers submitted their GHG emissions reports as shown in Table 3. This summary report reflects the MWh and GHG emissions data for all retail sellers that submitted their emission reports and includes data for the five competitive suppliers that failed to submit the unit-specific generation report or the GHG emissions report.

Table 3. Number of Retail Sellers Reporting GHG Emissions

	Electric Utilities	**Competitive Suppliers**	**Municipal Electric Departments**	**Total Retail Sellers**
2018	all 3	58 of 65	all 40	101 of 108
2019	all 3	56 of 61	all 40	99 of 104
2020	all 3	58 of 61	all 40	101 of 104
2021	all 3	54 of 59[11]	all 40	97 of 102

Figure 6 shows the total GHG emissions for the three types of retail sellers in 2021. Tables 4 and 5 show the corresponding values for Massachusetts-based and Regional-based non-biogenic and biogenic GHG emissions. Massachusetts-based non-biogenic GHG emissions decreased from 2020 to 2021 primarily due to the new CES-E requirement resulting in increased amounts of nuclear and hydro certificates retiring in Massachusetts. Regional emission factors and emissions are also affected because some CES-E certificates come from outside the region (see Table 2).

The information provided in Figures 3, 5 and 6 should not be used to draw comparisons between the three types of retail sellers because electric utilities and competitive suppliers are subject to two requirements that MEDs are not: 1. reporting all unit-specific electricity generation and 2. retiring MSW certificates, which causes electric utilities and competitive suppliers to have higher relative emissions than MEDs.

[11] Five competitive suppliers (Agera, Astral, Liberty, Mega and Sunwave) failed to report their 2021 GHG emissions. It is MassDEP's understanding that these competitive suppliers no longer operate in MA.

Figure 6. GHG Emissions Reported by Retail Seller Type and Year using the Massachusetts-based and Regional methodologies (Short Tons CO_2e)

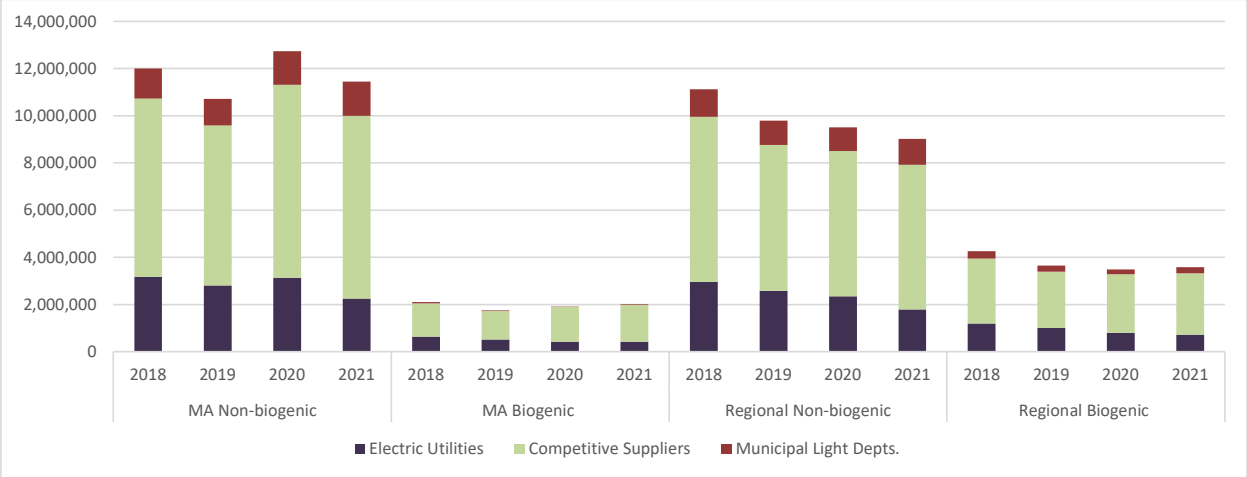


Table 4. GHG Emissions Reported by Retail Seller Type and Year using the Massachusetts-based methodology (Short Tons CO_2e)

	Non-biogenic GHG emissions				Biogenic GHG emissions			
	2018	2019	2020	2021	2018	2019	2020	2021
Electric Utilities	3,183,196	2,818,274	3,140,224	2,247,553	642,062	520,238	421,645	425,224
Competitive Suppliers	7,548,168	6,768,544	8,179,280	7,752,319	1,411,351	1,213,013	1,482,424	1,559,685
Municipal Light Depts.	1,285,864	1,140,160	1,424,945	1,449,539	50,927	19,490	8,410	35,258
Total	12,017,228	10,726,978	12,744,449	11,449,411	2,104,342	1,752,741	1,912,479	2,020,167

Table 5. GHG Emissions Reported by Retail Seller Type and Year using the Regional methodology (Short Tons CO_2e)

	Non-biogenic GHG emissions				Biogenic GHG emissions			
	2018	2019	2020	2021	2018	2019	2020	2021
Electric Utilities	2,957,292	2,581,163	2,356,779	1,789,729	1,193,045	1,004,550	804,363	722,600
Competitive Suppliers	6,997,842	6,191,248	6,142,781	6,141,486	2,753,611	2,392,169	2,477,265	2,605,989
Municipal Light Depts.	1,177,388	1,025,657	1,015,131	1,091,351	315,506	253,369	208,607	267,916
Total	11,132,522	9,798,068	9,514,691	9,022,566	4,262,162	3,650,089	3,490,235	3,596,505

The GHG emissions for each individual retail seller, and the total GHG emissions for each of the three types of retail seller, can be found in Appendix 1: *2021 Individual Retail Seller GHG Emissions*.

Appendix 1: 2021 Individual Retail Seller GHG Emissions

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

- the final GHG emission factors,
- MWh reported as retail load to MassDEP for compliance with the Clean Energy Standard by electric utilities and competitive suppliers and to the Department of Public Utilities (DPU) by MEDs, less MWh reported from unit-specific generation, and
- GHG emissions reported from unit-specific generation, as adjusted by MassDEP.[12]

Competitive suppliers that failed to submit reports as noted above, or that failed to re-submit corrected reports, are marked with an asterisk. GHG emissions were calculated for these retail sellers.

Table 6. 2021 Massachusetts Retail Seller GHG Emissions (Short Tons CO_2e)

	Massachusetts-based approach			Regional approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
Electric Utilities						
Unitil (Fitchburg Gas & Electric Co.)	35,724	6,833	42,557	28,461	11,551	40,012
National GRID (Mass. and Nantucket Electric)	1,203,333	227,977	1,431,310	958,472	387,025	1,345,497
Eversource/NSTAR Electric Co. and Western MA Electric Cos.	1,008,495	190,414	1,198,909	802,796	324,024	1,126,820
Competitive Suppliers						
Actual Energy Inc	2,979	538	3,517	2,365	937	3,302
Agera Energy LLC*	26	1	27	20	5	25
Alpha Gas & Electric, LLC	1,838	704	2,542	1,465	946	2,411
Ambit Northeast, LLC	40,375	8,104	48,479	32,007	13,539	45,547
American Power & Gas of MA, LLC	235	35	270	185	68	253
Astral Energy, LLC*	32	8	40	26	12	37
Atlantic Energy, LLC	14,235	2,562	16,797	11,299	4,469	15,768
BP Energy Retail Company LLC	418,075	83,665	501,740	331,583	139,845	471,428
Calpine Energy Solutions LLC	308,335	50,665	359,000	243,536	92,755	336,291
Champion Energy Services	72,359	11,235	83,594	56,964	21,235	78,199
CleanChoice Energy Inc.	41,804	7,724	49,528	33,744	12,960	46,704
Clearview Electric, Inc.	27,241	4,539	31,780	21,526	8,251	29,777
Constellation NewEnergy, Inc.	2,902,951	602,945	3,505,896	2,302,391	993,033	3,295,425
Devonshire Energy, LLC	15,463	6,450	21,912	12,233	8,547	20,781
Direct Energy Business LLC	1,171,431	192,847	1,364,278	926,967	351,636	1,278,604
Direct Energy Services, LLC	31,306	15,902	47,208	24,719	20,180	44,899
Discount Power, Inc.	8,276	4,873	13,149	6,589	5,969	12,558
Dynegy Energy Services (East), LLC	415,795	82,437	498,232	330,027	138,147	468,174

[12] Alternative Compliance Payments (ACPs) are not considered as part of Retail Seller GHG Reporting, and certificates previously banked with DOER are accounted for in the year they were generated, and therefore result in no MWh being subtracted and no emissions being added to a retail seller's GHG emissions report in Step 4.

	Massachusetts-based approach			Regional approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
Eligo Energy MA LLC	21,231	3,474	24,705	16,755	6,381	23,136
Energy Plus Holdings	3,200	1,227	4,427	2,544	1,653	4,197
Engie Resources, LLC	704,568	150,721	855,289	557,396	246,316	803,712
Everyday Energy LLC Rewards	235	41	276	186	72	259
First Point Power	186,362	34,794	221,156	147,445	60,072	207,517
Green Mountain Energy Company	2,912	541	3,453	2,316	929	3,244
Grid Power Direct, LLC	3,237	568	3,804	2,565	1,004	3,569
Harborside Energy of Massachusetts LLC	2,100	354	2,454	1,660	640	2,300
Harvard Dedicated Energy, Ltd.	30,409	737	31,145	22,895	5,617	28,512
Hudson Energy Services	175,169	36,198	211,367	138,454	60,046	198,500
Inspire Energy Holdings, LLC	99,848	22,536	122,384	79,135	35,990	115,125
Interstate Gas Supply, Inc (dba IGS Energy)	51,119	13,050	64,169	40,715	19,807	60,523
Just Energy Mass. Corp.	18,237	2,278	20,515	14,212	4,892	19,104
Liberty Power Holdings*	529	13	542	398	98	496
Major Energy Electric Service, LLC	8,286	1,904	10,190	6,685	2,944	9,629
Massachusetts Gas & Electric Co.	18,297	3,044	21,341	14,457	5,538	19,996
Mega Energy Holdings, LLC*	6,604	2,235	8,838	5,516	2,941	8,457
MidAmerican Energy Services LLC	5,325	129	5,454	4,010	984	4,993
MP2 Energy NE LLC	8,085	6,704	14,789	6,460	7,760	14,219
National Gas & Electric, Inc	8,565	1,560	10,125	6,803	2,704	9,508
NextEra Energy	475,438	102,049	577,487	377,917	165,393	543,310
Nordic Energy Services	4,967	899	5,866	3,944	1,564	5,508
Palmco Power MA, LLC	10,072	1,736	11,807	7,974	3,098	11,072
Provider Power MASS, LLC	26,900	4,547	31,447	21,274	8,201	29,475
Public Power, LLC	33,814	3,163	36,977	26,073	8,191	34,264
Reliant Energy Northeast	89,808	16,855	106,664	71,464	28,771	100,235
Renaissance Power and Gas	2,059	333	2,392	1,625	615	2,240
Residents Energy, LLC	78,501	34,330	112,831	62,891	44,470	107,360
SFE Energy Massachusetts	28,762	1,980	30,742	21,657	6,595	28,252
SmartEnergy Holdings, LLC	22,509	3,394	25,903	17,630	6,563	24,193
Spark Energy, LLC	1	1	2	1	1	2
Starion Energy, Inc.	27,425	5,140	32,566	21,822	8,780	30,602
Summer Energy	3,136	519	3,654	2,477	946	3,424
Sunwave Gas & Power Massachusetts, Inc.*	1,096	27	1,122	825	202	1,027
Texas Retail Energy	22,690	6,685	29,375	17,845	9,832	27,677
Think Energy, LLC	14,481	2,660	17,141	11,508	4,591	16,100
Titan Gas and Power	16,251	2,919	19,170	12,897	5,097	17,995
Town Square Energy, LLC	11,408	3,731	15,139	9,104	5,227	14,331

	Massachusetts-based approach			Regional approach		
	Non-Biogenic	Biogenic	Combined	Non-Biogenic	Biogenic	Combined
Verde Energy USA Massachusetts, LLC	13,660	2,401	16,061	10,827	4,241	15,068
Viridian Energy, LLC	32,231	5,498	37,728	25,503	9,868	35,370
Xoom Energy Massachusetts LLC	10,036	3,479	13,515	7,976	4,817	12,793
Municipal Electric Departments						
Ashburnham Muni. Light Dept.	7,766	188	7,955	5,847	1,435	7,282
Belmont Municipal Light Dept.	25,524	618	26,142	19,217	4,715	23,932
Boylston Municipal Light Dept.	6,979	169	7,148	5,254	1,289	6,543
Braintree Electric Light Dept.	47,267	1,145	48,412	35,587	8,732	44,319
Chester Muni. Electric Light Dept.	1,664	40	1,705	1,253	307	1,560
Chicopee Electric Light Dept.	136,374	3,304	139,678	102,675	25,192	127,868
Concord Municipal Light Plant	8,692	355	9,046	6,544	1,749	8,294
Danvers Electric Division	49,436	1,198	50,633	37,220	9,132	46,352
Georgetown Municipal Light Dept.	11,146	270	11,416	8,392	2,059	10,451
Groton Electric Light Dept.	18,026	437	18,462	13,571	3,330	16,901
Groveland Municipal Light Dept.	10,322	250	10,572	7,772	1,907	9,678
Hingham Municipal Lighting Plant	30,205	732	30,937	22,741	5,580	28,321
Holden Municipal Light Dept.	17,068	413	17,481	12,850	3,153	16,003
Holyoke Gas & Electric Dept.	13,360	324	13,684	10,059	2,468	12,527
Hudson Light & Power Dept.	13,151	319	13,469	9,901	2,429	12,330
Hull Municipal Lighting Plant	8,264	200	8,464	6,222	1,527	7,748
Ipswich Municipal Light Dept.	26,143	633	26,777	19,683	4,829	24,513
Littleton Electric Light & Water	64,501	1,562	66,063	48,562	11,915	60,477
Mansfield Municipal Electric Dept.	37,389	906	38,294	28,150	6,907	35,057
Marblehead Municipal Light Dept.	22,406	543	22,949	16,870	4,139	21,009
Merrimac Muni. Light & Water	7,876	191	8,067	5,930	1,455	7,385
Middleborough Gas & Elec. Dept.	30,793	746	31,539	23,184	5,688	28,872
Middleton Muni. Electric Dept.	18,201	441	18,642	13,704	3,362	17,066
North Attleboro Electric Dept.	49,215	1,192	50,408	37,054	9,092	46,146

	Massachusetts-based approach			Regional approach		
	Non-Biogenic	**Biogenic**	**Combined**	**Non-Biogenic**	**Biogenic**	**Combined**
Norwood Municipal Light Dept.	90,550	2,193	92,744	68,175	16,727	84,902
Paxton Municipal Light Dept.	3,630	88	3,718	2,733	671	3,404
Peabody Municipal Light Plant	102,849	2,491	105,341	77,435	18,999	96,434
Princeton Municipal Light Dept.	4,871	118	4,989	3,667	900	4,567
Reading Municipal Light Dept.	165,823	4,017	169,840	124,848	30,632	155,480
Rowley Municipal Lighting Plant	10,221	248	10,469	7,696	1,888	9,584
Russell Municipal Light Dept.	1,473	36	1,509	1,109	272	1,381
Shrewsbury Electric & Cable Ops.	58,394	1,415	59,809	43,965	10,787	54,752
South Hadley Electric Light Dept.	4,007	97	4,104	3,017	740	3,757
Sterling Municipal Light Dept.	12,264	297	12,561	9,234	2,266	11,499
Taunton Municipal Lighting Plant	176,255	4,270	180,525	132,701	32,559	165,261
Templeton Muni. Light & Water	12,276	297	12,574	9,243	2,268	11,511
Wakefield Muni. Gas & Light	33,427	810	34,237	25,167	6,175	31,342
Wellesley Municipal Light Plant	38,572	934	39,507	29,041	7,125	36,166
West Boylston Muni. Light. Plant	9,601	233	9,833	7,228	1,774	9,002
Westfield Gas & Electric	63,555	1,540	65,094	47,850	11,740	59,591
2021 Electric Utility Total	**2,247,553**	**425,224**	**2,672,777**	**1,789,729**	**722,600**	**2,512,329**
2021 Competitive Supplier Total	**7,752,319**	**1,559,685**	**9,312,005**	**6,141,486**	**2,605,989**	**8,747,475**
2021 MED Total	**1,449,539**	**35,258**	**1,484,797**	**1,091,351**	**267,916**	**1,359,267**
2021 RETAIL SELLER TOTAL	**11,449,411**	**2,020,167**	**13,469,578**	**9,022,566**	**3,596,505**	**12,619,070**

Appendix 2A: Optional Unit-Specific Generation Reported by MEDs for 2021

Below is a summary of the 2021 data that MEDs chose to submit from unit-specific generation. Most unit-specific generation submitted by MEDs in 2021 was non-emitting. Figures 7 and 8 show the unit-specific MWh reported by each MED and the ratio of their unit-specific MWh to their retail sales. MEDs are presented in order of increasing percentage of unit-specific generation reported. Figure 7 compares the unit-specific MWh reported as a percentage of total retail sales. Figure 8 shows the variation in total MWh sales. See Table 7 for individual MED values used in Figures 7 and 8. Table 8 shows the individual MED lb CO_2e/MWh emission rates (GHG emissions divided by retail load).

Figure 7. Unit-specific MWh Reported by MEDs (MWh and Percent of Total Retail Sales)

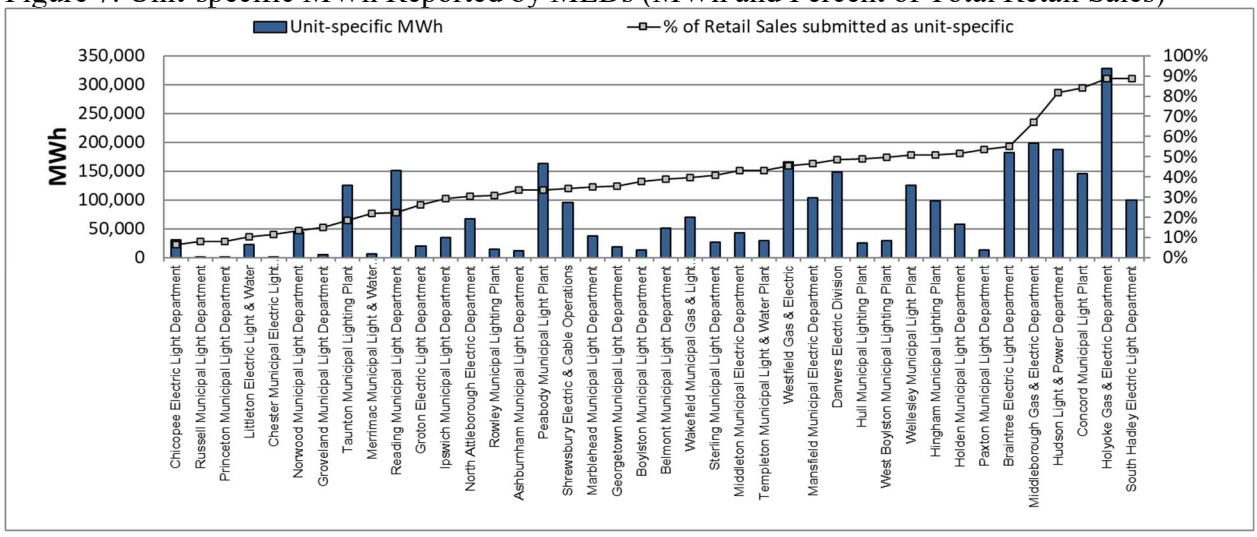


Figure 8. Electricity Sales by MED: Unit-Specific MWh vs. Total Retail Sales MWh

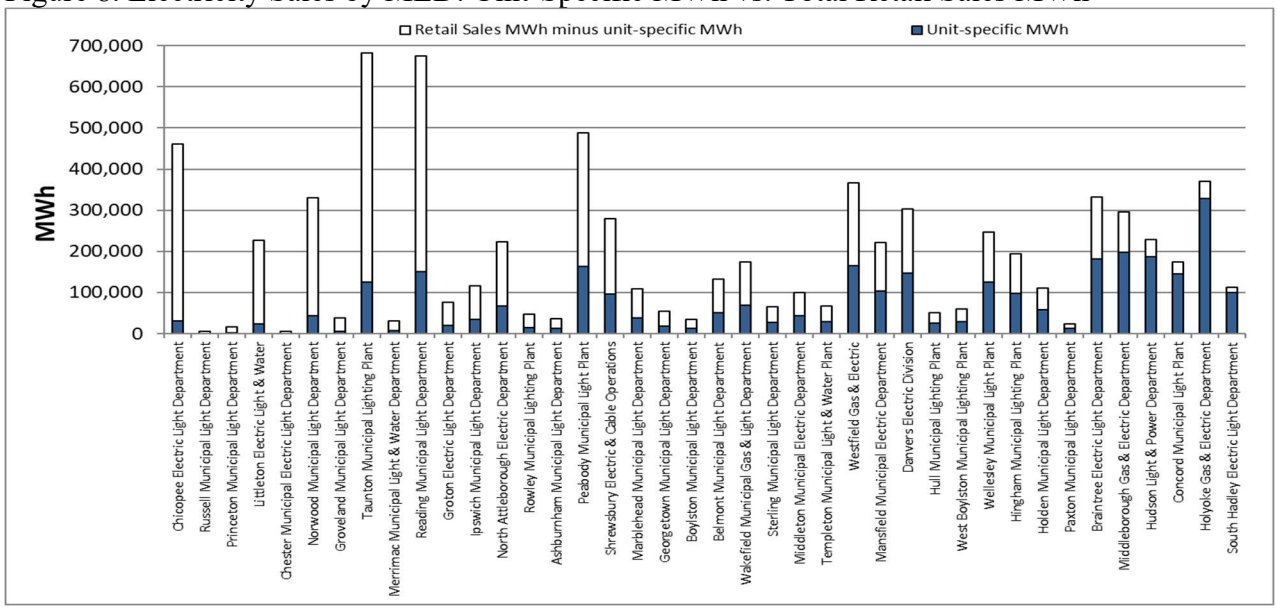


Table 7. Individual 2021 MED Percent of Sales Claimed as Unit-Specific Generation

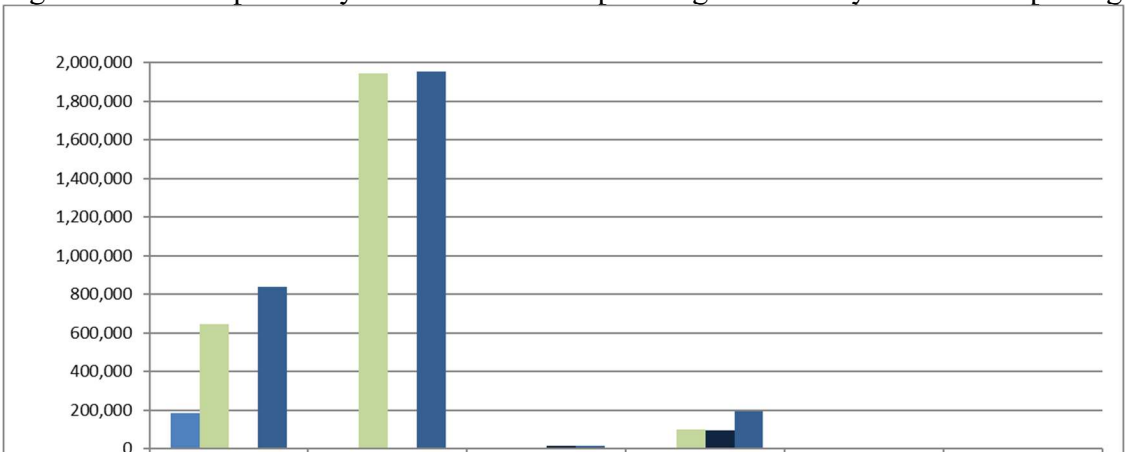
	MWh reported as retail sales	MWh claimed as unit-specific generation		% of sales claimed as unit-specific generation
		non-emitting	emitting	
Ashburnham Muni. Light Dept.	36,777	12,291	0	33.4%
Belmont Municipal Light Department	132,098	51,627	0	39.1%
Boylston Municipal Light Dept.	35,353	13,351	0	37.8%
Braintree Electric Light Dept.	331,418	182,396	0	55.0%
Chester Municipal Electric Light Dept.	5940	693	0	11.7%
Chicopee Electric Light Dept.	460,421	30,464	0	6.6%
Concord Municipal Light Plant	173,558	145,941	217	84.2%
Danvers Electric Division	303,684	147,824	0	48.7%
Georgetown Municipal Light Department	54,402	19,260	0	35.4%
Groton Electric Light Dept.	76,945	20,114	0	26.1%
Groveland Municipal Light Dept.	38,250	5,706	0	14.9%
Hingham Municipal Lighting Plant	194,242	99,013	0	51.0%
Holden Municipal Light Dept.	111,787	57,976	0	51.9%
Holyoke Gas & Electric Dept.	370,248	328,127	0	88.6%
Hudson Light & Power Dept.	229,105	187,644	0	81.9%
Hull Municipal Lighting Plant	51,223	25,170	0	49.1%
Ipswich Municipal Light Department	116,877	34,453	0	29.5%
Littleton Electric Light & Water	226,767	23,411	0	10.3%
Mansfield Municipal Electric Dept.	221,266	103,388	0	46.7%
Marblehead Municipal Light Dept.	108,607	37,965	0	35.0%
Merrimac Municipal Light & Water Dept.	31,858	7,027	0	22.1%
Middleborough Gas & Electric Dept.	294,991	197,907	0	67.1%
Middleton Municipal Electric Dept.	100,838	43,454	0	43.1%
North Attleboro Electric Dept.	222,891	67,726	0	30.4%
Norwood Municipal Light Dept.	329,836	44,352	0	13.4%
Paxton Municipal Light Dept.	24,571	13,125	0	53.4%
Peabody Municipal Light Plant	488,189	163,928	0	33.6%
Princeton Municipal Light Dept.	16,742	1,385	0	8.3%
Reading Municipal Light Dept.	674,175	151,371	0	22.5%
Rowley Municipal Lighting Plant	46,583	14,357	0	30.8%
Russell Municipal Light Department	5,046	401	0	7.9%
Shrewsbury Electric & Cable Ops.	280,143	96,039	0	34.3%
South Hadley Electric Light Dept.	112,712	100,078	0	88.8%
Sterling Municipal Light Dept.	65,341	26,675	0	40.8%
Taunton Municipal Lighting Plant	681,548	125,856	0	18.5%
Templeton Municipal Light & Water	68,048	29,343	0	43.1%
Wakefield Municipal Gas & Light Dept.	175,151	69,763	0	39.8%
Wellesley Municipal Light Plant	247,456	125,846	0	50.9%
West Boylston Municipal Lighting Plant	60,010	29,741	0	49.6%
Westfield Gas & Electric	366,545	166,171	0	45.3%
MED Total	**7,571,642**	**3,001,359**	**217**	**39.6%**

Table 8. Individual 2021 MED Emission Factors (lb CO_2e/MWh)

	Massachusetts-based approach		Regional approach	
	Non-Biogenic	**Biogenic**	**Non-Biogenic**	**Biogenic**
Final 2021 Retail Seller Emission Factors from Table 2 (applied only to non-unit-specific generation - shown for comparison)	**634.3619678**	**15.36682967**	**477.6078466**	**117.1851795**
Ashburnham Muni. Light Dept.	422	10	318	78
Belmont Municipal Light Department	386	9	291	71
Boylston Municipal Light Dept.	395	10	297	73
Braintree Electric Light Dept.	285	7	215	53
Chester Municipal Electric Light Dept.	560	14	422	104
Chicopee Electric Light Dept.	592	14	446	109
Concord Municipal Light Plant	100	4	75	20
Danvers Electric Division	326	8	245	60
Georgetown Municipal Light Department	410	10	309	76
Groton Electric Light Dept.	469	11	353	87
Groveland Municipal Light Dept.	540	13	406	100
Hingham Municipal Lighting Plant	311	8	234	57
Holden Municipal Light Dept.	305	7	230	56
Holyoke Gas & Electric Dept.	72	2	54	13
Hudson Light & Power Dept.	115	3	86	21
Hull Municipal Lighting Plant	323	8	243	60
Ipswich Municipal Light Department	447	11	337	83
Littleton Electric Light & Water	569	14	428	105
Mansfield Municipal Electric Dept.	338	8	254	62
Marblehead Municipal Light Dept.	413	10	311	76
Merrimac Municipal Light & Water Dept.	494	12	372	91
Middleborough Gas & Electric Dept.	209	5	157	39
Middleton Municipal Electric Dept.	361	9	272	67
North Attleboro Electric Dept.	442	11	332	82
Norwood Municipal Light Dept.	549	13	413	101
Paxton Municipal Light Dept.	296	7	222	55
Peabody Municipal Light Plant	421	10	317	78
Princeton Municipal Light Dept.	582	14	438	107
Reading Municipal Light Dept.	492	12	370	91
Rowley Municipal Lighting Plant	439	11	330	81
Russell Municipal Light Department	584	14	440	108
Shrewsbury Electric & Cable Ops.	417	10	314	77
South Hadley Electric Light Dept.	71	2	54	13
Sterling Municipal Light Dept.	375	9	283	69
Taunton Municipal Lighting Plant	517	13	389	96
Templeton Municipal Light & Water	361	9	272	67
Wakefield Municipal Gas & Light Dept.	382	9	287	71
Wellesley Municipal Light Plant	312	8	235	58
West Boylston Municipal Lighting Plant	320	8	241	59
Westfield Gas & Electric	347	8	261	64
Average MED Emission Factors	**383**	**9**	**288**	**71**

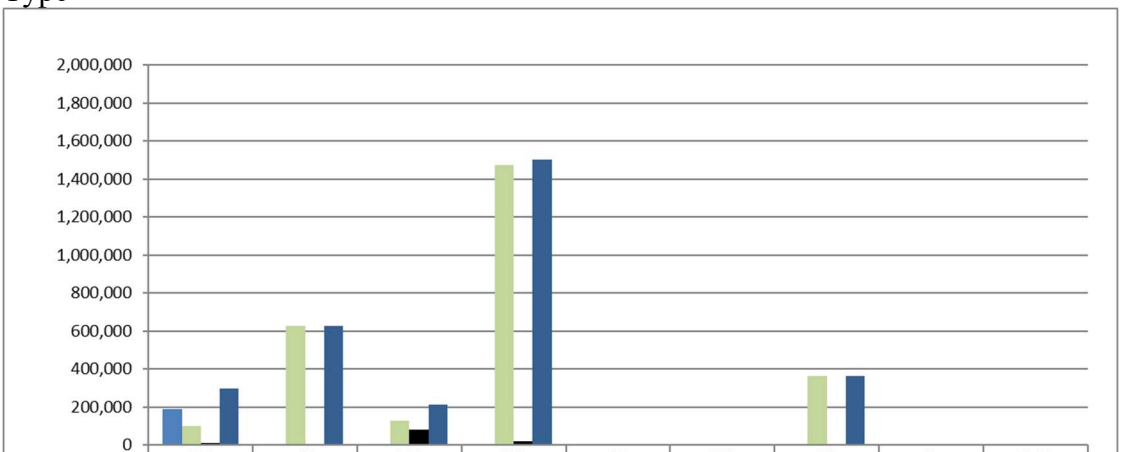
Figures 9 and 10 show the MWh reported by MEDs from unit-specific generation by fuel and reporting type and by location and reporting type. Figures 11, 12 and 13 show the unit-specific generation reported by MEDs as a percent by fuel, by location and by reporting type. Information on GHG emissions of each MED can be found in Appendix 1: *2021 Individual Retail Seller GHG Emissions*.

Figure 9. MWh reported by MEDs from unit-specific generation by Fuel and Reporting Type



	HYDRO	NUCLEAR	PV	WIND	DIGESTER GAS	LANDFILL GAS
OWNED	186,306	7,625	2,432	0	0	0
CONTRACT	647,777	1,945,155	0	100,995	0	0
CERTIFICATE	4,726	0	13,107	93,236	217	0
TOTAL	838,809	1,952,780	15,539	194,231	217	0

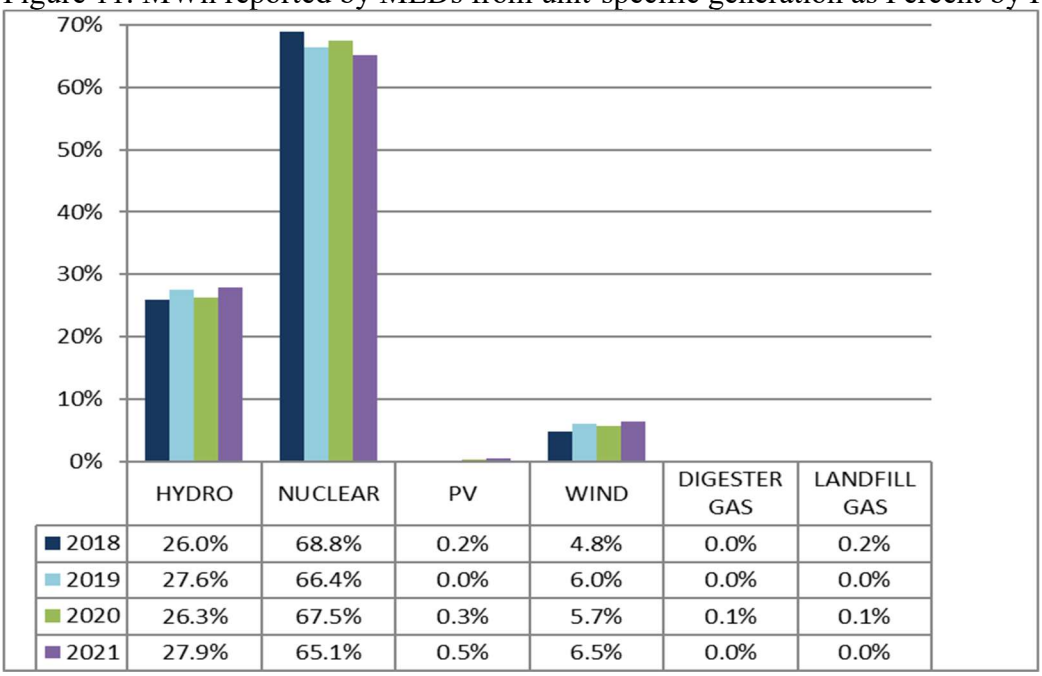
Figure 10. MWh reported by MEDs from unit-specific generation by Location and Reporting Type



	MA	CT	ME	NH	RI	VT	NY	Q	CMP
OWNED	188,738	0	0	7,625	0	0	0	0	0
CONTRACT	100,477	624,636	129,463	1,474,384	0	0	364,967	0	0
CERTIFICATE	8,145	0	81,640	19,434	1,670	397	0	0	0
TOTAL	297,360	624,636	211,103	1,501,443	1,670	397	364,967	0	0

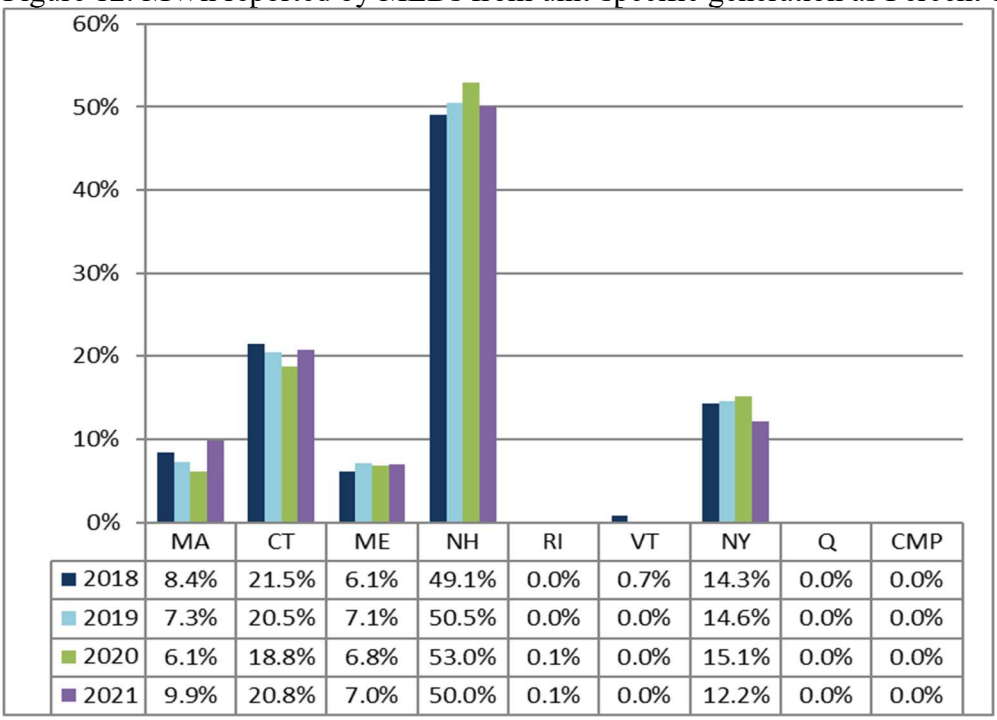
(Q = Quebec; CMP = Canadian Maritime Provinces)

Figure 11. MWh reported by MEDs from unit-specific generation as Percent by Fuel Type



	HYDRO	NUCLEAR	PV	WIND	DIGESTER GAS	LANDFILL GAS
2018	26.0%	68.8%	0.2%	4.8%	0.0%	0.2%
2019	27.6%	66.4%	0.0%	6.0%	0.0%	0.0%
2020	26.3%	67.5%	0.3%	5.7%	0.1%	0.1%
2021	27.9%	65.1%	0.5%	6.5%	0.0%	0.0%

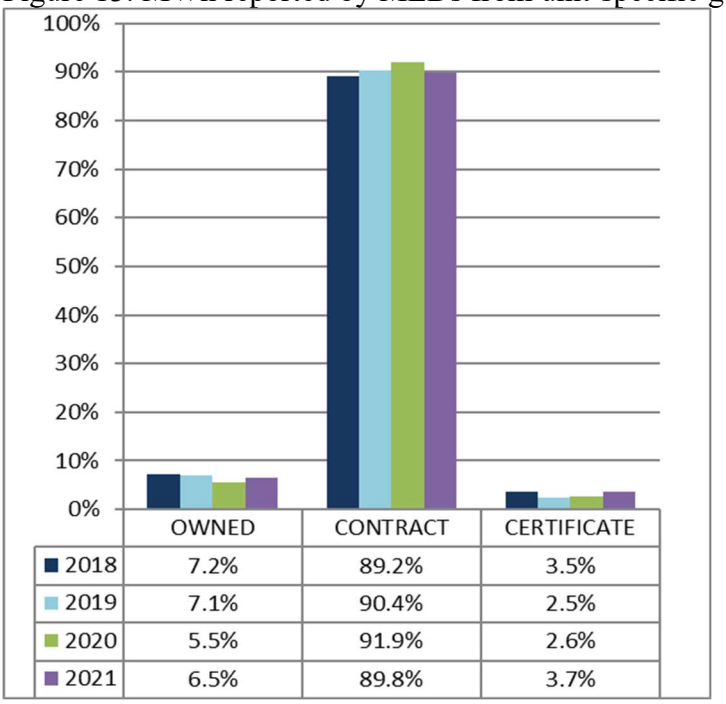
Figure 12. MWh reported by MEDs from unit-specific generation as Percent by Location



	MA	CT	ME	NH	RI	VT	NY	Q	CMP
2018	8.4%	21.5%	6.1%	49.1%	0.0%	0.7%	14.3%	0.0%	0.0%
2019	7.3%	20.5%	7.1%	50.5%	0.0%	0.0%	14.6%	0.0%	0.0%
2020	6.1%	18.8%	6.8%	53.0%	0.1%	0.0%	15.1%	0.0%	0.0%
2021	9.9%	20.8%	7.0%	50.0%	0.1%	0.0%	12.2%	0.0%	0.0%

(Q = Quebec; CMP = Canadian Maritime Provinces)

Figure 13. MWh reported by MEDs from unit-specific generation as Percent by Reporting Type



	OWNED	CONTRACT	CERTIFICATE
2018	7.2%	89.2%	3.5%
2019	7.1%	90.4%	2.5%
2020	5.5%	91.9%	2.6%
2021	6.5%	89.8%	3.7%

Appendix 2B: Unit-Specific Generation from GIS Certificates Reported by Electric Utilities and Competitive Suppliers for 2021

Below is a summary of the 2021 data reported by electric utilities and competitive suppliers from unit-specific generation. Because the certificates, by state and fuel type, purchased by electric utilities and competitive suppliers for compliance[13] with various programs are already included in the RPS/APS/CES Annual Compliance Reports,[14] that information is not repeated in this summary. The use of banked certificates or payments[15] by electric utilities and competitive suppliers to meet their compliance requirements with these programs is not reflected in this summary.

"N/A" appears in the unit-specific generation columns for competitive suppliers that did not submit any unit-specific information. Competitive suppliers that failed to submit, or to correct, a unit specific or GHG emissions report are marked with an asterisk. The percent of sales claimed as unit-specific generation were calculated for those retail sellers, where possible.

Table 9: Individual 2021 Electric Utility and Competitive Supplier Percent of Sales Claimed as Unit-Specific Generation

	MWh reported as retail sales	MWh claimed as unit-specific generation		% of sales claimed as unit-specific generation
		non-emitting	emitting	
Electric Utilities				
Unitil (Fitchburg Gas & Electric Co.)	174,325	75,251	6,400	46.8%
National GRID (Mass. and Nantucket Electric)	5,769,211	2,427,839	217,228	45.8%
Eversource/NSTAR Electric Co. and Western MA Electric Cos.	4,689,613	1,887,129	178,000	44.0%
Competitive Suppliers				
Actual Energy Inc	13,475	5,144	500	41.9%
Agera Energy LLC*	83	N/A	N/A	0.0%
Alpha Gas & Electric, LLC	8,736	3,116	858	45.5%
Ambit Northeast, LLC	172,350	57,518	8,070	38.1%
American Power & Gas of MA, LLC	824	149	31	21.8%
Astral Energy, LLC*	107	21	7	26.2%
Atlantic Energy, LLC	64,262	24,420	2,378	41.7%
BP Energy Retail Company LLC	1,829,277	642,935	82,802	39.7%
Calpine Energy Solutions LLC	1,192,562	318,729	47,078	30.7%
Champion Energy Services	281,622	75,032	10,169	30.3%
CleanChoice Energy Inc.	198,240	82,749	12,650	48.1%
Clearview Electric, Inc.	113,449	36,378	4,160	35.7%
Constellation New Energy, Inc.	12,496,758	4,202,871	631,445	38.7%
Devonshire Energy, LLC	51,672	2,300	8,169	20.3%
Direct Energy Business LLC	4,920,300	1,600,243	200,986	36.6%
Direct Energy Services, LLC	151,103	46,158	20,901	44.4%
Discount Power, Inc.	39,473	11,514	6,442	45.5%

[13] Retired certificates from units that produce thermal energy are not reported for the purpose of calculating GHG emissions from electricity.

[14] These reports can be found at https://www.mass.gov/service-details/annual-compliance-reports-and-other-publications.

[15] See footnote 12.

	MWh reported as retail sales	MWh claimed as unit-specific generation		% of sales claimed as unit-specific generation
		non-emitting	emitting	
Dynegy Energy Services (East), LLC	1,829,168	654,015	80,857	40.2%
Eligo Energy MA LLC	88,564	28,269	3,183	35.5%
Energy Plus Holdings	15,120	5,241	1,509	44.6%
Engie Resources, LLC	2,833,384	799,186	156,460	33.7%
Everyday Energy LLC	1,002	343	38	38.0%
First Point Power	774,291	242,810	34,944	35.9%
Green Mountain Energy Company	13,748	5,636	505	44.7%
Grid Power Direct, LLC	14,260	5,167	525	39.9%
Harborside Energy of Massachusetts LLC	9,789	3,856	325	42.7%
Harvard Dedicated Energy, Ltd.	158,204	62,332	0	39.4%
Hudson Energy Services	762,935	257,246	37,251	38.6%
Inspire Energy Holdings, LLC	438,022	149,992	23,744	39.7%
Interstate Gas Supply, Inc (dba IGS Energy)	245,980	99,146	14,100	46.0%
Just Energy Mass. Corp.	72,419	19,094	1,969	29.1%
Liberty Power Holdings*	1,668	N/A	N/A	0.0%
Major Energy Electric Service, LLC	52,253	29,999	1,827	60.9%
Massachusetts Gas & Electric Co.	78,535	26,759	2,789	37.6%
Mega Energy Holdings, LLC*	35,017	18,911	2,225	60.4%
MidAmerican Energy Services LLC	16,934	144	0	0.9%
MP2 Energy NE LLC	41,919	12,009	9,182	50.6%
National Gas & Electric, Inc	41,250	17,316	1,450	45.5%
NextEra Energy	2,219,421	871,854	103,311	43.9%
Nordic Energy Services	22,417	8,526	835	41.8%
Palmco Power MA, LLC	45,506	17,143	1,600	41.2%
Provider Power MASS, LLC	122,745	46,781	4,177	41.5%
Public Power, LLC	152,447	51,164	2,513	35.2%
Reliant Energy Northeast	419,713	169,916	15,743	44.2%
Renaissance Power and Gas Public Power, LLC	8,621	2,771	303	35.7%
Residents Energy, LLC	383,778	142,347	42,261	48.1%
SFE Energy Massachusetts	108,879	16,291	1,929	16.7%
SmartEnergy Holdings, LLC	78,959	13,548	3,160	21.2%
Spark Energy, LLC	7	5	1	85.7%
Starion Energy, Inc.	126,655	50,359	4,800	43.6%
Summer Energy	14,198	5,318	475	40.8%
Sunwave Gas & Power Massachusetts, Inc.*	3,454	N/A	N/A	0.0%
Texas Retail Energy	81,592	11,798	7,978	24.2%
Think Energy, LLC	66,936	26,528	2,477	43.3%
Titan Gas and Power	73,188	27,686	2,708	41.5%
Town Square Energy, LLC	55,384	21,643	4,348	46.9%
Verde Energy USA Massachusetts, LLC	64,400	26,037	2,220	43.9%
Viridian Energy, LLC	138,005	47,104	5,058	37.8%
Xoom Energy Massachusetts LLC	47,055	16,591	4,178	44.1%
Electric Utility Total	**10,633,149**	**4,390,219**	**401,628**	**45.1%**
Competitive Supplier Total	**33,292,115**	**11,120,158**	**1,619,604**	**38.3%**
Combined Total	**43,925,264**	**15,510,377**	**2,021,232**	**39.9%**

Table 10 shows the individual electric utility and competitive supplier lb CO_2e/MWh emission rates (GHG emissions divided by retail load). The emission factors for individual electric utilities and competitive suppliers in Table 10 should not be compared to the emission factors calculated

for MEDs in Table 8 in Appendix 2A: *Optional Unit-Specific Generation Reported by MEDs for 2021*, because the requirement to retire MSW certificates[16] causes electric utilities and competitive suppliers to have higher emission factors than MEDs.

Competitive suppliers that failed to submit, or to correct, a unit specific or GHG emissions report are marked with an asterisk. Individual emission factors were calculated for those retail sellers.

Table 10: Individual 2021 Emission Factors for Electric Utilities and Competitive Suppliers (lb CO_2e/MWh)

	Massachusetts-based approach		**Regional approach**	
	Non-Biogenic	**Biogenic**	**Non-Biogenic**	**Biogenic**
Final 2021 Retail Seller Emission Factors from Table 2 (applied only to non-unit-specific generation - shown for comparison)	**634**	**15**	**478**	**117**
Electric Utilities				
Unitil (Fitchburg Gas & Electric Co.)	410	78	327	133
National GRID (Mass. and Nantucket Electric)	417	79	332	134
Eversource/NSTAR Electric Co. and Western MA Electric Cos.	430	81	342	138
Competitive Suppliers				
Actual Energy Inc	442	80	351	139
Agera Energy LLC*	634	15	478	117
Alpha Gas & Electric, LLC	421	161	335	217
Ambit Northeast, LLC	469	94	371	157
American Power & Gas of MA, LLC	571	85	449	164
Astral Energy, LLC*	634	15	478	117
Atlantic Energy, LLC	443	80	352	139
BP Energy Retail Company LLC	457	91	363	153
Calpine Energy Solutions LLC	517	85	408	156
Champion Energy Services	514	80	405	151
CleanChoice Energy Inc.	422	78	340	131
Clearview Electric, Inc.	480	80	379	145
Constellation New Energy, Inc.	465	96	368	159
Devonshire Energy, LLC	598	250	474	331
Direct Energy Business LLC	476	78	377	143
Direct Energy Services, LLC	414	210	327	267
Discount Power, Inc.	419	247	334	302
Dynegy Energy Services (East), LLC	455	90	361	151
Eligo Energy MA LLC	479	78	378	144
Energy Plus Holdings	423	162	336	219
Engie Resources, LLC	497	106	393	174
Everyday Energy LLC	469	81	372	144
First Point Power	481	90	381	155
Green Mountain Energy Company	424	79	337	135
Grid Power Direct, LLC	454	80	360	141
Harborside Energy of Massachusetts LLC	429	72	339	131
Harvard Dedicated Energy, Ltd.	384	9	289	71
Hudson Energy Services	459	95	363	157

[16] See footnote 10.

	Massachusetts-based approach		Regional approach	
	Non-Biogenic	**Biogenic**	**Non-Biogenic**	**Biogenic**
Inspire Energy Holdings, LLC	456	103	361	164
Interstate Gas Supply, Inc (dba IGS Energy)	416	106	331	161
Just Energy Mass. Corp.	504	63	392	135
Liberty Power Holdings*	634	15	478	117
Major Energy Electric Service, LLC	317	73	256	113
Massachusetts Gas & Electric Co.	466	78	368	141
Mega Energy Holdings, LLC*	634	15	478	117
MidAmerican Energy Services LLC	629	15	474	116
MP2 Energy NE LLC	386	320	308	370
National Gas & Electric, Inc	415	76	330	131
NextEra Energy	428	92	341	149
Nordic Energy Services	443	80	352	140
Palmco Power MA, LLC	443	76	350	136
Provider Power MASS, LLC	438	74	347	134
Public Power, LLC	444	41	342	107
Reliant Energy Northeast	428	80	341	137
Renaissance Power and Gas Public Power, LLC	478	77	377	143
Residents Energy, LLC	409	179	328	232
SFE Energy Massachusetts	528	36	398	121
SmartEnergy Holdings, LLC	570	86	447	166
Spark Energy, LLC	376	288	354	302
Starion Energy, Inc.	433	81	345	139
Summer Energy	442	73	349	133
Sunwave Gas & Power Massachusetts, Inc.*	634	15	478	117
Texas Retail Energy	556	164	437	241
Think Energy, LLC	433	79	344	137
Titan Gas and Power	444	80	352	139
Town Square Energy, LLC	412	135	329	189
Verde Energy USA Massachusetts, LLC	424	75	336	132
Viridian Energy, LLC	467	80	370	143
Xoom Energy Massachusetts LLC	427	148	339	205
Average Electric Utility Emission Factors	**423**	**80**	**337**	**136**
Average Competitive Supplier Emission Factors	**466**	**94**	**369**	**157**

Appendix 3: 2021 Retail Level Emission Factors for Use by Consumers of Electricity to Report Greenhouse Gas Emissions (Massachusetts-based Emission Factors)

Some electricity consumers have expressed interest in using Massachusetts-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 2021 EFs that consumers of electricity would use to report their GHG emissions at a retail electricity level.

Combined, Biogenic and Non-Biogenic EFs: Progress on achieving the GHG reduction limits in the Global Warming Solutions Act is determined using Massachusetts-based emission calculations. Thus, it is Massachusetts-based EFs that consumers of electricity should use to determine GHG emissions. The Massachusetts-based non-biogenic EFs include all CO_2, CH_4 and N_2O emissions from non-biogenic (fossil) and CH_4 and N_2O emissions from biogenic (non-fossil) fuels combusted to generate the electricity sold by retail sellers of electricity in Massachusetts. The Massachusetts-based biogenic EFs include only the CO_2 from biogenic fuel combustion. The Combined EF adds the Non-Biogenic and Biogenic EFs together.

2021 RS Wholesale Non-Biogenic MA-based EF	466 lb	Non-Biogenic CO_2e/Wholesale MWh
+ 2021 RS Wholesale Biogenic MA-based EF	+ 71 lb	Biogenic CO_2e/Wholesale MWh
2021 RS Wholesale Combined MA-based EF	537 lb	Combined CO_2e/Wholesale MWh

Wholesale v. Retail EFs (line losses): Power lines lose 6%[17] (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, 6% 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 – 6% of MWh due to line losses) = Retail Combined EF

Specifically: 537 lb CO_2e/Wholesale MWh / (1 - 0.06) = 571 lb CO_2e/Retail MWh

Table 11. 2021 Massachusetts-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	466	496
Biogenic	71	76
Combined	537	571

[17] This value was updated to align with the line loss value used in the Interim Massachusetts Clean Energy and Climate Plan for 2030, dated December 2020.

Individual CO_2, CH_4, and N_2O EFs: If a consumer wants to use EFs by individual gas, then the lb CO_2e/MWh value needs to be separated into the individual components: lb CO_2/MWh, lb CH_4/MWh, and lb N_2O/MWh. MassDEP has separated the three gases by alternately zeroing out the other two gases on the 'Calculating CO2e' and the 'GIS CO2e' tabs of the retail seller EF spreadsheet at https://www.mass.gov/lists/massachusetts-greenhouse-gas-ghg-reporting-program-data#massdep-emission-factor-calculations-. For the 2021 retail level Combined EF, this results in 568 lb of CO_2e from CO_2, 1 lb of CO_2e from CH_4, and 2 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 2021 by MassDEP are: 1 for CO_2, 25 for CH_4, and 298 for N_2O.[18]

lb CO_2e/MWh = ((lb CO_2 *1) + (lb CH_4 * 25) + (lb N_2O * 298)) / MWh. *Specifically*,
1.2 lb CO_2e from CH_4 / 25 = 0.049 lb CH_4 *and* 1.8 lb CO_2e from N_2O / 298 = 0.006 lb N_2O;
therefore,
571 lb CO_2e/Retail MWh = (568 lb CO_2 + (0.049 lb CH_4 * 25) + (0.006 lb N_2O * 298))/Retail MWh

The breakdown of the 571 lb CO_2e/Retail MWh value from Table 11 into individual gases, at various scales of electricity, is shown in Table 12.

Table 12. 2021 Electricity Consumers Retail-level Massachusetts-based GHG Emission Factors by Individual Gas

	CO_2	**CH_4**	**N_2O**
lb/Retail kWh	0.568	0.000049	0.000006
lb/Retail MWh	568	0.049	0.006
lb/Retail GWh	568,000	49	6

The lb/Retail kWh values in the upper row of Table 12 may be the values most likely to be used by electricity consumers since most electric bills show kWh use.

The breakdown of the 568 lb CO_2/Retail MWh value from Table 12 into its non-biogenic and biogenic components is shown in Table 13. All CH_4 and N_2O emissions are considered non-biogenic and thus cannot be further broken down.

Table 13. 2021 Electricity Consumers Retail-level Massachusetts-based Non-Biogenic and Biogenic CO_2 Emission Factors

	CO_2	
	Non-Biogenic CO_2	**Biogenic CO_2**
lb/Retail kWh	0.492	0.076
lb/Retail MWh	492	76
lb/Retail GWh	482,000	76,000

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