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Maine Energy Overview

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Mariya Pominova and Jonathan Rubin

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Energy Sources

The U.S. Energy Information Administration (EIA) defines primary energy as energy that can be accounted for in a statistical energy balance without undergoing any transformation. There are two groups of primary energy sources: renewable and non-renewable (Table 1).

Table 1 - Main Primary Non-Renewable and Renewable Energy Sources (U.S. Energy Information Administration, 2018)

Non-Renewable Energy Sources	Renewable Energy Sources
Oil and Petroleum Products	Solar Energy
Hydrocarbon gas liquids	Geothermal Energy
Natural Gas	Wind Energy
Coal	Biomass
Nuclear Energy	Hydropower

Renewable energy sources, such as hydropower and wind energy, are non-depletable whereas non-renewable energy sources, such as coal or natural gas, have a finite amount (U.S. Energy Information Administration, 2018).

There are four major **end-use energy consuming sectors**: *industrial, transportation, residential, and commercial*. Electricity is a secondary energy source and can be produced through burning fossil fuels, nuclear reactors as well as from renewables.

Maine Energy:

Maine is the northernmost state in New England and highly rural. Furthermore, Maine's economy is highly dependent on forestry and wood-products, such as production of biofuel, tying in the industrial sector as well (EIA 3/15/2020).

Table 2 - Maine Energy Snapshot (2016). Source: EIA Maine Energy Overview

Description	Maine	US
Resident population ¹	1.33 million	0.4% (Share US)
Real GDP ²	\$55.6 billion	44 (Rank US)
Total Energy Consumption³	392 trillion BTUs	44 (Rank US)
→ Per Capita	294 million BTUs	27 (Rank US)
→ Per dollar real GDP	7.05 thousand BTUs	

¹Including armed forces; Source: Bureau of Labor Statistics (2016)

² Inflation adjust with 2009 as base year; Source: Bureau of Economic Analysis (2016)

³ Source: Energy Information Administration (2016)

Total Energy Production	153 trillion BTUs	0.2% (Share US)
Total energy expenditures	\$5,624 million	40 (Rank US)
Per capita	\$4,213	11 (Rank US)
Total energy average price	\$18.15 per million BTUs	

EIA Quick Facts:

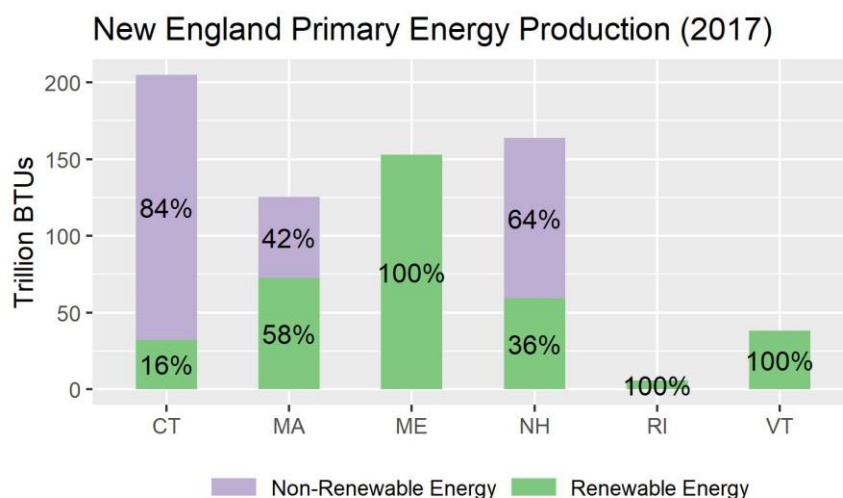
- Maine's households have the highest dependence on oil in the US, with approximately two-thirds of households reliant on fuel oil as the primary energy source for home heating.
- In 2018, 75% of Maine's net electricity generation was obtained from renewable sources: 31% from hydroelectricity, 22% from biomass, and 21% from wind.
- In 2017, about 49% of all Maine's end-use energy consumption came from petroleum product sources.
- The share of Maine's gross domestic product (GDP) from forestry and paper product manufacturing has shrunk considerably in the last decade. Today, Maine's economy is dominated by service industries such as finance, insurance, and real estate.
- Maine is a New England leader and sixth in the nation for share of wind-powered electricity generation.

Source: EIA Maine Energy Overview, (<https://www.eia.gov/state/?sid=ME>), June 20, 2019)

Energy Production in Maine

The EIA defines primary energy production as the transformation of energy from fossil fuels, and renewable and nuclear sources⁴. Primary energy production in Maine is 100% renewable, i.e., Maine does not produce oil, gas, coal or nuclear energy. Maine is a leader in New England in renewable energy production (Figure 1).

Figure 1: Maine Energy Production by Source (Source: EIA State Energy Data System (SEDS):2017)



The majority of primary energy production in Maine is from hydroelectricity and wood and wood products, but recently electricity production from primary energy resources wind and solar has begun to

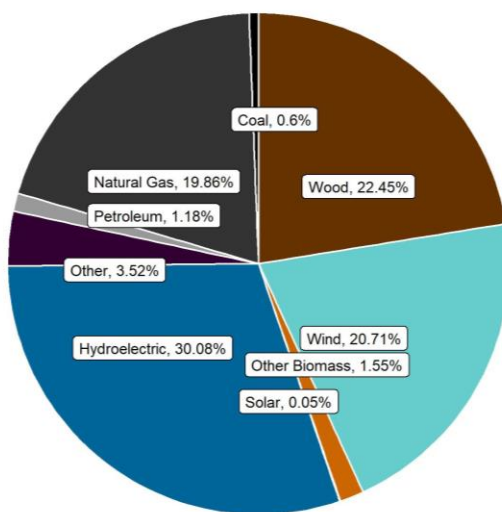
⁴ This includes harnessing energy from sources such as the sun, wind, and water for the generation of electricity but does not include the use of already harvested energy, such as coal, for electricity production.

increase. Maine is a New England leader and sixth in the nation for share of wind-powered electricity generation (EIA Maine Energy Overview 2019).

Maine has significantly decreased use of fossil fuels for the production of electricity in the last two decades, with 75% of all electricity production coming from renewable sources (Figure 2).

Figure 2: *Maine Net Electrical Generation by Energy Source (Source: EIA State Energy Data System (SEDS):2017)*

Maine Net Electrical Generation by Energy Source (2017)

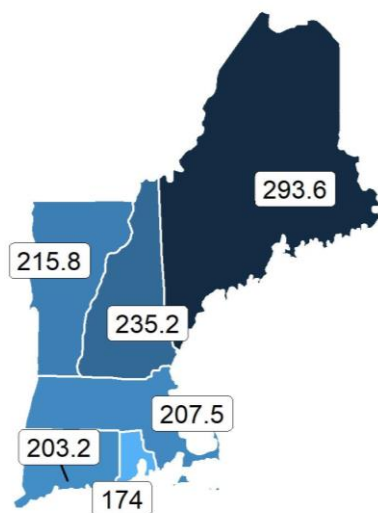


Energy Consumption in Maine:

On a per-capita basis, Maine consumes the most energy per person in New England (Figure 3).

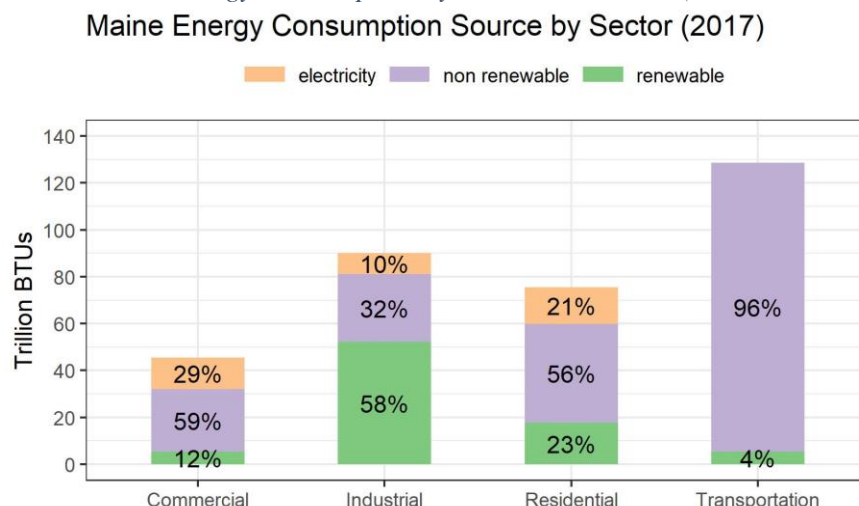
Figure 3: *New England Total Energy Consumption by State (Source: EIA SEDS: 2017)*

NE Energy Consumption Per Capita
2017 (Million BTUs)



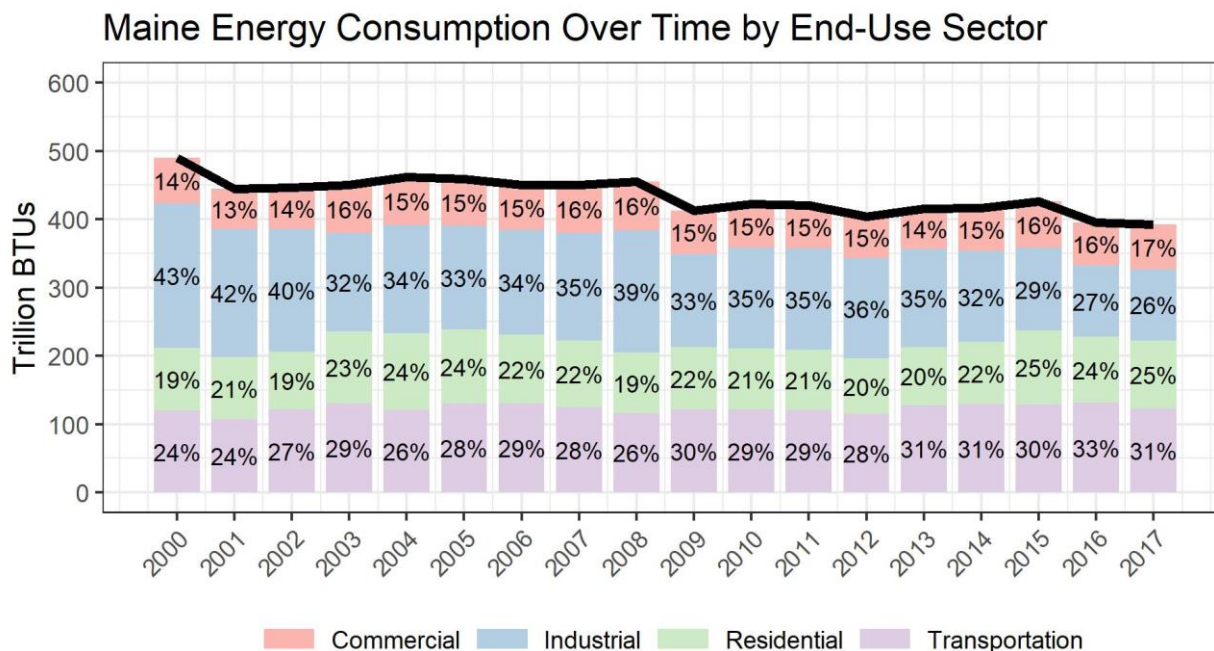
The majority of energy consumption in Maine is non-renewable, with three of the four energy consumption sectors using a majority of non-renewable energy (Figure 4).

Figure 4: Maine Total Energy Consumption by Source and Sector (Source: EIA SEDS 2017)



Energy consumption in Maine has been steadily decreasing for the last two decades (Figure 5). In this time, there has been a shift in the proportions of total energy consumption held by each sector. In 2000, 46% of all energy consumption was in the industrial sector. In 2017, this number dropped to 26%. The transportation sector, on the other hand, increased by 7 percentage points. The industrial and transportation sectors make up over 50% of the end-use energy consumption in Maine.

Figure 5: Maine Total Energy Consumption over time (Source: EIA SEDS 2000-2017)



Energy Prices and Expenditure in Maine

The lowest priced energy source in Maine is wood and biomass waste. The next cheapest is natural gas. Coal is an inexpensive input but only makes up 1% of energy consumption in Maine (Table 3).

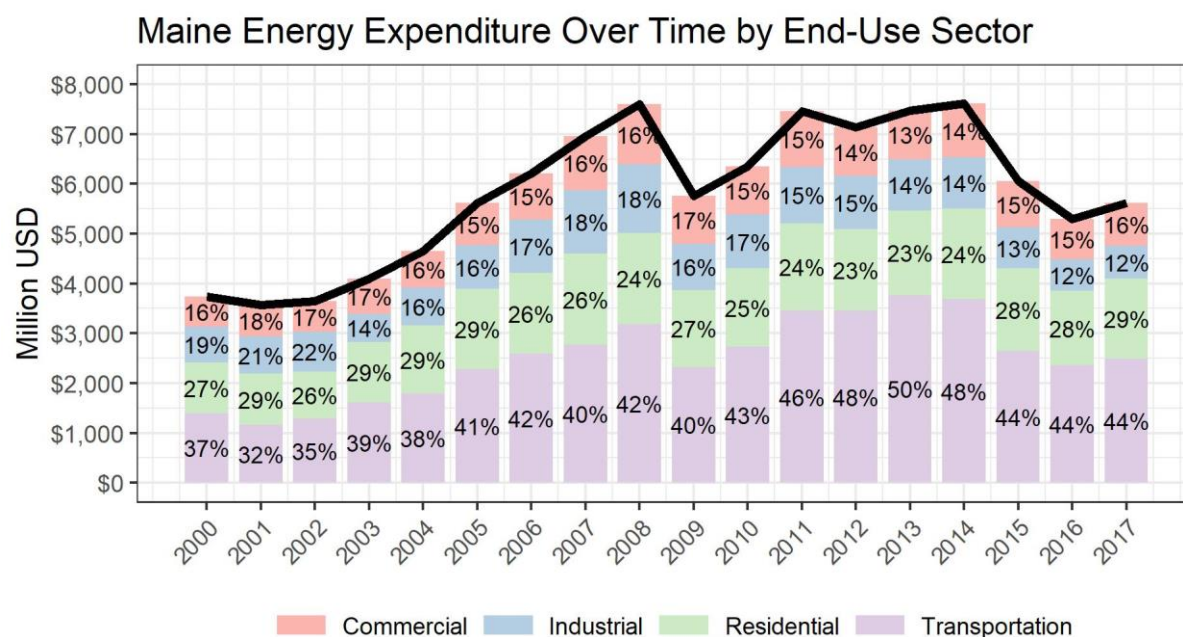
Table 3: Maine average energy price by source in 2017 (Source: EIA SEDS 2017)

Energy Source	Consumption (%)	Price (\$USD/ Million BTU)
Non-Renewable		
Coal	1%	\$4.29
natural gas	12%	\$6.42
all petroleum products	49%	\$17.19
Renewable		
wood and biomass waste	25%	\$2.91
Secondary		
electricity sales	10%	\$37.51
Total Energy		\$16.71

Energy Expenditure in Maine

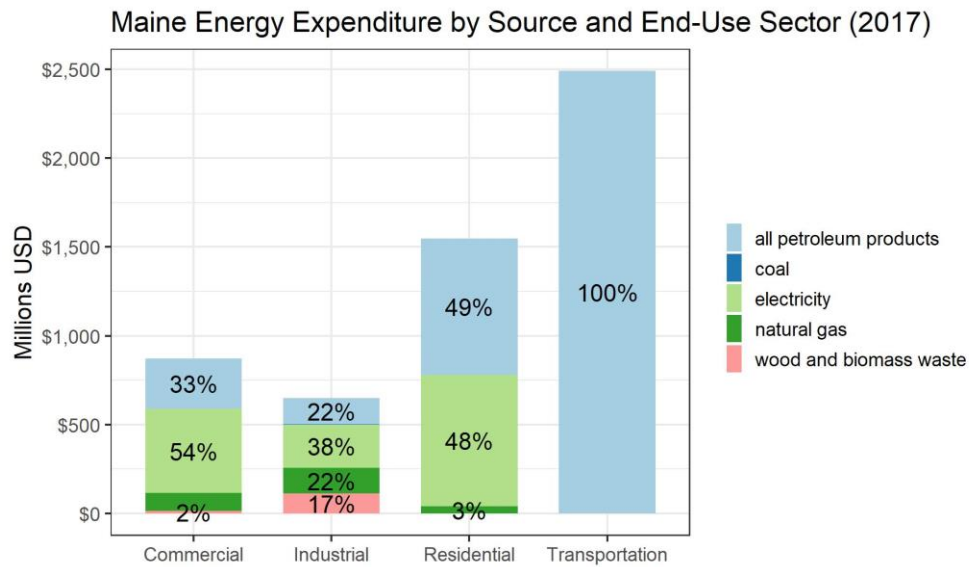
Since 2000, Maine energy expenditure increased by over 50% (Figure 6). The transportation sector has seen the most growth in this time and accounts for the greatest proportion of expenditure in the state (Figure 7).

Figure 6: Change in Maine Total Energy Expenditure by End-Use Sector Over Time (Source: EIA SEDS 2000-2017)



Maine's greatest expenditure is in petroleum products, for transportation and heating, and electricity, with nearly half of the Residential sector and 100% of the transportation sector expenditure used on petroleum products. Maine is the most petroleum-dependent state for home heating and has the highest per-capita petroleum consumption in New England, with approximately two-thirds of households reliant on fuel oil as the primary energy source for home heating. Only 10% of Maine households use electricity for home heating, despite the state having the lowest electricity prices in the New England region. (EIA Maine Energy Overview, 2019).

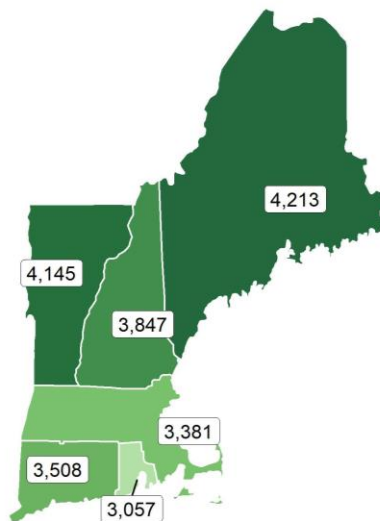
Figure 7: Maine Total Energy Expenditure by Source in 2017 USD (Source: EIA SEDS 2017)



Given its high per-capita energy use, Maine also has the highest energy expenditure per capita in New England (**Figure 8**).

Figure 8: New England Total Energy Expenditure Per Capita in 2017

NE Energy Expenditure Per Capita
2017 (USD)



Maine's high per-capita expenditure can be largely explained by high energy consumption relative to the population size (Figure 8). Much of these high costs can be explained through comparable proportions to consumption (Figure 9).

Figure 9: New England Per-Capita Total Expenditure per Sector in 2017 USD (Source: EIA SEDS 2017)

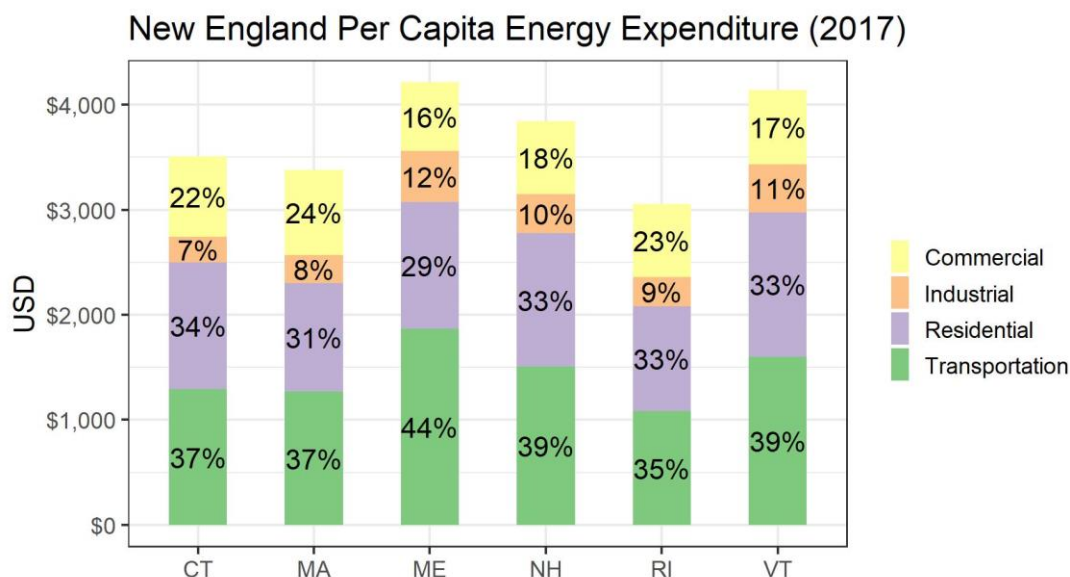


Figure 9 shows the energy expenditure per-person in each state by sector. Transportation accounts for 44% of Maine’s per capita expenditure, over 5% greater than the other states. This, again, is largely explained by the size of the state and its rural nature.

Conclusion:

The state of Maine is a regional leader in renewable energy production and highly ranked nationally in proportion of renewable energy consumed. Maine is 3rd in the nation for highest percentage of renewable energy consumption as a share of state total (Maine State Energy Profile 2019). However, 61% of all primary energy consumed in Maine in 2017 was from non-renewable sources, about half of which were petroleum products (Table 3). Because Maine does not have oil and natural gas reserves, it is reliant on oil and natural gas imports. This causes Maine to be subject to the volatility of national and world oil and natural gas prices. Striving towards developing the state’s renewable energy resources, such as offshore wind and solar, may help alleviate some of that volatility and drive down expenditure costs.

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Sector and Source	CT	MA	ME	NH	RI	VT
Commercial sector						
natural gas	54,014	112,741	9,247	9,356	11,684	6,391
coal	-	-	-	-	-	-
all petroleum products	14,828	19,235	17,585	11,732	3,493	6,173
wood and biomass waste	1,029	2,531	5,000	2,671	247	2,428
electricity sales	42,088	88,603	13,364	14,978	12,294	6,744
geothermal energy	-	807	-	-	-	-
hydroelectric power	-	36	-	-	-	-
solar thermal and photovoltaic energy	1,445	8,342	131	237	247	366
wind	-	193	-	-	66	-
total energy	188,139	401,606	65,554	70,080	44,591	24,642
Industrial sector						
natural gas	25,259	48,408	18,337	9,790	8,812	2,257
coal	-	103	465	-	-	-
all petroleum products	18,843	30,104	10,058	11,469	8,279	9,247
wood and biomass waste	4,262	7,456	48,694	4,016	134	396
electricity sales	11,067	23,404	9,070	6,674	2,476	4,857
hydroelectric power	-	54	3,353	-	-	-
solar thermal and photovoltaic energy	194	649	-	50	-	16
wind	-	15	-	-	-	-
total energy	79,275	154,862	103,705	45,858	23,037	18,603
Residential sector						
natural gas	49,815	124,802	2,847	7,556	18,983	3,614
all petroleum products	54,102	79,033	39,324	33,770	11,568	17,040
electricity sales	42,239	65,981	15,827	15,154	10,332	6,904
geothermal energy	21	52	72	29	57	29
solar thermal and photovoltaic energy	3,087	5,343	395	588	302	737
wood	5656	8386	17138	11275	1356	12400
total energy	229,922	409,530	99,557	99,843	56,517	43,325
Transportation sector						
natural gas	5,591	8,939	706	309	3,040	13
all petroleum products	221,786	445,760	122,481	101,404	56,466	48,210
electricity sales	604	1,188	-	-	94	-
total energy	229,054	458,156	123,187	101,713	59,726	48,223
Electric power sector						
natural gas	111,655	167,889	13,989	26,738	52,231	13
coal	2,507	12,304	1,704	3,617	-	-
all petroleum products	1,626	2,877	1,703	866	453	87
wood and biomass waste	13,061	19,982	28,524	23,591	1,950	6,152
total energy	306,755	274,914	110,331	176,590	56,761	57,038
hydroelectric power	3,060	9,468	27,867	13,022	22	11,796
solar thermal and photovoltaic energy	360	7,197	50	-	130	910
wind	117	1,936	21,493	3,792	1,306	2,814
nuclear electric power	172,570	52,788	-	104,493	-	-
Total of all sectors						
natural gas	246,334	462,781	45,127	53,748	94,751	12,288
coal	2,507	12,407	2,168	3,617	-	-
all petroleum products	311,185	577,010	191,151	159,241	80,259	80,757
biomass	36,917	62,219	104,855	47,645	6,899	23,864
wood and biomass waste	24,008	38,355	99,357	41,553	3,687	21,376
electricity sales	95,998	179,175	38,261	36,806	25,196	18,506
geothermal energy	21	859	72	29	57	29
hydroelectric power	3,060	9,558	31,221	13,022	22	11,796
solar thermal and photovoltaic energy	5,086	21,532	577	875	679	2,029
wind	117	2,143	21,493	3,792	1,372	2,814
total energy	726,389	1,424,156	392,002	317,495	183,872	134,794

Appendix B – New England Expenditure by State, Sector, and Source (2017) – Million Dollars

Sector and Source	CT	MA	ME	NH	RI	VT
Commercial sector						
natural gas	488	1,112	101	106	128	44
all petroleum products	251	319	284	178	59	101
wood and biomass waste	4	7	13	8	1	9
electricity sales	1,981	4,138	475	650	548	289
total energy	2,725	5,576	873	943	736	443
Industrial sector						
natural gas	159	377	144	86	73	11
coal	-	1	2	-	-	-
all petroleum products	294	512	146	173	119	129
wood and biomass waste	2	4	112	2	0	1
electricity sales	425	952	245	241	106	145
total energy	880	1,846	649	503	298	286
Residential sector						
natural gas	676	1,614	40	107	258	50
all petroleum products	1,112	1,566	765	709	235	404
electricity sales	2,512	3,879	741	853	555	358
total energy	4,322	7,092	1,613	1,713	1,053	860
wood	22	33	67	44	5	48
Transportation sector						
natural gas	0	6	-	2	1	-
all petroleum products	4,590	8,665	2,491	2,032	1,137	1,000
electricity sales	19	22	-	-	5	-
total energy	4,610	8,693	2,491	2,034	1,143	1,000
Electric power sector						
natural gas	395	623	53	114	194	-
coal	11	53	7	16	-	-
all petroleum products	19	30	18	11	6	1
wood and biomass waste	29	44	63	92	4	14
nuclear electric power	123	40	-	75	-	-
Total of all sectors						
natural gas	1,718	3,732	338	415	654	104
coal	11	54	10	16	-	-
all petroleum products	6,265	11,092	3,703	3,105	1,557	1,636
wood and biomass waste	57	87	255	147	11	72
electricity sales	4,938	8,991	1,460	1,744	1,213	792
total energy	12,536	23,206	5,624	5,193	3,229	2,589

Appendix C - Energy Prices in New England by State, Source, and Sector (2017) - Dollars per million BTU

Sector and Source	CT	MA	ME	NH	RI	VT
Commercial sector						
all petroleum products	14.62	14.83	13.62	12.88	14.42	13.83
coal	0	0	0	0	0	0
natural gas	8.55	9.2	10.32	11.03	10.83	6.47
electricity sales	46.16	45.72	35.42	42.3	43.6	42.62
wood and biomass waste	5.73	3.17	3.37	4.26	5.73	5.41
total energy	23.97	24.55	19.06	23.61	26.16	20.02
Industrial sector						
all petroleum products	14.7	15.85	13.06	15.22	12.96	13.23
coal	0	5.24	5.21	0	0	0
natural gas	5.91	7.18	7.46	8.34	8.44	5.08
electricity sales	37.55	39.2	26.26	36.16	39.52	29.97
wood and biomass waste	3.24	2.29	2.96	1.13	1.59	2.72
total energy	15.36	17.45	8.38	17.17	14.45	17.27
Residential sector						
all petroleum products	17.95	17.91	17.17	19.66	18.18	20.96
coal	0	0	0	0	0	0
natural gas	12.56	12.09	13.42	13.83	13.39	13.82
electricity sales	58.65	55.69	46.38	53.87	54.56	50.9
total energy	27.98	24.84	22.04	26.24	25.14	23.02
Transportation sector						
all petroleum products	18.43	17.17	18.07	17.92	18.01	18.43
coal	0	0	0	0	0	0
natural gas	12.19	14.17	10.32	13.4	13.08	6.47
electricity sales	31.78	17.41	0	0	54.85	0
total energy	18.47	17.17	18.07	17.91	18.07	18.43
Electric power sector, fuel consumption						
all petroleum products	8.53	6.5	7.73	8.99	9.76	9.76
coal	4.07	4.07	4.07	4.07	0	0
natural gas	3.58	3.2	3.22	4.07	3.39	2.97
wood and biomass waste	2.32	2.32	2.32	3.98	2.32	2.32
Electric power sector, net generation						
nuclear electric power	0.71	0.67	0	0.71	0	0
Total of all sectors						
all petroleum products	17.91	17.06	17.19	17.68	17.34	17.98
coal	4.07	4.08	4.29	4.07	0	0
natural gas	6.54	7.52	6.42	6.9	6.94	8.38
electricity sales	50.54	48.3	37.51	45.88	47.71	42.39
wood and biomass waste	2.99	2.98	3.11	4.11	3.39	4.23
total energy	21.89	20.65	16.71	21.03	21.17	19.87