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We have been tracking customer's PV systems in Western Mass since 2003 using a representative sample of roof and ground mounts with varying tilt angles and orientations.

Since we started tracking PV systems, equipment efficiencies and technology have improved significantly. For the greatest electricity generation, a pole mount system with Panasonic Modules positioned to receive the maximum amount of sunlight possible and adjusted seasonally is optimal. This updated sensitivity analysis includes a variety of sample PV systems to provide accurate production statistics guidance.

Consider the BPVS sample yearly average of 1,116.7 kWh. We noted in our emissions table below that our higher producers had 1,412.27 kWh. This is typical of our new Panasonic system installations for a yearly average over the last few years.

Environmental Benefits per 1 kW System Based on Massachusetts Generation Mix Year 2018

High= BPVS Sample Average of Highest Producer
 Low = BPVS Sample Average of Lowest Producer

Greenhouse Gas Offset per 1 kW of Installation					
Greenhouse Gas		Daily	Yearly	System Life of 30 Years	lbs/kWh
kWh generated	high	3.869	1,412.27	42,368.1	
	low	2.204	804.69	24,140.63	
CO2 (lbs) Carbon Dioxide	high	2.562	935.17	28,054.99	0.662
	low	1.459	532.53	15,976.05	0.662
SO2 (lbs) Sulfur Dioxide	high	0.0014	.51	15.33	0.0004
	low	0.0008	.29	8.76	0.0004
NOx (lbs) Nitrogen Oxide	high	0.0022	.803	24.09	0.0006
	low	0.0012	.436	13.14	0.0006
Hg (mg) Mercury	high	0.0017	.62	18.62	0.0004*
	low	0.00096	.35	10.51	0.0004*

*Mercury is in mg/kWh

This table was first created by Abby Krich in 2004 when she was an intern from Cornell University. BPVS interns have refined this table over the years- this year Hannah Poplawski, our intern from MCLA, updated Aidan Belangers' 2018/2019 research. Rebecca Martin of our office did the research when she interned in 2007 from MCLA and now guides summer interns on keeping it updated.

Alternating Current Production Range of 1 kW PV Capacity

Month	kWh		
	30 Year Average		2019 Average
	Boston	Albany	BPVS Sample 2019
Jan	100.85	87.57	44.05
Feb	107.18	98.79	53.01
March	124.02	124.79	102.35
April	121.36	120.04	110.57
May	126.25	119.01	108.11
June	121.39	119.83	132.5
July	131.38	129.3	139.76
Aug	126.35	121.94	135.27
Sep	119.69	113.94	118.96
Oct	107.53	94.49	72.44
Nov	85.65	78.39	58.87
Dec	83.8	68.98	40.8
Total Annual	1,355.48	1,277.11	1,116.70

*AC production generated from PV watts Grid Data Calculator (ver.6.1.3) at a 42 degree fixed tilt.
 **Courtesy of detailed data collection from BPVS W. Mass systems from 2004-2019 © BPVS 2020

Emissions rates were calculated using emissions data from the Environmental Protection Agency (EPA), with statistics from Volker-Quashning (a German professor of renewable energies at Hochschule für Technik und Wirtschaft Berlin) to verify, fuel mix data from eGrid by the EPA, and energy conversion efficiency statistics from the Energy Information Administration (EIA).

Massachusetts continues to diversify how its electricity is produced, yet fossil fuels still make up nearly 2/3 of the generation fuel mix. Since 2018, Massachusetts has not generated any electricity from coal. Today, most electricity is generated from natural gas with a small fraction from petroleum. These figures correspond with average emissions for electricity produced found at EIA along with regional producers taken from eGrid.

Not shown are trace amounts of cadmium and arsenates, as well as a host of toxins and radioactive elements which result from conventional electricity generation.

Other embedded emissions include those released during procurement of said energy resources, including significant methane (CH4) emissions from leakage of natural gas during extraction, transportation and storage. CH4 is 84 times as potent as CO2 over a 20 year time scale and about 2.3% of natural gas extracted is leaked.