



Berkshire Photovoltaic Services

www.bpvs.com

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

The original group of sample PV systems is now 15 years old. Equipment efficiencies and technology have improved significantly. This updated sensitivity analysis includes a variety of sample PV systems to provide the most accurate production statistics possible.

Consider the BPVS sample yearly average of 1141.29 kWh per kilowatt conservative. We noted in our emissions table below the average of our higher producers at 1344.6 kWh per kilowatt. This is typical of our new Panasonic system installations for a yearly average.

Environmental Benefits per 1 kW System Based on Massachusetts Generation Mix Year 2016

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

Emissions		Daily	Yearly	System Life of 30 Years	lbs/kWh
kWh	high	3.684	1344.613	40338.384	
	low	2.854	1041.810	31254.307	
CO2 (lbs) Carbon Dioxide	high	2.675	976.298	29288.941	0.726
	low	2.072	756.439	22693.164	0.726
SO2 (lbs) Sulfur Dioxide	high	0.006	2.187	65.603	0.00163
	low	0.005	1.694	50.829	0.00163
NOx (lbs) Nitrogen Oxide	high	0.003	1.045	31.341	0.00078
	low	0.002	0.809	24.283	0.00078
Hg (mg) Mercury	high	0.110	40.338	1210.151	0.03*
	low	0.085	31.254	937.629	0.03*

*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 Aidan Belanger, our intern from GCC, updated Hunter Phillips' 2017/2018 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.

AC Production Range 1 kW PV Capacity

Month	kWh		
	based on 20 yr avg		based on past 10 yr avg*
	Boston	Albany	BPVS Sample 2018
Jan	79.75	70.25	51.65
Feb	91.75	85.25	68.20
Mar	117.5	117.75	95.46
Apr	123.25	122	113.56
May	137	129	123.87
Jun	135	133.25	127.06
Jul	143.5	141.75	136.83
Aug	131.5	126.75	125.33
Sep	115	109.5	115.86
Oct	94.5	84	82.70
Nov	69.5	64.25	58.27
Dec	65	54.75	42.49
Total annual	1303.25	1238.5	1141.29

*AC production generated from PV watts Grid Data Calculator (ver.2) with a 0.833 derate factor at a 42 degree fixed tilt.

**Courtesy of detailed data collection from BPVS W. Mass systems from 2004-2018 © BPVS 2019

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 (mostly natural gas) still make up nearly 2/3 of the generation fuel mix. 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.