Solar Project Performance Metrics		
Maximum DC Kilowatts stored in Energy Storage System	316	refer to “solar project hourly output” worksheet
Solar project's land use (acres)	3.10	
Fuel cell's liquid fuel daily operational gallons consumed	132	
Total base load AC KW-h delivered to grid per 24 hours	2,996	
Total solar DC KW-h generated per 24 hours	1,703	
Total fuel cell DC KW-h generated per 24 hour	1,470	
Energy efficiency of inverter, battery, fuel cell inputs to AC out	76.87%	blend of inverter, battery, and fuel cell losses
Solar Project Economic Metrics		
Fuel cell's liquid fuel daily operational cost	$198	June 21th 2015 energy usage profile
Energy storage system initial cost	$79,000	
Fuel cell system initial cost	$409,500	
Solar photovoltaic array initial cost	$958,037	imported from COS Co-op biz model
Total solar power generation facility initial cost	$1,446,537	
Solar power generation facility initial cost per peak AC Watt	$9.64	
Vermont Distributed Solar Power Generation Network		
Maximum committed solar generated base load (MW-h)	500	
Number of solar projects deployed to achieve base load	3,334	
Initial capital outlays to realize base load network ($Million)	$4,823	
Total distributed solar power generation network land use	10,335	acres
Percentage of Vermont's 5.9M acres used by network	0.18%	

Solar Project's Tunable Assumptions

solar project's peak AC Kilowatts	150	maximum public grid interface without PSB hearing
energy storage system round trip efficiency (DC->DC)	92.00%	http://www.teslamotors.com/powerwall
DC->AC Inverter's conversion efficiency	96.00%	
solar array's peak DC Kilowatts	310	increase until minimum energy in storage is above zero
DC Kilowatt-hours in energy storage at 5AM	110	Manually set this equal to the required energy storage at 5AM
Energy Storage System cost per DC Kilowatt stored	$250	Tesla Power-Pack product announcement
Solar array's cost per peak DC Kilowatt (without storage)	$3,183	Imported from Community Owned Solar Co-op biz model 7/2015
Acreage used per DC Megawatt	10	depends on solar photovoltaic technology conversion efficiency
DC->AC Inverter's cost per AC watt	$0.23	Community Owned Solar Co-op, July 2014 business model
Solar radiation scaling factor	100.00%	tune lower than 100% for Winter season or cloudy days
Molten Carbonate Fuel Cell electricity production efficiency	67.00%	NREL/TP-560-49072, MCFC cost analysis, page 17, figure 3
MCFC initial cost per Kilowatt output capacity	$2,730	NREL/TP-560-49072, MCFC cost analysis forecast, year 2020
solar radiation threshold below which fuel cell powers up	10.00%	
Fuel cell's liquid fuel cost per gallon	$1.50	must be less than $1.62/G to be less than GMP rate 1 per KW-h
Fuel cell's liquid fuel Kilowatts of energy content per gallon	16.647	Methanol lower heat value

Intermediate Calculated Values

Maximum ISO-NE predicted MW consumed per hour	22,000	http://www.isone.org/isoexpress/ As of July 21st 2015
Scaling factor for solar array AC output	146.667	solar project output mimics ISO-NE hourly energy usage profile
Total ISO-NE predicted MW consumed per day	439,420	as of July 21st 2015
tune solar array peak DC KW until this quantity is positive	18	
Required energy in storage at 5AM (DC Kilowatts)	110	sum of energy storage withdrawals 5AM to 11AM
Fuel cell DC Kilowatts generated per hour	8.237	average over 24 hours
Minimum DC Kilowatts stored in Energy Storage System	26	

solar project hourly output

Hour	Fuel Cell Energy Cost	AC KW-h Output to Grid	DC KW-h Input into DC->AC Inverter	Percentage of Max Solar Power Available	Solar DC Kilowatts Generated	Fuel Cell DC Kilowatts Generated	DC Kilowatts Withdrawn from Storage	DC Kilowatts Placed into Energy Storage	Electricity in Storage (DC Kilowatts)
1	$14.79	102.477	106.747	0%	0.000	110.000	0.000	2.993	110.339
2	$14.79	96.409	100.426	0%	0.000	110.000	0.000	8.808	119.147
3	$13.45	92.455	96.307	0%	0.000	100.000	0.000	3.398	122.545
4	$13.45	90.341	94.105	0%	0.000	100.000	0.000	5.423	127.968
5	$13.45	93.409	97.301	1%	1.892	100.000	0.000	4.223	110.000
6	$14.79	97.091	101.136	5%	15.005	110.000	0.000	21.959	114.223
7	$0.00	106.432	110.866	11%	35.562	0.000	75.304	0.000	136.182
8	$0.00	116.932	121.804	28%	86.838	0.000	34.966	0.000	60.878
9	$0.00	124.091	129.261	44%	136.767	0.000	0.000	6.905	25.912
10	$0.00	130.023	135.440	58%	179.652	0.000	0.000	40.675	32.817
11	$0.00	133.432	138.991	66%	203.648	0.000	0.000	59.484	73.492
12	$0.00	138.682	144.460	69%	215.345	0.000	0.000	65.214	132.976
13	$0.00	142.023	147.940	69%	214.783	0.000	0.000	61.495	198.190
14	$0.00	145.091	151.136	63%	196.502	0.000	0.000	41.737	259.685
15	$0.00	148.159	154.332	55%	169.137	0.000	0.000	13.621	301.422
16	$0.00	149.795	156.037	40%	125.020	0.000	31.017	0.000	315.042
17	$0.00	150.000	156.250	25%	76.897	0.000	79.353	0.000	284.025
18	$0.00	149.659	155.895	11%	34.197	0.000	121.698	0.000	204.671
19	$20.17	145.636	151.705	3%	10.142	150.000	0.000	7.762	82.973
20	$20.17	141.205	147.088	1%	2.046	150.000	0.000	4.562	90.736
21	$20.17	140.114	145.952	0%	0.000	150.000	0.000	3.724	95.297
22	$18.83	133.091	138.636	0%	0.000	140.000	0.000	1.255	99.022
23	$17.48	121.159	126.207	0%	0.000	130.000	0.000	3.489	100.276
24	$16.14	108.341	112.855	0%	0.000	120.000	0.000	6.573	103.766

ISO-NE hourly forcast

Hour	Megawatts	
1	15,030	July 20th, 2015
2	14,140	
3	13,560	
4	13,250	
5	13,700	
6	14,240	
7	15,610	
8	17,150	
9	18,200	
10	19,070	
11	19,570	
12	20,340	
13	20,830	
14	21,280	
15	21,730	
16	21,970	
17	22,000	
18	21,950	
19	21,360	
20	20,710	
21	20,550	
22	19,520	
23	17,770	
24	15,890	

1	0	0	0	http://rredc.nrel.gov/solar/pubs/NSRDB/3-1F.html
2	0	0	0	
3	0	0	0	
4	0	0	0	
5	56	639	0	
6	221	1,323	0	
7	450	1,323	76	
8	672	1,323	180	
9	870	1,323	266	
10	1,032	1,323	363	
11	1,146	1,323	239	
12	1,205	1,323	642	
13	1,204	1,323	443	
14	1,143	1,323	366	
15	1,027	1,323	532	
16	863	1,323	425	
17	664	1,323	428	
18	441	1,323	165	
19	212	1,323	137	
20	55	595	10	
21	0	0	0	
22	0	0	0	
23	0	0	0	
24	0	0	0	
	1,205			