



# Gross load and BTM PV shapes and starting hour validation

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# Starting hour of NREL profile

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- NREL provided dGen BTM PV profiles that were already in Mountain Time. However, it is not clear if the time stamp starts at HE0 or HE1
  - All hourly profiles in ADS PCM start at HE1
  - It is import to use the same time stamps between dGen BTM PV and net load profiles in order to derive the right gross load shapes

# Examples of NREL dGen BTM PV profiles

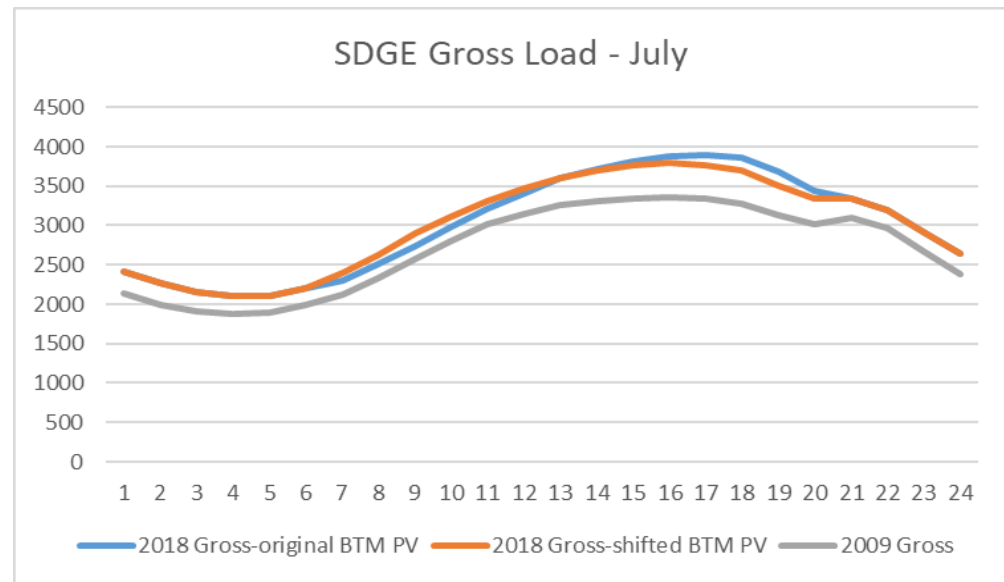
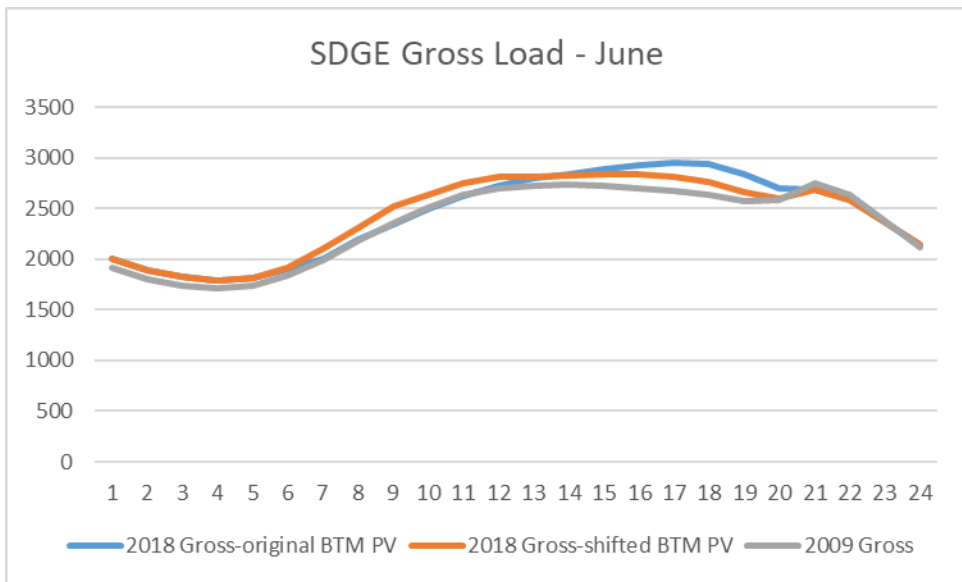
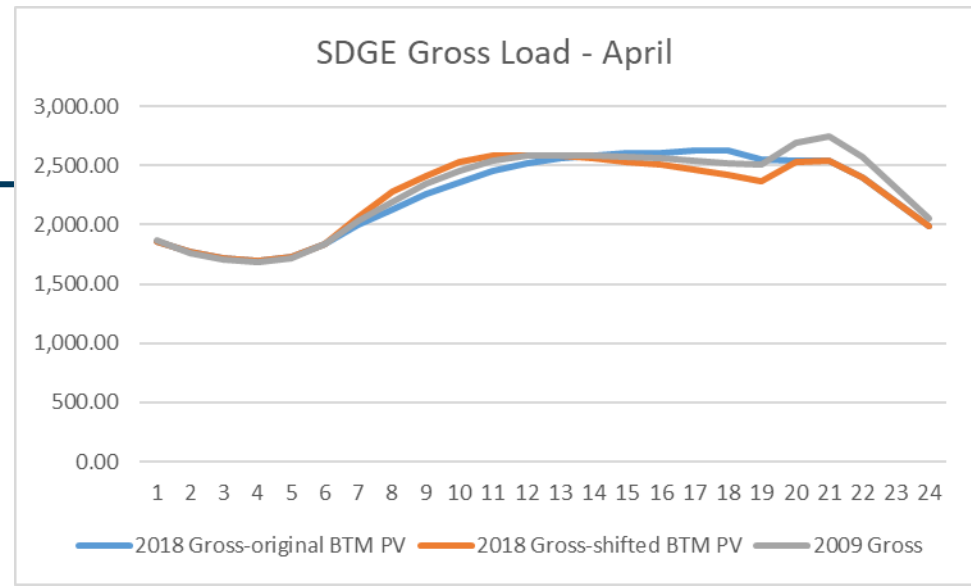
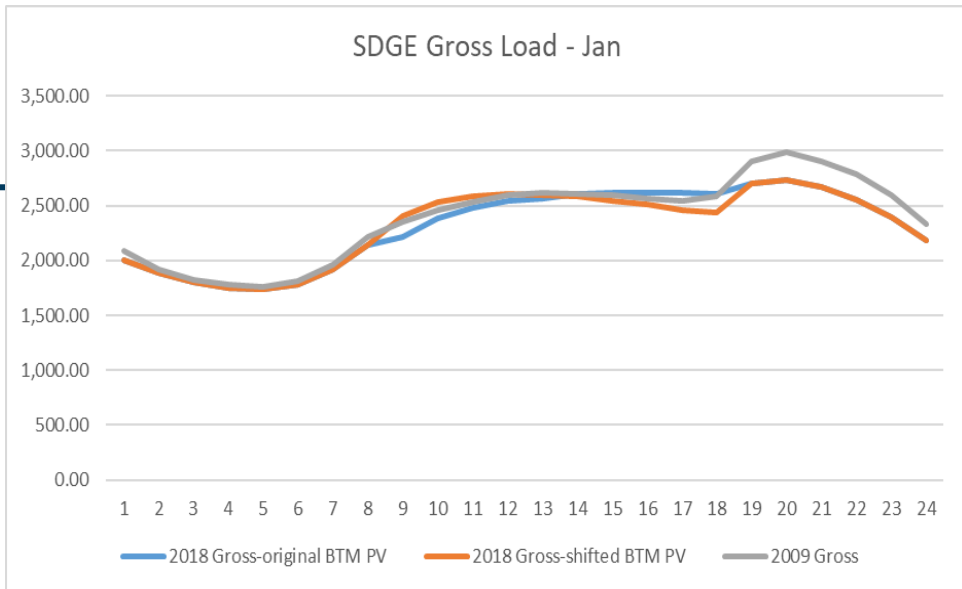
	▼ AESO ▼	▼ AVA ▼	▼ AZPS ▼	▼ BANC ▼	▼ BCHA ▼	▼ BPAT ▼	▼ CFE ▼	▼ CHPD ▼	▼ CIPB ▼	▼ CIPV ▼	▼ CISC ▼	▼ CISD ▼	▼ DOPD ▼	▼ EPE ▼	▼ GCPD ▼	▼ IID ▼	▼ IPFE ▼	▼ IPMV ▼	▼ IPTV ▼	▼ LDWP ▼	▼ NEVP ▼	▼ NWMT ▼	▼ PACW ▼	▼ PAID ▼	▼ I	
1		0	0	0			0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2		0	0	0			0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3		0	0	0			0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4		0	0	0			0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5		0	0	0			0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6		0	0	0			0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7		0	0	0			0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8		0	0	0			0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9		0	27.6983	0			0		0	0	0	0	0	8.07118	0	0	0	0	0	0	0	0	0	0	0	
10		0.01031	163.244	12.2339			0.10204		0	77.3963	178.35	356.063	171.463	0	18.5631	0	10.1384	0.35067	0.88702	1.51657	50.5999	31.3069	2.19759	0.11136	1.64472	
11		1.61584	275.311	50.7663			6.61618		0.02392	236.284	565.486	731.323	347.651	0.08943	25.0865	0.05773	23.5699	0.72489	1.768	4.43552	101.137	65.3325	4.43733	13.2042	3.65909	
12		1.61315	365.619	88.5906			10.1048		0.03796	370.481	865.811	1033.35	424.88	0.05781	28.6516	0.04126	32.4319	1.06203	2.82297	6.07531	133.267	97.9298	5.45214	15.7506	5.17612	
13		0.67639	436.591	103.97			12.2201		0.01154	455.932	1067.38	1216.04	484.292	0.02712	29.7491	0.03924	31.9034	1.18761	3.41412	6.88042	143.795	119.986	6.01525	18.2532	6.12806	
14		0.71913	441.329	111.602			13.973		0.05386	472.368	1145.85	1128.67	539.166	0.00989	28.9492	0.07374	32.442	1.28561	3.47877	7.05463	141.847	125.79	6.0848	19.3778	5.83119	
15		0.59442	421.877	111.557			13.2951		0.01503	461.886	1123.74	961.259	504.159	0.0092	26.1219	0.05441	29.4061	1.2243	3.2485	6.6799	128.209	121.635	5.75369	19.634	4.91927	
16		1.04924	352.949	107.563			11.5249		0.04386	413.024	993.886	894.422	390.147	0.0064	20.8318	0.05336	24.664	0.94029	2.67936	5.63217	112.991	102.747	4.60176	18.5119	3.57449	
17		0.24291	245.164	86.5856			6.91318		0.03018	324.83	749.566	546.417	244.994	0.02081	12.0671	0.0176	16.8897	0.44413	1.62946	3.47521	79.8018	61.5324	2.09589	9.90467	2.24907	
18		0	54.3584	33.5058			0.93445		0.00045	153.275	325.426	219.878	95.0898	0	0.07988	0	5.86613	0	0.00426	0.00842	32.4141	22.6171	0	3.13173	0	
19		0	0	0			0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20		0	0	0			0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

- Above showed dGen BTM PV profiles of some areas on the first day (Jan 1<sup>st</sup>) of the year,
- Solar hours for most areas are between the 10<sup>th</sup> hour and the 18<sup>th</sup> hour
  - If the time stamp starts at HE1, that means the solar hours of January 1 are between 10am and 6pm Mountain Time, which is not consistent with the actual sunrise and sunset time
  - Therefore, it is reasonable to assume the dGen BTM PV profiles provided by NREL start at HE0
- All BTM PV profiles need to be shifted one hour up

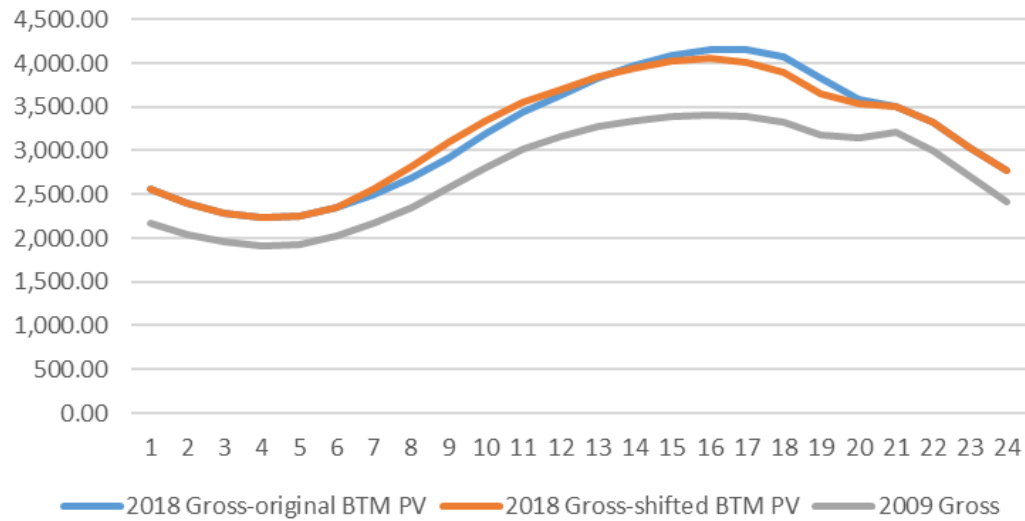
# Examine gross load profiles

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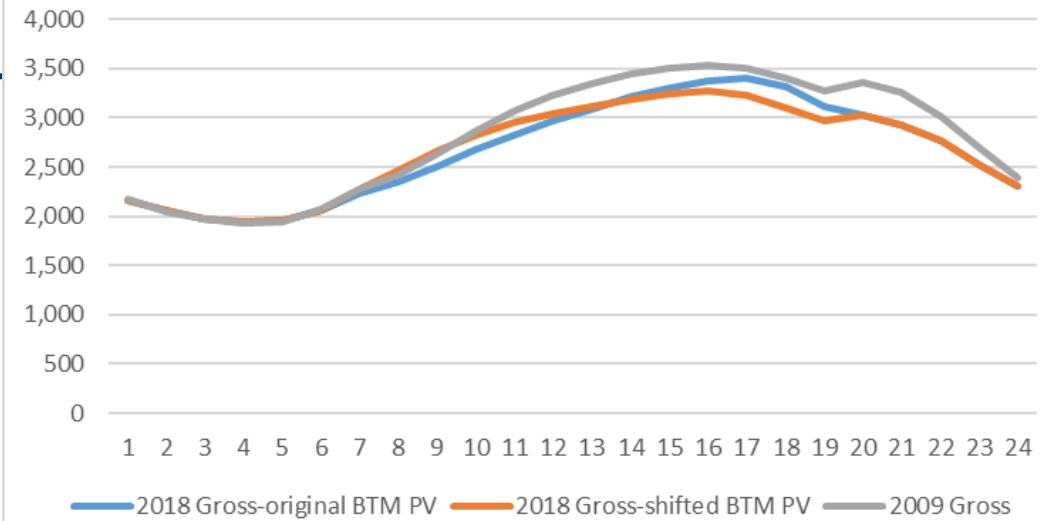
- Gross load profile can be derived using the L&R net load profile plus the dGen BTM PV profile of the same area
- Gross load profiles were derived using the original and the shifted NREL dGen BTM PV profiles, respectively, to further validate time stamp of NREL profiles
  - Compared with 2009 gross load profiles



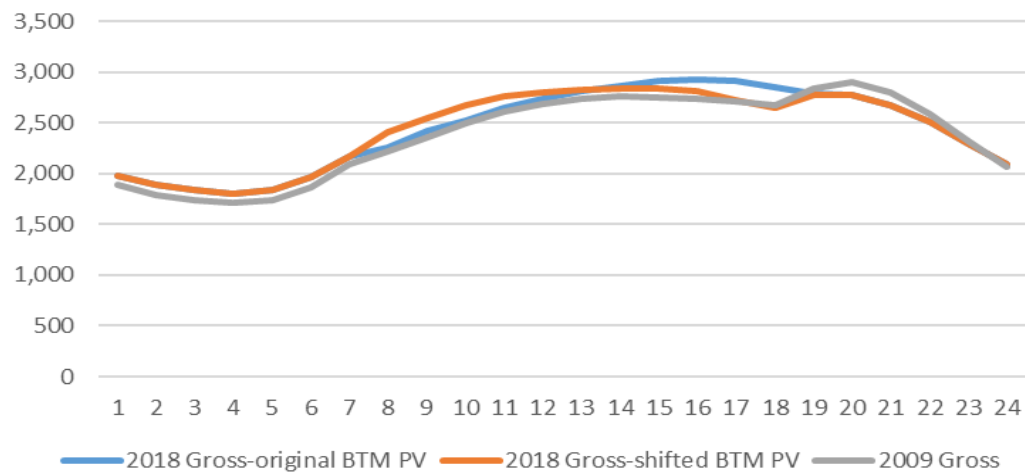
SDGE Gross Load - August



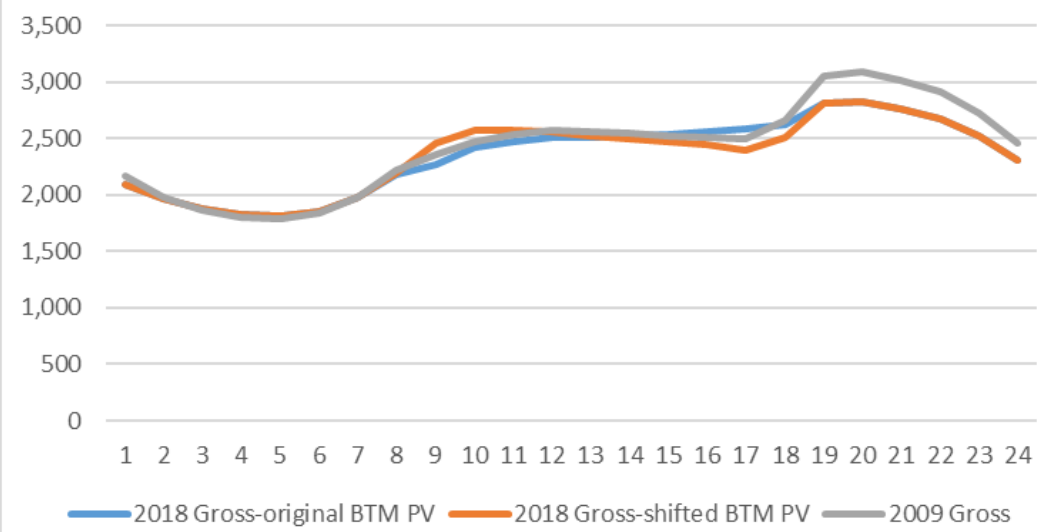
SDGE Gross Load -September



SDGE Gross Load - October



SDGE Gross Load - December



# Observations

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- The shapes of gross load (using SDGE data as example) based on the original BTM PV profiles don't match the 2009 shapes
- The shapes of gross load derived based on the shifted BTM PV profiles match the 2009 shapes very well
  - Magnitude of gross load of 2018 is lower than 2009 in most months, except for July and August
    - Can be because weather pattern changed or use of energy changed, or may be because other unknown reasons

# Compare dGen BTM PV and grid-connected PV shapes (Mountain Time)

4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.07	0.09	0.10	0.10	0.08	0.04	0.00	0.00	0.00
8	0.00	0.05	0.13	0.22	0.19	0.21	0.22	0.21	0.16	0.15	0.10	0.01
9	0.18	0.27	0.29	0.37	0.29	0.38	0.38	0.38	0.32	0.28	0.28	0.20
10	0.33	0.44	0.42	0.53	0.43	0.52	0.52	0.53	0.47	0.44	0.42	0.34
11	0.44	0.56	0.56	0.66	0.55	0.65	0.61	0.65	0.60	0.55	0.53	0.44
12	0.51	0.62	0.64	0.73	0.65	0.73	0.68	0.72	0.67	0.61	0.57	0.49
13	0.54	0.65	0.67	0.74	0.67	0.75	0.70	0.74	0.70	0.63	0.58	0.50
14	0.52	0.63	0.64	0.72	0.66	0.74	0.68	0.71	0.67	0.59	0.55	0.47
15	0.44	0.57	0.57	0.65	0.61	0.69	0.62	0.65	0.61	0.52	0.46	0.40
16	0.33	0.47	0.47	0.55	0.54	0.59	0.54	0.55	0.51	0.40	0.33	0.29
17	0.17	0.30	0.32	0.39	0.40	0.45	0.41	0.40	0.35	0.21	0.13	0.11
18	0.00	0.08	0.13	0.19	0.23	0.28	0.26	0.22	0.14	0.01	0.00	0.00
19	0.00	0.00	0.00	0.01	0.06	0.09	0.09	0.04	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SDGE dGen BTM PV (1003 MW installed capacity)

4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.02	0.03	0.02	0.01	0.00	0.00	0.00	0.00
8	0.00	0.00	0.04	0.14	0.14	0.19	0.15	0.15	0.14	0.08	0.01	0.00
9	0.13	0.18	0.19	0.35	0.34	0.42	0.36	0.38	0.39	0.29	0.26	0.16
10	0.34	0.42	0.38	0.57	0.53	0.60	0.53	0.59	0.61	0.45	0.45	0.34
11	0.52	0.61	0.54	0.71	0.69	0.74	0.65	0.72	0.75	0.60	0.61	0.51
12	0.63	0.69	0.68	0.82	0.79	0.83	0.70	0.82	0.85	0.71	0.70	0.59
13	0.69	0.75	0.74	0.88	0.82	0.87	0.74	0.85	0.89	0.76	0.73	0.64
14	0.70	0.74	0.74	0.86	0.82	0.88	0.73	0.84	0.86	0.73	0.72	0.61
15	0.62	0.70	0.69	0.79	0.74	0.83	0.68	0.78	0.79	0.64	0.63	0.56
16	0.49	0.58	0.56	0.68	0.65	0.72	0.61	0.67	0.66	0.53	0.50	0.43
17	0.32	0.41	0.43	0.50	0.50	0.55	0.49	0.49	0.47	0.35	0.26	0.25
18	0.10	0.18	0.22	0.28	0.29	0.33	0.31	0.29	0.23	0.10	0.01	0.00
19	0.00	0.00	0.02	0.06	0.08	0.11	0.11	0.08	0.02	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SDGE grid-connected PV1 with 1.1 ILR

4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.01	0.03	0.03	0.03	0.01	0.00	0.00	0.00	0.00
8	0.00	0.00	0.05	0.16	0.16	0.22	0.18	0.17	0.16	0.10	0.01	0.00
9	0.15	0.21	0.22	0.40	0.39	0.48	0.41	0.44	0.45	0.33	0.30	0.19
10	0.39	0.48	0.44	0.65	0.60	0.69	0.61	0.67	0.69	0.52	0.52	0.39
11	0.59	0.70	0.62	0.81	0.79	0.84	0.75	0.82	0.86	0.69	0.69	0.58
12	0.72	0.78	0.77	0.91	0.88	0.95	0.81	0.94	0.97	0.81	0.80	0.67
13	0.79	0.84	0.80	0.94	0.89	0.96	0.84	0.96	0.99	0.86	0.84	0.73
14	0.80	0.83	0.81	0.93	0.90	0.98	0.83	0.95	0.98	0.83	0.82	0.70
15	0.71	0.80	0.78	0.90	0.85	0.95	0.77	0.89	0.90	0.73	0.72	0.64
16	0.56	0.66	0.64	0.78	0.75	0.82	0.70	0.77	0.76	0.61	0.57	0.49
17	0.36	0.47	0.49	0.57	0.57	0.63	0.56	0.56	0.54	0.40	0.29	0.29
18	0.11	0.21	0.25	0.32	0.33	0.38	0.35	0.33	0.26	0.12	0.01	0.00
19	0.00	0.00	0.03	0.07	0.09	0.13	0.13	0.09	0.02	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SDGE grid-connected PV1 with 1.3 ILR

- All profiles have been adjusted to start at HE1, assuming NREL's profiles start at HE0
- The dGen BTM PV pattern is in line with grid-connected PV
- The equivalent ILR of the aggregated dGen BTM PV is between 1.1 and 1.3



# Summary

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- The time stamp of NREL's dGen BTM PV profiles and grid-connected solar profiles most likely starts at Hour Ending 0
  - Likely the NREL wind profiles also start at Hour Ending 0
  - Need to confirm with NREL
- With confirmation from NREL, all wind and solar and BTM PV profiles need to be shifted one hour up, i.e. starting time stamp is HE1
- Using the shifted dGen BTM PV, the gross load shape of 2018 is close to the one of 2009
  - Only tested using SDGE load, may need to test other areas
- The dGen BTM PV monthly and daily pattern is similar to the grid-connected PV pattern
  - Only tested using SDGE PV, may need to test other areas



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