

Supplementary Information for

Perspectives for Sustainability Analysis of Scalable Perovskite Photovoltaics

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This supplemental information file covers: (1) Data identifying the locations of perovskite companies; (2) Data on nip and pin perovskite solar cells; (3) Supplemental references.

Supplemental tables

The data identifying the locations of perovskite solar panel developers, material providers, and equipment manufacturers are presented in Tables S1 to S3.

Table S1. Global overview of leading perovskite solar panel developers.

#	Company Name	Latitude	Longitude
1	Ascent Solar Technologies	39.920	-104.981
2	Beijing Yaoneng Technology (Auner)	39.880	116.331
3	Beyond Silicon	33.392	-111.858
4	Caelux	34.153	-118.077
5	CubicPV	42.482	-71.261
6	DaZheng (Jiangsu) Micro-Nano Technologies	32.199	119.516
7	EneCoat	34.882	135.763
8	Enel Green Power	41.917	12.505
9	Energy America	37.790	-122.401
10	Energy Materials Corp. (EMC)	43.204	-77.627
11	Evolar	33.438	-111.943
12	Evolisun Energy	24.479	118.249
13	First Solar	33.438	-111.943
14	Golden Solar New Energy Technology Holdings	24.906	118.623
15	Grape Solar	44.052	-123.136
16	Greatcell Energy	-28.125	153.449
17	GreatCell Solar	-28.125	153.449

18	Halldata Solar	46.266	-119.497
19	Halocell Energy	-31.950	115.846
20	Hanwha Q Cells	37.568	126.989
21	Hiking PV	22.656	114.003
22	Holosolis	48.862	2.343
23	Huasun Energy	30.951	118.671
24	Hunt Perovskite Technologies (CubicPV)	32.787	-96.799
25	Jiangsu Akcome Science and Technology	30.283	120.035
26	Jinko Solar	31.199	121.316
27	LONGi Green Energy Technology (LONGi)	34.356	108.943
28	Mellow Energy / Vein Energy	23.116	113.266
29	Microquanta Semiconductor	30.012	120.006
30	Oxford Photovoltaics (Oxford PV)	51.817	-1.283
31	P3C	28.444	76.985
32	Panasonic	35.664	139.749
33	Perovskia	46.489	6.400
34	Perovskite Innovation	29.864	77.899
35	Phenosolar	22.364	114.131
36	Power Roll	54.910	-1.485
37	Quanwei Solar	34.784	117.312
38	Rayleigh Solar Tech	44.661	-63.541
39	Red Solar Flower	31.890	35.022
40	RenShine Solar	31.327	121.205
41	Saule Technologies	51.613	7.786
42	Sekisui Chemical	35.664	139.749
43	Singfilm Solar	1.353	103.696
44	Solaires Enterprises	48.437	-123.364
45	Solar-Tectic	41.134	-73.835
46	Solertix	41.863	12.502
47	Solliance	51.411	5.455
48	SOLRA-PV	31.776	35.198
49	SunDensity Canada (QD Solar)	43.659	-79.387
50	Swift Solar	37.497	-122.244
51	Taiwan Perovskite Technology	24.808	121.038
52	Tandem PV	37.413	-122.109
53	Toshiba	35.652	139.760
54	United Renewable Energy	34.119	-84.200

55	Verde Technologies	44.896	-93.441
56	Voltec Solar	48.542	7.436
57	WattByWatt	45.550	-73.724
58	Wuxi Utmost Light Technology (UtmoLight)	31.597	120.510
59	Xi'an Tianjiao New Energy	34.312	108.809

Table S2. Global overview of leading perovskite material providers.

#	Company Name	Latitude	Longitude
1	Greatcell Solar Materials	-35.341	149.252
2	Tokyo Chemical Industry	35.693	139.780
3	Ajay SQM	33.855	-84.652
4	Alfa Chemistry Materials	40.801	-73.109
5	American Perovskites	39.748	-105.160
6	Avantama	47.238	8.750
7	BlueDot Photonics	47.660	-122.311
8	BOC Sciences	40.844	-72.878
9	Borun	29.868	121.531
10	DOWA Electronics Materials	35.701	139.775
11	Dyename	59.349	18.075
12	Excyton	54.671	-1.453
13	FrontMaterials	25.014	121.532
14	Green Science Alliance	34.824	135.422
15	Heliatek	51.079	13.695
16	ISE Chemicals	35.689	139.751
17	Mendel Chemicals	46.980	28.884
18	Microchem	36.994	127.762
19	Nanox	46.797	-71.321
20	NANOXO	52.229	20.967
21	Ossila	53.383	-1.479
22	PEROLED	37.460	126.951
23	Perotech Energy	35.948	-79.079
24	Quantum Materials Corp	29.845	-97.977
25	Quantum Solutions	50.961	-1.425
26	Sefar	47.441	9.532
27	SN Display	37.453	126.959
28	SoFab Inks	38.281	-85.571
29	Solaris Chem	45.389	-74.081
30	Solaronix	46.489	6.400

31	Solaveni	51.613	7.786
32	Valais Perovskite Solar	46.231	7.362
33	VIVAN Life Sciences	19.199	72.947
34	William Blythe	53.753	-2.393
35	Zeon Corporation	35.684	139.784
36	Zhijing Nanotech	31.835	120.519

Table S3. Global overview of leading perovskite equipment manufacturers.

#	Company Name	Latitude	Longitude
1	Aixtron	50.823	6.081
2	Bergfeld Lasertech	50.786	6.075
3	Brightspot Automation	40.219	-105.077
4	BT Imaging	-33.899	151.211
5	Enli Technology	22.827	120.260
6	Eternal Sun Spire	52.064	4.386
7	FOM Technologies	55.662	12.576
8	Gosan Tech	36.829	127.128
9	Inert	42.857	-70.908
10	infinityPV	55.758	12.133
11	JACOMEX	45.847	5.065
12	Kortherm Science	37.517	126.718
13	Kurt J. Lesker Company	40.290	-79.910
14	Lumartix	46.489	6.402
15	MBRAUN	48.255	11.613
16	Mitsubishi Diamond Industrial	34.785	135.555
17	nTact	32.892	-96.707
18	Optigon	42.382	-71.101
19	Park Systems	37.293	127.044
20	Peccell Technologies	35.566	139.518
21	SALD	51.455	5.392
22	SC SOLAR	31.331	120.529
23	SparkNano	51.488	5.496
24	Toray Engineering	35.683	139.769

Table S4. Power conversion efficiency and T_{80} lifetime for nip perovskite solar cells. The data was extracted from the perovskite database by filtering for nip cells that contain valid efficiency and stability metrics.¹

Publication date	Cell architecture	PCE, %	T_{80} , hr
7/9/2013	nip	9	500

4/29/2014	nip	4.2	72
6/24/2014	nip	11.4	125
7/24/2014	nip	7.42	4
7/24/2014	nip	7.93	8
9/18/2014	nip	14.4	336
11/6/2014	nip	10.7	400
12/19/2014	nip	15.3	720
3/23/2015	nip	13.26	420
6/11/2015	nip	14.5	2.6
6/11/2015	nip	9.9	28
6/16/2015	nip	11.75	800
7/23/2015	nip	14.57	24
8/14/2015	nip	7.5	2500
8/14/2015	nip	10	2500
8/26/2015	nip	5.5	888
8/26/2015	nip	16.56	120
8/27/2015	nip	14.8	36
8/27/2015	nip	12.8	36
9/28/2015	nip	6.12	600
10/23/2015	nip	12	30
10/23/2015	nip	12	420
11/20/2015	nip	4.86	46
11/23/2015	nip	17.35	200
11/23/2015	nip	14.38	50
11/30/2015	nip	16.67	162
11/30/2015	nip	17.21	333
12/3/2015	nip	13.34	720
12/18/2015	nip	14.2	130
1/10/2016	nip	8.93	14
1/26/2016	nip	15.4	0.5
1/28/2016	nip	10.67	184
1/28/2016	nip	13.8	162
1/28/2016	nip	14.8	100
1/29/2016	nip	15.9	156
1/29/2016	nip	13.69	75
2/3/2016	nip	17.24	31.74
2/3/2016	nip	18.4	731.90
2/3/2016	nip	18.24	1295.21
2/3/2016	nip	17.24	6.89
2/3/2016	nip	18.4	13.59
2/24/2016	nip	0.9	48
2/24/2016	nip	5.2	0.5
3/5/2016	nip	4.08	91
3/5/2016	nip	12.66	8
3/5/2016	nip	10.59	54

3/9/2016	nip	7.85	0.4
3/9/2016	nip	3.04	2.25
3/11/2016	nip	12.9	168
4/15/2016	nip	13.4	8
5/2/2016	nip	9.08	96
5/9/2016	nip	5.86	288
5/16/2016	nip	12.5	10
5/16/2016	nip	14.2	40
5/17/2016	nip	5.94	0.02
5/24/2016	nip	9.73	168
5/24/2016	nip	11.52	168
5/24/2016	nip	13.15	120
6/14/2016	nip	6.88	105
6/14/2016	nip	14.33	2.33
6/14/2016	nip	16.53	2.91
6/16/2016	nip	9.97	60
6/20/2016	nip	12.17	84
6/27/2016	nip	12.4	400
6/27/2016	nip	8.7	100
6/28/2016	nip	15.9	500
7/1/2016	nip	2.47	105
7/1/2016	nip	2.47	5
7/3/2016	nip	11.91	150.384
7/8/2016	nip	8.08	0.83
7/8/2016	nip	9.74	0.05
7/9/2016	nip	11.18	216
7/9/2016	nip	12.62	312
7/26/2016	nip	18.25	1440
8/1/2016	nip	18.3	200
8/5/2016	nip	4.4	69
8/5/2016	nip	8.9	19
8/5/2016	nip	12.2	96
8/8/2016	nip	18	8.3
8/8/2016	nip	18	720
8/8/2016	nip	18.12	672
8/9/2016	nip	14	2
8/9/2016	nip	14.8	47
8/11/2016	nip	16.1	650
8/16/2016	nip	15.45	180
8/23/2016	nip	16	72
8/23/2016	nip	15	60
9/5/2016	nip	7.53	2880
9/15/2016	nip	20.8	60
9/19/2016	nip	11.26	120
9/27/2016	nip	16.9	480

9/28/2016	nip	14.2	20
9/30/2016	nip	17.31	75
9/30/2016	nip	18.67	240
10/10/2016	nip	18.01	20
10/10/2016	nip	19.46	60
10/12/2016	nip	11.18	51
10/12/2016	nip	14.85	69
10/14/2016	nip	17.7	240
10/14/2016	nip	15.6	65
10/20/2016	nip	10.31	40
10/20/2016	nip	14.26	90
10/21/2016	nip	19.4	100
10/21/2016	nip	18.8	1
11/16/2016	nip	17.3	648
11/28/2016	nip	14.2	23
11/28/2016	nip	14	21
12/1/2016	nip	17.9	20.7
12/1/2016	nip	16.7	3423
12/1/2016	nip	13.4	1775
12/1/2016	nip	14.5	656
12/1/2016	nip	12.8	581
12/1/2016	nip	16.56	72
12/1/2016	nip	15.02	155
12/14/2016	nip	16.62	240
12/14/2016	nip	18.93	672
12/14/2016	nip	9.5	1
12/16/2016	nip	9.08	65
12/17/2016	nip	17.14	8.5
12/19/2016	nip	11.64	432
12/19/2016	nip	17.82	1000
12/27/2016	nip	11.6	1600
12/27/2016	nip	11.9	1200
1/5/2017	nip	8.62	30
1/5/2017	nip	7.97	200
1/5/2017	nip	7.92	100
1/5/2017	nip	12.3	50
1/10/2017	nip	14.6	342
1/13/2017	nip	12.05	360
1/26/2017	nip	15	1200
2/7/2017	nip	8.2	60
2/7/2017	nip	9.1	100
2/7/2017	nip	12.42	300
2/7/2017	nip	17.6	13
2/7/2017	nip	18.8	30
2/8/2017	nip	10.94	80

2/8/2017	nip	12	300
2/8/2017	nip	12.1	0.7
2/9/2017	nip	14.92	160
2/9/2017	nip	16.74	160
2/9/2017	nip	13.3	160
2/9/2017	nip	15.01	160
2/10/2017	nip	7.06	700
2/13/2017	nip	17	720
2/14/2017	nip	9	48
2/28/2017	nip	9.15	20
3/9/2017	nip	13	45
3/9/2017	nip	17	85
3/9/2017	nip	12.62	168
3/9/2017	nip	18.59	50
3/9/2017	nip	20.26	50
3/14/2017	nip	18.91	1440
3/14/2017	nip	19.21	1440
3/20/2017	nip	14.9	0.5
3/22/2017	nip	15.89	5
3/25/2017	nip	14.8	1
3/25/2017	nip	16.83	1
3/25/2017	nip	12.2	1
3/25/2017	nip	16.07	2.6
3/27/2017	nip	16.9	100
3/29/2017	nip	19.03	50
3/29/2017	nip	19.01	20
3/29/2017	nip	11.6	168
3/31/2017	nip	11.6	216
3/31/2017	nip	9.7	216
4/7/2017	nip	14.6	3.7
4/7/2017	nip	15.48	5.48
4/7/2017	nip	16.5	5.6
4/7/2017	nip	15.08	5.94
4/7/2017	nip	14.83	6.46
4/10/2017	nip	18.4	720
4/10/2017	nip	10.2	100
4/13/2017	nip	20.8	1
4/19/2017	nip	15.96	2000
4/19/2017	nip	17.2	10
4/20/2017	nip	17.5	600
4/20/2017	nip	18.3	207.6
4/21/2017	nip	16	23
4/21/2017	nip	17.1	168
4/21/2017	nip	13.65	420
5/4/2017	nip	14.1	80

5/4/2017	nip	12	68
5/4/2017	nip	10.2	39
5/11/2017	nip	18.8	1
5/11/2017	nip	11.2	0.53
5/11/2017	nip	11.2	1.35
5/11/2017	nip	13.4	0.86
5/12/2017	nip	6.29	100
5/12/2017	nip	5.8	500
5/12/2017	nip	11.5	100
5/15/2017	nip	17.04	360
5/19/2017	nip	18.2	500
5/24/2017	nip	15.63	72
5/24/2017	nip	9.05	96
5/24/2017	nip	15.13	80
5/24/2017	nip	16.7	2
5/24/2017	nip	17.9	52
6/1/2017	nip	14.6	168
6/1/2017	nip	15.95	42
6/14/2017	nip	7.31	192
6/14/2017	nip	11.49	192
6/14/2017	nip	14.36	192
6/14/2017	nip	2.46	192
6/14/2017	nip	7.02	192
6/14/2017	nip	16.21	192
6/14/2017	nip	11.76	192
6/14/2017	nip	10.39	192
6/19/2017	nip	17.1	68
6/19/2017	nip	15.9	68
6/19/2017	nip	17.2	80
6/19/2017	nip	16.3	80
6/20/2017	nip	12.34	60
6/26/2017	nip	15.8	24
7/4/2017	nip	13.27	210
7/7/2017	nip	10.5	960
7/8/2017	nip	11.86	74
7/10/2017	nip	17	552
7/10/2017	nip	16.5	72
7/11/2017	nip	8.5	200
7/11/2017	nip	11	100
7/13/2017	nip	11.87	252
7/13/2017	nip	17.27	75
7/17/2017	nip	14.8	150
7/17/2017	nip	18.2	500
7/17/2017	nip	18	100
7/18/2017	nip	18.77	636

7/18/2017	nip	17.39	417
7/19/2017	nip	17.27	24
7/19/2017	nip	17.36	1
7/24/2017	nip	15.16	1.75
7/24/2017	nip	16.06	3.75
7/26/2017	nip	15.12	960
7/28/2017	nip	13.14	2.7
7/28/2017	nip	15.1	7.2
8/1/2017	nip	18.9	1560
8/1/2017	nip	16.8	9
8/7/2017	nip	15.8	720
8/7/2017	nip	13.41	300
8/15/2017	nip	18.1	6
8/15/2017	nip	16.7	55
8/15/2017	nip	15.7	215
8/16/2017	nip	17.4	720
8/17/2017	nip	10.3	50
8/21/2017	nip	17.2	960
8/22/2017	nip	16.5	120
8/22/2017	nip	15.2	96
8/25/2017	nip	14.2	250
8/25/2017	nip	15.1	480
8/26/2017	nip	11.33	72
8/26/2017	nip	14.14	480
8/26/2017	nip	16.53	2400
8/31/2017	nip	16.2	380
8/31/2017	nip	17.71	380
9/1/2017	nip	17.1	912
9/4/2017	nip	19.16	400
9/14/2017	nip	17.36	500
9/14/2017	nip	15.25	205
9/15/2017	nip	12.84	32
9/15/2017	nip	14.75	39
9/18/2017	nip	17	336
9/18/2017	nip	20.02	240
9/20/2017	nip	20.4	50
9/20/2017	nip	16.7	125
9/20/2017	nip	20.4	200
9/20/2017	nip	16.7	400
9/21/2017	nip	10.7	210
9/21/2017	nip	12.9	479.3
9/21/2017	nip	10.7	171.5
9/24/2017	nip	3.44	100
9/25/2017	nip	9	638
9/25/2017	nip	8.12	18

9/26/2017	nip	9.8	600
10/17/2017	nip	8.85	1440
10/17/2017	nip	9.01	400
10/17/2017	nip	10.1	1100
10/19/2017	nip	19.21	16.4
10/19/2017	nip	18.24	14
10/19/2017	nip	18.17	12.2
10/24/2017	nip	17.3	500
10/24/2017	nip	17.4	10
10/27/2017	nip	20.44	325
10/27/2017	nip	20.44	1
10/27/2017	nip	22.2	4
10/31/2017	nip	8.4	1.5
10/31/2017	nip	9.3	3
10/31/2017	nip	10.6	2.5
10/31/2017	nip	5.4	2.5
10/31/2017	nip	11	0.2
10/31/2017	nip	8.4	108
10/31/2017	nip	9.3	156
10/31/2017	nip	10.6	160
10/31/2017	nip	5.4	36
10/31/2017	nip	11	5
11/10/2017	nip	19.2	600
11/10/2017	nip	19.2	22
11/10/2017	nip	19.3	30
11/11/2017	nip	17.78	800
11/11/2017	nip	13.02	350
11/17/2017	nip	12.22	4.6
11/17/2017	nip	14.22	5.7
11/17/2017	nip	15.6	6.8
11/17/2017	nip	14.26	6.2
11/21/2017	nip	9.7	480
11/21/2017	nip	8.2	840
11/21/2017	nip	6.5	336
11/24/2017	nip	17.17	48
11/27/2017	nip	16.6	1.5
11/27/2017	nip	17.3	2
11/28/2017	nip	16.84	95
11/28/2017	nip	14	80
11/29/2017	nip	16.8	280
11/29/2017	nip	17.7	280
11/30/2017	nip	1.75	1000
12/1/2017	nip	16.77	600
12/1/2017	nip	18.88	50
12/1/2017	nip	18.3	30

12/1/2017	nip	18.14	50
12/1/2017	nip	18.99	30
12/6/2017	nip	16.39	319
12/6/2017	nip	17.46	1702
12/6/2017	nip	16.39	1.26
12/6/2017	nip	17.46	1.67
12/6/2017	nip	17.78	1.97
12/6/2017	nip	16.39	12.81
12/6/2017	nip	17.46	29.29
12/6/2017	nip	16.39	18.26
12/6/2017	nip	17.46	23.67
12/6/2017	nip	16.39	0.26
12/6/2017	nip	17.46	0.563
12/6/2017	nip	17.78	0.799
12/16/2017	nip	14.6	180
12/18/2017	nip	1.3	500
12/18/2017	nip	4	480
12/19/2017	nip	13.3	220
12/19/2017	nip	17.2	350
12/20/2017	nip	13.6	1582
12/21/2017	nip	8.5	36
12/21/2017	nip	15.1	120
12/22/2017	nip	17.9	500
12/26/2017	nip	17.13	1400
12/26/2017	nip	15.6	144
1/9/2018	nip	17.41	384
1/10/2018	nip	17.94	192
1/15/2018	nip	18.06	180
1/15/2018	nip	14.57	200
1/17/2018	nip	16	150
1/19/2018	nip	15.5	900
1/19/2018	nip	15.5	750
1/19/2018	nip	15	400
1/19/2018	nip	15	400
1/19/2018	nip	20.05	550
1/22/2018	nip	16.71	570
1/22/2018	nip	19.1	720
1/30/2018	nip	7.54	2880
2/5/2018	nip	7.62	100
2/7/2018	nip	18.4	1350
2/7/2018	nip	16.8	1200
2/8/2018	nip	20.08	80
2/8/2018	nip	18.65	1
2/13/2018	nip	17.02	45
2/13/2018	nip	18.51	85

2/13/2018	nip	16.05	90
2/13/2018	nip	15.07	95
2/16/2018	nip	11.2	565
2/16/2018	nip	4.77	161
2/16/2018	nip	5.26	223
2/19/2018	nip	12.35	1
2/19/2018	nip	15.17	336
2/21/2018	nip	17.69	120
2/23/2018	nip	11.8	500
2/23/2018	nip	17.5	200
2/23/2018	nip	19.4	750
3/7/2018	nip	17.56	360
3/7/2018	nip	18.83	672
3/8/2018	nip	10.74	500
3/9/2018	nip	6.3	1824
3/9/2018	nip	6.3	1824
3/12/2018	nip	16.96	600
3/12/2018	nip	18.2	816
3/14/2018	nip	19	2
3/15/2018	nip	15.6	16
3/15/2018	nip	17	15
3/15/2018	nip	13.1	200
3/15/2018	nip	17	20
3/15/2018	nip	13.1	1000
3/16/2018	nip	2.82	10
3/16/2018	nip	2.46	90
3/16/2018	nip	6.44	40
3/20/2018	nip	16.39	1000
3/22/2018	nip	16.59	500
3/22/2018	nip	20.2	950
3/23/2018	nip	16.9	1080
3/23/2018	nip	10.9	1440
3/25/2018	nip	18.3	96
3/25/2018	nip	19.4	528
3/25/2018	nip	19.4	96
3/25/2018	nip	19.4	216
3/25/2018	nip	19.4	408
3/26/2018	nip	5.2	5
3/27/2018	nip	16.89	672
3/29/2018	nip	15.17	168
4/2/2018	nip	14.8	2640
4/3/2018	nip	15.76	61.3
4/3/2018	nip	18.6	330.6
4/3/2018	nip	19.12	197
4/10/2018	nip	15.17	305

4/11/2018	nip	7.92	40
4/11/2018	nip	9.4	80
4/16/2018	nip	16.86	50
4/17/2018	nip	14.6	264
4/17/2018	nip	19.12	600
4/17/2018	nip	17.4	500
4/17/2018	nip	19.7	12.5
4/19/2018	nip	7.53	58
4/19/2018	nip	6.14	144
4/23/2018	nip	21.25	1000
4/23/2018	nip	18.17	1000
4/24/2018	nip	13.3	168
4/24/2018	nip	17.7	340
4/25/2018	nip	5.45	288
4/26/2018	nip	11.92	700
4/26/2018	nip	9.69	96
5/1/2018	nip	15.4	220
5/3/2018	nip	16.2	720
5/7/2018	nip	16.3	360
5/8/2018	nip	1.86	400
5/9/2018	nip	14.3	8400
5/9/2018	nip	17.55	24
5/9/2018	nip	10.74	300
5/9/2018	nip	14.12	480
5/9/2018	nip	15.37	600
5/9/2018	nip	16.5	840
5/9/2018	nip	16.67	480
5/10/2018	nip	17.91	2.5
5/11/2018	nip	17.3	960
5/15/2018	nip	16.74	8
5/17/2018	nip	18.61	70
5/17/2018	nip	19.89	70
5/18/2018	nip	8.3	480
5/21/2018	nip	16.8	104
5/21/2018	nip	18.5	72
5/21/2018	nip	16.25	200
5/24/2018	nip	16.24	504
5/24/2018	nip	16.89	1056
5/25/2018	nip	18.12	345
5/25/2018	nip	16.75	337
5/26/2018	nip	9.12	192
5/29/2018	nip	10.81	25
5/29/2018	nip	18.58	75
5/29/2018	nip	19.94	260
5/29/2018	nip	12.93	40

5/29/2018	nip	10.81	300
5/29/2018	nip	18.58	900
5/29/2018	nip	12.93	450
5/31/2018	nip	14.68	1000
6/1/2018	nip	18.2	10
6/1/2018	nip	18.8	24
6/1/2018	nip	18.2	150
6/1/2018	nip	4.38	0.002
6/1/2018	nip	10.99	0.002
6/6/2018	nip	18.08	540
6/6/2018	nip	14.68	120
6/7/2018	nip	14.1	350
6/8/2018	nip	19.57	700
6/12/2018	nip	15.67	300
6/12/2018	nip	17.77	320
6/12/2018	nip	17.88	420
6/12/2018	nip	18.12	400
6/12/2018	nip	18.62	300
6/12/2018	nip	18.62	20
6/12/2018	nip	8.55	12
6/12/2018	nip	10.26	200
6/18/2018	nip	12.17	573
7/2/2018	nip	7.18	70
7/2/2018	nip	16.46	15
7/3/2018	nip	12.6	5400
7/3/2018	nip	14.05	5400
7/3/2018	nip	12.24	5400
7/3/2018	nip	12.19	5400
7/4/2018	nip	14.1	300
7/5/2018	nip	20.15	435
7/7/2018	nip	16.08	216
7/9/2018	nip	8.51	111
7/9/2018	nip	10.04	430
7/10/2018	nip	12	720
7/10/2018	nip	15.2	120
7/10/2018	nip	17.9	165
7/13/2018	nip	14.16	360
7/13/2018	nip	16.9	2300
7/13/2018	nip	10.52	2712
7/13/2018	nip	10.8	240
7/13/2018	nip	20.45	314.4
7/13/2018	nip	20.45	8.2
7/13/2018	nip	20.57	54
7/13/2018	nip	20.51	194
7/17/2018	nip	8.7	20

7/17/2018	nip	19.5	10
7/17/2018	nip	18.44	50
7/24/2018	nip	6.04	720
7/25/2018	nip	10.74	4.5
7/25/2018	nip	11.78	7
7/25/2018	nip	11.9	7.5
7/25/2018	nip	12.12	9
7/26/2018	nip	13	400
7/26/2018	nip	16.8	523
7/26/2018	nip	16	128
7/26/2018	nip	15.02	121
7/26/2018	nip	13.43	106
7/30/2018	nip	21.52	600
7/30/2018	nip	19.48	100
8/2/2018	nip	6.5	96
8/2/2018	nip	10.5	12
8/3/2018	nip	13.6	0.5
8/3/2018	nip	12.06	48
8/3/2018	nip	14.21	168
8/7/2018	nip	19.2	1
8/7/2018	nip	19.2	120
8/9/2018	nip	14.4	17
8/11/2018	nip	10.32	2000
8/11/2018	nip	6.74	1008
8/15/2018	nip	10.1	1.75
8/16/2018	nip	15.2	360
8/17/2018	nip	16.46	288
8/20/2018	nip	11	265
8/20/2018	nip	19.01	1200
8/21/2018	nip	18.1	48
8/21/2018	nip	20.5	75
8/24/2018	nip	7.3	240
8/24/2018	nip	8.3	72
8/24/2018	nip	16.09	720
8/24/2018	nip	16.7	264
8/30/2018	nip	15.04	100
8/30/2018	nip	15.31	110
8/30/2018	nip	15.04	100
8/30/2018	nip	15.31	110
9/7/2018	nip	14.97	810
9/7/2018	nip	18.24	860
9/7/2018	nip	19.13	940
9/8/2018	nip	17.91	950
9/10/2018	nip	20.63	10
9/10/2018	nip	20.63	120

9/10/2018	nip	20.63	10
9/10/2018	nip	20.63	10
9/10/2018	nip	20.63	60
9/10/2018	nip	20.63	10
9/10/2018	nip	20.63	10
9/12/2018	nip	19.1	75
9/12/2018	nip	13.46	160
9/12/2018	nip	13.46	160
9/20/2018	nip	19.2	300
9/21/2018	nip	10.84	75
9/21/2018	nip	7.57	0.5
9/21/2018	nip	17.15	1000
9/24/2018	nip	11.58	1000
9/24/2018	nip	13.61	80
9/27/2018	nip	16.2	108
9/27/2018	nip	17.7	173
9/27/2018	nip	17.1	163
9/27/2018	nip	3.4	7
9/27/2018	nip	3.9	26
10/8/2018	nip	2.03	1500
10/8/2018	nip	4.32	1350
10/8/2018	nip	4.79	600
10/8/2018	nip	15.66	80
10/8/2018	nip	18.9	1500
10/8/2018	nip	20.3	2500
10/8/2018	nip	20.4	2500
10/8/2018	nip	18.9	1
10/8/2018	nip	20.3	1
10/8/2018	nip	20.4	1000
10/11/2018	nip	19.3	900
10/11/2018	nip	18.97	16
10/11/2018	nip	18.97	16
10/13/2018	nip	14.87	57
10/13/2018	nip	14.87	40
10/13/2018	nip	13.57	62
10/13/2018	nip	12.36	86
10/13/2018	nip	11.59	110
10/15/2018	nip	19.6	290
10/15/2018	nip	21.7	800
10/15/2018	nip	15.98	177.6
10/15/2018	nip	18.1	266.64
10/15/2018	nip	15.98	340.8
10/15/2018	nip	17.1	100
10/15/2018	nip	17.41	120
10/15/2018	nip	18.53	960

10/15/2018	nip	17.34	100
10/15/2018	nip	16.99	72
10/15/2018	nip	17.87	100
10/16/2018	nip	19.7	480
10/19/2018	nip	15.92	840
10/19/2018	nip	14.09	120
10/25/2018	nip	11.12	350
10/26/2018	nip	12.45	95
10/26/2018	nip	11.91	400
10/26/2018	nip	11.91	55
10/26/2018	nip	13.21	300
10/26/2018	nip	13.21	100
10/29/2018	nip	19.06	400
10/29/2018	nip	15.22	1000
11/6/2018	nip	6.96	240
11/8/2018	nip	17	72
11/8/2018	nip	16	72
11/9/2018	nip	0.41	720
11/12/2018	nip	17.08	5
11/12/2018	nip	20.48	15
11/13/2018	nip	18.7	1000
11/13/2018	nip	18.09	900
11/14/2018	nip	16	600
11/14/2018	nip	19.1	432
11/14/2018	nip	18.4	48
11/15/2018	nip	18.92	600
11/16/2018	nip	13.7	5
11/16/2018	nip	15.9	6
11/19/2018	nip	20.7	1500
11/20/2018	nip	13.2	360
11/21/2018	nip	14.5	170
11/21/2018	nip	15.18	170
11/21/2018	nip	11.42	170
11/21/2018	nip	16.87	300
11/26/2018	nip	9	323.28
11/26/2018	nip	9.13	323.28
11/26/2018	nip	9.23	439.68
11/26/2018	nip	4.13	307.44
11/26/2018	nip	3.91	383.28
11/26/2018	nip	3.5	359.52
12/3/2018	nip	19.92	300
12/4/2018	nip	17	982
12/4/2018	nip	19.5	1000
12/4/2018	nip	19.5	1000
12/5/2018	nip	18.8	24

12/5/2018	nip	10.25	75
12/8/2018	nip	0.7	60
12/8/2018	nip	5.86	243
12/10/2018	nip	17.01	150
12/12/2018	nip	15.14	651
12/12/2018	nip	11.7	80
12/13/2018	nip	17.81	350
12/16/2018	nip	15.9	528
12/21/2018	nip	8.11	60
12/21/2018	nip	12.62	90
1/2/2019	nip	18.33	150
1/2/2019	nip	0.27	408
1/2/2019	nip	10.4	140
1/2/2019	nip	9.73	27
1/5/2019	nip	17.96	500
1/8/2019	nip	2.07	50
1/8/2019	nip	5.29	170
1/9/2019	nip	9.15	100
1/9/2019	nip	5.7	480
1/9/2019	nip	6.6	480
1/9/2019	nip	8	720
1/11/2019	nip	12.78	8.5
1/11/2019	nip	14.73	14.2
1/11/2019	nip	17.23	1
1/11/2019	nip	16.29	1
1/11/2019	nip	16.77	280
1/11/2019	nip	15.63	36
1/11/2019	nip	14.52	160
1/12/2019	nip	14.23	288
1/12/2019	nip	15.96	364
1/16/2019	nip	14.65	19
1/17/2019	nip	18.6	50
1/21/2019	nip	18.96	55
1/21/2019	nip	5.13	300
1/21/2019	nip	18.13	1000
1/21/2019	nip	18.13	400
1/21/2019	nip	18.13	140
1/21/2019	nip	18.96	400
1/21/2019	nip	18.96	80
1/21/2019	nip	18.96	50
1/21/2019	nip	18.96	25
1/21/2019	nip	18.11	60
1/21/2019	nip	18.11	30
1/24/2019	nip	15.6	48
1/25/2019	nip	5.7	100

1/25/2019	nip	10.8	168
1/28/2019	nip	17.41	250
1/29/2019	nip	13.16	15
1/29/2019	nip	8.32	1
1/29/2019	nip	19.01	1200
1/31/2019	nip	16.94	475
2/1/2019	nip	20.56	1200
2/1/2019	nip	15.6	110
2/1/2019	nip	18.82	110
2/1/2019	nip	13.01	33
2/1/2019	nip	10.35	387
2/1/2019	nip	15.27	445
2/2/2019	nip	5.83	94
2/2/2019	nip	8.28	96
2/2/2019	nip	10.73	97
2/2/2019	nip	13.22	99
2/2/2019	nip	10.41	87
2/4/2019	nip	20.23	2400
2/5/2019	nip	17.23	700
2/5/2019	nip	18.34	700
2/5/2019	nip	5.28	215
2/6/2019	nip	18.12	350
2/6/2019	nip	18.82	350
2/6/2019	nip	19.07	350
2/11/2019	nip	18.89	10
2/14/2019	nip	20.62	1440
2/14/2019	nip	14.2	200
2/15/2019	nip	15.41	250
2/15/2019	nip	14.36	250
2/16/2019	nip	18.09	720
2/18/2019	nip	20.03	800
2/18/2019	nip	18.72	800
2/18/2019	nip	16.13	500
2/18/2019	nip	17.07	600
2/18/2019	nip	18.83	600
2/18/2019	nip	18.95	70
2/19/2019	nip	8.3	250
2/20/2019	nip	14.13	90
2/20/2019	nip	17.09	300
2/22/2019	nip	15.2	650
2/22/2019	nip	2.66	8
2/22/2019	nip	2	720
2/22/2019	nip	0.706	985
2/22/2019	nip	1.57	30
2/22/2019	nip	11.02	16

2/22/2019	nip	15.5	1
2/26/2019	nip	5.36	2500
2/26/2019	nip	12.23	5
2/26/2019	nip	16.47	10
2/26/2019	nip	7.23	5
2/26/2019	nip	14.75	10
2/26/2019	nip	18.18	23
2/26/2019	nip	16.06	10
2/26/2019	nip	15.97	15
2/26/2019	nip	16.68	10
2/26/2019	nip	18.36	23
2/27/2019	nip	10.49	1600
2/28/2019	nip	19.31	550
2/28/2019	nip	19.31	53.33
2/28/2019	nip	20.24	274.84
3/4/2019	nip	15.34	1920
3/6/2019	nip	19.43	150
3/6/2019	nip	19.3	285
3/7/2019	nip	18.61	600
3/7/2019	nip	16.37	400
3/11/2019	nip	18.67	50
3/11/2019	nip	20.62	65
3/12/2019	nip	15.5	20
3/12/2019	nip	19.62	0.1
3/15/2019	nip	16.46	50
3/15/2019	nip	17.92	120
3/15/2019	nip	20.12	1000
3/18/2019	nip	8.8	150
3/18/2019	nip	13.2	350
3/18/2019	nip	17.11	720
3/18/2019	nip	19.41	156
3/20/2019	nip	18.45	200
3/23/2019	nip	18.23	340
3/23/2019	nip	16.23	720
3/26/2019	nip	9.84	783
3/26/2019	nip	6.62	768
3/26/2019	nip	17.41	300
3/27/2019	nip	23.9	1000
3/29/2019	nip	18.33	600
3/30/2019	nip	11.2	1440
4/1/2019	nip	19.15	500
4/1/2019	nip	17.27	500
4/1/2019	nip	19.31	84
4/4/2019	nip	19.24	1000
4/7/2019	nip	12.55	120

4/8/2019	nip	18.4	816
4/9/2019	nip	5.81	220
4/10/2019	nip	17.6	150
4/10/2019	nip	17.6	75
4/11/2019	nip	14.86	100
4/11/2019	nip	17.21	312
4/11/2019	nip	14.86	3.5
4/11/2019	nip	17.21	4.5
4/12/2019	nip	13	400
4/17/2019	nip	17.09	400
4/18/2019	nip	12.5	20
4/20/2019	nip	7.54	48
4/20/2019	nip	6.43	528
4/23/2019	nip	14.55	1000
4/26/2019	nip	9.94	1000
4/26/2019	nip	11.7	0.1
4/26/2019	nip	13.7	2
4/28/2019	nip	6.23	100
4/28/2019	nip	12.13	270
5/1/2019	nip	12.6	45
5/1/2019	nip	13.4	60
5/1/2019	nip	14.9	72
5/1/2019	nip	13	54
5/6/2019	nip	16.52	450
5/7/2019	nip	10.78	192
5/10/2019	nip	18.94	2160
5/15/2019	nip	19.68	500
5/15/2019	nip	19.68	600
5/15/2019	nip	21.92	400
5/16/2019	nip	16.2	1440
5/17/2019	nip	18.7	52
5/19/2019	nip	15.72	320
5/20/2019	nip	10.29	720
5/22/2019	nip	17.68	500
5/22/2019	nip	17.5	300
5/28/2019	nip	16.86	550
5/28/2019	nip	17.23	750
6/1/2019	nip	18.71	400
6/7/2019	nip	19.97	300
6/10/2019	nip	20	1
6/11/2019	nip	1.49	1.5
6/11/2019	nip	10.02	12
6/11/2019	nip	8.13	8.8
6/12/2019	nip	19.2	290
6/12/2019	nip	19.2	800

6/13/2019	nip	9.79	624
6/13/2019	nip	19.16	1600
6/19/2019	nip	15.51	250
6/19/2019	nip	10.12	72
6/19/2019	nip	17.23	400
6/19/2019	nip	15.59	70
6/20/2019	nip	17.43	549
6/20/2019	nip	14.97	165
6/21/2019	nip	14.73	2.5
6/22/2019	nip	6.96	245
6/25/2019	nip	14.7	1780
6/25/2019	nip	10.9	2300
6/26/2019	nip	21.2	720
6/27/2019	nip	12.07	45
6/27/2019	nip	12.87	370
6/28/2019	nip	15.52	10
6/28/2019	nip	14.2	100
6/28/2019	nip	18	2
6/28/2019	nip	19.7	0.5
6/28/2019	nip	18	1
6/28/2019	nip	19.7	2
7/2/2019	nip	16.04	5
7/2/2019	nip	19.8	500
7/3/2019	nip	17.39	300
7/4/2019	nip	14.38	250
7/8/2019	nip	19.8	437
7/8/2019	nip	20.8	63
7/9/2019	nip	11.81	216
7/9/2019	nip	14.73	216
7/9/2019	nip	19.85	540
7/9/2019	nip	4.1	26
7/9/2019	nip	7.5	110
7/9/2019	nip	9.4	480
7/11/2019	nip	15.43	528
7/15/2019	nip	20.61	480
7/16/2019	nip	11.88	1440
7/21/2019	nip	17.8	1600
7/21/2019	nip	19	2240
7/21/2019	nip	18.1	2586
7/23/2019	nip	19.01	480
7/23/2019	nip	17.41	270
7/30/2019	nip	8.16	1440
7/31/2019	nip	18.56	173
7/31/2019	nip	17.36	60
8/1/2019	nip	12.43	20

8/2/2019	nip	17.14	6000
8/2/2019	nip	19.87	100
8/2/2019	nip	21.03	250
8/6/2019	nip	20.1	141
8/6/2019	nip	18	504
8/7/2019	nip	17.16	500
8/9/2019	nip	18.9	270
8/9/2019	nip	15	150
8/9/2019	nip	14.2	40
8/9/2019	nip	14.19	168
8/10/2019	nip	12.06	33
8/10/2019	nip	13.12	62
8/10/2019	nip	12.27	124
8/11/2019	nip	8.32	7
8/12/2019	nip	6	3.3
8/13/2019	nip	18	99
8/13/2019	nip	17.5	100
8/14/2019	nip	16.48	70
8/20/2019	nip	8.99	55
8/20/2019	nip	5.98	90
8/20/2019	nip	3.29	80
8/22/2019	nip	17	384
8/23/2019	nip	6.3	10
8/23/2019	nip	8.74	30
8/23/2019	nip	10.73	90
8/23/2019	nip	5.58	5
8/23/2019	nip	6.91	22
8/23/2019	nip	16.71	200
8/23/2019	nip	16.71	50
8/26/2019	nip	19.22	180
8/27/2019	nip	17.11	330
8/27/2019	nip	19.23	160
9/2/2019	nip	10.26	1440
9/2/2019	nip	11.28	1440
9/3/2019	nip	18.31	277
9/3/2019	nip	20.86	277
9/4/2019	nip	19.11	85
9/4/2019	nip	19.11	30
9/4/2019	nip	21.3	110
9/4/2019	nip	19.11	18
9/4/2019	nip	21.3	35
9/4/2019	nip	19.11	35
9/6/2019	nip	6.91	100
9/10/2019	nip	17.9	150
9/10/2019	nip	19.3	980

9/10/2019	nip	21.24	230
9/10/2019	nip	19.32	120
9/10/2019	nip	21.24	480
9/10/2019	nip	19.32	250
9/11/2019	nip	7.41	80
9/11/2019	nip	10.55	85
9/18/2019	nip	15.32	720
9/18/2019	nip	16.9	900
9/18/2019	nip	18.7	10
9/19/2019	nip	15.23	50
9/19/2019	nip	7.54	150
9/20/2019	nip	12.53	1
9/20/2019	nip	12.53	48
9/25/2019	nip	14.57	1400
9/27/2019	nip	14.5	1200
9/27/2019	nip	20.93	720
9/27/2019	nip	9.41	86
10/1/2019	nip	15.6	160
10/2/2019	nip	18.59	10
10/7/2019	nip	10.1	100
10/8/2019	nip	20.2	19.5
10/8/2019	nip	21.44	20.3
10/8/2019	nip	16.1	1500
10/9/2019	nip	20.7	700
10/9/2019	nip	18.33	700
10/9/2019	nip	18.49	125
10/9/2019	nip	20.03	25
10/12/2019	nip	18	4
10/12/2019	nip	20.9	500
10/14/2019	nip	19.74	150
10/14/2019	nip	17.9	360
10/15/2019	nip	19.46	900
10/15/2019	nip	14	450
10/15/2019	nip	11.1	20
10/21/2019	nip	18.5	2500
10/26/2019	nip	20.8	1795
10/26/2019	nip	18.43	806
10/30/2019	nip	19.05	200
10/30/2019	nip	17.64	250
10/30/2019	nip	19.38	250
10/30/2019	nip	15.6	0.43
11/3/2019	nip	14.1	3.34
11/4/2019	nip	3.3	30
11/4/2019	nip	6.8	5
11/4/2019	nip	14.9	0.5

11/5/2019	nip	17.9	14
11/5/2019	nip	19.46	14
11/5/2019	nip	17.45	250
11/6/2019	nip	20.55	150
11/7/2019	nip	15.91	96
11/7/2019	nip	16.05	96
11/8/2019	nip	15.2	200
11/8/2019	nip	18.5	60
11/11/2019	nip	20.26	1000
11/17/2019	nip	19.51	1248
11/17/2019	nip	16.03	200
11/17/2019	nip	19.09	400
11/20/2019	nip	6.53	480
11/28/2019	nip	21.45	1096
11/28/2019	nip	20.3	239
11/29/2019	nip	18.03	4200
12/2/2019	nip	17.7	405.4
12/3/2019	nip	11.68	48
12/3/2019	nip	9.87	60
12/3/2019	nip	8.53	72
12/3/2019	nip	6.54	72
12/3/2019	nip	5.39	84
12/4/2019	nip	18.82	282.47
12/5/2019	nip	8.3	150
12/7/2019	nip	19.12	1000
12/7/2019	nip	17.17	601.4
12/9/2019	nip	18.9	600
12/9/2019	nip	17.2	1080
12/10/2019	nip	21.07	455.9
12/11/2019	nip	10.29	92.3
12/12/2019	nip	16.63	120
12/13/2019	nip	18.91	100
12/13/2019	nip	3.41	40
12/16/2019	nip	18.21	100
12/16/2019	nip	18.66	720
12/16/2019	nip	17.48	720
12/16/2019	nip	20.52	144
12/16/2019	nip	17.88	110
12/17/2019	nip	13.75	120
12/17/2019	nip	12.86	120
12/17/2019	nip	12.15	113
12/17/2019	nip	12.97	113
12/17/2019	nip	12.6	113
12/17/2019	nip	11.71	113
12/17/2019	nip	0.94	12

12/17/2019	nip	19.54	240
12/18/2019	nip	14.57	200
12/18/2019	nip	20.05	400
12/20/2019	nip	18.53	600
12/20/2019	nip	14.03	508.8
12/20/2019	nip	17.29	372
12/20/2019	nip	16.89	669.6
12/27/2019	nip	19.26	100
12/27/2019	nip	19.26	720
12/27/2019	nip	17.1	40
12/27/2019	nip	17.3	40
12/27/2019	nip	17.4	40
12/27/2019	nip	17.5	40
12/27/2019	nip	17.4	40
12/27/2019	nip	17.7	40
12/27/2019	nip	16.9	40
12/28/2019	nip	17.4	200
12/30/2019	nip	7.95	200
12/30/2019	nip	10.3	300
12/30/2019	nip	9.15	400
12/30/2019	nip	18.85	139.91
12/30/2019	nip	19.97	900
12/30/2019	nip	16.52	900
12/30/2019	nip	14.46	100
1/3/2020	nip	12.77	381.6
1/3/2020	nip	17.8	602.4
1/3/2020	nip	12.77	36
1/3/2020	nip	17.8	61.44
1/6/2020	nip	7.35	1000
1/8/2020	nip	20.7	500
1/13/2020	nip	21.98	1440
1/16/2020	nip	11.8	20.4
1/16/2020	nip	10	3600
1/24/2020	nip	18.9	1120
1/24/2020	nip	19.1	500
1/27/2020	nip	19	11.3
1/27/2020	nip	20.5	946
1/29/2020	nip	16.91	745
1/31/2020	nip	10.35	250.6
1/31/2020	nip	10.35	486.5
1/31/2020	nip	18.4	72
1/31/2020	nip	21.8	672
2/3/2020	nip	20.9	70
2/3/2020	nip	20.9	70
2/3/2020	nip	18.4	65

2/3/2020	nip	18.4	65
2/5/2020	nip	20.12	158.99
2/12/2020	nip	8.28	480
2/14/2020	nip	17.5	250
2/14/2020	nip	18.3	240
2/14/2020	nip	17.5	375
2/14/2020	nip	17.5	25
3/10/2020	nip	13.9	144
3/10/2020	nip	15.9	144
3/30/2020	nip	18.2	500
3/30/2020	nip	19.67	500
4/3/2020	nip	19.34	5
4/21/2020	nip	10.3	0.4
4/21/2020	nip	7.9	7
4/21/2020	nip	9.9	2
4/24/2020	nip	12.53	400
4/27/2020	nip	18.24	1320
4/27/2020	nip	21.25	2400
5/19/2020	nip	17	168
5/19/2020	nip	15	288
5/19/2020	nip	15	84
5/21/2020	nip	15.25	408
7/6/2020	nip	13.16	600
9/24/2020	nip	16.5	200
9/24/2020	nip	16.5	200
9/24/2020	nip	17.1	300
9/24/2020	nip	17.1	300
9/24/2020	nip	18.7	500
9/24/2020	nip	18.7	500
2/28/2022	nip	2.31	600

Table S5. Power conversion efficiency and T₈₀ lifetime for pin perovskite solar cells. The data was extracted from the perovskite database by filtering for pin cells that contain valid efficiency and stability metrics.¹

Publication date	Cell architecture	PCE, %	T₈₀, hr
12/23/2014	pin	8.14	480
12/30/2014	pin	7.65	0.26
3/11/2015	pin	9.4	45
3/11/2015	pin	10.2	290
3/11/2015	pin	9.9	360
5/4/2015	pin	16	39
6/3/2015	pin	17	99
6/17/2015	pin	10.77	0.17
6/17/2015	pin	12.51	0.17
8/12/2015	pin	15.23	1680
8/24/2015	pin	5.47	0.4

8/24/2015	pin	12	10
8/24/2015	pin	12.5	28
8/24/2015	pin	12.5	16
10/12/2015	pin	0.1	120
10/29/2015	pin	15.1	2880
11/23/2015	pin	11.65	5.27
11/23/2015	pin	8.39	8.97
11/23/2015	pin	12.71	16.2
11/23/2015	pin	13.71	168
11/23/2015	pin	14.42	140
11/23/2015	pin	9.38	100
11/24/2015	pin	13.24	535
11/24/2015	pin	13.52	230
11/30/2015	pin	8.23	62
11/30/2015	pin	9.74	180
11/30/2015	pin	0.64	383
12/4/2015	pin	15.85	480
12/4/2015	pin	12.21	72
1/11/2016	pin	13.6	0.2
1/11/2016	pin	12.3	0.4
1/14/2016	pin	7.21	840
2/10/2016	pin	7.2	1680
2/16/2016	pin	12.3	124
2/16/2016	pin	13.5	0.025
3/22/2016	pin	15.1	320
3/22/2016	pin	13.6	50
3/22/2016	pin	12.6	275
3/22/2016	pin	11.7	24
4/12/2016	pin	5.82	50
4/12/2016	pin	12.98	100
4/26/2016	pin	9.2	1000
4/26/2016	pin	12.98	1000
5/11/2016	pin	12.05	101
5/11/2016	pin	16.97	377
5/11/2016	pin	12.05	9
5/11/2016	pin	16.97	99
6/17/2016	pin	10.1	1000
6/28/2016	pin	12.76	140
6/28/2016	pin	7.93	85
6/28/2016	pin	9	52
7/4/2016	pin	10.8	5
7/4/2016	pin	15.2	440
7/4/2016	pin	10.8	130
7/4/2016	pin	15.2	580
7/4/2016	pin	10.8	300

7/25/2016	pin	3.4	20
7/25/2016	pin	6.28	30
7/25/2016	pin	6.8	40
9/9/2016	pin	0.49	1.8
9/13/2016	pin	6.3	125
9/13/2016	pin	6.3	24
9/13/2016	pin	17.3	33
9/21/2016	pin	3.5	168
9/29/2016	pin	16.8	550
10/5/2016	pin	17.56	50
10/5/2016	pin	16.6	115
10/6/2016	pin	15.1	552
10/6/2016	pin	11.79	30
10/14/2016	pin	12.84	576
10/14/2016	pin	16.25	984
10/16/2016	pin	16.1	128
10/16/2016	pin	17.5	207
10/21/2016	pin	14.5	90
10/21/2016	pin	15.1	90
11/10/2016	pin	9.7	5000
11/10/2016	pin	9.06	1400
11/21/2016	pin	2.08	1.3
11/21/2016	pin	14.69	950
11/21/2016	pin	10.73	150
11/28/2016	pin	8	42
11/28/2016	pin	7.1	103
11/30/2016	pin	12.3	50
12/6/2016	pin	13.1	720
12/8/2016	pin	12.8	800
1/6/2017	pin	2.14	1.75
1/17/2017	pin	10.1	50
1/17/2017	pin	12.2	50
2/17/2017	pin	19.6	720
2/17/2017	pin	19.6	3
2/23/2017	pin	12.2	335
2/23/2017	pin	16.7	850
2/24/2017	pin	11.33	3.33
2/24/2017	pin	12.18	6.43
2/24/2017	pin	12.68	5.91
2/24/2017	pin	11.58	8.1
4/20/2017	pin	11.9	24
4/20/2017	pin	16.5	1670
4/26/2017	pin	7.05	168
4/26/2017	pin	8.09	348
5/24/2017	pin	15.15	400

6/5/2017	pin	15.38	100
6/5/2017	pin	12.14	190
6/5/2017	pin	14.39	190
6/5/2017	pin	16.33	300
6/9/2017	pin	12.7	12
6/10/2017	pin	12.83	100
6/12/2017	pin	15.1	450
6/12/2017	pin	17.44	360
6/16/2017	pin	6.9	336
6/17/2017	pin	10.4	61
6/23/2017	pin	9.1	1
6/28/2017	pin	12.58	120
7/11/2017	pin	12.44	10
7/11/2017	pin	14.35	1320
7/11/2017	pin	15	1200
7/14/2017	pin	7.48	400
7/19/2017	pin	14.07	8
7/25/2017	pin	14.73	200
7/26/2017	pin	14.3	210
7/26/2017	pin	12.8	101.4
8/8/2017	pin	16	149
8/17/2017	pin	8.9	38.2
8/17/2017	pin	5	4.07
8/24/2017	pin	9.17	1080
8/24/2017	pin	8.38	1080
9/7/2017	pin	14.5	360
9/8/2017	pin	18.84	240
9/8/2017	pin	16	26
9/8/2017	pin	14.4	15
9/9/2017	pin	13.28	288
9/9/2017	pin	10.24	24
9/22/2017	pin	10.76	400
9/26/2017	pin	14.2	39
9/26/2017	pin	14.9	97
9/26/2017	pin	15.9	105
10/4/2017	pin	18	480
10/9/2017	pin	17.13	1500
10/14/2017	pin	17	720
10/23/2017	pin	16.14	360
10/31/2017	pin	9.73	135
11/26/2017	pin	13.6	8
11/26/2017	pin	16.9	13
11/27/2017	pin	14.3	155
11/27/2017	pin	14.3	5
12/1/2017	pin	18.21	0.9

12/7/2017	pin	10.6	670
12/22/2017	pin	15.1	72
12/22/2017	pin	16.1	432
12/29/2017	pin	13.1	0.1
1/4/2018	pin	15.14	72
1/4/2018	pin	10.69	36
1/5/2018	pin	15.2	400
1/5/2018	pin	17.4	168
1/5/2018	pin	16.4	720
1/8/2018	pin	13.51	100
1/8/2018	pin	16.72	100
1/15/2018	pin	13.5	48
1/17/2018	pin	16.26	171
1/17/2018	pin	16.89	588
1/22/2018	pin	16.4	90
1/22/2018	pin	19.6	100
1/22/2018	pin	17.1	850
1/31/2018	pin	14.24	381
1/31/2018	pin	12.2	112
2/6/2018	pin	17.02	160
2/13/2018	pin	14.3	37.5
2/21/2018	pin	18.52	600
3/14/2018	pin	4.48	1
3/18/2018	pin	16.29	430
3/28/2018	pin	17	200
4/3/2018	pin	16.13	480
4/4/2018	pin	13.14	408
4/4/2018	pin	16.53	288
4/4/2018	pin	16.98	6
4/4/2018	pin	14.81	6
4/6/2018	pin	12.46	16.6
4/7/2018	pin	13.44	323
4/11/2018	pin	12.46	75
4/11/2018	pin	12.88	150
4/11/2018	pin	13.97	135
4/11/2018	pin	16.47	160
4/11/2018	pin	11.96	11
4/11/2018	pin	15.43	1
4/11/2018	pin	18.45	1
4/11/2018	pin	13.9	84
4/16/2018	pin	1	0.03
4/16/2018	pin	5.6	0.33
4/17/2018	pin	10.3	74
5/3/2018	pin	7.23	0.17
5/3/2018	pin	12.91	0.75

5/3/2018	pin	8.78	0.35
5/4/2018	pin	15.3	250
5/4/2018	pin	13.2	120
5/4/2018	pin	15.3	60
5/4/2018	pin	13.2	30
5/7/2018	pin	14.7	300
5/9/2018	pin	12.1	360
5/14/2018	pin	0.99	216
5/22/2018	pin	13.2	229
5/28/2018	pin	14.31	220
5/29/2018	pin	16.63	530
5/29/2018	pin	17.16	630
5/31/2018	pin	18.67	50
5/31/2018	pin	18.67	5
5/31/2018	pin	20.13	250
6/4/2018	pin	13.7	110
6/4/2018	pin	15.09	624
6/7/2018	pin	5.1	200
6/11/2018	pin	13	720
6/11/2018	pin	0.61	440
6/11/2018	pin	5.24	180
6/11/2018	pin	14.49	72
6/11/2018	pin	17.1	115.92
6/18/2018	pin	19.05	72
6/18/2018	pin	12.17	0.5
6/18/2018	pin	18.03	1
6/18/2018	pin	18.08	120
6/19/2018	pin	14.52	12
6/19/2018	pin	14.4	10
6/19/2018	pin	15	227
6/19/2018	pin	10.5	62
6/23/2018	pin	16.9	360
6/28/2018	pin	14.9	67
7/2/2018	pin	12.8	2000
7/3/2018	pin	16.2	108
7/3/2018	pin	17.9	37
7/9/2018	pin	19.6	720
7/10/2018	pin	13.2	50
7/13/2018	pin	13.9	70
7/13/2018	pin	11.8	149
7/13/2018	pin	12.3	48
7/17/2018	pin	18.16	720
8/4/2018	pin	16.7	120
8/7/2018	pin	11.26	350
8/7/2018	pin	12.51	350

8/7/2018	pin	10.2	91
8/8/2018	pin	15.66	720
8/11/2018	pin	8.61	120
8/11/2018	pin	12.29	650
8/11/2018	pin	8.46	144
8/11/2018	pin	13.54	720
8/11/2018	pin	9.01	720
8/11/2018	pin	7.92	120
8/11/2018	pin	9.77	700
8/11/2018	pin	13.45	36
8/11/2018	pin	11.05	24
8/11/2018	pin	15.78	72
8/11/2018	pin	10.56	24
8/11/2018	pin	10.81	20
8/29/2018	pin	15.06	1500
9/12/2018	pin	17.98	200
9/12/2018	pin	13.88	140
9/13/2018	pin	13.3	2800
9/13/2018	pin	13.8	2600
9/13/2018	pin	14.8	1600
9/13/2018	pin	15	1300
9/13/2018	pin	15.2	800
9/13/2018	pin	15.3	200
9/13/2018	pin	13.8	100
9/19/2018	pin	2.78	218
9/19/2018	pin	3.62	447
10/16/2018	pin	12.3	1440
10/19/2018	pin	14.15	50
10/23/2018	pin	18.38	0.5
10/23/2018	pin	18.53	0.16
10/23/2018	pin	15.55	1.16
10/23/2018	pin	17.2	110
10/23/2018	pin	13.2	55
10/23/2018	pin	17	55
10/29/2018	pin	14.4	216
11/1/2018	pin	12.5	87
11/2/2018	pin	16.72	750
11/2/2018	pin	19.95	2800
11/4/2018	pin	10.3	25
11/4/2018	pin	13.4	25
11/4/2018	pin	12.3	100
11/4/2018	pin	12.3	230
11/4/2018	pin	12.2	780
11/4/2018	pin	10.9	950
11/4/2018	pin	10.3	20

11/4/2018	pin	13.4	30
11/4/2018	pin	12.3	40
11/4/2018	pin	12.3	40
11/4/2018	pin	12.2	40
11/4/2018	pin	10.9	330
11/7/2018	pin	11.22	100
11/10/2018	pin	9.32	1464
11/10/2018	pin	12.78	1464
11/10/2018	pin	18.15	1000
11/27/2018	pin	18.16	240
11/27/2018	pin	19.26	720
11/28/2018	pin	17.29	6709
11/29/2018	pin	19.16	16
11/30/2018	pin	6.76	500
12/13/2018	pin	20	720
12/13/2018	pin	15	420
12/18/2018	pin	3.4	80
12/18/2018	pin	7	100
12/22/2018	pin	18.36	336
12/22/2018	pin	17.75	336
12/27/2018	pin	17.77	960
12/28/2018	pin	7.2	0.25
12/28/2018	pin	13	0.75
12/28/2018	pin	8.8	0.35
1/1/2019	pin	13.87	750
1/1/2019	pin	13.83	800
1/2/2019	pin	17.81	720
1/9/2019	pin	3.02	50
1/9/2019	pin	17.01	150
1/9/2019	pin	15.43	150
1/9/2019	pin	16.48	150
1/9/2019	pin	17.46	150
1/11/2019	pin	17.5	300
1/21/2019	pin	11.18	15
1/23/2019	pin	13.7	60
1/24/2019	pin	14.38	300
1/24/2019	pin	17.2	500
1/28/2019	pin	18.4	2
1/28/2019	pin	18.88	1
1/28/2019	pin	16.16	6
1/28/2019	pin	16.52	1
2/4/2019	pin	13.82	400
2/4/2019	pin	13.82	80
2/4/2019	pin	14.4	0.3
2/4/2019	pin	13.2	0.6

2/4/2019	pin	15.5	0.75
2/4/2019	pin	15.7	0.6
2/4/2019	pin	16.9	1.2
2/22/2019	pin	18.16	200
2/22/2019	pin	19.33	459
2/27/2019	pin	13.8	2200
2/27/2019	pin	16.1	3400
2/27/2019	pin	15.1	3400
3/6/2019	pin	18.75	645
3/7/2019	pin	13.72	4.02
3/7/2019	pin	16.64	600
3/9/2019	pin	18.3	100
3/15/2019	pin	15.26	100
3/15/2019	pin	14.98	100
3/26/2019	pin	16.11	75
3/27/2019	pin	2.71	1.8
3/28/2019	pin	17.32	960
4/2/2019	pin	11.97	500
4/2/2019	pin	12.58	524
4/13/2019	pin	20	890
4/15/2019	pin	16.61	26
4/15/2019	pin	17.23	370
4/15/2019	pin	20.67	1045
4/22/2019	pin	17.91	827.8
4/22/2019	pin	15.1	609.6
4/25/2019	pin	15.9	179
4/25/2019	pin	18.21	385
4/29/2019	pin	8.04	20
4/29/2019	pin	10.15	20
4/30/2019	pin	18.12	80
4/30/2019	pin	20.55	800
5/2/2019	pin	18	40
5/2/2019	pin	20	160
5/2/2019	pin	12.19	40
5/2/2019	pin	12.74	40
5/2/2019	pin	13.72	1400
5/2/2019	pin	20	100
5/7/2019	pin	19.1	290
5/7/2019	pin	20.1	480
5/7/2019	pin	19.1	242
5/7/2019	pin	19.8	175
5/7/2019	pin	21.3	624
5/18/2019	pin	9.19	207
5/18/2019	pin	11.32	270
5/24/2019	pin	20.3	30

5/27/2019	pin	10.6	240
5/27/2019	pin	14.9	240
6/2/2019	pin	14.91	500
6/2/2019	pin	17.42	500
6/5/2019	pin	5.55	120
6/5/2019	pin	8.82	48
6/5/2019	pin	6.42	24
6/7/2019	pin	17.2	20
6/7/2019	pin	16.34	120
6/17/2019	pin	17.08	145
6/17/2019	pin	20.34	335
6/17/2019	pin	21.01	600
6/18/2019	pin	17.01	480
6/18/2019	pin	15.2	240
6/22/2019	pin	15.34	70
6/25/2019	pin	14.53	700
6/25/2019	pin	18.6	700
6/28/2019	pin	12.5	80
6/28/2019	pin	15.7	100
7/3/2019	pin	15.9	97
7/3/2019	pin	19	100
7/3/2019	pin	12.5	100
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7/8/2019	pin	17.69	960
7/8/2019	pin	17.02	370
7/8/2019	pin	17.46	160
7/16/2019	pin	12.85	720
7/16/2019	pin	18.45	200
7/16/2019	pin	19.73	280
7/19/2019	pin	13.86	720
7/19/2019	pin	8.94	216
7/19/2019	pin	5.87	40
7/19/2019	pin	5.87	193
7/23/2019	pin	13.24	170
7/23/2019	pin	15.37	240
7/27/2019	pin	17.15	140
7/27/2019	pin	16.24	80
7/31/2019	pin	5	144
8/5/2019	pin	18.69	131.29
8/7/2019	pin	17.85	340
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8/19/2019	pin	11.17	500
8/20/2019	pin	14.81	840
8/21/2019	pin	18.55	500
8/22/2019	pin	19.1	17

8/22/2019	pin	21.37	18.5
8/23/2019	pin	19.79	720
8/26/2019	pin	15	47
8/26/2019	pin	10.3	25
8/29/2019	pin	13.5	150
8/30/2019	pin	15.89	2400
8/30/2019	pin	4.77	40
8/30/2019	pin	7.86	350
9/2/2019	pin	17.5	40
9/3/2019	pin	14.01	200
9/3/2019	pin	14.01	200
9/7/2019	pin	12.18	450
9/7/2019	pin	15.15	450
9/8/2019	pin	14.35	100
9/11/2019	pin	17.3	117
9/25/2019	pin	10.42	100
9/25/2019	pin	13.81	322
9/25/2019	pin	16.94	1000
9/30/2019	pin	11.2	600
10/8/2019	pin	18.52	2160
10/9/2019	pin	10.5	900
10/9/2019	pin	10.61	700
10/9/2019	pin	11.19	700
10/9/2019	pin	11.08	600
10/15/2019	pin	12.67	1032
10/15/2019	pin	11.97	2160
10/23/2019	pin	11.1	50
10/28/2019	pin	13.8	22
10/28/2019	pin	15.08	30
10/28/2019	pin	15.81	41
10/30/2019	pin	14.1	700
10/30/2019	pin	7.34	100
11/4/2019	pin	17.3	750
11/5/2019	pin	20.46	720
11/14/2019	pin	9.68	24
11/14/2019	pin	9.72	100
11/19/2019	pin	7.57	100.6
11/21/2019	pin	20.05	1500
11/21/2019	pin	17.46	900
12/4/2019	pin	15.9	200
12/9/2019	pin	15.83	400
12/17/2019	pin	5.19	156
12/17/2019	pin	4.48	432
12/18/2019	pin	17.19	100
12/19/2019	pin	20.31	2

12/19/2019	pin	16.54	2
12/23/2019	pin	6.34	1
12/27/2019	pin	5.64	70.8
12/28/2019	pin	18.11	264
12/28/2019	pin	15.38	48
1/9/2020	pin	12.51	653
1/10/2020	pin	11	80
1/11/2020	pin	18.13	210
1/11/2020	pin	18.13	3
1/11/2020	pin	20.18	13
1/13/2020	pin	20.4	534.8
1/13/2020	pin	20.4	14.1
1/13/2020	pin	14.9	20
1/17/2020	pin	17.02	140
1/20/2020	pin	20	600
1/22/2020	pin	16.57	200
1/22/2020	pin	19.15	430
1/24/2020	pin	8.7	142.8
1/24/2020	pin	11.6	336.24
1/24/2020	pin	16.5	125
1/31/2020	pin	16.83	612
2/5/2020	pin	14.4	50.6
2/5/2020	pin	16.6	212.8
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3/27/2020	pin	6.48	60
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4/21/2020	pin	13	7.1
4/21/2020	pin	11.8	8.3
5/26/2020	pin	13.18	240
5/26/2020	pin	16.7	600
5/26/2020	pin	15.03	360
5/26/2020	pin	18.73	720
5/28/2020	pin	19.9	1350
5/28/2020	pin	16.4	500
7/8/2020	pin	19.9	720
7/8/2020	pin	18.2	240
7/21/2020	pin	18.7	550
7/21/2020	pin	17.3	80
6/11/2024	pin	19.05	0.533
6/11/2024	pin	20.89	3.13
6/11/2024	pin	17.61	4.85
6/11/2024	pin	16.93	2.467

Supplemental references

1. The Perovskite Database, <https://www.perovskitedatabase.com/>, (accessed May 20th, 2023).