



THE UNIVERSITY OF CHICAGO
THE LAW SCHOOL
Abrams Environmental
Law Clinic

June 24, 2024

Via E-Filing

Ms. Lisa Felice
Executive Secretary
Michigan Public Service Commission
7109 West Saginaw Highway
Lansing, MI 48917

RE: MPSC Case No. U-21291

Dear Ms. Felice:

Please find enclosed the Official Exhibits FLO-135 to FLO-167 sponsored by Justin Schott (Part 7 of 13) on Behalf of Frontline Organizations, along with proof of service for electronic filing in the above-referenced matter. Please do not hesitate to contact me with any questions or comments.

Sincerely,

A handwritten signature in black ink, appearing to read "Mark N. Templeton".

Mark N. Templeton, *pro hac vice*
6020 S. University Avenue
Chicago, IL 60637
Phone: (773) 702-9611
Email: templeton@uchicago.edu

xc: Parties to Case No. U-21291

FLO JS Workpaper 3 - High Energy Burden Low-Income Tracts vs. % Black

DATA SOURCE: Climate and Economic Justice Screening Tool (CEJST) - Council on Environmental Quality (CEQ). Downloaded April 1, 2024.
<https://screeningtool.geoplatform.gov/en/downloads#4.27/34.38/-99.17>

Location	Energy Burden (% income)	Avg. Annual Energy Cost (\$)	Total Households	Household Income	Black/ African American (% pop.)	American Indian/ Native Alaskan (% pop.)	Asian (% pop.)	Native Hawaiian/ Other Pacific Islander (% pop.)	White Hispanic or Latino (% pop.)	White Non- Hispanic or Latino (% pop.)	Two or More Races (% pop.)	Other Races (% pop.)	Less Than High School (% pop.)	High School (% pop.)	Associates or Some College (% pop.)	Bachelors or Higher (% pop.)
Census Tract 5112, Wayne County, Michigan	49	\$3,536	298	\$7,221	93	0	0	0	0	6	0	0	6	29	55	9
Census Tract 5382, Wayne County, Michigan	45	\$3,869	67	\$8,589	94	0	0	0	0	6	0	0	0	10	18	72
Census Tract 5301, Wayne County, Michigan	42	\$2,900	569	\$6,931	99	0	0	0	0	0	1	0	36	21	40	3
Census Tract 5231, Wayne County, Michigan	39	\$3,009	410	\$7,651	18	0	0	0	24	33	10	16	46	22	26	6
Census Tract 5313, Wayne County, Michigan	39	\$3,000	201	\$7,622	94	0	0	0	0	2	4	0	26	24	45	5
Census Tract 1527, Oakland County, Michigan	38	\$2,658	87	\$7,036	3	0	0	0	1	95	0	0	0	1	10	89
Census Tract 9854, Wayne County, Michigan	36	\$3,174	4	\$8,764	0	0	0	0	0	100	0	0	0	53	47	0
Census Tract 5451, Wayne County, Michigan	35	\$2,793	131	\$7,996	97	1	0	0	0	1	1	0	17	53	26	5
Census Tract 5452, Wayne County, Michigan	35	\$3,524	387	\$10,192	100	0	0	0	0	0	0	0	25	26	43	6
Census Tract 5002, Wayne County, Michigan	32	\$3,491	208	\$10,818	99	0	0	0	0	1	0	0	2	22	67	9
Census Tract 5071, Wayne County, Michigan	32	\$3,137	449	\$9,934	96	0	0	0	0	1	3	0	13	50	23	14
Census Tract 5190, Wayne County, Michigan	31	\$2,910	121	\$9,438	90	0	0	0	0	9	0	0	15	55	26	5
Census Tract 5265, Wayne County, Michigan	30	\$2,896	326	\$9,738	81	0	0	0	10	1	0	9	44	22	26	8
Census Tract 5393, Wayne County, Michigan	30	\$3,537	375	\$11,758	100	0	0	0	0	0	0	0	6	12	49	33
Census Tract 5113, Wayne County, Michigan	29	\$3,709	427	\$12,639	39	0	9	0	0	48	3	1	25	30	33	13
Census Tract 5333, Wayne County, Michigan	29	\$3,109	154	\$10,810	91	0	1	0	0	5	3	0	17	46	24	12
Census Tract 5391, Wayne County, Michigan	29	\$3,591	267	\$12,206	98	1	0	0	0	0	0	0	31	29	34	7
Census Tract 5406, Wayne County, Michigan	29	\$2,752	267	\$9,399	78	0	0	0	0	7	2	13	9	36	40	15
Census Tract 5074, Wayne County, Michigan	28	\$3,152	336	\$11,401	97	1	0	0	0	1	0	1	16	38	40	6
Census Tract 5303, Wayne County, Michigan	28	\$3,990	235	\$14,065	97	0	0	0	0	1	2	0	8	53	35	4
Census Tract 5334, Wayne County, Michigan	28	\$3,015	692	\$10,959	100	0	0	0	0	0	0	0	11	41	42	6
Census Tract 5336, Wayne County, Michigan	28	\$2,982	353	\$10,784	97	0	0	0	0	2	1	0	32	39	25	4
Census Tract 5368, Wayne County, Michigan	28	\$3,380	287	\$11,925	97	1	0	0	0	1	1	0	11	52	31	6
Census Tract 5401, Wayne County, Michigan	28	\$3,294	649	\$11,915	94	0	0	0	0	6	0	0	26	37	32	5
Census Tract 5517, Wayne County, Michigan	28	\$3,170	92	\$11,272	0	0	3	0	0	96	1	0	4	16	33	47
Census Tract 2473.02, Macomb County, Michigan	27	\$2,577	33	\$9,608	0	0	0	0	0	99	1	0	0	13	80	7
Census Tract 1981, Oakland County, Michigan	27	\$3,081	416	\$11,537	2	0	40	0	0	55	0	3	61	14	14	11
Census Tract 5015, Wayne County, Michigan	27	\$3,348	676	\$12,340	95	0	0	0	0	4	0	1	17	40	33	11
Census Tract 5248, Wayne County, Michigan	27	\$3,109	344	\$11,336	65	0	0	0	12	8	5	10	21	32	40	6
Census Tract 5318, Wayne County, Michigan	27	\$2,643	400	\$9,685	98	0	0	0	0	2	1	0	29	30	37	4
Census Tract 5378, Wayne County, Michigan	27	\$3,340	300	\$12,256	98	0	0	0	0	1	0	1	25	39	34	2
Census Tract 5403, Wayne County, Michigan	27	\$3,487	718	\$12,820	95	0	0	0	0	2	0	3	16	33	42	9
Census Tract 5411, Wayne County, Michigan	27	\$2,918	322	\$10,757	85	0	2	0	0	5	4	3	32	27	38	3
Census Tract 5423, Wayne County, Michigan	27	\$2,642	622	\$9,788	98	0	0	0	0	2	0	0	14	28	50	8
Census Tract 5508, Wayne County, Michigan	27	\$2,923	45	\$10,680	3	0	2	0	0	94	1	0	2	13	34	50
Census Tract 5132, Wayne County, Michigan	26	\$3,247	187	\$12,489	89	0	1	0	0	10	1	0	35	30	26	8
Census Tract 5224, Wayne County, Michigan	26	\$2,030	235	\$7,679	93	0	0	0	1	3	2	0	7	47	35	12
Census Tract 5364, Wayne County, Michigan	26	\$3,609	452	\$13,695	100	0	0	0	0	0	0	0	11	51	31	8
Census Tract 5367, Wayne County, Michigan	26	\$3,470	148	\$13,256	99	0	1	0	0	0	0	0	16	39	44	2
Census Tract 5370, Wayne County, Michigan	26	\$3,208	566	\$12,555	99	0	0	0	0	1	0	0	15	33	46	5
Census Tract 5371, Wayne County, Michigan	26	\$3,406	330	\$12,912	98	0	0	0	0	1	1	0	20	35	38	6
Census Tract 5402, Wayne County, Michigan	26	\$3,555	483	\$13,803	99	0	0	0	0	0	0	0	29	37	31	3
Census Tract 5404, Wayne County, Michigan	26	\$2,879	590	\$11,197	99	0	0	0	0	1	0	0	19	36	42	3
Census Tract 5530, Wayne County, Michigan	26	\$2,550	193	\$9,845	93	0	0	0	0	7	0	0	31	29	34	7
Census Tract 1580, Oakland County, Michigan	25	\$2,568	48	\$10,074	3	0	1	0	0	96	1	0	0	3	7	91
Census Tract 5014, Wayne County, Michigan	25	\$3,851	333	\$15,198	94	0	0	0	0	6	0	0	23	29	39	8
Census Tract 5027, Wayne County, Michigan	25	\$2,471	581	\$9,762	98	0	0	0	0	2	0	0	32	37	29	2
Census Tract 5070, Wayne County, Michigan	25	\$3,059	477	\$12,204	97	0	0	0	0	1	1	0	18	43	31	8
Census Tract 5073, Wayne County, Michigan	25	\$3,378	183	\$13,619	98	0	0	0	0	1	1	0	8	27	53	12
Census Tract 5128, Wayne County, Michigan	25	\$2,840	536	\$11,570	95	0	0	0	0	2	0	2	26	50	17	6
Census Tract 5264, Wayne County, Michigan	25	\$3,390	149	\$13,650	10	1	0	0	49	6	9	25	59	28	13	0

Census Tract 5311, Wayne County, Michigan	25	\$2,296	187	\$9,041	89	0	0	0	1	9	1	0	15	45	37	3
Census Tract 5373, Wayne County, Michigan	25	\$3,105	298	\$12,272	99	0	0	0	0	0	0	0	19	40	41	0
Census Tract 5377, Wayne County, Michigan	25	\$2,967	421	\$11,758	99	0	0	0	0	0	0	0	28	40	29	3
Census Tract 5425, Wayne County, Michigan	25	\$3,423	269	\$13,781	98	0	0	0	0	1	1	0	9	29	50	12
Census Tract 5435, Wayne County, Michigan	25	\$2,738	174	\$10,922	88	1	0	0	0	7	4	0	23	38	32	7
Census Tract 5751, Wayne County, Michigan	25	\$2,056	224	\$8,184	0	0	0	0	3	95	1	0	19	25	37	18
Census Tract 5061, Wayne County, Michigan	24	\$3,228	245	\$13,508	90	1	1	0	0	7	0	0	17	39	39	4
Census Tract 5192, Wayne County, Michigan	24	\$2,378	301	\$9,972	79	0	13	0	0	8	0	0	23	27	26	23
Census Tract 5302, Wayne County, Michigan	24	\$3,062	388	\$12,818	91	0	1	0	0	7	1	0	12	37	37	15
Census Tract 5338, Wayne County, Michigan	24	\$3,093	362	\$12,755	89	0	0	0	3	5	2	1	28	28	41	3
Census Tract 5358, Wayne County, Michigan	24	\$2,874	723	\$12,224	86	0	0	0	0	4	0	9	24	47	28	1
Census Tract 5375, Wayne County, Michigan	24	\$3,545	392	\$14,761	96	0	0	0	0	3	0	0	26	29	35	10
Census Tract 5422, Wayne County, Michigan	24	\$3,207	564	\$13,387	99	0	0	0	0	0	1	0	16	42	35	7
Census Tract 5509, Wayne County, Michigan	24	\$3,305	54	\$13,721	2	0	6	0	0	90	1	0	3	17	29	51
Census Tract 2588, Macomb County, Michigan	23	\$1,854	359	\$8,073	69	0	0	0	1	29	1	0	8	19	43	30
Census Tract 1846, Oakland County, Michigan	23	\$1,546	162	\$6,642	3	0	1	0	0	95	1	0	10	8	19	64
Census Tract 5017, Wayne County, Michigan	23	\$3,068	258	\$13,557	74	1	0	0	0	25	1	0	21	43	31	4
Census Tract 5065, Wayne County, Michigan	23	\$3,237	270	\$13,952	96	0	0	0	0	4	0	0	18	42	35	5
Census Tract 5081, Wayne County, Michigan	23	\$3,341	205	\$14,833	78	0	0	0	9	7	6	0	29	39	22	10
Census Tract 5246, Wayne County, Michigan	23	\$2,969	495	\$12,861	16	0	0	0	18	26	12	28	33	55	11	2
Census Tract 5247, Wayne County, Michigan	23	\$2,858	508	\$12,386	80	0	0	0	8	1	1	9	22	50	23	4
Census Tract 5279, Wayne County, Michigan	23	\$2,983	376	\$13,167	73	0	0	0	8	5	11	3	21	18	49	12
Census Tract 5321, Wayne County, Michigan	23	\$3,040	188	\$13,022	84	0	0	0	0	14	0	1	21	24	37	17
Census Tract 5331, Wayne County, Michigan	23	\$2,509	248	\$10,922	97	0	0	0	0	2	1	0	20	27	47	5
Census Tract 5332, Wayne County, Michigan	23	\$3,001	183	\$13,250	86	0	0	0	0	10	5	0	3	44	37	17
Census Tract 5356, Wayne County, Michigan	23	\$2,883	749	\$12,612	95	0	0	0	0	4	1	0	10	29	55	6
Census Tract 5381, Wayne County, Michigan	23	\$3,227	118	\$14,236	88	0	0	0	0	11	0	0	17	14	25	44
Census Tract 5397, Wayne County, Michigan	23	\$3,096	312	\$13,217	100	0	0	0	0	0	0	0	38	31	23	7
Census Tract 5405, Wayne County, Michigan	23	\$2,981	417	\$13,176	99	0	0	0	0	1	0	0	5	43	44	8
Census Tract 5407, Wayne County, Michigan	23	\$3,392	398	\$14,538	89	0	0	0	1	4	2	4	36	23	39	3
Census Tract 5424, Wayne County, Michigan	23	\$3,318	376	\$14,551	98	0	0	0	0	2	0	0	8	27	55	10
Census Tract 5426, Wayne County, Michigan	23	\$3,192	493	\$13,730	100	0	0	0	0	0	0	0	4	49	43	5
Census Tract 5461, Wayne County, Michigan	23	\$3,144	627	\$13,734	89	0	0	0	1	6	5	0	34	25	33	8
Census Tract 5466, Wayne County, Michigan	23	\$3,000	280	\$12,876	94	0	0	0	0	3	4	0	25	31	41	3
Census Tract 1545, Oakland County, Michigan	22	\$2,918	51	\$13,210	1	0	2	0	0	96	0	0	11	8	14	67
Census Tract 1684, Oakland County, Michigan	22	\$1,908	21	\$8,784	18	0	2	0	0	77	2	1	2	16	34	48
Census Tract 1700, Oakland County, Michigan	22	\$1,629	83	\$7,318	1	0	0	0	1	97	1	0	4	10	25	61
Census Tract 5041, Wayne County, Michigan	22	\$2,912	209	\$13,049	100	0	0	0	0	0	0	0	26	48	19	7
Census Tract 5056, Wayne County, Michigan	22	\$3,368	619	\$15,100	98	0	0	0	0	1	1	1	19	34	40	8
Census Tract 5063, Wayne County, Michigan	22	\$3,185	277	\$14,276	96	0	0	0	0	2	1	1	17	43	33	7
Census Tract 5064, Wayne County, Michigan	22	\$3,254	155	\$14,621	72	0	0	0	1	21	5	0	48	30	15	7
Census Tract 5211, Wayne County, Michigan	22	\$2,213	283	\$9,921	30	0	0	0	17	25	2	26	30	21	42	6
Census Tract 5214, Wayne County, Michigan	22	\$2,643	178	\$11,931	64	0	1	0	0	23	0	12	17	53	19	11
Census Tract 5223, Wayne County, Michigan	22	\$2,145	416	\$9,627	90	0	0	0	0	3	8	0	19	49	28	4
Census Tract 5258, Wayne County, Michigan	22	\$3,597	273	\$16,525	14	0	0	0	11	19	20	37	58	27	14	1
Census Tract 5305, Wayne County, Michigan	22	\$2,848	356	\$12,760	95	0	0	0	0	3	2	0	26	22	31	20
Census Tract 5315.01, Wayne County, Michigan	22	\$3,072	265	\$13,834	67	1	0	0	0	3	29	0	5	46	49	0
Census Tract 5412, Wayne County, Michigan	22	\$2,411	332	\$11,073	93	0	0	0	1	6	0	0	43	25	23	9
Census Tract 5415, Wayne County, Michigan	22	\$2,874	442	\$13,317	98	0	0	0	0	1	1	0	10	32	49	9
Census Tract 5455, Wayne County, Michigan	22	\$2,969	789	\$13,590	85	0	0	0	0	9	3	3	25	32	37	7
Census Tract 5457, Wayne County, Michigan	22	\$3,075	554	\$14,067	61	0	0	0	5	31	2	1	23	41	25	11
Census Tract 5460, Wayne County, Michigan	22	\$2,965	549	\$13,419	84	0	0	0	0	5	6	4	13	30	56	2
Census Tract 5563, Wayne County, Michigan	22	\$1,633	313	\$7,399	3	0	2	0	0	95	0	0	7	46	20	27
Census Tract 5795.01, Wayne County, Michigan	22	\$2,003	310	\$9,037	25	0	0	3	5	52	6	9	22	31	46	1
Census Tract 5819, Wayne County, Michigan	22	\$1,907	178	\$8,569	0	1	1	0	1	96	1	0	3	45	49	4
Census Tract 5847, Wayne County, Michigan	22	\$2,441	265	\$10,985	1	0	0	0	0	98	0	0	30	35	33	1
Census Tract 1506, Oakland County, Michigan	21	\$2,672	32	\$12,894	1	0	2	0	0	97	0	0	1	1	10	88
Census Tract 1565, Oakland County, Michigan	21	\$2,856	144	\$13,769	3	0	1	0	0	96	0	0	3	3	11	83
Census Tract 1733, Oakland County, Michigan	21	\$1,295	170	\$6,066	10	0	0	0	0	88	1	0	1	9	11	78
Census Tract 1976, Oakland County, Michigan	21	\$1,996	40	\$9,341	2	0	3	0	1	93	1	0	4	56	10	29
Census Tract 5005, Wayne County, Michigan	21	\$3,495	108	\$16,431	95	0	0	0	0	5	0	0	10	24	62	3
Census Tract 5032, Wayne County, Michigan	21	\$3,603	324	\$17,180	95	0	0	0	0	5	0	0	11	45	44	1

Census Tract 5035, Wayne County, Michigan	21	\$3,744	294	\$17,620	100	0	0	0	0	0	0	0	11	39	48	2
Census Tract 5043, Wayne County, Michigan	21	\$3,278	230	\$15,987	96	0	0	0	0	4	0	0	33	36	25	6
Census Tract 5057, Wayne County, Michigan	21	\$2,997	469	\$14,386	98	0	1	0	0	1	0	0	33	30	33	5
Census Tract 5062, Wayne County, Michigan	21	\$3,155	274	\$15,070	97	0	0	0	0	2	1	0	9	65	20	6
Census Tract 5066, Wayne County, Michigan	21	\$3,380	365	\$16,197	94	0	5	0	0	1	0	0	13	31	37	19
Census Tract 5068, Wayne County, Michigan	21	\$2,885	571	\$14,055	98	0	0	0	0	1	1	0	8	47	36	9
Census Tract 5138, Wayne County, Michigan	21	\$2,554	400	\$12,028	96	0	0	0	0	2	2	0	27	33	32	8
Census Tract 5145, Wayne County, Michigan	21	\$3,022	165	\$14,634	100	0	0	0	0	0	0	0	13	27	59	1
Census Tract 5164, Wayne County, Michigan	21	\$2,792	80	\$13,572	79	2	0	0	0	13	6	0	13	48	26	13
Census Tract 5173, Wayne County, Michigan	21	\$1,808	410	\$8,772	87	0	1	0	0	10	1	0	29	24	29	18
Census Tract 5215, Wayne County, Michigan	21	\$2,415	156	\$11,626	86	0	0	0	0	12	0	1	24	41	15	19
Census Tract 5220, Wayne County, Michigan	21	\$2,191	317	\$10,677	96	0	0	0	0	3	0	1	23	18	56	3
Census Tract 5263, Wayne County, Michigan	21	\$3,134	533	\$14,955	10	0	0	0	43	14	3	31	68	16	13	3
Census Tract 5314, Wayne County, Michigan	21	\$2,909	278	\$13,789	97	0	0	0	0	3	0	0	30	35	27	8
Census Tract 5330, Wayne County, Michigan	21	\$2,291	268	\$10,720	86	0	5	0	0	8	0	1	26	26	31	18
Census Tract 5341, Wayne County, Michigan	21	\$2,487	239	\$11,744	97	0	0	0	0	2	1	0	22	29	45	4
Census Tract 5342, Wayne County, Michigan	21	\$3,190	515	\$15,520	96	0	0	0	0	3	1	0	20	29	45	5
Census Tract 5343, Wayne County, Michigan	21	\$2,744	239	\$12,994	92	0	4	0	3	0	0	1	15	47	36	2
Census Tract 5351, Wayne County, Michigan	21	\$2,985	207	\$14,008	100	0	0	0	0	0	0	0	40	16	42	1
Census Tract 5352, Wayne County, Michigan	21	\$2,751	406	\$13,104	97	0	0	0	0	2	1	0	27	29	36	7
Census Tract 5357, Wayne County, Michigan	21	\$2,966	183	\$14,081	85	0	0	0	0	3	12	0	34	26	36	4
Census Tract 5366, Wayne County, Michigan	21	\$2,925	412	\$14,128	99	0	0	0	0	0	0	0	22	47	22	9
Census Tract 5369, Wayne County, Michigan	21	\$3,007	413	\$14,283	97	0	0	0	0	0	3	0	16	37	38	8
Census Tract 5386, Wayne County, Michigan	21	\$3,309	654	\$15,424	98	0	0	0	0	2	0	0	6	36	40	18
Census Tract 5387, Wayne County, Michigan	21	\$3,399	478	\$15,960	96	0	0	0	0	1	0	3	14	32	40	14
Census Tract 5389, Wayne County, Michigan	21	\$2,941	308	\$13,772	97	0	2	0	0	1	0	0	18	39	27	16
Census Tract 5394, Wayne County, Michigan	21	\$3,373	502	\$16,418	99	0	0	0	0	0	0	0	2	23	66	9
Census Tract 5413, Wayne County, Michigan	21	\$2,852	363	\$13,553	78	0	0	0	1	20	0	1	12	32	44	12
Census Tract 5421, Wayne County, Michigan	21	\$3,131	536	\$15,048	99	0	0	0	0	0	0	0	23	37	35	5
Census Tract 5432, Wayne County, Michigan	21	\$3,069	279	\$14,656	97	0	0	0	0	0	1	1	34	28	27	11
Census Tract 5456, Wayne County, Michigan	21	\$3,109	645	\$14,734	13	0	0	0	5	75	0	7	31	23	28	18
Census Tract 5458, Wayne County, Michigan	21	\$3,197	740	\$15,409	50	0	0	0	8	42	0	0	32	32	27	9
Census Tract 5604, Wayne County, Michigan	21	\$2,045	189	\$9,885	1	0	1	0	0	98	0	0	0	9	24	67
Census Tract 5760.01, Wayne County, Michigan	21	\$2,210	169	\$10,309	6	0	1	0	3	81	4	4	26	37	26	11
Census Tract 1501, Oakland County, Michigan	20	\$2,307	169	\$11,552	9	0	1	0	1	89	1	0	21	6	10	63
Census Tract 1509, Oakland County, Michigan	20	\$2,159	153	\$10,750	4	0	1	0	0	93	1	0	19	3	11	67
Census Tract 1520, Oakland County, Michigan	20	\$2,421	29	\$12,398	1	0	1	0	0	96	2	0	0	9	8	83
Census Tract 1569, Oakland County, Michigan	20	\$2,814	108	\$13,819	5	0	2	0	0	92	0	0	4	2	15	79
Census Tract 1962, Oakland County, Michigan	20	\$2,014	153	\$10,051	0	0	5	0	1	93	0	0	0	7	34	58
Census Tract 5016, Wayne County, Michigan	20	\$3,160	276	\$15,563	86	0	0	0	0	10	0	4	16	35	44	5
Census Tract 5019, Wayne County, Michigan	20	\$3,215	433	\$16,422	97	0	0	0	0	3	0	0	16	46	35	4
Census Tract 5031, Wayne County, Michigan	20	\$3,377	326	\$16,883	97	0	0	0	0	2	1	0	7	33	52	9
Census Tract 5044, Wayne County, Michigan	20	\$3,103	261	\$15,176	99	0	0	0	0	1	0	0	23	47	28	2
Census Tract 5054, Wayne County, Michigan	20	\$3,210	291	\$16,189	90	1	0	0	0	6	2	1	16	54	23	7
Census Tract 5069, Wayne County, Michigan	20	\$3,287	441	\$16,324	97	0	0	0	0	1	2	0	19	37	29	15
Census Tract 5090, Wayne County, Michigan	20	\$2,573	227	\$13,027	86	0	0	0	0	10	4	0	34	31	14	21
Census Tract 5114, Wayne County, Michigan	20	\$2,811	412	\$13,895	89	0	0	0	0	9	1	1	17	46	26	10
Census Tract 5133, Wayne County, Michigan	20	\$2,919	177	\$14,637	83	0	0	0	0	17	0	0	14	26	40	21
Census Tract 5141, Wayne County, Michigan	20	\$2,645	608	\$13,096	99	0	0	0	0	1	0	0	48	16	31	5
Census Tract 5152, Wayne County, Michigan	20	\$3,256	230	\$16,465	88	0	0	0	0	12	0	0	17	40	36	7
Census Tract 5154, Wayne County, Michigan	20	\$2,535	21	\$12,612	56	0	1	0	0	42	0	0	6	18	32	45
Census Tract 5193, Wayne County, Michigan	20	\$2,874	242	\$14,165	80	0	0	0	0	18	1	1	27	28	34	12
Census Tract 5240.01, Wayne County, Michigan	20	\$2,750	368	\$14,030	5	0	0	0	16	15	4	60	39	38	16	7
Census Tract 5309, Wayne County, Michigan	20	\$2,611	212	\$12,905	95	0	0	0	0	3	2	0	36	33	31	0
Census Tract 5317, Wayne County, Michigan	20	\$2,505	289	\$12,707	97	0	2	0	0	0	0	0	25	27	34	13
Census Tract 5319, Wayne County, Michigan	20	\$2,574	86	\$12,652	91	0	0	0	2	4	2	1	16	7	54	24
Census Tract 5344, Wayne County, Michigan	20	\$2,481	341	\$12,127	92	0	0	0	2	6	0	0	30	40	30	0
Census Tract 5350, Wayne County, Michigan	20	\$3,030	320	\$15,192	95	0	0	0	2	0	0	3	25	26	32	16
Census Tract 5361, Wayne County, Michigan	20	\$3,121	532	\$15,941	97	0	0	0	0	3	0	0	29	32	30	8
Census Tract 5385, Wayne County, Michigan	20	\$2,910	691	\$14,288	98	0	0	0	0	1	0	0	7	25	53	15
Census Tract 5392, Wayne County, Michigan	20	\$3,329	657	\$16,842	100	0	0	0	0	0	0	0	11	39	41	9
Census Tract 5395, Wayne County, Michigan	20	\$2,886	283	\$14,220	99	0	0	0	0	1	0	0	6	47	43	3

Census Tract 5396, Wayne County, Michigan	20	\$3,119	391	\$15,215	98	0	0	0	0	0	1	0	7	31	45	18
Census Tract 5418, Wayne County, Michigan	20	\$2,657	210	\$13,063	72	0	6	0	0	17	1	4	18	38	37	7
Census Tract 5443, Wayne County, Michigan	20	\$3,201	372	\$15,730	79	0	0	0	0	18	2	0	7	31	53	10
Census Tract 5448, Wayne County, Michigan	20	\$2,852	320	\$14,459	88	0	0	0	0	11	1	0	24	35	34	7
Census Tract 5462.01, Wayne County, Michigan	20	\$3,350	239	\$16,942	57	0	0	0	0	41	0	1	21	25	42	12
Census Tract 5637, Wayne County, Michigan	20	\$2,131	26	\$10,741	7	0	2	0	0	91	0	0	12	14	43	31
Census Tract 2406.02, Macomb County, Michigan	19	\$2,812	187	\$14,631	0	0	0	0	0	100	0	0	6	48	30	16
Census Tract 2408.02, Macomb County, Michigan	19	\$2,869	494	\$15,410	14	0	0	0	0	84	1	0	16	34	47	4
Census Tract 1504, Oakland County, Michigan	19	\$2,724	38	\$13,989	3	0	4	0	1	92	1	0	0	2	14	83
Census Tract 1526, Oakland County, Michigan	19	\$2,325	76	\$12,404	4	0	1	0	1	94	1	0	0	6	10	84
Census Tract 1570, Oakland County, Michigan	19	\$2,824	29	\$14,940	3	0	1	0	0	95	2	0	2	8	15	74
Census Tract 1839, Oakland County, Michigan	19	\$1,500	202	\$8,028	2	0	1	0	6	89	1	0	0	25	19	57
Census Tract 1870, Oakland County, Michigan	19	\$1,911	38	\$10,166	2	0	0	0	0	96	2	0	1	8	11	81
Census Tract 1968, Oakland County, Michigan	19	\$3,010	21	\$15,505	0	0	56	0	0	44	0	0	0	4	37	60
Census Tract 5003, Wayne County, Michigan	19	\$3,092	167	\$16,542	91	0	4	0	0	4	0	0	14	36	47	2
Census Tract 5020, Wayne County, Michigan	19	\$3,425	176	\$17,867	97	0	0	0	0	2	1	0	20	22	45	12
Census Tract 5026, Wayne County, Michigan	19	\$2,714	650	\$14,393	99	0	0	0	0	1	0	0	26	46	24	5
Census Tract 5036, Wayne County, Michigan	19	\$2,958	196	\$15,634	96	0	3	0	0	1	0	0	7	51	38	3
Census Tract 5039, Wayne County, Michigan	19	\$3,131	298	\$16,282	98	0	0	0	0	2	0	0	32	30	36	3
Census Tract 5040, Wayne County, Michigan	19	\$3,217	218	\$17,140	98	1	0	0	0	1	0	0	18	48	31	3
Census Tract 5051, Wayne County, Michigan	19	\$2,260	787	\$11,592	93	0	0	0	0	7	0	0	23	46	27	4
Census Tract 5052, Wayne County, Michigan	19	\$2,535	476	\$13,086	95	0	0	0	0	1	0	4	5	58	35	2
Census Tract 5075, Wayne County, Michigan	19	\$2,825	373	\$14,515	96	0	0	0	0	4	0	0	23	35	36	6
Census Tract 5091, Wayne County, Michigan	19	\$3,204	744	\$17,152	18	0	74	0	0	7	0	0	27	32	31	10
Census Tract 5137, Wayne County, Michigan	19	\$2,386	488	\$12,603	99	0	0	0	0	1	0	0	30	29	37	4
Census Tract 5143, Wayne County, Michigan	19	\$2,418	477	\$12,447	96	0	0	0	0	3	0	0	21	33	43	3
Census Tract 5168, Wayne County, Michigan	19	\$3,342	118	\$17,483	89	0	0	0	0	10	0	1	8	59	23	10
Census Tract 5191, Wayne County, Michigan	19	\$2,900	182	\$15,132	78	0	8	0	0	13	1	0	17	36	41	6
Census Tract 5233, Wayne County, Michigan	19	\$3,423	348	\$18,058	3	0	0	0	38	10	1	49	49	24	18	8
Census Tract 5234, Wayne County, Michigan	19	\$2,436	278	\$12,493	42	1	0	0	22	17	4	14	27	22	39	12
Census Tract 5308, Wayne County, Michigan	19	\$2,898	237	\$15,367	94	0	0	0	0	4	1	0	36	32	27	5
Census Tract 5348, Wayne County, Michigan	19	\$2,909	356	\$14,983	84	0	0	0	9	5	2	0	10	33	50	7
Census Tract 5362, Wayne County, Michigan	19	\$3,492	371	\$18,244	97	0	0	0	0	3	1	0	9	16	62	13
Census Tract 5365, Wayne County, Michigan	19	\$2,976	259	\$15,504	79	0	0	0	0	12	9	0	14	18	58	10
Census Tract 5372, Wayne County, Michigan	19	\$2,809	104	\$14,502	98	0	0	0	0	2	1	0	20	35	44	1
Census Tract 5376, Wayne County, Michigan	19	\$3,319	546	\$17,147	99	0	0	0	0	1	0	0	16	54	23	8
Census Tract 5429, Wayne County, Michigan	19	\$3,108	322	\$15,972	89	0	0	0	0	10	1	0	7	21	39	34
Census Tract 5437, Wayne County, Michigan	19	\$2,801	468	\$15,117	97	0	0	0	1	2	1	0	30	45	21	4
Census Tract 5442, Wayne County, Michigan	19	\$2,645	341	\$13,609	91	0	0	0	0	8	0	0	20	26	48	6
Census Tract 5472, Wayne County, Michigan	19	\$2,495	589	\$12,947	92	0	0	0	0	4	3	0	20	34	37	9
Census Tract 5506, Wayne County, Michigan	19	\$2,871	24	\$14,804	0	0	1	0	0	96	3	0	0	5	7	89
Census Tract 5731, Wayne County, Michigan	19	\$3,031	316	\$15,674	6	0	2	0	2	89	0	0	9	41	21	28
Census Tract 5746, Wayne County, Michigan	19	\$2,581	298	\$13,915	2	0	0	0	4	94	0	0	4	21	31	44
Census Tract 5749, Wayne County, Michigan	19	\$1,935	177	\$10,257	2	0	1	0	3	95	0	0	12	14	48	26
Census Tract 2566, Macomb County, Michigan	18	\$2,204	376	\$12,426	25	0	2	0	1	67	4	1	10	45	36	9
Census Tract 1348, Oakland County, Michigan	18	\$1,851	121	\$10,324	0	0	3	0	0	97	0	0	36	21	10	33
Census Tract 1507, Oakland County, Michigan	18	\$2,588	49	\$14,385	1	0	2	0	0	95	2	0	1	2	8	88
Census Tract 1541, Oakland County, Michigan	18	\$2,705	108	\$14,817	1	0	0	0	0	98	0	0	0	53	12	35
Census Tract 1578, Oakland County, Michigan	18	\$1,701	118	\$9,448	28	0	1	0	1	69	0	0	0	15	25	60
Census Tract 1612, Oakland County, Michigan	18	\$2,165	201	\$11,711	86	3	0	0	0	10	1	0	1	15	29	55
Census Tract 1662, Oakland County, Michigan	18	\$2,146	33	\$11,795	5	0	0	0	0	92	1	1	3	5	22	71
Census Tract 5001, Wayne County, Michigan	18	\$3,408	242	\$19,474	97	0	0	0	0	2	0	0	9	28	57	7
Census Tract 5008, Wayne County, Michigan	18	\$2,835	515	\$15,757	93	1	0	0	0	5	0	0	18	43	35	4
Census Tract 5012, Wayne County, Michigan	18	\$3,093	188	\$17,652	99	0	0	0	0	1	1	0	19	49	30	1
Census Tract 5013, Wayne County, Michigan	18	\$3,377	364	\$18,416	99	0	0	0	0	1	0	0	21	51	25	3
Census Tract 5033, Wayne County, Michigan	18	\$3,325	471	\$18,119	98	0	1	0	0	1	0	0	10	38	49	3
Census Tract 5042, Wayne County, Michigan	18	\$3,324	237	\$18,856	97	0	0	0	0	3	0	0	23	43	27	7
Census Tract 5072, Wayne County, Michigan	18	\$3,156	154	\$17,747	88	1	0	0	0	1	10	0	21	42	27	10
Census Tract 5106, Wayne County, Michigan	18	\$3,521	873	\$19,742	21	0	46	0	0	31	1	1	29	37	23	11
Census Tract 5166, Wayne County, Michigan	18	\$2,103	696	\$11,605	96	0	0	0	0	3	0	1	32	25	33	10
Census Tract 5204, Wayne County, Michigan	18	\$1,831	273	\$10,444	68	0	14	0	0	16	2	1	39	9	37	16
Census Tract 5228, Wayne County, Michigan	18	\$2,754	355	\$15,580	73	0	0	0	15	9	0	2	18	29	40	13

Census Tract 5316, Wayne County, Michigan	18	\$2,429	291	\$13,355	95	0	0	0	0	2	2	0	10	30	53	8
Census Tract 5353, Wayne County, Michigan	18	\$3,164	605	\$17,118	98	0	0	0	0	1	1	0	14	42	36	8
Census Tract 5363, Wayne County, Michigan	18	\$3,141	344	\$17,155	99	0	0	0	0	0	1	0	30	20	41	9
Census Tract 5390, Wayne County, Michigan	18	\$3,006	395	\$16,488	95	0	0	0	0	3	1	1	14	28	51	7
Census Tract 5410, Wayne County, Michigan	18	\$2,423	461	\$13,814	99	0	0	0	0	0	1	0	25	20	51	5
Census Tract 5431, Wayne County, Michigan	18	\$3,095	91	\$16,755	85	0	0	0	0	11	3	0	5	22	53	20
Census Tract 5433, Wayne County, Michigan	18	\$2,899	295	\$16,221	88	0	0	0	0	10	2	0	5	33	43	19
Census Tract 5439, Wayne County, Michigan	18	\$2,587	197	\$14,047	77	1	0	0	1	17	3	0	24	35	39	2
Census Tract 5467, Wayne County, Michigan	18	\$2,868	285	\$15,739	86	0	0	0	0	7	1	6	7	27	54	12
Census Tract 5470, Wayne County, Michigan	18	\$2,661	520	\$14,428	95	0	0	0	0	5	0	0	24	28	38	10
Census Tract 5471, Wayne County, Michigan	18	\$2,790	592	\$15,351	96	0	0	0	0	2	2	0	17	28	37	18
Census Tract 5502, Wayne County, Michigan	18	\$2,703	162	\$15,179	13	0	6	0	0	76	5	0	4	11	40	46
Census Tract 5511, Wayne County, Michigan	18	\$2,977	96	\$16,493	2	0	4	0	0	93	1	0	3	8	36	53
Census Tract 5531, Wayne County, Michigan	18	\$2,917	206	\$15,802	89	0	0	0	0	11	0	0	2	42	50	6
Census Tract 5603, Wayne County, Michigan	18	\$1,843	152	\$10,251	2	0	3	0	1	94	1	0	0	9	44	47
Census Tract 5689, Wayne County, Michigan	18	\$2,033	330	\$11,211	6	0	6	0	3	81	4	1	20	38	32	10
Census Tract 5706, Wayne County, Michigan	18	\$2,187	237	\$11,943	93	0	0	0	0	4	3	1	30	29	32	9
Census Tract 5718, Wayne County, Michigan	18	\$3,253	185	\$18,264	13	0	1	0	3	79	4	1	5	36	40	19
Census Tract 5722, Wayne County, Michigan	18	\$2,756	534	\$14,989	1	0	2	0	1	95	1	0	7	40	33	20
Census Tract 5766, Wayne County, Michigan	18	\$1,915	214	\$10,458	3	0	0	0	5	90	1	0	5	21	59	15
Census Tract 5832, Wayne County, Michigan	18	\$2,764	218	\$15,445	3	1	0	0	1	88	7	1	31	32	36	1
Census Tract 2408.01, Macomb County, Michigan	17	\$2,532	63	\$14,609	6	0	0	0	0	94	0	0	3	45	38	14
Census Tract 2412, Macomb County, Michigan	17	\$2,901	373	\$17,347	17	0	0	0	0	81	1	1	13	47	38	3
Census Tract 2683, Macomb County, Michigan	17	\$2,020	468	\$11,985	50	0	0	0	2	47	2	0	29	36	33	2
Census Tract 1563, Oakland County, Michigan	17	\$2,470	46	\$14,283	4	0	4	0	0	91	1	0	0	1	11	88
Census Tract 1579, Oakland County, Michigan	17	\$2,337	72	\$14,159	11	0	6	0	0	82	1	0	10	15	28	46
Census Tract 1980, Oakland County, Michigan	17	\$2,167	123	\$12,435	0	0	21	0	2	77	0	0	0	6	26	68
Census Tract 5007, Wayne County, Michigan	17	\$3,405	429	\$19,809	97	0	0	0	0	2	0	0	23	37	33	7
Census Tract 5011, Wayne County, Michigan	17	\$2,906	457	\$17,278	97	0	0	0	0	2	0	0	22	30	45	3
Census Tract 5058, Wayne County, Michigan	17	\$3,227	691	\$18,792	53	0	1	0	0	35	8	2	35	33	28	4
Census Tract 5139, Wayne County, Michigan	17	\$2,868	257	\$16,923	100	0	0	0	0	0	0	0	43	30	22	6
Census Tract 5219, Wayne County, Michigan	17	\$2,331	444	\$13,347	74	0	0	0	0	23	1	2	26	21	36	17
Census Tract 5232, Wayne County, Michigan	17	\$2,972	466	\$17,969	2	0	0	0	25	20	5	48	42	35	20	3
Census Tract 5241.01, Wayne County, Michigan	17	\$2,576	636	\$15,224	16	1	0	0	15	23	1	44	39	44	16	0
Census Tract 5260, Wayne County, Michigan	17	\$3,430	428	\$19,908	3	0	0	0	18	59	4	17	68	21	10	1
Census Tract 5261, Wayne County, Michigan	17	\$3,368	464	\$20,017	1	0	0	0	10	65	10	13	38	28	28	5
Census Tract 5324, Wayne County, Michigan	17	\$2,479	262	\$14,376	92	0	0	0	0	7	1	0	14	28	53	5
Census Tract 5326, Wayne County, Michigan	17	\$1,936	223	\$11,562	81	3	0	0	0	9	5	2	12	33	33	22
Census Tract 5388, Wayne County, Michigan	17	\$3,527	184	\$20,972	97	0	0	0	0	0	2	0	2	34	54	9
Census Tract 5409, Wayne County, Michigan	17	\$3,190	295	\$18,789	98	0	0	0	0	2	0	0	12	28	48	12
Census Tract 5414, Wayne County, Michigan	17	\$2,782	247	\$16,347	82	0	0	0	0	8	2	8	14	41	42	4
Census Tract 5434, Wayne County, Michigan	17	\$3,121	300	\$17,934	96	0	0	0	0	3	1	0	21	24	47	8
Census Tract 5441, Wayne County, Michigan	17	\$2,753	417	\$16,277	95	1	0	0	0	3	0	1	7	35	46	12
Census Tract 5459, Wayne County, Michigan	17	\$2,963	622	\$16,995	84	0	0	0	4	10	1	1	12	38	38	11
Census Tract 5463.01, Wayne County, Michigan	17	\$3,262	167	\$19,567	90	0	0	0	0	5	1	4	22	45	29	3
Census Tract 5503, Wayne County, Michigan	17	\$2,602	14	\$15,064	5	0	0	0	0	93	1	0	7	5	25	64
Census Tract 5504, Wayne County, Michigan	17	\$2,309	74	\$13,959	7	0	0	0	0	90	3	0	6	7	43	44
Census Tract 5532, Wayne County, Michigan	17	\$2,488	154	\$14,538	80	0	0	0	0	9	10	1	8	58	30	3
Census Tract 5568, Wayne County, Michigan	17	\$2,376	53	\$14,189	0	0	4	0	0	95	0	0	4	26	45	25
Census Tract 5571, Wayne County, Michigan	17	\$1,900	109	\$10,971	5	0	4	0	0	90	1	0	1	22	50	27
Census Tract 5577, Wayne County, Michigan	17	\$1,975	84	\$11,572	0	0	0	0	0	100	0	0	2	19	41	38
Census Tract 5627, Wayne County, Michigan	17	\$2,162	83	\$12,644	1	0	0	0	0	99	0	0	4	24	17	55
Census Tract 5640, Wayne County, Michigan	17	\$1,721	168	\$10,423	11	0	10	0	1	66	12	0	11	45	21	23
Census Tract 5785, Wayne County, Michigan	17	\$2,122	692	\$12,724	11	0	0	0	9	72	2	5	23	36	30	11
Census Tract 5857, Wayne County, Michigan	17	\$2,545	131	\$14,978	41	0	0	0	0	59	0	0	10	44	44	2
Census Tract 5951, Wayne County, Michigan	17	\$1,830	341	\$10,688	16	0	0	0	1	83	0	0	4	46	27	23
Census Tract 2413, Macomb County, Michigan	16	\$2,841	123	\$17,876	23	0	0	0	0	74	3	0	15	48	29	9
Census Tract 2421, Macomb County, Michigan	16	\$2,336	144	\$14,885	25	0	0	0	0	65	2	8	14	20	49	17
Census Tract 2425, Macomb County, Michigan	16	\$2,309	380	\$14,730	17	0	0	0	0	82	1	0	5	46	44	5
Census Tract 2430, Macomb County, Michigan	16	\$2,470	85	\$15,219	4	0	1	0	0	94	0	0	7	16	68	10
Census Tract 2440, Macomb County, Michigan	16	\$2,594	56	\$16,276	2	0	0	0	0	97	0	0	21	35	32	13
Census Tract 2471, Macomb County, Michigan	16	\$1,763	155	\$11,111	1	0	0	0	0	84	16	0	38	10	29	24

Census Tract 1510, Oakland County, Michigan	16	\$2,428	55	\$14,821	0	0	0	0	0	100	0	0	0	7	10	82
Census Tract 1529, Oakland County, Michigan	16	\$2,034	179	\$12,701	1	0	1	0	0	97	1	0	10	10	15	65
Census Tract 1531, Oakland County, Michigan	16	\$2,524	50	\$15,377	1	0	1	0	2	95	0	0	1	8	9	83
Census Tract 1533, Oakland County, Michigan	16	\$2,592	94	\$16,398	2	0	2	0	0	96	0	0	0	9	7	84
Census Tract 1560, Oakland County, Michigan	16	\$2,225	75	\$14,083	4	0	4	0	2	89	1	0	1	6	20	73
Census Tract 1571, Oakland County, Michigan	16	\$2,882	37	\$17,639	5	0	7	0	0	85	3	0	2	8	22	68
Census Tract 1577, Oakland County, Michigan	16	\$3,107	54	\$19,441	7	0	3	0	0	90	0	0	11	7	15	66
Census Tract 1582, Oakland County, Michigan	16	\$2,216	64	\$14,220	1	0	0	0	1	98	0	0	0	3	12	85
Census Tract 1590, Oakland County, Michigan	16	\$2,468	94	\$15,050	4	0	2	0	1	93	1	0	1	7	15	78
Census Tract 1619, Oakland County, Michigan	16	\$2,227	101	\$13,789	76	0	0	0	0	17	6	0	9	17	40	34
Census Tract 1965, Oakland County, Michigan	16	\$1,651	127	\$10,635	0	0	8	0	3	86	3	0	16	13	14	58
Census Tract 1969, Oakland County, Michigan	16	\$1,616	96	\$10,220	0	0	34	0	0	65	0	0	0	12	39	49
Census Tract 1971, Oakland County, Michigan	16	\$2,303	56	\$14,617	0	0	23	0	2	75	1	0	0	13	12	75
Census Tract 5004, Wayne County, Michigan	16	\$2,871	195	\$17,900	97	0	0	0	0	2	1	0	22	57	20	1
Census Tract 5006, Wayne County, Michigan	16	\$3,664	158	\$23,499	100	0	0	0	0	0	0	0	5	40	47	8
Census Tract 5010, Wayne County, Michigan	16	\$2,972	346	\$19,090	99	0	0	0	0	1	0	0	37	36	26	1
Census Tract 5142, Wayne County, Michigan	16	\$1,893	368	\$11,830	97	0	0	0	0	3	0	0	24	40	27	9
Census Tract 5160, Wayne County, Michigan	16	\$3,456	194	\$21,516	95	0	0	0	0	4	0	1	26	33	29	12
Census Tract 5203, Wayne County, Michigan	16	\$1,143	193	\$7,009	22	0	49	0	9	16	3	0	13	25	24	38
Census Tract 5242, Wayne County, Michigan	16	\$3,080	717	\$19,464	6	0	0	0	19	30	2	42	58	23	15	4
Census Tract 5304, Wayne County, Michigan	16	\$1,934	173	\$11,815	98	0	0	0	0	2	0	0	38	24	38	0
Census Tract 5315.02, Wayne County, Michigan	16	\$2,635	95	\$16,095	90	0	0	0	0	0	10	0	13	33	48	6
Census Tract 5327, Wayne County, Michigan	16	\$2,920	79	\$18,166	98	0	0	0	0	2	0	0	13	42	30	15
Census Tract 5384, Wayne County, Michigan	16	\$3,548	96	\$21,990	91	0	0	0	0	5	0	4	1	34	40	26
Census Tract 5408, Wayne County, Michigan	16	\$3,232	224	\$19,924	99	0	0	0	0	1	0	0	15	23	46	17
Census Tract 5512, Wayne County, Michigan	16	\$2,855	61	\$17,734	16	0	0	0	0	82	2	0	0	15	37	48
Census Tract 5579.01, Wayne County, Michigan	16	\$1,950	118	\$12,147	1	0	2	0	1	96	0	0	2	30	20	48
Census Tract 5592, Wayne County, Michigan	16	\$2,051	102	\$12,922	2	0	2	0	1	95	1	0	3	22	46	29
Census Tract 5648, Wayne County, Michigan	16	\$2,489	167	\$15,768	9	0	13	0	1	77	0	0	3	8	28	61
Census Tract 5708, Wayne County, Michigan	16	\$2,158	447	\$13,347	89	0	0	0	1	10	0	1	29	40	28	4
Census Tract 5715, Wayne County, Michigan	16	\$2,791	495	\$17,731	5	0	0	0	1	90	3	1	14	13	48	25
Census Tract 5719, Wayne County, Michigan	16	\$2,861	278	\$17,345	14	0	1	0	0	85	0	0	36	21	24	18
Census Tract 5720, Wayne County, Michigan	16	\$3,058	131	\$19,111	2	0	1	0	1	94	1	0	15	15	40	31
Census Tract 5721, Wayne County, Michigan	16	\$2,655	603	\$16,646	4	0	0	0	0	95	0	0	15	36	32	17
Census Tract 5830.01, Wayne County, Michigan	16	\$2,946	239	\$18,457	6	0	0	0	1	93	1	0	13	44	37	6
Census Tract 5841, Wayne County, Michigan	16	\$2,446	133	\$14,853	3	2	0	0	0	94	1	0	12	57	30	1
Census Tract 5848.01, Wayne County, Michigan	16	\$1,825	780	\$11,646	69	4	0	0	0	27	0	0	18	58	19	5
Census Tract 5855, Wayne County, Michigan	16	\$2,581	190	\$16,551	9	0	0	0	6	82	1	2	18	50	27	5
Census Tract 2417, Macomb County, Michigan	15	\$2,792	344	\$18,436	18	0	4	0	0	71	3	5	12	53	34	2
Census Tract 2512, Macomb County, Michigan	15	\$1,933	188	\$12,913	2	0	0	0	1	95	3	0	2	36	32	30
Census Tract 1340, Oakland County, Michigan	15	\$1,937	154	\$13,042	0	0	1	0	0	99	0	0	3	26	34	37
Census Tract 1360, Oakland County, Michigan	15	\$1,732	129	\$11,401	0	0	0	0	0	99	1	0	12	27	12	49
Census Tract 1503, Oakland County, Michigan	15	\$2,291	79	\$15,331	1	0	3	0	0	95	0	0	0	9	22	69
Census Tract 1540, Oakland County, Michigan	15	\$2,273	53	\$15,115	2	0	0	0	1	97	0	0	0	12	22	66
Census Tract 1546, Oakland County, Michigan	15	\$3,117	72	\$20,462	4	0	1	0	0	94	0	0	1	13	22	63
Census Tract 1561, Oakland County, Michigan	15	\$3,054	69	\$20,541	5	0	3	0	0	91	1	0	2	4	26	67
Census Tract 1574, Oakland County, Michigan	15	\$2,708	94	\$18,566	8	0	2	0	0	89	1	0	2	28	19	52
Census Tract 1606, Oakland County, Michigan	15	\$2,054	152	\$13,744	49	0	0	0	0	48	2	1	5	6	35	54
Census Tract 1620, Oakland County, Michigan	15	\$2,108	218	\$13,938	69	0	0	0	0	28	0	2	5	22	41	31
Census Tract 1670, Oakland County, Michigan	15	\$1,897	155	\$12,777	14	2	2	0	0	82	0	0	1	23	19	58
Census Tract 1687, Oakland County, Michigan	15	\$2,012	129	\$13,013	28	0	3	0	0	68	0	0	2	9	36	53
Census Tract 1735, Oakland County, Michigan	15	\$1,572	163	\$10,409	8	0	1	0	0	88	3	0	2	11	57	30
Census Tract 1802, Oakland County, Michigan	15	\$1,545	122	\$10,476	1	0	1	0	1	96	2	0	6	21	35	38
Census Tract 1967, Oakland County, Michigan	15	\$1,996	27	\$13,144	0	0	3	0	1	95	0	0	0	4	13	83
Census Tract 6480, St. Clair County, Michigan	15	\$1,526	65	\$10,220	0	0	0	0	0	98	2	0	20	26	38	16
Census Tract 5009, Wayne County, Michigan	15	\$2,716	334	\$18,542	96	0	0	0	0	3	1	0	28	39	30	4
Census Tract 5018, Wayne County, Michigan	15	\$2,646	291	\$17,869	83	0	0	0	0	15	2	0	4	12	66	18
Census Tract 5034, Wayne County, Michigan	15	\$2,564	166	\$16,733	87	0	11	0	0	2	1	0	10	65	21	4
Census Tract 5167, Wayne County, Michigan	15	\$1,707	461	\$11,275	98	0	0	0	0	0	2	0	27	29	32	12
Census Tract 5180, Wayne County, Michigan	15	\$1,702	307	\$11,361	67	0	7	0	1	23	2	0	7	27	31	35
Census Tract 5245, Wayne County, Michigan	15	\$2,967	24	\$19,742	7	0	0	0	71	22	0	0	5	27	68	0
Census Tract 5254, Wayne County, Michigan	15	\$2,488	369	\$16,542	48	0	0	0	21	15	7	9	42	31	25	3

Census Tract 5347, Wayne County, Michigan	15	\$2,613	527	\$17,721	80	4	0	0	0	4	13	0	7	55	30	8
Census Tract 5417, Wayne County, Michigan	15	\$1,801	303	\$11,925	98	0	0	0	0	1	0	0	8	31	41	20
Census Tract 5440, Wayne County, Michigan	15	\$2,517	340	\$16,524	88	0	0	0	0	8	1	2	19	24	46	10
Census Tract 5501, Wayne County, Michigan	15	\$2,979	101	\$19,768	7	0	1	0	0	91	0	0	0	12	66	22
Census Tract 5507, Wayne County, Michigan	15	\$3,060	99	\$20,045	1	0	2	0	2	94	1	0	27	20	13	40
Census Tract 5514, Wayne County, Michigan	15	\$2,705	315	\$17,823	63	0	8	0	0	28	1	0	7	32	33	29
Census Tract 5516, Wayne County, Michigan	15	\$2,946	430	\$19,373	79	1	0	0	0	18	2	0	9	36	44	11
Census Tract 5521, Wayne County, Michigan	15	\$2,509	633	\$16,737	23	0	26	0	0	41	9	1	19	36	36	9
Census Tract 5523, Wayne County, Michigan	15	\$2,631	474	\$18,132	2	0	45	0	0	48	1	5	22	44	24	10
Census Tract 5538, Wayne County, Michigan	15	\$1,758	417	\$12,118	84	0	0	0	0	4	11	0	8	13	23	55
Census Tract 5551, Wayne County, Michigan	15	\$2,320	308	\$15,954	23	0	0	0	0	76	1	0	5	30	44	21
Census Tract 5626, Wayne County, Michigan	15	\$1,887	81	\$12,765	1	0	1	0	0	98	1	0	10	22	29	39
Census Tract 5629, Wayne County, Michigan	15	\$2,351	144	\$15,866	1	0	0	0	0	98	1	0	15	38	28	19
Census Tract 5633, Wayne County, Michigan	15	\$2,381	151	\$16,182	6	0	3	0	0	87	4	0	3	32	33	32
Census Tract 5687, Wayne County, Michigan	15	\$2,818	290	\$18,926	20	0	0	0	0	49	30	0	11	13	31	45
Census Tract 5694, Wayne County, Michigan	15	\$2,279	218	\$15,068	6	0	1	0	0	93	0	0	13	33	47	8
Census Tract 5710, Wayne County, Michigan	15	\$2,163	232	\$14,149	92	0	0	0	0	6	2	0	25	38	34	3
Census Tract 5724, Wayne County, Michigan	15	\$2,693	97	\$18,157	5	0	0	0	1	93	2	0	6	49	23	23
Census Tract 5726, Wayne County, Michigan	15	\$2,469	535	\$16,229	8	0	0	0	1	89	2	0	9	31	43	17
Census Tract 5727, Wayne County, Michigan	15	\$2,498	266	\$16,273	3	0	1	0	4	90	1	1	14	31	39	16
Census Tract 5743.01, Wayne County, Michigan	15	\$2,628	241	\$17,578	1	0	1	0	1	97	0	0	12	14	38	36
Census Tract 5748, Wayne County, Michigan	15	\$2,720	94	\$17,563	0	0	0	0	1	97	1	0	14	13	21	53
Census Tract 5750, Wayne County, Michigan	15	\$1,982	167	\$13,633	1	0	0	0	0	98	0	0	32	21	20	27
Census Tract 5755, Wayne County, Michigan	15	\$2,473	179	\$16,571	3	0	0	0	1	87	8	0	6	21	45	28
Census Tract 5773, Wayne County, Michigan	15	\$2,305	321	\$15,130	2	0	0	0	11	82	2	3	24	38	29	9
Census Tract 5796, Wayne County, Michigan	15	\$2,038	264	\$13,610	72	0	0	0	2	2	15	9	12	52	24	13
Census Tract 5797, Wayne County, Michigan	15	\$1,989	617	\$13,428	16	6	0	0	11	54	3	10	39	33	26	2
Census Tract 5818, Wayne County, Michigan	15	\$2,239	208	\$15,418	2	0	0	0	1	97	0	0	7	36	53	5
Census Tract 5862.01, Wayne County, Michigan	15	\$2,571	347	\$17,314	46	0	0	0	0	53	1	0	17	20	56	8
Census Tract 5950, Wayne County, Michigan	15	\$2,104	326	\$14,081	0	0	0	0	1	94	3	2	13	33	47	7
Census Tract 2324, Macomb County, Michigan	14	\$2,056	433	\$14,611	0	0	8	0	0	91	1	0	9	38	34	20
Census Tract 2419, Macomb County, Michigan	14	\$2,765	257	\$20,012	14	0	0	0	1	80	2	3	8	49	42	2
Census Tract 2473.01, Macomb County, Michigan	14	\$1,734	98	\$12,056	4	0	4	0	0	92	0	0	2	27	61	10
Census Tract 2507, Macomb County, Michigan	14	\$1,849	167	\$12,907	4	0	0	0	2	93	1	0	4	37	47	12
Census Tract 2587, Macomb County, Michigan	14	\$2,776	212	\$19,461	47	0	2	0	1	44	5	1	11	42	37	10
Census Tract 1366.02, Oakland County, Michigan	14	\$2,199	48	\$15,674	0	0	2	0	0	98	0	0	8	21	26	45
Census Tract 1502, Oakland County, Michigan	14	\$2,683	31	\$19,779	4	0	6	0	0	90	0	0	0	5	14	81
Census Tract 1505, Oakland County, Michigan	14	\$2,527	29	\$18,103	2	0	2	0	0	96	0	0	0	5	18	77
Census Tract 1542, Oakland County, Michigan	14	\$2,368	216	\$16,829	1	0	2	0	7	90	0	0	9	28	24	39
Census Tract 1623, Oakland County, Michigan	14	\$1,773	211	\$12,602	91	0	0	0	0	6	2	0	3	20	38	38
Census Tract 1678, Oakland County, Michigan	14	\$1,950	98	\$13,745	12	0	3	0	0	81	0	4	3	16	21	60
Census Tract 1734, Oakland County, Michigan	14	\$1,712	253	\$12,055	5	0	1	0	0	93	1	0	16	8	42	33
Census Tract 1837, Oakland County, Michigan	14	\$1,445	146	\$9,980	1	0	1	0	1	96	1	0	1	32	17	50
Census Tract 1964, Oakland County, Michigan	14	\$2,054	43	\$15,149	0	0	17	0	0	82	0	0	0	10	14	75
Census Tract 5119, Wayne County, Michigan	14	\$1,438	273	\$10,425	87	0	1	0	1	11	0	0	24	33	27	16
Census Tract 5238, Wayne County, Michigan	14	\$2,814	485	\$20,507	12	0	0	0	20	29	3	36	53	17	25	4
Census Tract 5257, Wayne County, Michigan	14	\$2,863	453	\$20,560	4	0	0	0	50	19	4	23	44	35	8	13
Census Tract 5262, Wayne County, Michigan	14	\$2,869	424	\$20,017	3	0	0	0	42	36	5	14	59	22	14	4
Census Tract 5312, Wayne County, Michigan	14	\$3,009	110	\$21,726	82	1	0	0	0	16	2	0	3	25	33	39
Census Tract 5513, Wayne County, Michigan	14	\$2,164	265	\$15,719	52	0	1	0	0	37	10	0	17	24	40	19
Census Tract 5515, Wayne County, Michigan	14	\$3,421	67	\$25,253	68	0	2	0	0	28	2	0	5	35	50	10
Census Tract 5518, Wayne County, Michigan	14	\$2,611	153	\$18,978	9	0	2	0	0	89	0	0	2	15	35	48
Census Tract 5524, Wayne County, Michigan	14	\$2,934	377	\$20,380	12	0	28	0	0	53	6	1	34	30	24	11
Census Tract 5528.01, Wayne County, Michigan	14	\$2,700	546	\$18,935	4	0	13	0	0	68	14	0	43	35	14	8
Census Tract 5541, Wayne County, Michigan	14	\$2,334	364	\$16,829	54	0	0	0	0	44	2	0	4	38	49	9
Census Tract 5545, Wayne County, Michigan	14	\$2,222	279	\$15,422	37	0	0	0	0	61	1	0	9	43	36	12
Census Tract 5567, Wayne County, Michigan	14	\$2,153	41	\$15,425	1	0	1	0	0	98	0	0	1	43	30	26
Census Tract 5583.01, Wayne County, Michigan	14	\$1,934	87	\$13,439	3	0	0	0	0	96	1	0	15	30	44	10
Census Tract 5584, Wayne County, Michigan	14	\$2,124	76	\$15,675	2	0	2	0	0	95	0	0	2	16	58	25
Census Tract 5588, Wayne County, Michigan	14	\$2,137	84	\$15,634	1	0	3	0	0	94	1	0	11	21	37	30
Census Tract 5602.02, Wayne County, Michigan	14	\$1,705	91	\$12,093	2	0	5	0	1	92	0	0	0	22	30	48
Census Tract 5638, Wayne County, Michigan	14	\$2,917	84	\$21,605	20	0	2	0	0	77	1	0	0	17	52	31

Census Tract 5646, Wayne County, Michigan	14	\$2,412	112	\$17,251	1	0	17	0	0	80	1	0	0	13	20	66
Census Tract 5651, Wayne County, Michigan	14	\$2,067	309	\$14,546	40	0	4	0	0	53	1	1	7	30	51	12
Census Tract 5656, Wayne County, Michigan	14	\$2,409	41	\$17,031	1	0	0	0	0	97	1	0	11	26	54	9
Census Tract 5658, Wayne County, Michigan	14	\$2,033	284	\$14,069	12	0	0	0	2	84	0	1	20	35	37	7
Census Tract 5666, Wayne County, Michigan	14	\$2,096	88	\$15,079	24	3	0	0	2	70	1	0	12	35	38	16
Census Tract 5696, Wayne County, Michigan	14	\$2,209	153	\$15,456	3	0	1	0	0	95	0	0	7	41	44	8
Census Tract 5709, Wayne County, Michigan	14	\$2,191	296	\$15,405	95	0	0	0	0	3	1	1	26	27	41	6
Census Tract 5725, Wayne County, Michigan	14	\$2,624	119	\$18,419	9	0	0	0	2	87	2	0	9	42	39	9
Census Tract 5729, Wayne County, Michigan	14	\$2,411	210	\$16,925	8	0	0	0	0	91	0	0	13	42	33	13
Census Tract 5734, Wayne County, Michigan	14	\$2,567	378	\$18,224	2	0	0	0	0	97	1	0	19	27	38	16
Census Tract 5735.01, Wayne County, Michigan	14	\$2,599	567	\$18,665	3	0	1	0	0	90	6	0	54	15	22	10
Census Tract 5737.01, Wayne County, Michigan	14	\$2,886	164	\$20,489	3	0	0	0	1	86	11	0	34	20	19	26
Census Tract 5737.02, Wayne County, Michigan	14	\$2,831	644	\$20,426	1	0	0	0	0	98	1	0	33	32	22	13
Census Tract 5752, Wayne County, Michigan	14	\$2,483	225	\$18,367	3	0	1	0	2	91	2	0	6	28	47	19
Census Tract 5753, Wayne County, Michigan	14	\$2,256	127	\$15,570	4	0	0	0	2	92	1	0	6	21	49	24
Census Tract 5754.01, Wayne County, Michigan	14	\$2,406	149	\$17,699	1	0	0	0	2	94	3	0	2	22	55	22
Census Tract 5761, Wayne County, Michigan	14	\$2,100	450	\$14,630	2	0	0	0	11	82	2	4	8	28	44	20
Census Tract 5771, Wayne County, Michigan	14	\$1,828	336	\$13,299	8	1	0	0	10	58	9	14	28	49	22	1
Census Tract 5777, Wayne County, Michigan	14	\$2,105	98	\$14,864	1	1	0	0	1	85	2	10	11	45	32	12
Census Tract 5799, Wayne County, Michigan	14	\$1,886	283	\$13,360	2	0	5	0	1	91	1	0	13	21	26	40
Census Tract 5806, Wayne County, Michigan	14	\$1,633	218	\$11,853	2	1	0	0	3	85	0	9	12	45	32	11
Census Tract 5811.01, Wayne County, Michigan	14	\$2,005	201	\$14,842	13	0	11	0	0	75	1	0	6	26	53	15
Census Tract 5821, Wayne County, Michigan	14	\$2,381	119	\$16,790	0	0	0	0	1	97	1	0	5	36	46	13
Census Tract 5834, Wayne County, Michigan	14	\$2,387	283	\$16,534	4	0	0	0	2	92	1	1	9	41	44	6
Census Tract 5835, Wayne County, Michigan	14	\$2,663	133	\$18,858	2	0	0	0	1	97	0	0	7	59	27	8
Census Tract 5836, Wayne County, Michigan	14	\$2,450	121	\$17,942	1	0	0	0	0	97	1	0	17	32	33	18
Census Tract 5845.01, Wayne County, Michigan	14	\$2,334	125	\$16,565	30	2	0	0	0	64	0	3	15	54	29	3
Census Tract 5848.02, Wayne County, Michigan	14	\$2,118	356	\$15,459	48	0	0	0	0	51	0	0	16	44	26	14
Census Tract 5859, Wayne County, Michigan	14	\$1,471	334	\$10,357	34	0	0	0	0	61	1	3	30	36	12	21
Census Tract 5879, Wayne County, Michigan	14	\$2,022	468	\$14,841	52	0	2	0	0	45	1	0	27	40	16	17
Census Tract 5880.02, Wayne County, Michigan	14	\$2,541	104	\$18,557	8	0	0	0	0	87	5	0	4	36	31	29
Census Tract 5884, Wayne County, Michigan	14	\$3,029	112	\$21,662	3	1	1	0	0	95	1	0	22	17	24	37
Census Tract 2406.01, Macomb County, Michigan	13	\$2,186	200	\$16,427	15	0	5	0	5	69	6	0	7	49	37	7
Census Tract 2418, Macomb County, Michigan	13	\$1,798	451	\$13,572	40	0	3	0	0	54	0	3	9	46	38	6
Census Tract 2420.01, Macomb County, Michigan	13	\$2,105	66	\$16,676	4	0	0	0	0	93	3	0	13	39	46	1
Census Tract 2508, Macomb County, Michigan	13	\$1,945	124	\$14,905	2	0	0	0	1	96	1	0	9	34	42	15
Census Tract 2511, Macomb County, Michigan	13	\$2,216	61	\$16,444	4	0	0	0	0	94	1	0	2	24	52	22
Census Tract 2520, Macomb County, Michigan	13	\$1,803	123	\$14,056	3	0	0	0	0	89	4	3	6	14	58	22
Census Tract 2561, Macomb County, Michigan	13	\$1,985	231	\$15,052	20	0	0	0	2	72	2	4	15	39	40	6
Census Tract 2564, Macomb County, Michigan	13	\$1,941	79	\$14,519	23	0	0	0	1	69	7	0	10	53	34	3
Census Tract 2586, Macomb County, Michigan	13	\$2,183	402	\$16,517	57	0	0	0	0	39	3	0	12	31	42	15
Census Tract 2621, Macomb County, Michigan	13	\$2,046	95	\$15,175	16	0	0	0	0	76	9	0	31	29	23	17
Census Tract 1345, Oakland County, Michigan	13	\$2,339	34	\$18,040	0	0	0	0	0	100	0	0	67	7	14	12
Census Tract 1423, Oakland County, Michigan	13	\$1,469	408	\$11,626	81	0	4	0	0	13	2	0	31	35	26	8
Census Tract 1500, Oakland County, Michigan	13	\$2,057	232	\$15,497	5	0	3	0	1	91	0	0	10	7	14	69
Census Tract 1562, Oakland County, Michigan	13	\$2,310	260	\$17,964	0	0	1	0	1	98	0	0	1	16	56	28
Census Tract 1564, Oakland County, Michigan	13	\$2,594	96	\$20,181	2	0	2	0	0	95	0	0	3	10	11	76
Census Tract 1573, Oakland County, Michigan	13	\$2,115	79	\$16,299	10	0	2	0	0	88	0	0	4	6	16	75
Census Tract 1576, Oakland County, Michigan	13	\$2,519	123	\$19,272	10	0	6	0	0	84	1	0	10	17	9	63
Census Tract 1600, Oakland County, Michigan	13	\$2,028	65	\$15,573	63	0	0	0	1	36	0	0	2	15	26	58
Census Tract 1607, Oakland County, Michigan	13	\$2,706	19	\$20,324	81	0	0	0	0	19	1	0	4	8	22	65
Census Tract 1610, Oakland County, Michigan	13	\$1,510	149	\$12,025	85	0	1	0	0	14	1	0	26	15	27	32
Census Tract 1613, Oakland County, Michigan	13	\$1,985	187	\$15,273	60	0	0	0	0	40	0	0	6	28	23	43
Census Tract 1616, Oakland County, Michigan	13	\$1,521	147	\$11,319	74	0	1	0	1	21	3	0	4	31	43	22
Census Tract 1625, Oakland County, Michigan	13	\$1,656	311	\$12,864	76	0	0	0	0	23	0	0	7	33	46	14
Census Tract 1661, Oakland County, Michigan	13	\$1,701	112	\$13,024	28	0	1	0	0	71	0	0	6	16	45	32
Census Tract 1667, Oakland County, Michigan	13	\$2,389	56	\$18,260	35	1	3	0	1	50	10	0	2	29	16	53
Census Tract 1669, Oakland County, Michigan	13	\$2,386	109	\$18,298	28	0	0	0	0	65	6	0	5	5	23	67
Census Tract 1686.02, Oakland County, Michigan	13	\$1,782	135	\$13,799	16	0	10	0	0	74	0	0	1	23	34	42
Census Tract 1689.01, Oakland County, Michigan	13	\$1,440	81	\$11,496	27	0	27	0	1	37	8	0	0	15	36	48
Census Tract 1833, Oakland County, Michigan	13	\$1,504	105	\$11,375	3	0	1	0	1	95	0	0	3	15	32	51
Census Tract 1836, Oakland County, Michigan	13	\$1,438	120	\$11,259	3	0	1	0	0	96	0	0	4	12	24	60

Census Tract 1842, Oakland County, Michigan	13	\$1,453	194	\$11,235	6	0	2	0	5	83	5	0	14	7	23	56
Census Tract 1961, Oakland County, Michigan	13	\$1,948	115	\$15,431	0	0	9	0	0	90	0	0	0	9	22	69
Census Tract 1979, Oakland County, Michigan	13	\$1,968	43	\$15,558	0	0	4	0	1	95	0	0	0	5	22	73
Census Tract 5067, Wayne County, Michigan	13	\$3,160	49	\$24,484	98	0	0	0	1	2	0	0	13	36	46	4
Census Tract 5208, Wayne County, Michigan	13	\$500	46	\$3,812	50	0	49	0	0	1	0	0	0	0	45	55
Census Tract 5218, Wayne County, Michigan	13	\$1,237	427	\$9,581	94	0	0	0	0	5	1	1	25	26	44	6
Census Tract 5243, Wayne County, Michigan	13	\$2,971	372	\$23,121	4	0	0	0	23	21	5	47	55	29	14	2
Census Tract 5259, Wayne County, Michigan	13	\$3,125	299	\$23,552	22	0	0	0	23	13	7	36	45	25	24	6
Census Tract 5339, Wayne County, Michigan	13	\$1,303	418	\$10,374	64	0	12	0	1	22	1	0	11	25	46	18
Census Tract 5383, Wayne County, Michigan	13	\$1,238	216	\$9,839	93	0	5	0	0	2	0	0	11	23	21	45
Census Tract 5505, Wayne County, Michigan	13	\$2,693	61	\$20,494	2	0	2	0	0	94	2	0	2	36	16	45
Census Tract 5522, Wayne County, Michigan	13	\$2,682	368	\$20,080	3	0	26	0	0	66	4	0	26	37	23	14
Census Tract 5542, Wayne County, Michigan	13	\$2,069	235	\$16,333	19	0	0	0	1	75	5	0	13	45	32	9
Census Tract 5544, Wayne County, Michigan	13	\$2,341	207	\$17,606	49	0	2	0	0	47	3	0	9	41	43	8
Census Tract 5546, Wayne County, Michigan	13	\$1,953	124	\$14,622	25	0	0	0	2	73	1	0	7	26	48	19
Census Tract 5547, Wayne County, Michigan	13	\$1,918	65	\$14,911	37	0	0	0	0	62	0	0	24	36	23	17
Census Tract 5562, Wayne County, Michigan	13	\$1,686	166	\$13,213	6	0	1	0	0	93	0	0	52	15	21	13
Census Tract 5569, Wayne County, Michigan	13	\$1,991	84	\$15,517	1	0	3	0	1	95	0	0	2	25	45	29
Census Tract 5580, Wayne County, Michigan	13	\$1,920	125	\$15,326	1	0	0	0	0	96	2	0	1	27	42	30
Census Tract 5581, Wayne County, Michigan	13	\$2,121	115	\$16,908	4	0	1	0	1	92	2	0	11	27	36	26
Census Tract 5582, Wayne County, Michigan	13	\$2,387	93	\$18,592	5	0	0	0	0	93	1	0	11	23	38	28
Census Tract 5586, Wayne County, Michigan	13	\$2,063	25	\$16,134	4	0	1	0	1	94	0	0	19	20	40	21
Census Tract 5598, Wayne County, Michigan	13	\$1,562	845	\$12,391	95	0	0	0	0	3	1	0	40	21	30	9
Census Tract 5616, Wayne County, Michigan	13	\$1,722	254	\$13,662	3	0	1	0	0	96	0	0	9	25	27	39
Census Tract 5639, Wayne County, Michigan	13	\$2,652	38	\$20,329	4	0	15	0	0	80	2	0	1	18	29	52
Census Tract 5642, Wayne County, Michigan	13	\$2,112	216	\$16,492	5	0	4	0	0	90	1	0	26	26	18	30
Census Tract 5649, Wayne County, Michigan	13	\$2,231	207	\$17,126	1	0	0	0	1	86	13	0	10	44	43	3
Census Tract 5665, Wayne County, Michigan	13	\$1,420	231	\$10,737	31	0	4	0	0	64	1	0	42	19	38	1
Census Tract 5668, Wayne County, Michigan	13	\$2,005	196	\$15,756	43	1	0	0	2	54	0	1	22	21	45	12
Census Tract 5692, Wayne County, Michigan	13	\$1,859	237	\$14,002	8	0	0	0	2	89	1	0	37	27	27	9
Census Tract 5699, Wayne County, Michigan	13	\$2,168	181	\$16,432	2	0	1	0	3	93	2	0	13	42	37	7
Census Tract 5701, Wayne County, Michigan	13	\$1,859	536	\$14,331	70	0	1	0	0	27	2	0	21	23	47	9
Census Tract 5704, Wayne County, Michigan	13	\$2,136	661	\$16,160	80	0	0	0	0	19	1	0	41	34	23	1
Census Tract 5716, Wayne County, Michigan	13	\$1,819	263	\$14,274	13	0	0	0	0	87	0	0	18	38	31	13
Census Tract 5717, Wayne County, Michigan	13	\$2,454	237	\$18,685	14	0	0	0	1	83	2	0	35	15	40	10
Census Tract 5730, Wayne County, Michigan	13	\$2,827	98	\$21,126	1	0	1	0	2	94	1	0	14	18	42	26
Census Tract 5733, Wayne County, Michigan	13	\$2,780	376	\$21,939	0	0	0	0	0	95	4	0	38	17	21	24
Census Tract 5741, Wayne County, Michigan	13	\$2,618	492	\$19,922	1	0	1	0	0	93	5	0	24	22	28	26
Census Tract 5763, Wayne County, Michigan	13	\$2,325	60	\$18,100	1	0	0	0	2	92	3	1	5	38	35	21
Census Tract 5764, Wayne County, Michigan	13	\$1,887	150	\$14,169	3	0	0	0	4	87	5	1	3	27	43	27
Census Tract 5776, Wayne County, Michigan	13	\$2,190	344	\$17,264	1	1	0	0	6	86	2	4	9	37	40	14
Census Tract 5786, Wayne County, Michigan	13	\$1,831	669	\$14,593	8	1	0	0	7	77	3	5	26	43	24	7
Census Tract 5792, Wayne County, Michigan	13	\$1,652	621	\$12,740	36	0	0	0	5	53	1	5	20	52	24	4
Census Tract 5793, Wayne County, Michigan	13	\$1,780	500	\$13,664	93	0	0	0	0	3	3	0	24	23	47	5
Census Tract 5815, Wayne County, Michigan	13	\$2,147	91	\$16,193	0	1	0	0	1	95	1	2	6	44	42	8
Census Tract 5816, Wayne County, Michigan	13	\$1,810	203	\$13,930	6	0	8	0	0	79	5	1	7	32	45	16
Census Tract 5820, Wayne County, Michigan	13	\$1,708	264	\$12,972	10	0	3	0	4	68	1	14	7	51	35	7
Census Tract 5831.01, Wayne County, Michigan	13	\$2,475	309	\$19,638	7	2	0	0	1	89	1	0	32	44	21	3
Census Tract 5833, Wayne County, Michigan	13	\$2,369	162	\$18,271	3	0	0	0	0	93	3	1	17	46	34	3
Census Tract 5842, Wayne County, Michigan	13	\$2,040	289	\$15,196	21	0	1	0	0	77	0	0	12	46	40	2
Census Tract 5844, Wayne County, Michigan	13	\$2,107	190	\$16,506	15	0	0	0	0	82	2	0	17	57	18	8
Census Tract 5856, Wayne County, Michigan	13	\$1,929	312	\$14,821	87	0	1	0	0	10	1	0	30	30	35	6
Census Tract 5916, Wayne County, Michigan	13	\$2,257	33	\$17,993	7	0	3	0	2	86	0	2	18	26	36	21
Census Tract 2306.04, Macomb County, Michigan	12	\$1,871	100	\$15,454	1	0	2	0	0	98	0	0	23	8	36	33
Census Tract 2315, Macomb County, Michigan	12	\$2,329	245	\$18,640	0	0	4	0	0	95	1	0	28	23	28	21
Census Tract 2325, Macomb County, Michigan	12	\$2,203	178	\$18,479	2	0	1	0	0	96	0	0	9	20	40	31
Census Tract 2407, Macomb County, Michigan	12	\$2,181	82	\$18,354	1	0	1	0	0	97	1	0	8	24	52	16
Census Tract 2453, Macomb County, Michigan	12	\$1,651	373	\$13,626	9	0	0	0	0	90	0	0	27	38	30	5
Census Tract 2472.01, Macomb County, Michigan	12	\$1,565	95	\$12,956	7	0	0	0	1	92	0	0	5	46	40	9
Census Tract 2474, Macomb County, Michigan	12	\$1,848	76	\$16,041	0	0	0	0	0	99	0	0	6	33	56	6
Census Tract 2505, Macomb County, Michigan	12	\$1,917	105	\$15,870	2	0	0	0	0	96	2	0	12	23	37	28
Census Tract 2515, Macomb County, Michigan	12	\$1,918	136	\$15,947	9	0	0	0	1	90	0	0	12	21	48	19

Census Tract 2516, Macomb County, Michigan	12	\$1,622	219	\$13,040	3	0	0	0	0	94	2	0	2	51	39	9
Census Tract 2517, Macomb County, Michigan	12	\$1,498	238	\$12,907	10	0	1	0	1	87	1	0	9	31	43	17
Census Tract 2540, Macomb County, Michigan	12	\$2,213	53	\$19,015	2	0	0	0	0	97	0	0	3	18	60	18
Census Tract 2584, Macomb County, Michigan	12	\$2,175	362	\$18,017	45	0	1	0	1	48	5	0	18	31	43	7
Census Tract 2629, Macomb County, Michigan	12	\$2,034	390	\$17,493	16	0	2	0	1	79	2	0	26	39	31	4
Census Tract 2684, Macomb County, Michigan	12	\$1,909	458	\$16,309	24	0	0	0	0	72	4	0	9	54	37	1
Census Tract 1508, Oakland County, Michigan	12	\$2,158	64	\$17,525	5	0	4	0	0	90	1	0	1	6	10	84
Census Tract 1530, Oakland County, Michigan	12	\$1,796	114	\$14,785	0	0	1	0	2	97	0	0	3	5	13	79
Census Tract 1605, Oakland County, Michigan	12	\$2,051	176	\$17,232	52	0	0	0	0	46	1	0	18	12	28	42
Census Tract 1650, Oakland County, Michigan	12	\$1,397	167	\$11,594	7	0	1	0	0	91	1	0	3	18	45	34
Census Tract 1652, Oakland County, Michigan	12	\$1,917	108	\$16,085	36	0	6	0	0	47	10	1	0	14	28	58
Census Tract 1665, Oakland County, Michigan	12	\$1,956	89	\$16,399	8	1	3	0	0	87	0	0	4	20	26	51
Census Tract 1668, Oakland County, Michigan	12	\$1,934	83	\$16,644	47	0	0	0	0	51	2	0	11	18	13	57
Census Tract 1673, Oakland County, Michigan	12	\$1,597	159	\$12,848	22	0	5	0	1	71	1	0	6	17	42	36
Census Tract 1675, Oakland County, Michigan	12	\$1,625	680	\$12,994	11	0	1	0	1	86	2	0	6	65	14	14
Census Tract 1701, Oakland County, Michigan	12	\$1,693	57	\$13,544	2	0	0	0	1	88	9	0	0	14	36	49
Census Tract 1730, Oakland County, Michigan	12	\$1,564	324	\$12,793	4	0	0	0	0	92	3	0	4	16	42	38
Census Tract 1731, Oakland County, Michigan	12	\$1,688	79	\$14,074	7	0	0	0	0	90	2	0	10	10	34	46
Census Tract 1752, Oakland County, Michigan	12	\$1,841	557	\$15,398	17	0	1	0	0	77	5	0	7	45	35	13
Census Tract 1803, Oakland County, Michigan	12	\$1,343	210	\$11,660	0	0	0	0	1	97	1	0	4	35	30	31
Census Tract 1834, Oakland County, Michigan	12	\$1,408	116	\$11,959	3	0	1	0	2	92	2	0	13	9	15	64
Census Tract 1960, Oakland County, Michigan	12	\$2,107	81	\$17,147	0	0	14	0	0	85	1	0	0	12	31	58
Census Tract 1972, Oakland County, Michigan	12	\$2,202	56	\$18,824	0	0	19	0	0	81	0	0	0	13	20	67
Census Tract 1973, Oakland County, Michigan	12	\$1,864	151	\$15,924	0	0	6	0	0	92	1	0	16	25	20	38
Census Tract 1977.01, Oakland County, Michigan	12	\$1,181	102	\$9,954	1	0	10	0	3	85	1	0	4	1	15	79
Census Tract 5080, Wayne County, Michigan	12	\$1,506	434	\$12,619	79	0	0	0	0	20	0	1	28	48	23	2
Census Tract 5153, Wayne County, Michigan	12	\$1,335	532	\$10,702	72	0	0	0	0	21	4	2	32	37	18	13
Census Tract 5175, Wayne County, Michigan	12	\$1,129	722	\$9,634	77	0	7	0	0	14	1	1	20	40	21	19
Census Tract 5561, Wayne County, Michigan	12	\$2,607	176	\$21,444	5	0	2	0	1	87	5	0	13	33	36	17
Census Tract 5564, Wayne County, Michigan	12	\$1,715	140	\$14,351	0	0	0	0	0	99	0	0	0	23	50	27
Census Tract 5572, Wayne County, Michigan	12	\$1,923	107	\$15,842	1	0	1	0	1	97	1	0	3	27	46	24
Census Tract 5573, Wayne County, Michigan	12	\$2,117	45	\$17,336	3	0	0	0	1	96	0	0	21	24	44	12
Census Tract 5576, Wayne County, Michigan	12	\$1,954	47	\$16,932	0	0	0	0	1	99	1	0	3	21	37	39
Census Tract 5585, Wayne County, Michigan	12	\$2,056	149	\$17,261	1	0	0	0	1	98	0	0	2	29	49	20
Census Tract 5587, Wayne County, Michigan	12	\$2,614	61	\$21,197	2	0	1	0	0	96	0	0	1	19	44	36
Census Tract 5591, Wayne County, Michigan	12	\$2,422	93	\$20,336	6	0	0	0	3	90	1	0	1	30	34	35
Census Tract 5643, Wayne County, Michigan	12	\$2,151	66	\$17,485	1	0	6	0	1	92	0	0	18	12	29	42
Census Tract 5667, Wayne County, Michigan	12	\$2,242	326	\$18,250	3	0	0	0	0	92	3	1	14	41	41	3
Census Tract 5669, Wayne County, Michigan	12	\$1,885	438	\$15,388	33	0	0	0	0	65	1	0	14	41	42	3
Census Tract 5672.02, Wayne County, Michigan	12	\$1,718	130	\$14,406	32	0	1	0	0	62	4	0	21	21	35	23
Census Tract 5678, Wayne County, Michigan	12	\$1,721	393	\$14,698	24	0	1	0	0	73	1	0	13	33	37	17
Census Tract 5682, Wayne County, Michigan	12	\$2,376	153	\$19,461	11	0	0	0	1	86	2	0	33	35	24	7
Census Tract 5683, Wayne County, Michigan	12	\$2,031	269	\$16,966	23	0	0	0	1	72	3	1	20	35	38	7
Census Tract 5684, Wayne County, Michigan	12	\$2,377	231	\$19,452	13	0	1	0	1	76	8	1	12	38	47	4
Census Tract 5685, Wayne County, Michigan	12	\$1,970	531	\$16,370	21	0	0	0	1	71	3	4	25	29	44	2
Census Tract 5693, Wayne County, Michigan	12	\$1,881	185	\$15,756	1	0	0	0	1	96	1	0	7	46	39	8
Census Tract 5695, Wayne County, Michigan	12	\$2,201	200	\$18,832	0	0	0	0	0	94	5	0	9	39	47	6
Census Tract 5705, Wayne County, Michigan	12	\$1,987	264	\$16,423	76	0	0	0	1	20	3	0	18	34	43	5
Census Tract 5728, Wayne County, Michigan	12	\$2,461	372	\$20,821	4	0	1	0	2	93	0	0	11	44	28	17
Census Tract 5736, Wayne County, Michigan	12	\$2,333	873	\$19,667	3	0	0	0	1	96	1	0	49	21	16	14
Census Tract 5738, Wayne County, Michigan	12	\$2,562	599	\$20,950	0	0	1	0	0	89	9	0	43	24	19	13
Census Tract 5739, Wayne County, Michigan	12	\$2,807	509	\$23,037	0	0	0	0	0	100	0	0	29	33	18	19
Census Tract 5740, Wayne County, Michigan	12	\$2,427	584	\$20,893	0	0	0	0	0	97	3	0	30	29	28	12
Census Tract 5747, Wayne County, Michigan	12	\$2,895	132	\$24,066	0	0	0	0	2	97	1	0	3	12	47	38
Census Tract 5756, Wayne County, Michigan	12	\$2,602	115	\$21,246	4	0	5	0	1	90	0	0	6	25	43	27
Census Tract 5762, Wayne County, Michigan	12	\$1,707	70	\$14,206	2	0	0	0	2	95	0	0	15	42	34	9
Census Tract 5767, Wayne County, Michigan	12	\$2,081	164	\$17,757	5	0	0	0	2	89	3	1	12	22	45	22
Census Tract 5778, Wayne County, Michigan	12	\$2,081	280	\$17,676	2	0	0	0	5	90	0	3	26	36	33	5
Census Tract 5791, Wayne County, Michigan	12	\$1,704	318	\$14,430	31	1	0	0	1	63	1	3	16	47	37	0
Census Tract 5798, Wayne County, Michigan	12	\$1,959	256	\$16,280	53	3	0	0	4	31	9	0	13	31	42	14
Census Tract 5837, Wayne County, Michigan	12	\$2,093	142	\$17,469	10	0	0	0	1	87	1	1	18	37	31	14
Census Tract 5863, Wayne County, Michigan	12	\$2,554	59	\$21,585	4	0	0	0	0	95	0	0	13	44	39	5

Census Tract 9851, Wayne County, Michigan	12	\$1,406	10	\$11,880	74	0	0	0	0	0	26	0	16	3	0	81
Census Tract 9853, Wayne County, Michigan	12	\$1,160	13	\$9,464	27	0	0	0	0	64	9	0	40	11	35	14
Census Tract 2304, Macomb County, Michigan	11	\$1,821	186	\$16,542	0	0	0	0	0	95	5	0	4	27	37	32
Census Tract 2305.02, Macomb County, Michigan	11	\$790	20	\$7,148	0	0	0	0	0	100	0	0	0	100	0	0
Census Tract 2306.02, Macomb County, Michigan	11	\$2,194	387	\$19,198	1	0	5	0	0	93	0	0	24	22	35	19
Census Tract 2307, Macomb County, Michigan	11	\$2,406	190	\$22,199	0	0	7	0	0	91	1	0	24	17	31	29
Census Tract 2311, Macomb County, Michigan	11	\$1,627	279	\$15,227	2	0	3	0	0	93	3	0	14	40	23	24
Census Tract 2323.01, Macomb County, Michigan	11	\$1,808	356	\$17,005	1	0	4	0	0	94	1	0	22	32	30	16
Census Tract 2400, Macomb County, Michigan	11	\$1,626	612	\$14,526	34	0	0	0	0	60	5	0	17	47	31	5
Census Tract 2404, Macomb County, Michigan	11	\$1,665	330	\$15,048	5	0	0	0	0	94	0	0	12	42	38	8
Census Tract 2435.01, Macomb County, Michigan	11	\$1,827	93	\$17,000	1	0	0	0	4	95	0	0	17	17	34	32
Census Tract 2450, Macomb County, Michigan	11	\$1,575	558	\$14,858	37	0	0	0	0	60	2	0	29	42	24	6
Census Tract 2452, Macomb County, Michigan	11	\$1,892	144	\$17,287	22	0	0	0	0	77	1	0	7	44	46	3
Census Tract 2476.02, Macomb County, Michigan	11	\$1,354	487	\$12,654	4	0	0	0	0	95	0	0	9	38	41	12
Census Tract 2501, Macomb County, Michigan	11	\$1,958	117	\$18,319	7	0	0	0	0	91	2	0	4	28	43	24
Census Tract 2506, Macomb County, Michigan	11	\$2,067	128	\$19,583	0	0	0	0	0	97	2	0	5	34	46	16
Census Tract 2510, Macomb County, Michigan	11	\$1,938	61	\$17,884	1	0	0	0	0	96	3	0	9	20	50	21
Census Tract 2513, Macomb County, Michigan	11	\$2,125	99	\$18,586	0	0	0	0	2	97	1	0	5	25	50	20
Census Tract 2514, Macomb County, Michigan	11	\$2,024	153	\$18,835	1	0	0	0	1	97	1	0	5	33	52	10
Census Tract 2542, Macomb County, Michigan	11	\$1,646	305	\$14,352	1	0	0	0	0	98	1	0	15	49	28	8
Census Tract 2551, Macomb County, Michigan	11	\$1,622	271	\$15,268	6	0	0	0	2	89	0	2	19	41	32	8
Census Tract 2553, Macomb County, Michigan	11	\$1,785	344	\$15,576	24	0	1	2	0	68	1	5	13	35	43	9
Census Tract 2554, Macomb County, Michigan	11	\$2,168	91	\$20,375	5	0	0	0	0	91	4	0	30	26	43	2
Census Tract 2555, Macomb County, Michigan	11	\$1,750	88	\$15,440	14	0	0	0	0	84	0	1	12	29	49	10
Census Tract 2556, Macomb County, Michigan	11	\$1,998	255	\$18,099	8	0	0	0	0	85	7	0	14	35	39	12
Census Tract 2557, Macomb County, Michigan	11	\$2,021	111	\$18,249	21	0	0	0	0	78	1	0	24	27	44	5
Census Tract 2558, Macomb County, Michigan	11	\$1,901	124	\$18,002	19	0	0	0	0	79	1	0	16	47	33	4
Census Tract 2559, Macomb County, Michigan	11	\$2,126	164	\$19,975	16	0	0	1	4	77	2	1	12	28	57	2
Census Tract 2562, Macomb County, Michigan	11	\$1,761	157	\$15,632	15	0	0	0	0	78	7	0	16	37	38	9
Census Tract 2568, Macomb County, Michigan	11	\$2,005	140	\$17,742	7	0	0	0	1	91	1	0	18	39	38	6
Census Tract 2581, Macomb County, Michigan	11	\$2,169	196	\$20,340	32	0	0	0	0	63	3	3	8	35	38	20
Census Tract 2583, Macomb County, Michigan	11	\$1,768	224	\$16,517	40	0	0	0	0	56	3	0	20	27	43	11
Census Tract 2604, Macomb County, Michigan	11	\$1,644	179	\$15,636	4	0	7	0	1	88	1	0	7	35	44	14
Census Tract 2606, Macomb County, Michigan	11	\$2,060	233	\$19,470	3	0	6	0	0	89	2	0	16	38	31	15
Census Tract 2612, Macomb County, Michigan	11	\$1,717	111	\$14,961	8	0	2	0	0	88	1	0	11	28	50	10
Census Tract 2613, Macomb County, Michigan	11	\$1,893	133	\$16,947	5	0	1	0	2	92	0	0	8	40	41	10
Census Tract 2625, Macomb County, Michigan	11	\$1,569	572	\$14,785	13	0	17	0	1	68	1	0	20	36	34	10
Census Tract 2628, Macomb County, Michigan	11	\$1,813	190	\$16,325	22	0	4	0	4	70	1	0	23	27	47	2
Census Tract 2636, Macomb County, Michigan	11	\$2,304	600	\$20,690	42	3	23	0	1	29	1	0	16	28	47	9
Census Tract 2639, Macomb County, Michigan	11	\$2,030	363	\$18,130	41	0	1	0	5	51	2	1	14	43	40	3
Census Tract 2642, Macomb County, Michigan	11	\$1,957	597	\$17,308	46	0	2	0	1	50	1	0	22	43	28	8
Census Tract 1349, Oakland County, Michigan	11	\$1,466	279	\$13,246	1	0	0	0	0	97	2	0	12	41	18	29
Census Tract 1363, Oakland County, Michigan	11	\$1,950	61	\$18,237	0	0	0	0	0	99	0	0	1	35	14	50
Census Tract 1365, Oakland County, Michigan	11	\$1,986	101	\$17,882	0	0	1	0	0	98	1	0	0	5	42	53
Census Tract 1367, Oakland County, Michigan	11	\$1,892	70	\$17,864	0	0	0	0	1	99	0	0	14	48	3	34
Census Tract 1575, Oakland County, Michigan	11	\$1,351	238	\$12,096	9	0	3	0	0	87	1	0	2	22	17	60
Census Tract 1581, Oakland County, Michigan	11	\$1,933	92	\$16,823	15	0	1	0	1	83	0	0	0	4	12	83
Census Tract 1615, Oakland County, Michigan	11	\$2,109	28	\$18,884	86	0	0	0	0	12	2	0	3	16	35	46
Census Tract 1618, Oakland County, Michigan	11	\$1,736	228	\$15,770	73	0	0	0	1	22	4	0	6	22	38	34
Census Tract 1624, Oakland County, Michigan	11	\$2,033	110	\$19,287	73	0	1	0	0	13	12	1	7	30	25	38
Census Tract 1651, Oakland County, Michigan	11	\$1,811	137	\$16,799	10	0	0	0	0	88	1	0	3	15	34	49
Census Tract 1664, Oakland County, Michigan	11	\$2,392	39	\$21,798	8	0	0	0	0	90	1	0	15	16	9	60
Census Tract 1679, Oakland County, Michigan	11	\$2,151	23	\$19,872	36	0	1	0	0	61	2	0	4	6	17	73
Census Tract 1702, Oakland County, Michigan	11	\$1,829	57	\$16,162	4	0	0	0	1	93	1	0	10	27	31	32
Census Tract 1711, Oakland County, Michigan	11	\$1,840	100	\$16,172	43	0	1	0	0	50	6	0	2	32	36	30
Census Tract 1712, Oakland County, Michigan	11	\$1,739	143	\$16,446	35	0	3	0	1	59	3	0	9	12	46	33
Census Tract 1716, Oakland County, Michigan	11	\$1,886	193	\$17,139	60	0	1	0	0	37	1	0	23	21	38	18
Census Tract 1751, Oakland County, Michigan	11	\$1,523	637	\$14,033	6	0	0	0	0	89	4	0	12	38	42	9
Census Tract 1753, Oakland County, Michigan	11	\$1,975	339	\$17,313	23	0	0	0	0	73	2	0	11	23	44	22
Census Tract 1801, Oakland County, Michigan	11	\$1,737	133	\$15,774	0	0	0	0	1	99	0	0	5	19	50	26
Census Tract 1815, Oakland County, Michigan	11	\$1,747	201	\$15,950	6	0	0	0	2	87	4	0	21	39	25	15
Census Tract 1816, Oakland County, Michigan	11	\$1,800	463	\$15,915	10	0	0	0	0	86	3	0	15	35	28	22

Census Tract 1831, Oakland County, Michigan	11	\$1,679	199	\$15,908	1	0	1	0	1	92	3	1	3	13	27	57
Census Tract 1840, Oakland County, Michigan	11	\$1,593	39	\$15,103	2	0	1	0	0	96	1	0	1	11	25	63
Census Tract 1841, Oakland County, Michigan	11	\$1,795	51	\$16,906	11	0	0	0	0	85	3	0	0	14	36	50
Census Tract 1844, Oakland County, Michigan	11	\$1,383	178	\$12,956	3	0	2	0	1	93	1	0	6	26	28	40
Census Tract 1845, Oakland County, Michigan	11	\$1,648	44	\$14,505	1	0	0	0	1	94	4	0	4	12	34	50
Census Tract 1847, Oakland County, Michigan	11	\$1,703	57	\$16,005	5	0	0	0	1	89	5	0	7	15	24	54
Census Tract 1963, Oakland County, Michigan	11	\$1,962	73	\$17,126	0	0	14	0	0	85	0	0	2	11	14	74
Census Tract 1970, Oakland County, Michigan	11	\$1,961	94	\$17,924	0	0	33	0	0	67	0	0	34	14	10	41
Census Tract 5170, Wayne County, Michigan	11	\$836	178	\$7,892	63	0	10	0	0	23	2	2	6	13	33	48
Census Tract 5189, Wayne County, Michigan	11	\$1,519	317	\$14,092	95	0	0	0	0	3	0	1	27	34	30	8
Census Tract 5430, Wayne County, Michigan	11	\$2,637	111	\$23,796	82	0	0	0	0	11	6	0	4	10	26	60
Census Tract 5520, Wayne County, Michigan	11	\$2,858	343	\$25,091	2	0	51	0	0	39	3	6	14	44	27	15
Census Tract 5536.01, Wayne County, Michigan	11	\$1,897	165	\$16,572	90	0	0	0	0	6	1	4	14	47	15	24
Census Tract 5543, Wayne County, Michigan	11	\$2,162	164	\$20,584	25	0	0	0	2	67	6	0	2	40	34	25
Census Tract 5548, Wayne County, Michigan	11	\$2,381	120	\$21,882	25	0	0	0	1	73	0	0	4	54	24	18
Census Tract 5553, Wayne County, Michigan	11	\$2,380	226	\$22,458	58	0	0	0	0	42	1	0	2	54	37	6
Census Tract 5555, Wayne County, Michigan	11	\$1,780	295	\$16,604	59	0	0	0	0	39	2	0	6	48	33	13
Census Tract 5556, Wayne County, Michigan	11	\$1,967	187	\$17,915	26	0	1	0	2	71	1	0	3	47	37	13
Census Tract 5565, Wayne County, Michigan	11	\$1,342	167	\$11,720	11	0	1	0	0	87	1	0	20	35	32	13
Census Tract 5566, Wayne County, Michigan	11	\$2,184	68	\$19,070	0	0	0	0	0	98	2	0	2	14	40	44
Census Tract 5589, Wayne County, Michigan	11	\$2,312	30	\$20,390	3	0	3	0	0	92	2	0	3	38	29	31
Census Tract 5602.01, Wayne County, Michigan	11	\$1,588	54	\$14,456	0	1	9	0	0	89	1	0	0	11	37	53
Census Tract 5628, Wayne County, Michigan	11	\$2,322	113	\$21,315	2	0	1	0	0	95	1	0	6	20	25	49
Census Tract 5653.01, Wayne County, Michigan	11	\$1,044	410	\$9,699	65	0	5	0	0	30	0	0	18	21	54	8
Census Tract 5670, Wayne County, Michigan	11	\$2,678	312	\$23,431	75	2	0	0	1	20	2	0	17	21	52	10
Census Tract 5674, Wayne County, Michigan	11	\$1,777	148	\$15,799	4	0	0	0	0	93	1	0	8	37	37	17
Census Tract 5680, Wayne County, Michigan	11	\$1,680	201	\$15,430	15	0	0	0	0	80	2	2	18	36	33	12
Census Tract 5691, Wayne County, Michigan	11	\$2,325	116	\$22,072	0	0	0	0	1	96	1	2	5	38	53	4
Census Tract 5698, Wayne County, Michigan	11	\$2,435	149	\$21,222	8	0	1	0	1	88	1	1	26	37	32	5
Census Tract 5702, Wayne County, Michigan	11	\$2,365	337	\$20,655	69	0	0	0	2	25	1	3	14	30	53	3
Census Tract 5770, Wayne County, Michigan	11	\$1,620	477	\$15,159	24	0	0	0	7	43	4	23	24	39	28	9
Census Tract 5772, Wayne County, Michigan	11	\$2,005	342	\$18,878	9	5	0	0	5	61	2	17	21	55	21	3
Census Tract 5775, Wayne County, Michigan	11	\$2,071	229	\$19,452	12	0	0	0	8	63	3	14	11	54	31	5
Census Tract 5807, Wayne County, Michigan	11	\$1,374	494	\$12,891	4	0	1	0	1	86	1	6	8	33	46	13
Census Tract 5812, Wayne County, Michigan	11	\$1,520	322	\$14,460	9	0	1	0	2	86	1	1	11	47	33	9
Census Tract 5838, Wayne County, Michigan	11	\$1,829	206	\$16,822	11	0	0	0	0	87	1	1	19	35	43	3
Census Tract 5843, Wayne County, Michigan	11	\$1,769	140	\$16,319	23	0	1	0	1	72	2	1	19	37	37	7
Census Tract 5846, Wayne County, Michigan	11	\$1,539	196	\$14,363	37	0	19	0	2	40	1	1	23	49	19	9
Census Tract 5858, Wayne County, Michigan	11	\$2,343	257	\$21,387	53	0	0	0	0	46	1	0	7	40	45	7
Census Tract 5915.01, Wayne County, Michigan	11	\$2,185	333	\$19,051	17	0	36	0	0	43	3	1	22	55	19	4
Census Tract 5963, Wayne County, Michigan	11	\$2,392	9	\$21,239	0	0	1	0	0	98	1	0	0	8	48	44
Census Tract 2308, Macomb County, Michigan	10	\$2,158	380	\$22,054	2	0	2	0	0	87	9	0	32	24	17	28
Census Tract 2309.01, Macomb County, Michigan	10	\$2,098	249	\$20,807	0	0	0	0	0	100	0	0	8	28	27	37
Census Tract 2314, Macomb County, Michigan	10	\$2,402	324	\$23,229	1	0	6	0	0	93	0	0	33	19	25	23
Census Tract 2316, Macomb County, Michigan	10	\$1,774	349	\$18,319	9	0	9	0	0	82	1	0	33	21	31	16
Census Tract 2321, Macomb County, Michigan	10	\$1,999	358	\$19,779	8	0	3	0	0	89	0	0	18	24	35	23
Census Tract 2409, Macomb County, Michigan	10	\$1,975	72	\$20,106	1	0	0	0	0	94	5	0	12	27	59	2
Census Tract 2416, Macomb County, Michigan	10	\$1,923	163	\$19,355	48	0	0	0	1	50	1	0	4	40	55	1
Census Tract 2451, Macomb County, Michigan	10	\$1,651	399	\$16,241	35	0	0	0	1	62	2	0	9	68	21	3
Census Tract 2454, Macomb County, Michigan	10	\$1,790	118	\$18,508	57	0	0	0	0	37	2	4	4	52	39	6
Census Tract 2500, Macomb County, Michigan	10	\$1,850	70	\$19,387	1	0	0	0	1	95	3	0	10	32	45	14
Census Tract 2502, Macomb County, Michigan	10	\$1,882	122	\$18,653	0	0	0	0	0	97	3	0	3	44	37	16
Census Tract 2509, Macomb County, Michigan	10	\$2,201	150	\$21,760	0	0	1	0	0	96	3	0	11	32	40	17
Census Tract 2518, Macomb County, Michigan	10	\$1,550	262	\$16,208	19	0	0	0	0	78	2	0	14	30	42	15
Census Tract 2550, Macomb County, Michigan	10	\$1,464	454	\$14,667	28	0	1	0	0	70	1	1	9	32	50	9
Census Tract 2567, Macomb County, Michigan	10	\$1,880	164	\$18,011	7	0	1	0	7	81	4	0	9	56	29	7
Census Tract 2580, Macomb County, Michigan	10	\$1,925	133	\$18,458	31	0	0	0	4	60	5	1	9	41	27	23
Census Tract 2617, Macomb County, Michigan	10	\$1,637	272	\$15,986	32	0	0	0	0	66	1	0	9	52	32	8
Census Tract 2619, Macomb County, Michigan	10	\$1,755	192	\$17,502	24	0	3	0	2	62	9	0	18	41	30	11
Census Tract 2620, Macomb County, Michigan	10	\$1,858	146	\$17,732	9	0	6	0	1	83	1	0	8	33	33	26
Census Tract 2622, Macomb County, Michigan	10	\$1,727	253	\$17,088	1	0	20	0	0	79	0	0	12	26	47	16
Census Tract 2624, Macomb County, Michigan	10	\$1,828	340	\$17,969	7	0	24	0	0	65	3	0	41	25	23	11

Census Tract 2627, Macomb County, Michigan	10	\$1,775	308	\$18,458	23	0	16	0	1	57	2	0	13	26	47	14
Census Tract 2632, Macomb County, Michigan	10	\$1,810	402	\$17,670	22	0	9	0	0	59	10	0	11	40	45	4
Census Tract 2634, Macomb County, Michigan	10	\$2,045	286	\$20,156	11	0	20	0	0	67	2	0	12	31	41	15
Census Tract 2635, Macomb County, Michigan	10	\$1,646	578	\$16,313	8	0	5	0	3	77	6	0	14	36	42	8
Census Tract 2637, Macomb County, Michigan	10	\$1,904	423	\$19,034	51	0	3	0	2	41	4	0	6	48	40	6
Census Tract 2676, Macomb County, Michigan	10	\$1,759	57	\$16,957	1	0	5	0	0	93	0	0	8	25	43	23
Census Tract 2681, Macomb County, Michigan	10	\$1,751	213	\$18,017	36	2	5	0	0	54	3	0	7	32	47	14
Census Tract 1344, Oakland County, Michigan	10	\$1,795	103	\$17,732	0	0	0	0	0	100	0	0	1	8	48	43
Census Tract 1347, Oakland County, Michigan	10	\$1,533	210	\$14,870	0	0	0	0	1	98	0	0	5	68	14	13
Census Tract 1368, Oakland County, Michigan	10	\$2,093	248	\$21,927	0	0	0	0	1	89	10	0	24	21	25	31
Census Tract 1608, Oakland County, Michigan	10	\$1,670	79	\$17,497	71	0	0	0	0	24	5	0	1	28	37	33
Census Tract 1614, Oakland County, Michigan	10	\$1,317	384	\$13,660	55	0	0	0	0	45	0	0	18	32	20	30
Census Tract 1622, Oakland County, Michigan	10	\$1,013	62	\$9,700	91	0	1	0	0	9	0	0	1	47	42	10
Census Tract 1666, Oakland County, Michigan	10	\$1,199	382	\$12,267	32	0	7	0	1	60	0	0	13	25	20	43
Census Tract 1688, Oakland County, Michigan	10	\$2,513	20	\$24,273	15	0	2	0	0	80	3	0	1	7	17	74
Census Tract 1704, Oakland County, Michigan	10	\$1,336	167	\$12,886	7	0	0	0	0	91	2	0	9	23	41	27
Census Tract 1713, Oakland County, Michigan	10	\$1,847	232	\$17,638	80	0	0	0	0	18	2	0	20	24	41	16
Census Tract 1725, Oakland County, Michigan	10	\$1,451	331	\$14,716	89	0	0	0	0	4	5	2	14	46	26	14
Census Tract 1732, Oakland County, Michigan	10	\$1,471	67	\$14,277	1	0	0	0	1	95	3	0	0	19	36	45
Census Tract 1800, Oakland County, Michigan	10	\$1,669	88	\$16,333	0	0	0	0	3	93	4	0	11	26	25	38
Census Tract 1811, Oakland County, Michigan	10	\$1,561	149	\$15,982	4	0	0	0	0	95	0	0	3	47	29	22
Census Tract 1813, Oakland County, Michigan	10	\$1,580	318	\$15,923	7	0	3	0	1	88	1	0	25	24	31	20
Census Tract 1814, Oakland County, Michigan	10	\$1,658	158	\$16,716	10	0	0	0	1	88	1	0	15	26	38	21
Census Tract 1830, Oakland County, Michigan	10	\$1,565	133	\$15,327	12	0	1	0	2	84	0	0	0	20	45	36
Census Tract 1832, Oakland County, Michigan	10	\$1,384	141	\$13,508	6	0	1	0	1	91	1	0	5	20	26	48
Census Tract 1838, Oakland County, Michigan	10	\$1,586	150	\$15,842	2	0	1	0	1	95	1	0	23	21	25	31
Census Tract 1977.02, Oakland County, Michigan	10	\$982	42	\$9,549	2	0	10	0	6	81	1	0	11	9	16	64
Census Tract 5169, Wayne County, Michigan	10	\$1,054	227	\$10,442	92	0	0	0	0	5	3	0	24	32	38	6
Census Tract 5202, Wayne County, Michigan	10	\$1,214	236	\$12,200	23	0	37	0	4	32	2	2	5	9	48	38
Census Tract 5225, Wayne County, Michigan	10	\$1,172	453	\$11,899	83	0	0	0	0	12	3	2	17	33	25	25
Census Tract 5549, Wayne County, Michigan	10	\$2,694	94	\$25,814	60	0	1	0	1	38	0	0	9	17	61	13
Census Tract 5570, Wayne County, Michigan	10	\$2,532	48	\$24,418	6	0	2	0	1	89	2	0	10	22	48	20
Census Tract 5575, Wayne County, Michigan	10	\$2,231	78	\$22,586	0	0	2	0	0	98	0	0	4	32	32	32
Census Tract 5625, Wayne County, Michigan	10	\$1,412	84	\$14,226	7	0	0	0	0	92	1	0	12	28	35	24
Census Tract 5641, Wayne County, Michigan	10	\$1,522	225	\$14,544	13	0	14	0	0	68	4	0	12	21	31	36
Census Tract 5647, Wayne County, Michigan	10	\$2,073	77	\$19,884	13	6	3	0	0	54	23	0	1	52	16	32
Census Tract 5650.01, Wayne County, Michigan	10	\$1,957	129	\$19,701	6	1	16	0	0	76	2	0	9	13	41	38
Census Tract 5657, Wayne County, Michigan	10	\$2,081	130	\$21,530	7	0	14	0	0	78	1	0	5	22	34	40
Census Tract 5671, Wayne County, Michigan	10	\$1,614	251	\$15,401	11	0	0	0	1	83	3	1	16	41	32	10
Census Tract 5672.01, Wayne County, Michigan	10	\$2,272	208	\$22,880	1	0	0	0	1	97	1	0	3	38	42	17
Census Tract 5679, Wayne County, Michigan	10	\$1,885	164	\$19,200	10	0	1	0	2	87	1	0	9	33	37	21
Census Tract 5742.03, Wayne County, Michigan	10	\$1,772	188	\$18,226	4	0	1	0	1	88	5	0	3	33	21	42
Census Tract 5774, Wayne County, Michigan	10	\$2,105	272	\$20,693	4	0	0	0	10	72	4	11	25	36	35	4
Census Tract 5780, Wayne County, Michigan	10	\$1,637	308	\$15,610	6	0	0	0	3	88	2	1	6	49	43	2
Census Tract 5804, Wayne County, Michigan	10	\$1,620	155	\$15,855	0	0	0	0	0	99	0	0	7	31	47	15
Census Tract 5809, Wayne County, Michigan	10	\$1,663	228	\$16,616	2	0	0	0	1	92	5	1	20	36	40	4
Census Tract 5839, Wayne County, Michigan	10	\$1,721	451	\$16,771	39	0	8	0	0	53	0	0	24	41	32	3
Census Tract 2302, Macomb County, Michigan	9	\$2,203	111	\$23,331	0	0	1	0	0	99	0	0	13	20	46	21
Census Tract 2310, Macomb County, Michigan	9	\$2,403	148	\$27,342	0	0	1	0	0	98	0	0	13	30	38	19
Census Tract 2312, Macomb County, Michigan	9	\$1,724	135	\$19,666	2	0	9	0	0	89	0	0	11	39	33	16
Census Tract 2317, Macomb County, Michigan	9	\$2,026	352	\$22,526	1	7	2	0	0	88	1	0	24	23	28	25
Census Tract 2319, Macomb County, Michigan	9	\$2,141	187	\$23,317	1	0	3	0	0	96	1	0	16	13	44	26
Census Tract 2322, Macomb County, Michigan	9	\$1,792	354	\$19,833	12	0	6	0	0	82	0	0	14	34	29	23
Census Tract 2415, Macomb County, Michigan	9	\$1,571	187	\$17,056	10	0	0	0	0	89	1	0	16	42	29	12
Census Tract 2475, Macomb County, Michigan	9	\$1,291	211	\$14,035	13	0	0	0	0	87	0	0	15	49	27	9
Census Tract 2476.01, Macomb County, Michigan	9	\$1,273	237	\$13,479	32	0	0	0	0	68	0	0	7	24	63	6
Census Tract 2504, Macomb County, Michigan	9	\$1,750	62	\$20,250	7	0	0	0	3	88	2	0	4	22	60	14
Census Tract 2519, Macomb County, Michigan	9	\$1,706	129	\$19,134	1	0	0	0	1	96	3	0	8	23	54	15
Census Tract 2521, Macomb County, Michigan	9	\$1,614	107	\$17,811	3	0	0	0	1	96	0	0	9	21	39	31
Census Tract 2541, Macomb County, Michigan	9	\$1,500	292	\$17,588	7	0	0	0	1	91	1	0	9	41	42	9
Census Tract 2560, Macomb County, Michigan	9	\$1,929	126	\$21,208	8	0	0	0	0	91	1	0	11	46	37	7
Census Tract 2563, Macomb County, Michigan	9	\$1,775	139	\$19,343	31	0	0	0	1	67	1	0	7	42	38	12

Census Tract 2582, Macomb County, Michigan	9	\$1,944	214	\$21,354	39	0	0	0	0	61	0	0	31	26	35	7
Census Tract 2589, Macomb County, Michigan	9	\$2,271	138	\$24,596	60	0	0	0	0	37	2	0	33	25	36	5
Census Tract 2600, Macomb County, Michigan	9	\$1,900	138	\$20,394	5	0	2	0	1	87	5	0	5	46	37	12
Census Tract 2602, Macomb County, Michigan	9	\$1,765	120	\$20,337	3	0	0	0	4	93	0	0	8	36	43	14
Census Tract 2608, Macomb County, Michigan	9	\$1,931	168	\$21,186	4	0	3	0	1	91	1	0	20	29	40	11
Census Tract 2611, Macomb County, Michigan	9	\$1,619	485	\$17,271	22	0	5	0	1	71	1	0	20	22	34	24
Census Tract 2615, Macomb County, Michigan	9	\$1,538	220	\$16,403	16	0	5	0	3	75	0	0	10	38	42	10
Census Tract 2618, Macomb County, Michigan	9	\$1,825	87	\$20,183	7	0	17	0	0	75	1	0	5	40	37	19
Census Tract 2623, Macomb County, Michigan	9	\$1,536	240	\$17,098	10	0	26	0	0	64	0	0	17	32	35	16
Census Tract 2638, Macomb County, Michigan	9	\$1,940	239	\$22,556	50	0	4	0	4	39	2	0	18	40	41	1
Census Tract 2640, Macomb County, Michigan	9	\$1,893	205	\$20,527	52	0	5	0	0	30	12	0	14	39	35	11
Census Tract 1366.01, Oakland County, Michigan	9	\$1,456	140	\$17,002	2	0	2	0	3	87	7	0	1	29	23	47
Census Tract 1611, Oakland County, Michigan	9	\$969	226	\$10,695	72	0	1	0	1	24	2	0	17	17	43	22
Census Tract 1617, Oakland County, Michigan	9	\$1,933	101	\$22,438	70	0	0	0	1	14	14	0	6	18	24	52
Census Tract 1621, Oakland County, Michigan	9	\$1,047	281	\$12,069	97	0	0	0	0	2	1	0	14	25	46	15
Census Tract 1674, Oakland County, Michigan	9	\$1,437	327	\$15,615	38	0	0	0	2	59	1	0	2	20	58	20
Census Tract 1681, Oakland County, Michigan	9	\$1,525	124	\$16,846	11	0	1	0	2	85	0	0	0	76	11	13
Census Tract 1710, Oakland County, Michigan	9	\$1,343	361	\$14,736	28	0	3	0	0	65	2	1	7	40	28	26
Census Tract 1714, Oakland County, Michigan	9	\$1,825	521	\$20,111	68	0	0	0	0	30	2	0	4	19	40	38
Census Tract 1715, Oakland County, Michigan	9	\$1,661	317	\$17,663	95	0	0	0	0	3	2	0	16	22	47	15
Census Tract 1812, Oakland County, Michigan	9	\$1,455	343	\$16,306	5	0	4	0	0	90	2	0	16	30	37	18
Census Tract 1880.01, Oakland County, Michigan	9	\$1,725	55	\$18,723	1	0	0	0	0	96	2	0	0	15	24	61
Census Tract 1966, Oakland County, Michigan	9	\$1,992	7	\$21,170	0	0	21	0	0	78	0	0	0	6	14	80
Census Tract 1974, Oakland County, Michigan	9	\$1,365	163	\$15,450	1	0	14	0	0	85	0	0	46	16	18	20
Census Tract 5554.01, Wayne County, Michigan	9	\$1,952	103	\$22,069	82	0	1	0	2	15	1	0	22	16	35	28
Census Tract 5574, Wayne County, Michigan	9	\$2,471	37	\$29,055	1	0	0	0	0	95	4	0	1	16	16	67
Census Tract 5590, Wayne County, Michigan	9	\$2,672	55	\$28,747	5	0	0	0	1	93	1	0	1	31	44	24
Census Tract 5632, Wayne County, Michigan	9	\$1,515	179	\$17,069	14	0	1	0	0	78	8	0	0	52	30	18
Census Tract 5659, Wayne County, Michigan	9	\$1,799	58	\$21,108	12	0	3	0	1	84	0	0	18	32	38	11
Census Tract 5664, Wayne County, Michigan	9	\$1,929	42	\$21,921	44	0	0	0	1	55	0	0	4	48	33	15
Census Tract 5673, Wayne County, Michigan	9	\$1,742	195	\$18,598	6	0	1	0	2	90	1	1	12	35	46	7
Census Tract 5688, Wayne County, Michigan	9	\$1,083	324	\$12,715	62	0	10	0	2	24	1	1	31	36	22	12
Census Tract 5697, Wayne County, Michigan	9	\$1,991	178	\$21,505	5	0	0	0	0	91	4	0	18	32	44	7
Census Tract 5765, Wayne County, Michigan	9	\$2,038	82	\$23,518	0	0	1	0	1	84	12	1	5	31	47	17
Census Tract 5779, Wayne County, Michigan	9	\$1,765	388	\$18,841	4	1	0	0	2	87	1	5	23	36	37	5
Census Tract 5801, Wayne County, Michigan	9	\$1,492	155	\$17,163	3	0	1	0	5	88	2	2	13	27	48	12
Census Tract 5805, Wayne County, Michigan	9	\$1,830	106	\$19,432	0	0	0	0	1	98	0	0	7	19	48	26
Census Tract 5840, Wayne County, Michigan	9	\$2,170	229	\$23,465	17	0	0	0	0	82	0	0	4	25	69	3
Census Tract 5880.01, Wayne County, Michigan	9	\$1,134	196	\$12,460	31	0	1	0	0	68	0	0	4	14	44	39
Census Tract 5915.02, Wayne County, Michigan	9	\$1,599	100	\$18,509	5	0	9	0	1	85	0	0	6	41	45	8
Census Tract 2305.01, Macomb County, Michigan	8	\$1,520	401	\$18,500	2	0	1	0	0	89	2	6	14	31	39	16
Census Tract 2318, Macomb County, Michigan	8	\$2,100	203	\$25,239	2	0	4	0	0	94	1	0	24	17	28	31
Census Tract 2320, Macomb County, Michigan	8	\$2,230	63	\$29,479	4	0	2	0	0	94	0	0	15	29	38	18
Census Tract 2330, Macomb County, Michigan	8	\$2,217	159	\$26,506	2	0	0	0	0	98	0	0	9	20	40	31
Census Tract 2405, Macomb County, Michigan	8	\$2,061	108	\$24,251	3	0	0	0	0	95	2	0	3	15	70	13
Census Tract 2410, Macomb County, Michigan	8	\$1,322	293	\$16,724	44	0	2	0	0	54	0	0	9	38	48	4
Census Tract 2414, Macomb County, Michigan	8	\$1,387	123	\$18,222	2	0	0	0	0	98	0	0	12	42	42	5
Census Tract 2503, Macomb County, Michigan	8	\$1,578	153	\$20,720	5	0	0	0	3	91	1	0	6	45	25	24
Census Tract 2522, Macomb County, Michigan	8	\$1,122	187	\$13,252	2	0	1	0	1	96	1	0	5	15	46	35
Census Tract 2545, Macomb County, Michigan	8	\$1,327	371	\$15,785	2	0	0	0	0	97	0	0	19	36	33	12
Census Tract 2552, Macomb County, Michigan	8	\$1,254	348	\$15,392	36	0	1	0	0	57	3	3	5	37	49	9
Census Tract 2585, Macomb County, Michigan	8	\$1,862	65	\$22,469	44	0	0	0	0	50	4	1	23	28	33	17
Census Tract 2603, Macomb County, Michigan	8	\$1,697	187	\$20,786	3	0	5	0	0	91	1	0	9	33	38	20
Census Tract 2607, Macomb County, Michigan	8	\$1,726	145	\$20,715	5	0	12	0	0	79	3	0	6	43	30	22
Census Tract 2609, Macomb County, Michigan	8	\$1,915	166	\$23,985	2	0	37	0	1	59	0	1	4	36	27	34
Census Tract 2610, Macomb County, Michigan	8	\$1,610	199	\$19,772	35	0	8	0	1	56	0	0	15	34	36	16
Census Tract 2614, Macomb County, Michigan	8	\$1,998	150	\$23,657	5	0	7	0	3	83	1	2	12	40	31	18
Census Tract 2616.01, Macomb County, Michigan	8	\$1,874	39	\$24,653	4	0	5	0	2	88	0	0	19	37	29	16
Census Tract 2680, Macomb County, Michigan	8	\$1,402	419	\$18,177	12	0	3	0	1	81	2	0	20	40	33	6
Census Tract 1532, Oakland County, Michigan	8	\$1,349	15	\$16,542	0	0	0	0	0	99	0	0	50	2	4	44
Census Tract 1572, Oakland County, Michigan	8	\$2,052	248	\$26,606	31	0	1	0	0	62	6	0	21	32	28	19
Census Tract 1604, Oakland County, Michigan	8	\$1,052	408	\$12,613	89	0	2	0	0	8	1	0	15	12	49	25

Census Tract 1609, Oakland County, Michigan	8	\$1,205	159	\$15,418	56	0	1	0	0	41	1	0	11	27	26	36
Census Tract 1660, Oakland County, Michigan	8	\$1,645	95	\$20,305	29	0	8	0	0	61	1	0	6	24	27	43
Census Tract 1685, Oakland County, Michigan	8	\$1,187	193	\$14,198	27	0	2	0	1	69	1	0	17	17	24	42
Census Tract 1689.02, Oakland County, Michigan	8	\$1,232	142	\$14,492	29	0	34	0	5	32	0	0	4	4	50	42
Census Tract 1736, Oakland County, Michigan	8	\$1,734	62	\$20,746	7	0	0	0	4	84	5	0	6	20	33	41
Census Tract 1750, Oakland County, Michigan	8	\$1,534	285	\$18,374	9	0	0	0	0	88	3	0	20	33	36	12
Census Tract 1843, Oakland County, Michigan	8	\$1,735	42	\$20,680	5	0	0	0	1	91	2	0	1	33	33	33
Census Tract 1881, Oakland County, Michigan	8	\$1,814	19	\$21,724	2	0	1	0	1	96	0	0	0	6	14	80
Census Tract 5172, Wayne County, Michigan	8	\$754	67	\$9,579	62	10	5	0	1	12	1	10	1	27	43	29
Census Tract 5652, Wayne County, Michigan	8	\$1,333	226	\$17,700	39	0	4	0	2	53	0	1	10	38	43	9
Census Tract 5803, Wayne County, Michigan	8	\$1,660	228	\$20,901	0	0	0	0	1	96	2	0	10	31	50	9
Census Tract 5808, Wayne County, Michigan	8	\$1,426	82	\$17,752	1	0	0	0	3	95	0	0	9	57	31	3
Census Tract 2309.02, Macomb County, Michigan	7	\$1,273	215	\$17,921	12	0	0	0	0	86	3	0	1	34	56	10
Census Tract 2472.02, Macomb County, Michigan	7	\$2,010	72	\$29,716	2	0	0	0	0	89	2	7	10	15	60	15
Census Tract 2565, Macomb County, Michigan	7	\$1,950	81	\$26,670	26	0	0	0	1	71	2	0	6	22	66	6
Census Tract 2626, Macomb County, Michigan	7	\$1,163	257	\$15,626	17	0	10	0	1	71	0	1	17	45	21	16
Census Tract 1686.01, Oakland County, Michigan	7	\$1,324	9	\$18,835	10	0	21	0	0	69	0	0	0	0	1	99
Census Tract 1703, Oakland County, Michigan	7	\$1,676	33	\$22,411	2	0	0	0	1	93	2	1	7	15	42	36
Census Tract 1724, Oakland County, Michigan	7	\$881	245	\$12,367	52	0	2	0	0	45	0	0	16	24	41	20
Census Tract 5157, Wayne County, Michigan	7	\$726	667	\$10,463	87	0	0	0	0	9	2	2	11	25	38	26
Census Tract 5165, Wayne County, Michigan	7	\$828	145	\$12,723	74	0	2	0	1	21	0	2	9	19	55	16
Census Tract 5171, Wayne County, Michigan	7	\$826	59	\$11,102	75	0	1	0	0	22	2	0	13	8	51	28
Census Tract 5207, Wayne County, Michigan	7	\$759	265	\$10,859	49	1	4	0	0	37	2	7	14	27	29	30
Census Tract 5653.02, Wayne County, Michigan	7	\$948	517	\$13,644	34	0	1	0	1	64	0	0	62	8	15	15
Census Tract 5802, Wayne County, Michigan	7	\$1,332	316	\$19,115	0	0	0	0	1	96	2	1	5	66	26	3
Census Tract 2403, Macomb County, Michigan	6	\$1,530	267	\$24,409	2	0	0	0	0	71	27	0	13	37	42	8
Census Tract 2601, Macomb County, Michigan	6	\$1,298	196	\$21,389	16	0	7	0	5	71	0	1	10	41	31	19
Census Tract 1603, Oakland County, Michigan	6	\$801	582	\$12,979	79	0	1	0	0	19	1	0	16	19	42	23
Census Tract 1835, Oakland County, Michigan	6	\$1,276	229	\$22,474	73	0	1	0	0	25	0	0	7	12	68	13
Census Tract 1975, Oakland County, Michigan	6	\$1,263	83	\$20,129	1	0	47	0	1	50	0	0	21	5	14	60
Census Tract 1810.01, Oakland County, Michigan	5	\$789	505	\$15,540	27	0	6	0	0	59	8	0	15	20	30	35
Census Tract 9824, Wayne County, Michigan	2	\$296	2	\$15,546	100	0	0	0	0	0	0	0	0	0	100	0
Census Tract 9820.02, Macomb County, Michigan	0	\$0	12	\$0	0	0	0	0	0	0	0	0	0	0	0	0
Census Tract 9834, Wayne County, Michigan	0	\$0	8	\$55,861	0	0	0	0	0	100	0	0	0	0	100	0
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Census Tract 9820.01, Macomb County, Michigan																
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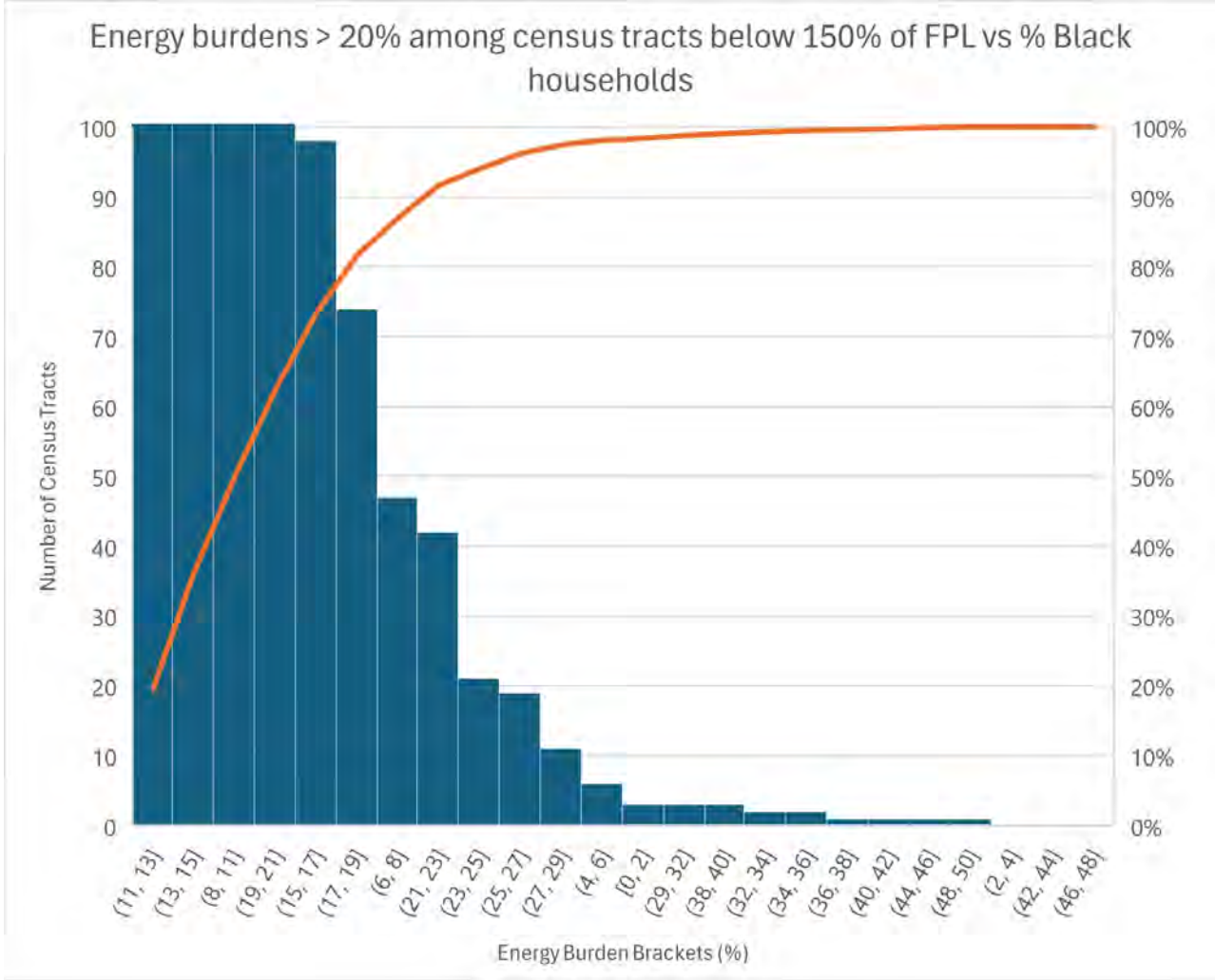
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Unveiling hidden energy poverty using the energy equity gap

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Income-based energy poverty metrics ignore people's behavior patterns, particularly reducing energy consumption to limit financial stress. We investigate energy-limiting behavior in low-income households using a residential electricity consumption dataset. We first determine the outdoor temperature at which households start using cooling systems, the inflection temperature. Our relative energy poverty metric, the *energy equity gap*, is defined as the difference in the inflection temperatures between low and high-income groups. In our study region, we estimate the energy equity gap to be between 4.7–7.5 °F (2.6–4.2 °C). Within a sample of 4577 households, we found 86 energy-poor and 214 energy-insecure households. In contrast, the income-based energy poverty metric, energy burden (10% threshold), identified 141 households as energy-insecure. Only three households overlap between our energy equity gap and the income-based measure. Thus, the energy equity gap reveals a hidden but complementary aspect of energy poverty and insecurity.

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Energy poverty manifests itself in a high percentage of income spent covering energy bills, increased risk of electricity shutoffs, and a household's inability to maintain comfortable indoor temperatures or use desired services (e.g., air conditioning, heat, computers)^{1,2}. An often-overlooked space in energy poverty analysis lies in the cavity between metrics that measure financial stress (energy burden defined as energy expenditure over total income) and complete lack of energy services (utility shutoffs). Within this cavity are the households which limit their energy consumption to reduce financial strain. These households may appear to spend small amounts of their income on their energy bills while limiting enough energy to avoid having the utility cut their power supply. It is estimated that, annually, 1300 people die every year in the U.S. from extreme heat³. In 2009 and 2010 alone, over 8250 emergency room visits in the US were caused by heat stroke⁴, with low-income, minority, and elderly populations being disproportionately affected³. A large portion of these deaths may have been prevented if people could cool their homes properly. We acknowledge that proper cooling ability includes being able to acquire and sufficiently use an AC system^{5,6}.

As the effects of climate change manifest themselves in heatwaves⁷ and deep freezes, communities will need to adapt (i.e., reduce their risk of illness and death⁸) by creating comfortable indoor temperatures within their homes. However, this depends on whether they can rely on their resources for adopting energy-efficient heating and cooling systems, meaning many vulnerable households who limit their energy consumption, potentially putting themselves at risk of heatstroke or hypothermia, may not qualify for energy poverty alleviation under current programs.

For example, in the US, the two main energy assistance programs, the Low Income Home Energy Assistance Program (LIHEAP) and the Weatherization Assistance Program (WAP), use an income threshold to determine eligibility^{9,10}. LIHEAP uses reduction in a household's energy burden, service loss prevention, and service restoration, to calculate the effectiveness of its assistance⁹. WAP is geared more towards homeowners with its performance based on the number of households weatherized and post-weatherization surveys for those receiving assistance, with questions including change in energy burden and change in forgoing other necessities like food to pay energy bills^{9,11}. This suggests that these programs make an implicit assumption that people meet or try to meet their energy needs first compared to other necessities like food or healthcare. Neither WAP nor LIHEAP takes into explicit account those who forgo energy consumption to pay for other necessities (i.e., energy limiting behavior), nor do they offer a clear definition of energy poverty⁹. The lack of consideration for households who forgo energy for other needs poses a limitation in identifying the multidimensional nature of poverty^{12,13} and reduces the options for policy intervention. In LIHEAP and WAP, spending patterns are viewed as adequate ways to measure the effectiveness of these energy assistance programs^{9,11}.

In a broader sense, energy poverty is defined as insufficient energy access due to lack of supply, low affordability, limited quantity, poor quality, unreliability, or a combination of these shortcomings. Existing energy poverty metrics fall into the following categories: A) primary or secondary, and B) relative or absolute, as seen in Fig. 1. Here we define each category combination and provide some examples of each. A primary metric is defined as a metric that directly utilizes consumer-level information. A secondary metric would require derivation to reach a conclusion. Secondary metrics include metrics that aggregate utility information or use weighted scoring for poverty indices. A relative metric compares the energy poverty status of two or more entities (i.e., country-to-country or household-to-household) or

one with oneself (i.e., progress over time for one country). Finally, an absolute metric will provide a strict threshold for energy poverty.

Relative-secondary metrics for energy poverty use summary statistics from the regional or local level (not individuals) and compare the progress of different regions to some benchmark. These are often used to describe progress in energy poverty reduction in developing countries. One example is an access-consumption matrix at a national level¹⁴. Access-consumption matrices portray shifts in a country's energy profile, mainly the change in fuel utilization and how many people use each fuel. If more people are gaining access to energy services in an under-developed country, and more people are shifting from dirtier to cleaner fuels in developing regions, energy poverty is reported as decreasing^{14,15}. Due to the fact that energy poverty in developing regions often means a lack of access to modern energy services, these national energy access metrics are best used for countries beginning their clean energy transition and expanding access to modern energy services^{14,15}.

Relative-primary metrics come directly from households or individuals, and benchmark feelings of energy poverty in comparison to others in the population. These can be scores from a survey asking questions on self-perception of energy poverty. For example, a survey done in Greece used indicators such as "inability to keep home adequately warm," "leakages, damp walls, mold," and "restriction of other essential needs" to solicit the subjective feeling of energy poverty^{16,17}. Compared with the 10% energy burden threshold, the study found that when a household is objectively categorized as energy-poor, they were more likely to respond "yes" for the subjective indicators. Another study explores the relationship between social relations and energy access, where a positive feedback loop exists between good social relations and higher quality energy access^{2,18}. However, drawbacks of survey-based metrics are long completion times and difficulty comparing the level of energy poverty experienced

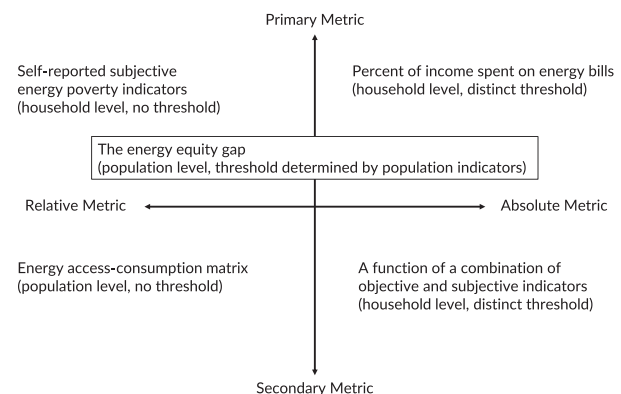


Fig. 1 Categories of energy poverty metrics. The X-axis represents relative or absolute metrics, or whether the metric has a distinct threshold for energy poverty. The Y-axis represents primary or secondary metrics, or whether a metric requires more than basic consumer-level data to calculate. A primary-absolute metric can be energy burden, or percent of income spent on energy bills; a primary-relative metric can be self-reported energy poverty indicators; a secondary-absolute metric can be a combination of the previous two, where an arbitrary score is calculated based on energy burden and survey results; and a secondary-relative metric can be an energy access-consumption matrix, often used to portray the progress of energy access in developing countries. The energy equity gap is a primary metric that can be both relative and absolute, where it can tell us the relative energy equity progress of a region, as well as household-level energy poverty.

between households. Although there are many survey studies on housing characteristics and perceived energy poverty^{16,19,20}, we find a lack of metrics which can quantify the amount of energy a household forgoes to alleviate financial burden (i.e., energy limiting behavior). Thus, there is a need to use surveys in combination with data driven approaches to elicit perceptions of energy limited behavior, while also determining the degree to which people actually limit energy consumption.

Absolute-secondary metrics compare information related to energy usage against some predetermined threshold. These metrics often combine income-based metrics with socio-demographic factors and housing conditions to calculate a weighted score to measure energy poverty^{2,18}. However, because these measures (income-based, survey, and combined) single out those currently experiencing energy poverty, they can miss distributional changes over time and the severity of the energy poverty experience relative to the rest of the population. Additionally, a limitation is that these metrics often focus on equality (i.e., all households reaching a certain status) but miss equity because they cannot identify how the energy-poor compare to the non-energy-poor. Achieving energy equality entails giving everyone the same tools to achieve a desired level of energy consumption. For example, providing households with a voucher to spend less than 10% of their income on their current energy bills. Achieving energy equity entails giving groups different types of tools such that they can equally take advantage of opportunities or reach a desired goal. For example, an energy equity policy could entail each person receiving enough assistance to cool or heat their homes to their desired comfortable temperature.

Absolute-primary metrics use individual or household information and measure energy usage and other information against some predetermined threshold. These metrics are often used to measure household-level energy burden (i.e., energy expenditure over income). The underlying theory is that the more significant percentage of income spent on energy, the more energy-poor one is, similar to Engel's Coefficient for food expenditure²¹. A common threshold for energy burden to indicate a household is energy poor (proposed in 1991) is 10%^{9,18}. Energy burden can depend on a number of factors such as electricity price, prices of other goods, and heating or cooling needs¹. The advantage of this threshold metric is that it indicates the economic burden of meeting energy needs and does not have a high computational burden. However, limitations of using the energy burden threshold metric include not distinguishing between gross (i.e., pre-tax) and disposable income (i.e., post-tax and other mandatory charges like mortgage and rent), not considering indoor comfort levels, and not considering local and current costs of living¹⁸. As a result, households may have the same pre-tax income level but have vastly different mortgage or rental costs, meaning that the 10% threshold on gross income may miss people who are spending more than 90% of their income on other basic necessities²².

Despite the recent development of new metrics to capture consumer behaviors (e.g., under-consumption of energy and choice of thermal comfort)^{3,8}, household-level energy poverty evaluation for government assistance programs in developed countries has been led by absolute-primary income-based metrics^{9,18,23,24}. While these income-based metrics are widely used, they have a few shortcomings. First, they are sensitive to energy prices and mask the degree to which households change their energy consumption behavior following a price shift¹⁸. Second, and perhaps more importantly, the energy burden metric does not capture vulnerable low-income households who forgo energy usage to reduce financial stress. Lastly, income-based metrics miss essential dimensions of energy poverty, such as the inability to use enough energy to cool or heat homes to comfortable, and/or safe temperatures²⁵.

Most papers investigating the inability to satisfy a household's desired energy demand focus on electricity supply and reliability constraints in developing countries^{26–28} and energy affordability in developed countries^{1,29,30}. Within developed countries (i.e., those with close to 100% electricity supply access)³¹, energy poverty and insecurity can manifest themselves in 1) electricity shutoffs resulting from nonpayment, 2) forgoing heating services due to financial strain and participating in unsafe practices (e.g., using the stove or oven for heat, unsafe uses of space heating technologies which lead to fires³²), 3) spending a large percentage of income on energy bills, and 4) difficulty adopting clean energy and efficient technologies^{17,33–35}. While multiple papers address the indicators of energy poverty^{9,36,37} and insecurity^{17,35}, we find a void of metrics that can identify energy-limiting households (i.e., those without comfortable indoor temperatures) who may put themselves at risk of heat-related illness, excess indoor moisture, mold growth, and other adverse health effects^{35,38,39} (e.g., respiratory illness and asthma).

In countries where the entire population has access to modern energy infrastructure, household-level energy poverty manifests itself as having inadequate energy services within the household, or an inability to consume energy at a desired level². Thus, a more holistic definition of energy poverty would include people who limit their energy consumption (i.e., display energy limiting behavior), and those who spend a large portion of their income on their energy bills (i.e., high energy burden). Our work fills this gap by creating a metric which can identify energy limiting behavior. We define energy limiting behavior as a household's inability or unwillingness to consume enough energy to reach a desired level of comfort. A household displays energy limiting behavior if they reduce their energy consumption significantly below another household within the same region that does not have a budget constraint for energy spending. For example, assume households A and B live in the same region and have similar preferences for their ideal indoor temperature, around 70 °F (21 °C). Household A is a low-income household (i.e., a budget constraint on energy spending), and Household B is a high-income household (i.e., no budget constraint). If Household B starts using their air conditioning unit when it is 70 °F (21 °C) outside, but Household A waits until it is 75 °F (24 °C) outside, then household A is displaying 5 °F (3 °C) of energy limiting behavior compared to Household B.

Here, we introduce a behavior-based energy poverty measure, the energy equity gap, which captures one critical aspect of energy poverty (i.e., energy-limiting behavior), providing a complementary metric to capture inequity within a region. We first determine the outdoor temperature at which households start using cooling systems, the inflection temperature. Then, our relative energy poverty metric, the energy equity gap, is defined as the difference in the inflection temperatures between low and high-income groups. In our study region, we estimate the energy equity gap to be between 4.7 °F (2.6 °C) and 7.5 °F (4.2 °C). In 2015–2016, within our sample of 4577 households, we found 86 energy-poor and 214 energy-insecure households. In contrast, the income-based energy poverty metric, energy burden, identified 141 households as energy insecure when the threshold is set to 10%, with only three households overlapping between our energy equity gap and the income-based measure.

Results

Quantifying residential electricity consumption patterns. To capture those households left behind by income-based energy poverty measures, we propose a different energy poverty metric: the energy equity gap. We illustrate its effectiveness for identifying households at risk for inability to reach comfortable indoor

temperatures, and possibly heat-related illness. Our study region in the US, Arizona, has long, high-heat summers and mild winters (see Supplementary Information Note 6). Arizona has a higher level of heat-related illnesses (2944 heat-related ER visits in 2019⁴⁰) compared to cold-related illnesses (495 cold-related ER visits in 2019⁴¹), leading us to focus our energy poverty analysis on the electricity sector due to this providing the bulk of cooling energy in the summer (air conditioning (AC) or fan usage). Identifying cooling system use is vital for addressing and planning for energy justice, which hinges on the proper distribution of benefits for a clean energy transition^{42–44} and an ability to mitigate the effect of heatwaves. We also introduce a tiered system for identifying and addressing the energy poverty needs of the most vulnerable households and contrast this with the existing income-based metric.

The energy equity gap is a measure that investigates how consumer electricity consumption behavior across income groups shifts with temperature (i.e., consumers' temperature response functions). Previous research has investigated how consumers' temperature response functions (modeling energy usage against temperature or other climate factors) change with climate^{45,46}, but have not incorporated these functions into energy poverty identification. The energy equity gap metric considers the effect of outdoor temperature on energy consumption and quantifies relative energy limiting behavior, where those with fewer constraints on their budget set the threshold for a desired level of energy consumption to maintain a comfortable indoor temperature in the region (see Methods). Using the energy equity gap, we measure electricity usage patterns between income groups within a metropolitan region, thus eliminating the effect of weather or outdoor temperature on electricity usage for different households, which might occur in large study areas. A benefit of our primary-relative energy poverty metric, energy equity gap, is that policymakers can have more targeted energy justice efforts by first identifying the outdoor temperature that places their region at risk for heat-related illnesses or energy limiting behavior. Once the threshold has been set, policymakers can then use our relative metric to identify energy insecure households that are dangerously close to sinking into energy poverty and create proactive measures for reducing their burden and increasing their ability to consume energy to increase their comfort. In addition to capturing household-level electricity consumption behavior, the energy equity gap allows for a cross-temporal comparison of population-level energy equity within a region.

The basis of the energy equity gap is household-level inflection temperatures. To best incorporate behavior into the metric, we define the inflection temperature as the outdoor temperature at which a household starts using its cooling system as it shifts from spring to summer temperatures, assuming there is no difference in comfort preference or need across income groups. To find the inflection temperature of each household, daily electricity consumption is modeled using average daily temperature, electricity pricing plan, holiday effects, and day-of-the-week and month-of-the-year fixed effects (see Methods). The minimum of the quadratic equation between electricity consumption and temperature after controlling for the covariates mentioned above is defined as the temperature at which people start using their cooling systems, the inflection temperature (Fig. 2). This assumption stems from 1) heating and AC systems being the largest energy consumer within a household⁴⁵, and 2) our study region having a warm and dry climate, with short, mild winters and long, high-heat summers. If the study region is in a colder climate or a climate with more distinct seasons, we recommend separating the year into two climate zones (i.e., spring-summer-fall and fall-winter-spring). To adapt the energy equity gap to identify heating system energy use, we would need to include

information from the gas and oil sector. We leave the heating sector analysis for future work. We hypothesize that low-income households are more likely to endure higher temperatures before they start cooling their homes in the summer to save money and will thus have higher inflection temperatures.

Redefining energy poverty and energy insecurity. The energy equity gap is defined as the difference between the highest and lowest median household inflection temperatures among all income groups (Fig. 3) of the study region, a metropolitan area in Arizona (see Methods). We chose to use the median instead of the mean to desensitize the measure from outliers. The energy equity gap indicates the disparity in energy use across the income spectrum for a region while eliminating the effect of climate and electricity pricing. Within our metropolitan region, we assume the climate is uniform for households in the sample data, and everyone has access to the same energy services. Therefore, a sign of reduced energy inequity would be a narrowing energy equity gap, indicating that households are converging to a similar inflection temperature, thus reduced energy inequity.

The distribution of household-level inflection temperatures across income groups is shown in Fig. 3. We see that the energy equity gap ranges from 4.7–7.5 °F (2.6–4.2 °C), highlighting that low-income groups are more likely to forgo cooling services until later in the summer than high-income groups (see Supplementary Info Note 5 for another sample analysis). Furthermore, there is a statistically significant difference between the median inflection temperatures between each income group for all years, meaning there is little chance that the inflection temperature differences occurred by chance, verified using the Mood's Median test (see Methods).

Figure 4 illustrates the change in the energy equity gap across income groups for the four years in our analysis. The higher inflection temperatures further show low-income households tend to wait longer to turn on their AC units, pointing to underlying constraints, budget or otherwise, restricting their access to cooling. When cooling is restricted, it has been shown that buildings are at a higher risk for increased rates of mold, allergens, and fungi growth^{47,48} and that when the degree of

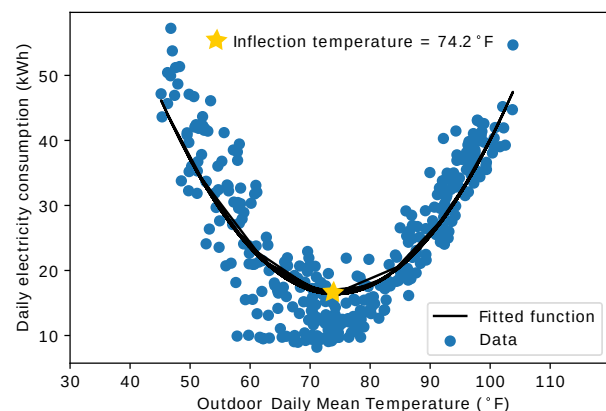


Fig. 2 Identifying the inflection temperature for daily electricity consumption and local daily mean outdoor temperature. This graph represents the daily electricity consumption of one household for one year ($N = 365$). The star marks the inflection temperature for this household for this year. We note that our true temperature response function includes electricity price, weekend, holiday, day of the week, and month of the year effects. The inflection temperature is the minimum of the quadratic temperature response function between the residuals after controlling for these factors and outdoor temperature.

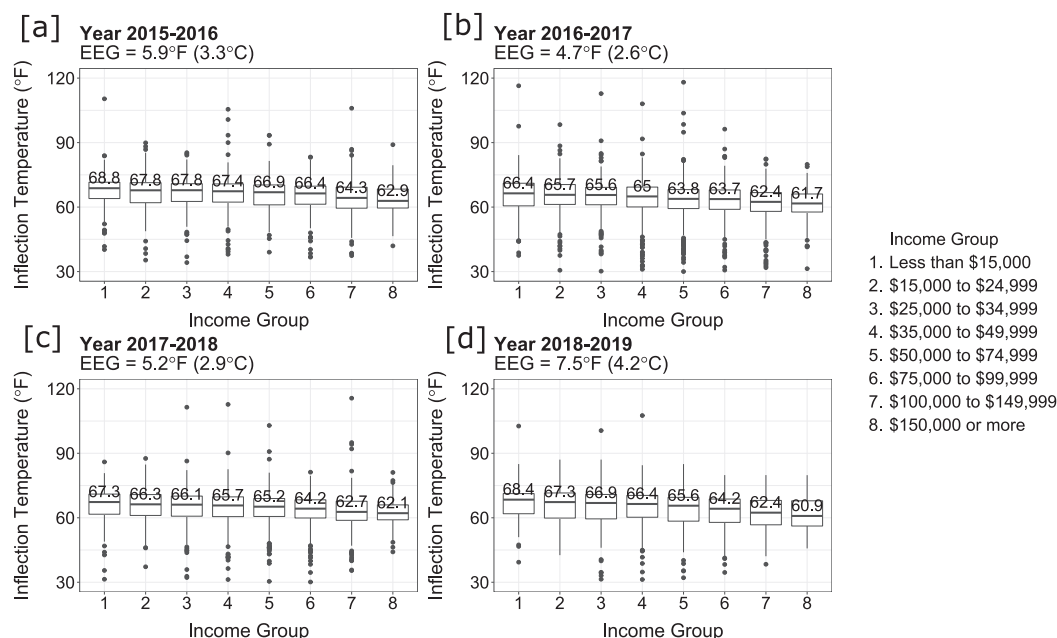


Fig. 3 The distribution of inflection temperature across income groups. The energy equity gap (EEG) for each year is calculated as the difference between the highest and lowest median inflection temperature (indicated by the middle bar and number) among all income groups in all four panels, income group 1 had the highest, and income group 8 had the lowest median inflection temperature. The energy equity gap (EEG) is shown at the top of each panel. **(a)** 2015-2016 $N = 4577$ households, **(b)** 2016-2017 $N = 4522$ households, **(c)** 2017-2018 $N = 3852$ households, **(d)** 2018-2019 $N = 2650$ households. Each box and whiskers plot indicates the minima and maxima of inflection temperatures of one income group for one year (the lower and upper bound of the whiskers), the first and third quartiles (the lower and upper bound of the box), and the median (the middle line). The outliers are shown as dots on either side of the whiskers. Source data can be found in our code repository.

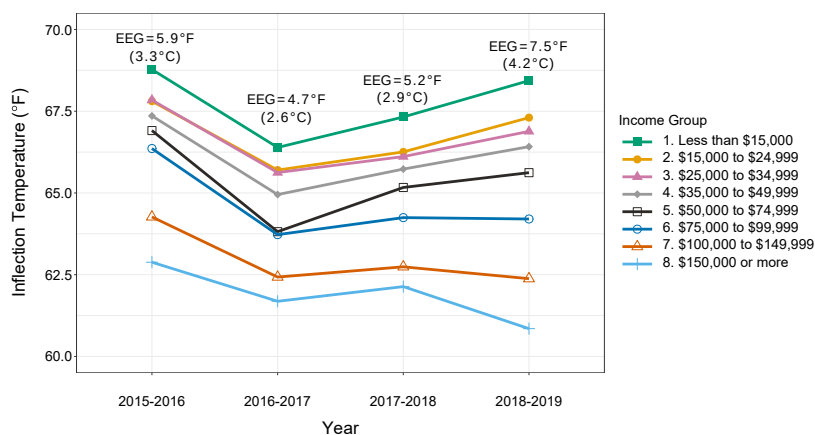


Fig. 4 Energy equity gap (EEG) and median inflection temperature changes across study years. Each line represents one income group. Each data point represents the median inflection temperature of the income group for that year.

discomfort becomes too great (high indoor temperature) populations are at a higher risk for heat stroke⁴⁹.

The energy equity gap shrinks and widens, resulting from low-income households first lowering then increasing their inflection temperatures while high-income households have a general trend of lowering their inflection temperatures across the years in our analysis. Thus, highlighting increasing energy inequity in the region.

The energy equity gap narrowed by 20.3% between the first two years of our study, but then widened by 10.6% and 44.2% in the last three years of our study, as seen in Table 1. We find that a change in cooling degree days or residential electricity price correlates to energy equity gap changes in the following year.

Between years one and two, there was a 2.4 % increase in residential electricity prices and a 3.6% increase in cooling degree days. This parallels with a 10.6% increase in the energy equity gap in year 3, most likely caused by low-income groups waiting longer to turn on their AC systems. This may signify a delayed price elasticity of demand effects in year-to-year residential electricity price changes and a warming climate. Between years two and three, the residential electricity price rose again by 2.7% and cooling degree days by 2.5%, which corresponds to a 44.2% increase in the year's energy equity gap. Thus, both a higher temperature and a higher electricity price can cause energy equity to deteriorate. Within our study population, low-income

Table 1 Temperature, electricity price, and energy equity gap shifts in Arizona.

Arizona metric	Change from year 1 to 2	Change from year 2 to 3	Change from year 3 to 4
Warmest Month Average Max outdoor temperature	1.0%	−0.2%	−0.2%
Cooling Degree Days (CDD)	3.6%	2.5%	−5.2%
Average residential electricity retail price (cents/kWh)	2.4%	2.7%	−2.7%
Energy equity gap	−20.3%	10.6%	44.2%

Warmest Month Average Max is the average maximum temperature of the hottest month in a year.

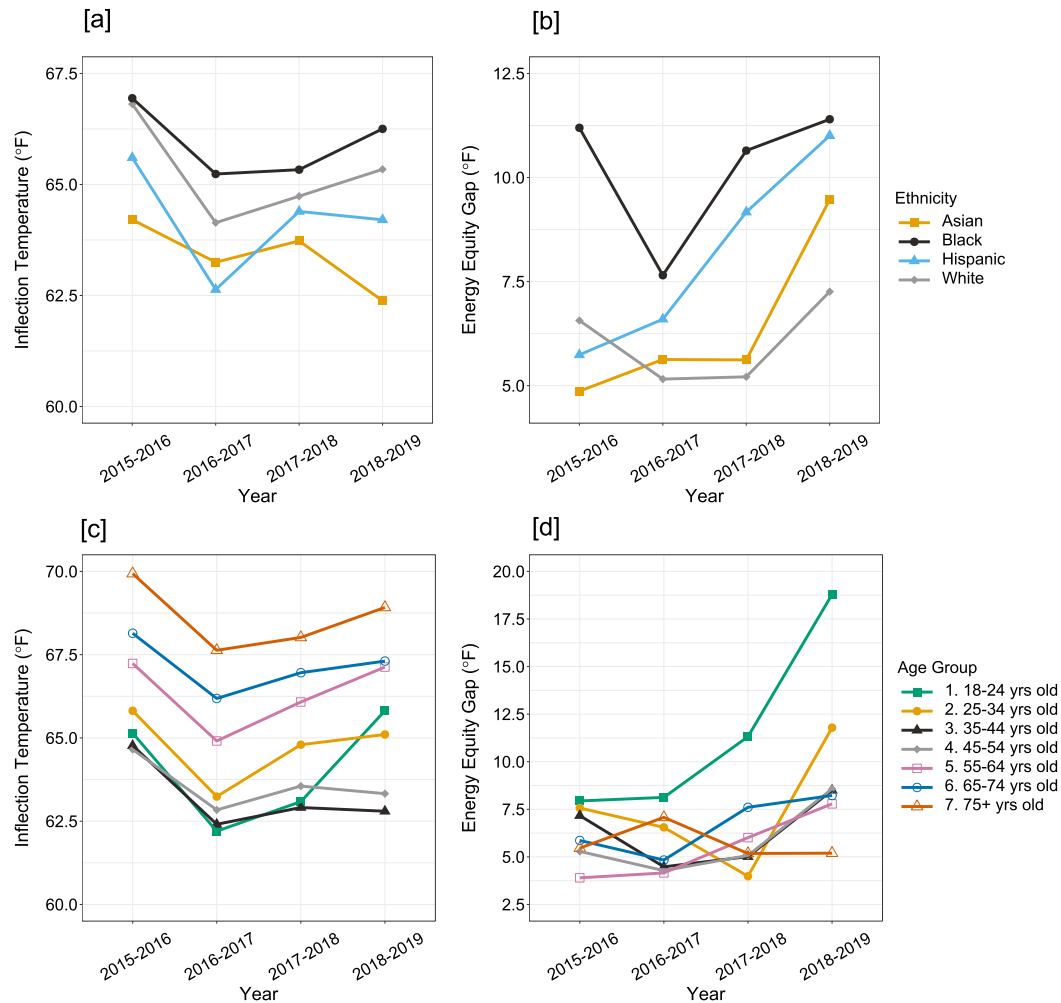


Fig. 5 Inter- and intra-group comparison of the inflection temperature and energy equity gap for ethnicity and age groups. Median inflection temperatures by (a) ethnicity and (c) age group show disparities across demographics. The energy equity gap highlights energy consumption behavior differences between high and low-income populations within their respective (b) ethnicity and (d) age groups. See Supplementary Information Notes 3 and 4 for more details.

households are more likely to live in older residences (see Supplementary Information Note 2), which can contribute to more significant energy needs and financial strain required to cool the home.

Price shifts will impact electricity consumption shifts within minority groups and those at the intersection of multiple vulnerable groups (e.g., low-income minority groups or low-income elderly populations) differently. Figure 5a, c show the median inflection temperature for each ethnicity and age group; Fig. 5b, d show the energy equity gap within each ethnicity and age group, respectively. Comparing Fig. 5a, b (assuming similar

temperature preference between ethnicities^{50,51}), we see that the overall inflection temperature is highest in the Black population. This combined with high energy equity gaps, indicates that the Black population is worse off and experiences high levels of inequity. In the Asian population, the overall median inflection temperatures are low yet there are wide energy equity gaps, indicating high income disparity within the group.

In the Black population, we see increasing disparity followed by the 2.4% electricity price increase from year 1 to 2, resulting in a 39% increase in the energy equity gap from year 2 to 3, earlier than the large price shock that affected the whole population.

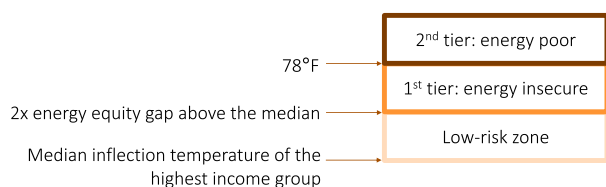


Fig. 6 Tier systems for energy poverty and insecurity identification using the energy equity gap. The darker the shade the more severe the level of energy poverty experienced by a household is.

This indicates that the Black population is disproportionately affected by price shifts compared to the other ethnicities. The white population most closely resembles the overall population trend because white populations account for the majority (>70%) of residents in our sample. In general, we find that even when a minority group's median inflection temperature is low, there can be a high disparity between low and high-income populations (see Supplementary Information Note 3), evident in the Asian population.

We also investigated energy poverty and equity across head of household age groups (Fig. 5c, d). There are statistically significant differences between median inflection temperatures across age groups ($p < 0.05$), as confirmed using the Mood's Median test (see Methods), indicating low probability that these variations occur solely due to chance. For the 18–24 age group, both the median inflection temperature ($>7^\circ\text{F}$, 3.9°C) and the energy equity gap increased sharply ($>14^\circ\text{F}$, 7.8°C) between 2018 and 2019, while for the older populations, the energy equity gap had little change across the years. From an energy poverty targeting standpoint, this highlights that within the elderly population, all residents should be targeted to reduce inflection temperatures, while for the youngest age groups, the most effective poverty eradication policy would be to target low-income groups.

For all age groups except for 75+, the later increase in the energy equity gap is from low-income households getting worse off and high-income households performing better, most evident in age groups 18–24 and 25–34. The difference in inflection temperatures between age groups may be attributed to each age group's different temperature comfort levels. Elders may prefer warmer indoor temperatures, and cooling air from an AC system may inflame arthritis⁵², but caution should be used when differentiating between a comfortably warm temperature and one that puts the resident at risk for a heat-related illness⁵³. Because there is a significant relationship between household income and inflection temperature, the high energy equity gap in younger age groups may be attributed to larger income inequality among young people.

We acknowledge that there is a chance that the inflection temperature and energy equity gap can be affected by indoor thermostat preferences. To account for varying preferences across ethnic and age groups, we investigate the inflection temperature disparities for different income groups within demographic distinctions (see Supplementary Information Note 3). For example, if one ethnic group preferred to turn on their AC units at a certain temperature, we expect to find a narrow vertical distribution for the inflection temperatures (i.e., the Hispanic population in Supplementary Information Note 3). On the other hand, if the different inflection temperatures represent inequity, we expect to find a wide vertical distribution (i.e., the Black and Asian population in Supplementary Information Note 3). Thus, the energy equity gap can highlight inequities across and within groups in a region. We present a more detailed discussion of the preference limitation in the Supplementary Information Note 3.

We introduce a tiered system (Fig. 6) to identify the households with the highest risk of heat-related illness and death. First, we assume the median inflection temperature of the highest income group is the ideal inflection temperature for this region. This assumption stems from the belief that the highest income groups are the least likely to constrain their budget and thus would initiate cooling systems earliest in the year. Similar to using a standard deviation, we define people with inflection temperatures between one and two energy equity gaps above the ideal inflection temperature to be in the low-risk zone. Next, households with inflection temperatures between two energy equity gaps and 78°F (25.6°C) are in the energy insecure zone. Within government buildings, it is recommended that 78°F degrees be the indoor set point⁵⁴, meaning this temperature setting may limit the risk for mold and allergen build-up, as well as heat-related illness and death. Finally, households with inflection temperatures higher than 78°F (25.6°C) are defined as energy poor. We use the indoor 78°F (25.6°C) comfort set point as our energy poverty threshold because households would need some degree of cooling above this outdoor temperature.

We acknowledge that there are multiple factors that can influence comfort levels and the health risk of occupants in high heat temperatures. Previous studies have shown that heat-mortality risk occurs when outdoor temperature rises above 90°F (32.2°C)⁵⁵. However, our goal is to identify households at risk for both health-related illness and death, which can result from a lower temperature threshold. We derive this lower threshold (78°F , 25.6°C) from recommended indoor AC setting for government buildings^{54,56}, as well as from recommendations of various utility companies^{57,58}. A key assumption in this threshold is that when the outdoor temperature is above this level, the indoor temperature would rise enough to warrant turning on the AC.

Using this tiered system, policymakers and utility companies can create more targeted weatherization aid programs. When we apply the tiers system to 2015–2016 data (Table 2), we identify 86 energy poor (1.9% of our sample) and 214 energy insecure households (4.7% of our sample).

Comparing the energy equity gap to income-based measures.

While US government assistance programs lack a clear definition for energy poverty, change in energy burden is often used to measure the outcome of these programs^{9,11}. Both LIHEAP and WAP use income limit by household size to determine eligibility^{59,60}, with some flexibility for states to determine what income level to set as the eligibility threshold. When using the 10% energy burden threshold to identify energy-insecure households in our study region, we found that less than 3% of households were defined as energy insecure (Fig. 7), of which over 70% reside in the lowest income group ($<\$15,000$) for all years in our study. Comparing the energy equity gap categorization with the energy burden measure of individual households, we find that few households (≤ 20) were identified as energy insecure or energy poor under both metrics (Table 2, also see Supplementary Information Note 7 for a visual representation). The energy burden metric categorizes more households as energy insecure, but our tiered system identifies more energy-poor households who may be placing themselves at risk by limiting cooling-associated energy use. The energy burden metric misses more than 95% of those with high inflection temperatures and, therefore, a higher risk of extreme heat exposure. Of that 95%, around half of the households are in one of the three low-income groups ($<\$35,000$). There are energy insecure households identified in the non-low-income groups, which hints that while some

Table 2 Comparing the energy equity gap (EEG) and financial-based energy assistance categories.

(Number of households in each category)	2015–2016	2016–2017	2017–2018	2018–2019
Total households	4577	4522	3852	2650
Energy equity gap (EEG) low risk zone	2719	2143	1889	1619
EEG 1 st tier: Energy insecure	214	631	484	42
EEG 2 nd tier: Energy poor	86	83	57	59
Households with energy burden $\geq 10\%$	141	135	111	88
EEG low-risk zone households with energy burden $\geq 10\%$	94	59	64	55
EEG 1 st tier households with energy burden $\geq 10\%$	6	16	9	1
EEG 2 nd tier households with energy burden $\geq 10\%$	3	4	1	2
EEG 1 st and 2 nd tier households with energy burden $< 10\%$	274	587	286	93
EEG 2nd tier households not eligible for LIHEAP	72	63	48	48
EEG 2nd tier households not eligible for WAP	53	37	33	29

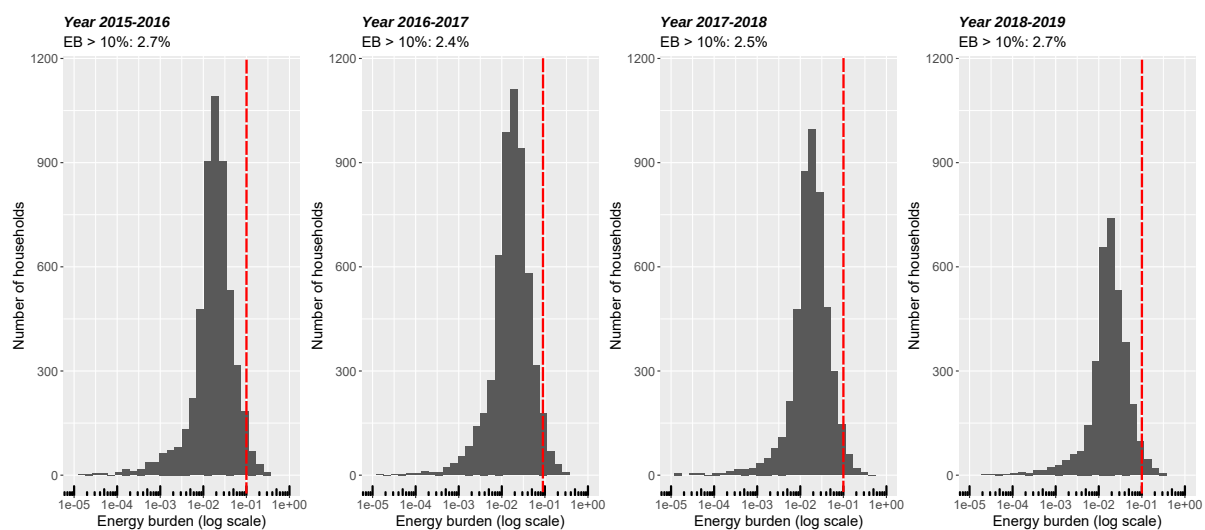


Fig. 7 Energy insecurity measured using the energy burden (EB) metric. The x-axis represents the percent of income a household spends on electricity. The red dotted line indicates the 10% income spending threshold, and EB10 details the proportion of households above the energy spending threshold. For example, in 2015–2016, 2.7% of households in our sample spent more than 10% of their income on electricity. The maximum amount of spending in our sample population is 35%.

households are not classified as low-income, they may have low disposable income (e.g., high mortgage or rent costs) and limit their financial burden by reducing their energy consumption. This further highlights the need for multiple energy poverty and insecurity measures to determine financial and behavioral energy consumption trends in energy-insecure households.

We also compared eligibility for LIHEAP and WAP and households in the 2nd tier of the energy equity gap metric. In our dataset of 6002 households, 871 qualified for LIHEAP and 1553 qualified for WAP using their respective income threshold⁹. We found that 48–72 households each year have high inflection temperatures but are not eligible for LIHEAP. Because WAP has a higher income threshold than LIHEAP, all households that qualify for LIHEAP also qualify for WAP, so this range reduces to 29–53 households when comparing the energy equity gap and WAP. Many of these missed households are just on the edge of the low-income threshold but have uncomfortably and sometimes dangerously high inflection temperatures, making them vulnerable without assistance.

Limitations of analysis and opportunities for future work. Energy poverty exists in multiple forms, leading to numerous

limitations in any quantification method. Here we present a discussion of the limitations of our methods and opportunities for future improvements. Uncertainties in using the iteration of the energy equity gap outlined in this paper include the lack of heating data from the natural gas provider. From the dataset provided by the electric utility, we gather that 60% of households in this study use electricity for both cooling and heating, while the remaining most likely use natural gas or oil for heating. However, we did not find the type of heating system to be a significant indicator of household inflection temperatures. Thus, the model used to calculate the inflection temperature still stands for this particular electricity-based dataset (see Methods), particularly for a high-heat area like Arizona where heat-related illness and death is significantly higher than cold-related ones^{40,41}.

Housing characteristics that relate to the energy efficiency of the home⁶¹ (e.g., number of windows, insulation, wall thickness, finishing material, the orientation of the home, etc.) were not included in the dataset but would be valuable additions to future utilities data collection effort. We did find a relationship between residence age and income group, where a large proportion of low-income households lived in older homes (see Supplementary Information Note 2), which could contribute to higher inflection temperatures and less overall household energy efficiency.

One limitation of this study is a lack of indoor thermostat data and an inability to quantify the actual indoor temperature of homes. Thermostat data could provide more information about the willingness of occupants to consume energy for cooling and heating needs. However, thermostat information would not reveal a consumer's true temperature comfort preferences. The inability of thermostat data to identify true household preferences results from household occupants adjusting their thermostat based on multiple factors such as spending limits (i.e., disposable income), comfort, and energy conservation habits. Thus, a person might deliberately keep their thermostats at non-ideal temperatures (i.e., energy limiting behavior), rather than their true comfortable temperature, to save money or energy. Another possibility is that the energy equity gap could be wider than our analyses suggest due to the urban heat islanding effect^{62,63}, with low-income households being more exposed to high heat due to less shading and vegetation in their urban environments.

In spite of these limitations, we believe this analysis provides a crucial first step in identifying energy limiting behavior in low-income households in a metropolitan region. A fruitful direction for future work would be to investigate actual temperature discrepancies within the home.

Discussion

The energy burden metric targets households who limit other necessities to meet energy needs but misses out on those who limit energy spending to meet other needs. The energy equity gap fills this void by identifying who chooses to endure higher temperatures in the summer and how their behavior may change due to price spikes and weather changes. The two types of metrics should be used in conjunction to identify households experiencing multiple forms of energy poverty: those who experience financial strain while satisfying their energy needs, and those who forgo energy consumption to reduce financial strain and satisfy other necessities. By considering behavior patterns in addition to spending patterns, policy makers will be able to better identify who is in need of energy assistance. As nations continue designing equitable and sustainable energy policies, regions need a straightforward method to evaluate the current level of energy poverty from an economic, consumption, and behavioral perspective.

By grouping households by income and energy equity gap severity, policymakers and utility companies can target the most at-risk households requiring urgent financial help with energy bills and weatherization. The value of the energy equity gap is that it creates the possibility of a sliding-scale energy poverty assistance program, which could set weatherization targets for the population based on their ability to adapt to extreme weather events (e.g., heatwaves) and how they are performing relative to others in the region. For example, if primary policies were designed to target households with an inflection temperature above 78 °F (25.6 °C) and those that spend more than 10% of their income on meeting their energy needs, this could reduce financial strain and risk of heat-related illnesses in the region. Secondary policy targets should focus on households with low income and above-average inflection temperatures. These households are likely to suffer from multiple forms of energy poverty and insecurity but are not at high risk for heat-related death.

On the other hand, high-income households with high inflection temperatures may be best suited for discounted weatherization programs. Despite having higher incomes, weatherization costs may still be too high for these households if they have limited disposal income. When adapting the energy

equity gap to other regions, electricity consumption may be sufficient for similarly high-heat regions. However, researchers and energy planners should consider gas, electric, and potentially other fuels used for heating to estimate total energy consumption for colder climates. Calculating the energy equity gap requires the same information for the traditional energy poverty metric, so the cost to compute and utilize the energy equity gap would be marginal.

In the ever-evolving discussion around equity, justice, and policy, we need to study and develop policy that answers the needs of those historically and systemically marginalized. We can start by identifying those falling through the policy cracks of economic-based poverty metrics by casting a finer net which also includes poverty displayed through energy consumption behavior. The energy equity gap contributes to the discussion of existing energy poverty metrics by capturing a region's relative progress while including the households that income-based metrics may have left behind. By targeting the population with higher-than-ideal inflection temperatures with equity-centered policies, regions will more effectively eradicate energy poverty and assist their residents in adapting to climate change.

Methods

Data. The data was provided by Salt River Project, a large utility company in Arizona. The dataset comprises two parts: first, hourly electricity consumption in kWh from May 2015 to April 2019 for 6000 households and the billing plan for each household; second, a comprehensive Residential Equipment and Technology Survey conducted in 2017 for those households. The survey included information on household sociodemographic information, and dwelling characteristics (e.g., residence age, size, and type). For summaries of demographics information please see Supplementary Information Note 1.

Salt River Project provides different billing packages from which customers can choose based on their preferences. Each billing package has its own pricing rules and condition. The billing packages can be categorized into Basic Rate Plan, Time-of-Use Plans, and Prepaid Plans. Pricing rules were integrated into the consumption dataset to account for energy consumption patterns based on electricity pricing, where a uniform weighted average electricity price is calculated across 24 h of the day.

The hourly electricity consumption was aggregated into daily consumption. Daily consumption information was then coupled with daily average temperatures for the study region, compiled from WeatherForYou.com⁶⁴.

Inflection temperature. The inflection temperature is defined as the outdoor temperature where a household shifts from using its heating system to its cooling system. We recognize that there may be a temperature range where the household uses neither heating nor cooling, and the base level energy consumption during that period would be temperature-independent⁴⁶. In this context, the inflection temperature is still an indicator of the shift in energy consumption behavior. A household's inflection temperature is calculated using a nonlinear regression model (Eq. (1)), which estimates daily electricity consumption of household i on day t ($E_{i,t}$) based on the following variables: daily average temperature (T_t), electricity price based on the billing plan of the household and season ($P_{i,t}$), dummy variables of whether day t is a holiday (H_t), day-of-the-week fixed effects (δ_t), and month-of-the-year fixed effects (μ_t). When modeling day-of-the-week and month-of-the-year dummy variables, Wednesday and March were dropped, respectively, to prevent collinearity.

$$E_{i,t} = \alpha + \beta_1 \times T_t + \beta_2 \times T_t^2 + \beta_3 \times P_{i,t} + H_t + \delta_t + \mu_t \quad (1)$$

The quadratic equation models the relationship between daily electricity consumption and daily average temperature. We chose a quadratic relationship because it best coincides with the shape of the electricity consumption and temperature data, and a median R^2 value of 0.8 for all households (Fig. 2). The convex shape of the curve confirms the notion that electricity consumption is highly correlated with temperature. The inflection temperature is the minimum electricity consumption point (Eq. (2)) and signifies the outdoor temperature a household must experience before initiating their AC units.

$$T_{\text{inf}} = T_t \text{ when } f'(E_{i,t}) = 0 \quad (2)$$

We acknowledge that in building literature there are studies that use a piecewise linear function to identify cooling and heating turn on points (often referred to as balance points)^{45,46,65–67}. We use the quadratic function over the piecewise linear function due to higher R^2 values, which is consistent with other studies⁶⁸ (see Supplementary Information Note 12 for more discussion).

The outliers of the inflection temperature model are defined as any household with an inflection temperature below 30 °F (−1.1 °C) or above 120 °F (48.9 °C), based on outdoor temperature limit ranges measured within the study region. An inflection temperature outside of this bound may indicate incomplete electricity consumption data. Within our study, we filtered out 0.5% in year one, 1.6% in year two, 1.2% in year three, and 0.2% in year four from our analysis due to their classification as outliers. There are a total of 6002 households across the four years of study, but not all households have complete data for all years, which is why the total number of households in Table 2 decreased. One reason for the incomplete data may be that households started or stopped service midway with this utility company.

Computing the energy equity gap. The energy equity gap quantifies the relative energy consumption behavior differences between low and high-income groups using the inflection temperatures. We hypothesized that lower-income households are more likely to have higher inflection temperatures due to financial limitations and a desire to delay cooling their homes to reduce their energy burden (i.e., percent of income spent on energy services). After calculating the inflection temperature (T_{inf}) for each household for one year, we group households by income. The energy equity gap for year y , G_y , is the maximum median inflection temperature ($\max(T_{inf,median})$) minus the minimum inflection temperature ($\min(T_{inf,median})$) among all income groups.

$$G_y = \max(T_{inf,median}) - \min(T_{inf,median}) \quad (3)$$

We hypothesized that lower-income households are more likely to have higher inflection temperatures. To test our hypothesis, we performed two-tailed Mood's Median tests, a nonparametric alternative to a one-way analysis of variance, for significance. A significant result from a Mood's Median test demonstrates that one sample stochastically dominates another, and the differences between sample medians are statistically different. Tests were also performed on median inflection temperatures of ethnicity and age groups, with P -values shown in Table 3. When we group the households by income, we see significant P -value results for all four years, which indicates that the difference in median inflection temperatures of income groups have a close to 0% chance of solely being random (i.e., they are statistically significant). We see similar results when we group the sample population by age, which means age may also be a strong indicator of inflection temperature. Therefore, we cannot rule out that age may play a role in electricity consumption habits (e.g., older people may prefer to turn on their AC at a higher temperature), which would affect the inflection temperatures seen across groups. That being said, when computed within an age or ethnicity group, the energy equity gap can highlight when members are experiencing worsening poverty (i.e., the gap is widening), or when members of the group are adapting to temperature changes in a similar fashion (i.e., the gap is narrowing). While the ethnicity p -values are not on the same order of magnitude as income or age groups, we find that there is less than a 1% chance that the variation between ethnic groups is solely due to chance for years one, two, and four, and less than 6% for year three, thus indicating high statistical significance.

We also considered the potential effects of type of residence (i.e., single-family home, multi-family home, condo, mobile home, townhouse), residence age, and residence size that can have on the household's inflection temperature. However, we find including these variables would introduce multicollinearity into the model because they are correlated with income. For more details see Supplementary Information Note 8.

Computing the traditional energy poverty metric. The traditional economic based energy poverty metric, energy burden, is defined as the percent of income a household spends on satisfying their energy (e.g., electricity) demand. We calculate the proportion of energy expenditure of each household for each year using income, residential electricity price, and energy consumption. For each household, the utility company provides the income bracket each household falls into. We use the midpoint of each income group to estimate the percent of income spent on energy consumption. For the lowest income group (<\$15,000), \$10,000 was taken as the midpoint; for the highest income group (>\$150,000), \$175,000 was taken as

the midpoint.

$$S_{i,y} = \frac{\sum E_{i,t} \times P_i}{I_{i,m}} \quad (4)$$

$S_{i,y}$ is the energy expenditure over income of household i in year y , $E_{i,t}$ is the daily electricity consumption of household i on day t , P_i is the average electricity price of the billing plan of household i , $I_{i,m}$ is the midpoint estimate of income for household i .

Reporting summary. Further information on research design is available in the Nature Research Reporting Summary linked to this article.

Data availability

The raw and processed electricity consumption data and the residential energy technology survey data are available under restricted access bound by a non-disclosure agreement, access can be obtained by upon reasonable request to the authors and with permission from the Salt River Project. Records of mean daily outdoor temperatures were retrieved from WeatherForYou.com by way of web scraping and can be accessed here. Source data for Fig. 3, Supplementary Information Figs. S3, S6, and S9 can be accessed here.

Code availability

All data and models are processed in Python 3.8.5. The figures are produced in PowerPoint and R studio (based on R 4.0.3). All custom code⁶⁹ is available on GitHub at <https://github.com/Pa223/The-Energy-Equity-Gap>.

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References

1. Sovacool, B. K. Fuel poverty, affordability, and energy justice in England: Policy insights from the Warm Front Program. *Energy* **93**, 361–371 (2015).
2. Primc, K., Slabe-Erker, R. & Majcen, B. Constructing energy poverty profiles for an effective energy policy. *Energy Policy* **128**, 727–734 (2019).
3. *Climate Change Impacts in the United States: The Third National Climate Assessment*. <https://nca2014.globalchange.gov/downloads> <https://doi.org/10.7930/J0Z31WJ2> (2014).
4. Wu, X., Brady, J. E., Rosenberg, H. & Li, G. Emergency department visits for heat stroke in the United States, 2009 and 2010. *Injury Epidemiol.* **1**, 8 (2014).
5. *Heat wave: a social autopsy of disaster in Chicago*, Klinenberg. <https://press.uchicago.edu/ucp/books/book/chicago/H/bo20809880.html> (2015).
6. Canouï-Poittrine, F. et al. Excess deaths during the August 2003 heat wave in Paris, France. *Rev. Epidemiol. Sante Publique* **54**, 127–135 (2006).
7. Baldwin, J. W., Dessy, J. B., Vecchi, G. A. & Oppenheimer, M. Temporally compound heat wave events and global warming: an emerging hazard. *Earth Future* **7**, 411–427 (2019).
8. Dong, W., Liu, Z., Liao, H., Tang, Q. & Li, X. New climate and socio-economic scenarios for assessing global human health challenges due to heat risk. *Clim. Change* **130**, 505–518 (2015).
9. Bednar, D. J. & Reames, T. G. Recognition of and response to energy poverty in the United States. *Nat. Energy* **5**, 432–439 (2020).
10. *Low Income Home Energy Assistance Program (LIHEAP) | The Administration for Children and Families*. <https://www.acf.hhs.gov/ocs/low-income-home-energy-assistance-program-liheap> (2022).
11. Rose, E. M. & Hawkins, B. A. Background Data and Statistics on Low-Income Energy Use and Burden for the Weatherization Assistance Program: Update for Fiscal Year 2020. <https://doi.org/10.2172/1761662> (2020).
12. Okushima, S. Gauging energy poverty: a multidimensional approach. *Energy* **137**, 1159–1166 (2017).
13. Duclos, J.-Y., Sahn, D. E. & Younger, S. D. Robust multidimensional poverty comparisons*. *Economic J.* **116**, 943–968 (2006).
14. Pachauri, S. & Spreng, D. Measuring and monitoring energy poverty. *Energy Policy* **39**, 7497–7504 (2011).
15. Culver, L. C. Energy poverty: what you measure matters. *The Stanford Natural Gas Initiative* (2017).
16. Middlemiss, L. et al. Energy poverty and social relations: a capabilities approach. *Energy Res. Soc. Sci.* **55**, 227–235 (2019).
17. Memmott, T., Carley, S., Graff, M. & Konisky, D. M. Sociodemographic disparities in energy insecurity among low-income households before and during the COVID-19 pandemic. *Nat. Energy* **6**, 186–193 (2021).

Table 3 P -values from two-tailed Mood's Median tests on median inflection temperatures of income, ethnicity, and age groups.

Grouping	2015–2016	2016–2017	2017–2018	2018–2019
Income	5.36E–23***	6.85E–22***	2.50E–16***	2.05E–13***
Ethnicity	5.94E–03*	6.02E–05***	2.85E–01	1.73E–02
Age	2.30E–29***	1.61E–32***	8.91E–20***	7.36E–17***

Alpha = 0.05.
Signif. codes: "****" [0, 0.001] "***" (0.01, 0.05] "**" (0.05, 0.1] "*" (0.1, 1].

18. Romero, J. C., Linares, P. & López, X. The policy implications of energy poverty indicators. *Energy Policy* **115**, 98–108 (2018).
19. Spiliotis, E., Arsenopoulos, A., Kanellou, E., Psarras, J. & Kontogiorgos, P. A multi-sourced data based framework for assisting utilities identify energy poor households: a case-study in Greece. <https://doi.org/10.1080/15567249.2020.1739783> **15**, 49–71 (2020).
20. Memmott, T., Carley, S., Graff, M. & Konisky, D. M. Sociodemographic disparities in energy insecurity among low-income households before and during the COVID-19 pandemic. *Nat. Energy* **2021** 6:2 **6**, 186–193 (2021).
21. USDA ERS. *Percent of income spent on food falls as income rises*. <https://www.ers.usda.gov/amber-waves/2016/september/percent-of-income-spent-on-food-falls-as-income-rises/> (2016).
22. Papada, L. & Kaliampakos, D. Measuring energy poverty in Greece. *Energy Policy* **94**, 157–165 (2016).
23. Liddell, C., Morris, C., McKenzie, S. J. P. & Rae, G. Measuring and monitoring fuel poverty in the UK: National and regional perspectives. *Energy Policy* **49**, 27–32 (2012).
24. Moore, R. Definitions of fuel poverty: Implications for policy. *Energy Policy* **49**, 19–26 (2012).
25. Herrero, S. T. Energy poverty indicators: a critical review of methods. *Indoor Built Environ.* **26**, 1018–1031 (2017).
26. Dagnachew, A. G., Lucas, P. L., Hof, A. F. & van Vuuren, D. P. Trade-offs and synergies between universal electricity access and climate change mitigation in Sub-Saharan Africa. *Energy Policy* **114**, 355–366 (2018).
27. Batinge, B., Kaviti Musango, J. & Brent, A. C. Perpetuating energy poverty: Assessing roadmaps for universal energy access in unmet African electricity markets. *Energy Res. Soc. Sci.* **55**, 1–13 (2019).
28. Karplus, V. J. & von Hirschhausen, C. Electricity access: an introduction. *Econ. Energy Environ. Policy* **8**, 1–18 (2019).
29. Higgins, L. & Lutzenhiser, L. Ceremonial equity: low-income energy assistance and the failure of socio-environmental policy. *Soc. Probl.* **42**, 468–492 (1995).
30. MURRAY, A. G. & MILLS, B. F. The impact of low-income home energy assistance program participation on household energy insecurity. *Contemp. Economic Policy* **32**, 811–825 (2014).
31. *Access to electricity (% of population)*, Data. <https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS> (2020).
32. Held, J. S. *Common causes of electric space heater fire examined*. <https://jsheld.com/insights/articles/common-causes-of-electric-space-heater-fires-methods-of-prevention> (2022).
33. Reames, T. G. Targeting energy justice: exploring spatial, racial/ethnic and socioeconomic disparities in urban residential heating energy efficiency. *Energy Policy* **97**, 549–558 (2016).
34. Reames, T. G. A community-based approach to low-income residential energy efficiency participation barriers. *Local Environ.* **21**, 1449–1466 (2016).
35. Hernández, D. & Siegel, E. Energy insecurity and its ill health effects: a community perspective on the energy-health nexus in New York City. *Energy Res. Soc. Sci.* **47**, 78–83 (2019).
36. Union of Concerned Scientists. *The energy burden: how bad is it and how to make it less bad*. <https://blog.ucsusa.org/joseph-daniel/how-to-make-energy-burden-less-bad> (2019).
37. Middlemiss, L. & Gillard, R. Fuel poverty from the bottom-up: characterising household energy vulnerability through the lived experience of the fuel poor. *Energy Res. Soc. Sci.* **6**, 146–154 (2015).
38. *Damp Indoor Spaces and Health. Damp Indoor Spaces and Health*, <https://doi.org/10.17226/11011> (National Academies Press, 2004).
39. Evans, J., Hyndman, S., Stewart-Brown, S., Smith, D. & Petersen, S. An epidemiological study of the relative importance of damp housing in relation to adult health on JSTOR. *J. Epidemiol. Community Health* **54**, 677–686 (2000).
40. *Heat-related illness by year emergency department visit inpatient admission (hospitalization)*. <https://www.azdhs.gov/documents/preparedness/epidemiology-disease-control/extreme-weather/pubs/heat-related-illness-emergency-department-and-inpatient-admissions-in-arizona-by-year.pdf> (2021).
41. *Cold-related illness by year*. <https://www.azdhs.gov/preparedness/epidemiology-disease-control/extreme-weather/index.php#cold-home> (2021).
42. Jenkins, K., McCauley, D., Heffron, R., Stephan, H. & Rehner, R. Energy justice: a conceptual review. *Energy Res. Soc. Sci.* **11**, 174–182 (2016).
43. Sovacool, B. K., Burke, M., Baker, L., Kotikalapudi, C. K. & Wlokas, H. New frontiers and conceptual frameworks for energy justice. *Energy Policy* **105**, 677–691 (2017).
44. Sovacool, B. K. & Dworkin, M. H. Energy justice: conceptual insights and practical applications. *Appl. Energy* **142**, 435–444 (2015).
45. Chong, H. Building vintage and electricity use: old homes use less electricity in hot weather. *Eur. Economic Rev.* **56**, 906–930 (2012).
46. Fazeli, R., Ruth, M. & Davidsdottir, B. Temperature response functions for residential energy demand - a review of models. *Urban Clim.* **15**, 45–59 (2016).
47. Tang, W., Kuehn, T. H. & Simcik, M. F. Effects of temperature, humidity and air flow on fungal growth rate on loaded ventilation filters. *J. Occup. Environ. Hyg.* **12**, 525–537 (2015).
48. Hirsch, D. J., Hirsch, S. R. & Kalbfleisch, J. H. Effect of central air conditioning and meteorologic factors on indoor spore counts. *J. Allergy Clin. Immunol.* **62**, 22–26 (1978).
49. Kilbourne, E. M., Choi, K., Jones, T. S. & Thacker, S. B. Risk factors for heatstroke: a case-control study. *JAMA: J. Am. Med. Assoc.* **247**, 3332–3336 (2012).
50. Lawes, M., Havenith, G. & Hodder, S. Ethnic differences: the influence of relative humidity on thermal perception. *CIEHF Publications* (2021).
51. Wang, L., Chen, M. & Yang, J. Interindividual differences of male college students in thermal preference in winter. *Build. Environ.* **173**, 106744 (2020).
52. Aikman, H. The association between arthritis and the weather. *Int. J. Biometeorol.* **40**, 192–199 (1997).
53. Oudin Åström, D., Bertil, F. & Joacim, R. Heat wave impact on morbidity and mortality in the elderly population: a review of recent studies. *Maturitas* **69**, 99–105 (2011).
54. DDOE. *Energy tips for institutional and government buildings*. <https://doee.dc.gov/service/energy-tips-institutional-and-government-buildings> (2021).
55. Diaz, J. et al. Heat waves in Madrid 1986–1997: effects on the health of the elderly. *Int. Arch. Occup. Environ. Health* **75**, 163–170 (2002).
56. Department of Energy. *Thermostats*. <https://www.energy.gov/energysaver/thermostats> (2021).
57. *Thermostat settings: the ideal settings for summer & winter*. <https://valleyservice.net/blogs/thermostat-settings> (2020).
58. *Recommended thermostat settings for winter and summer*. <https://www.centralhtg.com/blog/recommended-thermostat-settings> (2018).
59. Benefits.gov. *Low Income Home Energy Assistance Program (LIHEAP)*. <https://www.benefits.gov/benefit/623> (2020).
60. Department of Energy. *How to apply for weatherization assistance*. <https://www.energy.gov/eere/wap/how-apply-weatherization-assistance> (2022).
61. Thomson, H., Simcock, N., Bouzarovski, S. & Petrova, S. Energy poverty and indoor cooling: an overlooked issue in Europe. *Energy Build.* **196**, 21–29 (2019).
62. Hsu, A., Sheriff, G., Chakraborty, T. & Many, D. Disproportionate exposure to urban heat island intensity across major US cities. *Nat. Commun.* **12**, 1–11 (2021).
63. Harlan, S. L. et al. In the shade of affluence: the inequitable distribution of the urban heat island. *Res. Soc. Probl. Public Policy* **15**, 173–202 (2007).
64. Phoenix Arizona Local Weather Forecasts and Conditions - WeatherForYou.com. <https://www.weatherforyou.com/reports/index.php?config=&pass=&dpp=&forecast=zandh&config=&place=phoenix&state=az&pands=phoenix,az&country=us> (2019).
65. Brown, M. A., Cox, M., Staver, B. & Baer, P. Modeling climate-driven changes in U.S. buildings energy demand. *Climatic Change* **134**, 29–44 (2015).
66. Hiruta, Y., Gao, L. & Ashina, S. A novel method for acquiring rigorous temperature response functions for electricity demand at a regional scale. *Sci. Total Environ.* **819**, 152893 (2022).
67. ASHRAE Guideline 14-2002 Measurement of energy and demand savings. ISSN 1049-894X (2002).
68. Kim, Y. J., Lee, S. J., Jin, H. S., Suh, I. A. & Song, S. Y. Comparison of linear and nonlinear statistical models for analyzing determinants of residential energy consumption. *Energy Build.* **223**, 110226 (2020).
69. Pa223. *Pa223/The-Energy-Equity-Gap*, <https://doi.org/10.5281/zenodo.6369436> (2022).

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Author contributions

D.N. conceived the research idea and designed and oversaw the research process. S.C. designed and performed the analysis. S.C. wrote and revised the initial draft of the paper. D.N. and Y.Q. reviewed and revised the paper. B.X. collected and cleaned the data. Correspondence and requests for materials should be addressed to D.N. or Y.Q.

Competing interests

The authors declare no competing interests.

Additional information

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HOME ENERGY AFFORDABILITY GAP

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Introduction

The objective was to quantify the gap between "affordable" home energy bills and "actual" home energy bills. We were successful.

In 2003, Fisher, Sheehan & Colton (FSC) introduced a model that calculated the dollar amount by which "actual" home energy bills exceeded "affordable" home energy bills on a county-by-county basis for the entire country. This is the "home energy affordability gap." Updated every year since then, the model has become an invaluable tool for research, legislative analysis, program-planning and advocacy. The analyses are used by individuals and organizations across the country. The 2012 Home Energy Affordability Gap, published in May 2013, introduces the 2nd Series of FSC's annual Affordability Gap analysis. While remaining fundamentally the same, several improvements have been introduced in both data and methodology in the Affordability Gap (2nd Series). Explore our site to learn more.

For Example **Connecticut's 5th Congressional District**

The aggregate 2012 Home Energy Affordability Gap for all households **at or below**

For Example **Marion County Oregon**

The 2013 Home Energy Affordability Gap for each household **at or below 50%** of the Federal Poverty Level was \$1,206. That was a home energy burden (bill as a

For Example **The Commonwealth of Pennsylvania**

The aggregate 2012 Home Energy Affordability Gap for all households **at or below 200%** of the Federal Poverty Level in

4/30/24, 12:38 PM

Home Energy Affordability Gap



200% of the Federal Poverty Level in Connecticut's 5th Congressional District was \$131,743,402. The gross 2012 LIHEAP allocation for the entire state was \$79,532,000.



percentage of income) of 22.9%. Housing analysts consider an energy burden of more than six percent (6%) to be unaffordable.



Pennsylvania was \$1,840,924,328. The 2012 "Gap" for each household was \$1,252 or \$104/month.

Fisher, Sheehan & Colton
Public Finance and General Economics

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utility	date	disconnections
Electric	1/1/2020	19907
Electric	2/1/2020	19339
Electric	3/1/2020	11898
Natural Gas	1/1/2020	618
Natural Gas	2/1/2020	1121
Natural Gas	3/1/2020	1003
Electric	4/1/2020	NA
Electric	5/1/2020	NA
Electric	6/1/2020	NA
Natural Gas	4/1/2020	NA
Natural Gas	5/1/2020	NA
Natural Gas	6/1/2020	NA
Electric	7/1/2020	507
Electric	8/1/2020	3642
Electric	9/1/2020	9997
Natural Gas	7/1/2020	0
Natural Gas	8/1/2020	0
Natural Gas	9/1/2020	639
Electric	10/1/2020	14392
Electric	11/1/2020	672
Electric	12/1/2020	252
Natural Gas	10/1/2020	928
Natural Gas	11/1/2020	142
Natural Gas	12/1/2020	1
Electric	1/1/2021	10049
Electric	2/1/2021	9818
Electric	3/1/2021	22977
Natural Gas	1/1/2021	366
Natural Gas	2/1/2021	1197
Natural Gas	3/1/2021	2129
Electric	4/1/2021	19017
Electric	5/1/2021	21860
Electric	6/1/2021	18485
Natural Gas	4/1/2021	1899
Natural Gas	5/1/2021	1877
Natural Gas	6/1/2021	2274
Electric	7/1/2021	13180
Electric	8/1/2021	9148
Electric	9/1/2021	15606
Natural Gas	7/1/2021	1881
Natural Gas	8/1/2021	1785
Natural Gas	9/1/2021	2218
Electric	10/1/2021	7020
Electric	11/1/2021	17270
Electric	12/1/2021	13757
Natural Gas	10/1/2021	1660

Natural Gas	11/1/2021	931
Natural Gas	12/1/2021	487
Electric	1/1/2022	17365
Electric	2/1/2022	19243
Electric	3/1/2022	22132
Natural Gas	1/1/2022	812
Natural Gas	2/1/2022	1157
Natural Gas	3/1/2022	2659
Electric	4/1/2022	19431
Electric	5/1/2022	20641
Electric	6/1/2022	19887
Natural Gas	4/1/2022	1450
Natural Gas	5/1/2022	1911
Natural Gas	6/1/2022	2118
Electric	7/1/2022	18108
Electric	8/1/2022	20476
Electric	9/1/2022	19640
Natural Gas	7/1/2022	2071
Natural Gas	8/1/2022	2075
Natural Gas	9/1/2022	1600
Electric	10/1/2022	14515
Electric	11/1/2022	13359
Electric	12/1/2022	9183
Natural Gas	10/1/2022	1417
Natural Gas	11/1/2022	421
Natural Gas	12/1/2022	525
Electric	1/1/2023	18129
Electric	2/1/2023	8083
Electric	3/1/2023	15618
Natural Gas	1/1/2023	852
Natural Gas	2/1/2023	965
Natural Gas	3/1/2023	745
Electric	4/1/2023	17725
Electric	5/1/2023	13247
Electric	6/1/2023	21450
Natural Gas	4/1/2023	1555
Natural Gas	5/1/2023	1674
Natural Gas	6/1/2023	1358
Electric	7/1/2023	18841
Electric	8/1/2023	19887
Electric	9/1/2023	19451
Natural Gas	7/1/2023	828
Natural Gas	8/1/2023	503
Natural Gas	9/1/2023	1217
Electric	10/1/2023	18027
Electric	11/1/2023	14285
Electric	12/1/2023	6362

Natural Gas	10/1/2023	855
Natural Gas	11/1/2023	930
Natural Gas	12/1/2023	389
	TOTAL	717121



February 15, 2024

Ms. Lisa Felice
Executive Secretary
Michigan Public Service Commission
7109 W. Saginaw Hwy
Lansing, MI 48917

Re: MPSC Case No. U-18120 – Rule 460.151

Dear Ms. Felice:

Attached are DTE Gas's and Electric's revised quarterly report for 1st, 2nd, and 3rd quarters of 2023. The revisions are to item A. total customer contacts. Revisions are shown in bold and italics. These revised reports supersede the reports filed previously. DTE is filing these revised report as directed by Michigan Public Service Commission Staff (MPSC Staff). In addition, DTE has unloaded this revised information to the MPSC's Quarterly report Salesforce. These reports are pursuant to the Consumer Standards and Billing Practices for Electric and Natural Gas Service Rule 460.151.

Sincerely,

Denise Diz Digitally signed by Denise Diz
Date: 2024.02.15 13:02:27
-05'00'

Denise Diz
Sr. Executive Consumer Affairs Consultant

Enclosure

1st Quarter Report
Complaints/Hearings
January - March 2023



	January 23	February 23	March 23	Total	Comments
Customer Service					
A. Total customer contacts (Res and Non-Res)	3,774,033	3,864,260	4,328,229	11,966,522	January and March have five weeks. Storms in February and March
B. Total customer complaints	1,730	2,143	2,670	6,543	
a. Billing	846	1,126	1,345	3,317	
b. Service	436	617	819	1,872	
c. Credit and Collection	182	131	158	471	
d. Other	266	269	348	883	January - HPP 52, Administrative 119, Claims 33, Property Restoration 55, Energy Waste Reduction/Renewables 7, Totals 266 February - HPP 27, Administrative 106, Claims 34, Property Restoration 82, Energy Waste Reduction/Renewables 20 Totals 269 March - HPP 40, Administrative 126, Claims 54, Property Restoration 120, Energy Waste Reduction/Renewables 8, Totals, 348
Freeform area, if complaint is not listed above, provide general description					
Customer Payment Performance					
C. Number of customers paid by the due date	2,502,344	2,496,067	2,493,023		Customers that are on an active payment arrangement that are current on their monthly payment amount are considered paid by the due date.
D. Number of customers delinquent 31-60 days or more	53,907	58,755	61,027		Data reported is for customers with oldest arrears in the 31-60 days past the due date bucket as of month end.
E. Number of customers delinquent 61-90 days or more	39,004	36,839	36,048		Data reported is for customers with oldest arrears in the 61-90 days past the due date bucket as of month end.
F. Number of customers delinquent 91 days or more	300,476	295,766	290,213		Data reported is for customers with oldest arrears in the >90 days past the due date bucket which includes customers with final arrears as of month end. Final arrears are written off 150 days after the final bill due date.
Payment Plans and Settlements					
G. Number of written settlement agreements	1	0	1	2	
H. Number of payment plan arrangements issued	3,952	3,949	5,689	13,590	
Winter Protection Plan (WPP)					
I. Total enrolled in program at the end of the month	1,256	1,305	961		The month end count is higher than the combined senior and low-income customers because DTE has additional customers enrolled in the program.
a. Number of low-income customers enrolled at end of month	997	1,033	731		
b. Number of seniors enrolled at end of month	232	233	196		
J. Number of defaults at end of month	229	423	420	1,072	
Alternative Shutoff Protection Plan					
K. Total enrolled in program at end of month	35,451	33,076	30,756		Non low-income and non-seniors are included in the month end count for Total enrolled in the program
a. Number of low-income customers enrolled at end of month	11,298	11,271	11,218		
b. Number of seniors enrolled at end of month	16,175	14,648	13,488		
L. Number of defaults at end of month	6,534	6,129	6,105	18,768	
Informal Hearings					
M. Number of hearings requested	2	2	1	5	
N. Number of hearings scheduled		1		1	
O. Total number of hearing determinations issued	0	1	0	1	
a. Hearings resolved in favor of customer				0	
b. Hearings resolved in favor of company		1		1	
c. Hearings resolved in compromise				0	
P. Reasons for the hearings		Billing		0	
Shutoff Information					
Q. Total discontinuation notices issued at end of month	231,338	242,323	219,324	692,985	
a. Electric	231,338	242,323	219,324	692,985	All customer types, and all products, electric, gas or combination
b. Natural Gas				0	
R. Total of customers physically discontinued due to non-payment	18,981	9,048	16,363	44,392	
a. Electric	18,129	8,083	15,618	41,830	
b. Natural Gas	852	965	745	2,562	
S. Total of customers physically discontinued due to unauthorized use	868	777	1300	2,945	
a. Electric	627	473	1,015	2,115	
b. Natural Gas	241	304	285	830	
T. Total of customers physically discontinued due to safety	0	0	0	0	
a. Electric				0	
b. Natural Gas				0	
U. Total of customers physically discontinued due to access	132	49	102	283	
a. Electric				0	
b. Natural Gas	132	49	102	283	
V. Total of customers physically discontinued due to "other" (*ADD new line for each reason)	0	0	0	0	
a. Electric				0	
b. Natural Gas				0	
W. Discontinuations prevented or restored due to "medical emergency"	42	36	54	132	
X. Discontinuations prevented or restored due to "critical care"	17	8	27	52	
Y. Total number of seniors identified	837,368	839,582	841,689		
Restoration Information					
Z. Total number of customers restored	14,642	6,691	12,334	33,667	
a. Electric	14,441	6,340	12,034	32,815	
b. Natural Gas	201	351	300	852	
AA. Total restored due to receiving assistance	443	282	719	1,444	
a. Electric	433	259	689	1,381	
b. Natural Gas	10	23	30	63	

2nd Quarter Report
Complaints/Hearings
April - June 2023



	April-23	May-23	June-23	Total	Comments
Customer Service					
A. Total customer contacts (Res and Non-Res)	2,975,688	2,946,978	3,885,764	9,808,430	
B. Total customer complaints	1,800	1,991	2,381	6,172	
a. Billing	892	978	1,082	2,952	
b. Service	331	258	605	1,194	
c. Credit and Collection	128	107	131	366	
d. Other	449	648	563	1,660	April - HPP 142, Administrative 82, Claims 58, Property Restoration 265, Energy Waste Reduction/Renewables 2, Totals 449 May - HPP 51, Administrative 94, Claims 97, Property Restoration 402, Energy Waste Reduction/Renewables 4, Totals 648 June - HPP 31, Administrative 153, Claims 108, Property Restoration 266, Energy Waste Reduction/Renewables 5, Totals 563
Freeform area, if complaint is not listed above, provide general description					
Customer Payment Performance					
C. Number of customers paid by the due date	2,495,343	2,485,640	2,486,490		Customers that are on an active payment arrangement that are current on their monthly payment amount are considered paid by the due date.
D. Number of customers delinquent 31-60 days or more	59,457	51,392	74,467		Data reported is for customers with oldest arrears in the 31-60 days past the due date bucket as of month end.
E. Number of customers delinquent 61-90 days or more	37,747	38,998	31,499		Data reported is for customers with oldest arrears in the 61-90 days past the due date bucket as of month end.
F. Number of customers delinquent 91 days or more	286,192	288,696	292,992		Data reported is for customers with oldest arrears in the >90 days past the due date bucket which includes customers with final arrears as of month end. Final arrears are written off 150 days after the final bill due date.
Payment Plans and Settlements					
G. Number of written settlement agreements	1	1	1	3	
H. Number of payment plan arrangements issued	4,465	5,251	4,925	14,641	
Winter Protection Plan (WPP)					
I. Total enrolled in program at the end of the month	690	525	425		The month end count is higher than the combined senior and low-income customers because DTE has additional customers enrolled in the program.
a. Number of low-income customers enrolled at end of month	497	355	269		
b. Number of seniors enrolled at end of month	143	121	107		
J. Number of defaults at end of month	156	91	89	336	
Alternative Shutoff Protection Plan					
K. Total enrolled in program at end of month	31,488	32,666	33,122		Non low-income and non-seniors are included in the month end count for Total enrolled in the program
a. Number of low-income customers enrolled at end of month	12,133	12,543	13,786		
b. Number of seniors enrolled at end of month	14,074	15,666	15,692		
L. Number of defaults at end of month	5,892	5,453	7,678	19,023	
Informal Hearings					
M. Number of hearings requested	1	0	1	2	
N. Number of hearings scheduled	0	0	0	0	
O. Total number of hearing determinations issued	0	0	0	0	
a. Hearings resolved in favor of customer				0	
b. Hearings resolved in favor of company				0	
c. Hearings resolved in compromise				0	
P. Reasons for the hearings				0	
Shutoff Information					
Q. Total discontinuation notices issued at end of month	251,193	238,306	201,394	690,893	All customer types, and all products, electric, gas or combination
a. Electric	251,193	238,306	201,394	690,893	
b. Natural Gas				0	
R. Total of customers physically discontinued due to non-payment	19,280	14,921	22,808	57,009	
a. Electric	17,725	13,247	21,450	52,422	
b. Natural Gas	1,555	1,674	1,358	4,587	
S. Total of customers physically discontinued due to unauthorized use	1,147	858	788	2,793	
a. Electric	1,031	659	553	2,243	
b. Natural Gas	116	199	235	550	
T. Total of customers physically discontinued due to safety	0	0	0	0	
a. Electric				0	
b. Natural Gas				0	
U. Total of customers physically discontinued due to access	183	117	105	405	
a. Electric				0	
b. Natural Gas	183	117	105	405	
V. Total of customers physically discontinued due to "other" (*ADD new line for each reason)	0	0	0	0	
a. Electric				0	
b. Natural Gas				0	
W. Discontinuations prevented or restored due to "medical emergency"	63	86	100	249	
X. Discontinuations prevented or restored due to "critical care"	19	25	23	67	
Y. Total number of seniors identified	843,260	844,505	845,664		
Restoration Information					
Z. Total number of customers restored	14,304	10,020	16,602	40,926	
a. Electric	13,897	9,693	16,377	39,967	
b. Natural Gas	407	327	225	959	
AA. Total restored due to receiving assistance	591	393	512	1,496	
a. Electric	545	365	499	1,409	
b. Natural Gas	46	28	13	87	

3rd Quarter Report
Complaints/Hearings
July - September 2023



	July 23	August 23	September 23	Total	Comments
Customer Service					
A. Total customer contacts (Res and Non-Res)	3,614,311	3,501,489	3,764,588	10,880,388	
B. Total customer complaints	2,429	3,100	2,671	8,200	
a. Billing	1,119	1,699	1,848	4,666	
b. Service	755	827	405	1,987	
c. Credit and Collection	104	154	91	349	
d. Other	451	420	327	1,198	July – HPP 13, Administrative 138, Claims 73, Property Restoration 220, Energy Waste Reduction/Renewables 7, Totals 451 August – HPP 15, Administrative 135, Claims 48, Property Restoration 210, Energy Waste Reduction/Renewables 12, Totals 420 September – HPP 21, Administrative 98, Claims 49, Property Restoration 150, Energy Waste Reduction/Renewables 9, Totals 327
Freeform area, if complaint is not listed above, provide general description					
Customer Payment Performance					
C. Number of customers paid by the due date	2,519,259	2,488,444	2,516,176		Customers that are on an active payment arrangement that are current on their monthly payment amount are considered paid by the due date.
D. Number of customers delinquent 31-60 days or more	65,500	60,363	67,872		Data reported is for customers with oldest arrears in the 31-60 days past the due date bucket as of month end.
E. Number of customers delinquent 61-90 days or more	45,481	37,126	37,566		Data reported is for customers with oldest arrears in the 61-90 days past the due date bucket as of month end.
F. Number of customers delinquent 91 days or more	293,537	306,814	301,103		Data reported is for customers with oldest arrears in the >90 days past the due date bucket which includes customers with final arrears as of month end. Final arrears are written off 150 days after the final bill due date.
Payment Plans and Settlements					
G. Number of written settlement agreements	0	0	1	1	
H. Number of payment plan arrangements issued	4,958	5,786	6,229	16,973	
Winter Protection Plan (WPP)					
I. Total enrolled in program at the end of the month	332	275	237		The month end count is higher than the combined senior and low-income customers because DTE has additional customers enrolled in the program.
a. Number of low-income customers enrolled at end of month	188	144	103		
b. Number of seniors enrolled at end of month	83	75	55		
J. Number of defaults at end of month	46	22	28	96	
Alternative Shutoff Protection Plan					
K. Total enrolled in program at end of month	32,400	33,136	34,093		Non low-income and non-seniors are included in the month end count for Total enrolled in the program
a. Number of low-income customers enrolled at end of month	14,546	16,349	17,594		
b. Number of seniors enrolled at end of month	15,011	14,517	14,302		
L. Number of defaults at end of month	6,579	6,780	9,558	22,917	
Informal Hearings					
M. Number of hearings requested	0	0	2	2	
N. Number of hearings scheduled			1	1	
O. Total number of hearing determinations issued	0	0	0	0	
a. Hearings resolved in favor of customer				0	
b. Hearings resolved in favor of company				0	
c. Hearings resolved in compromise				0	
P. Reasons for the hearings			Billing	0	
Shutoff Information					
Q. Total discontinuation notices issued at end of month	226,566	248,578	236,436	711,580	All customer types, and all products, electric, gas or combination
a. Electric	226,566	248,578	236,436	711,580	
b. Natural Gas				0	
R. Total of customers physically discontinued due to non-payment	19,669	20,390	20,668	60,727	
a. Electric	18,841	19,887	19,451	58,179	
b. Natural Gas	828	503	1,217	2,548	
S. Total of customers physically discontinued due to unauthorized use	766	1,112	850	2,728	
a. Electric	645	957	757	2,359	
b. Natural Gas	121	155	93	369	
T. Total of customers physically discontinued due to safety	0	0	0	0	
a. Electric				0	
b. Natural Gas				0	
U. Total of customers physically discontinued due to access	42	57	68	167	
a. Electric				0	
b. Natural Gas	42	57	68	167	
V. Total of customers physically discontinued due to "other" (*ADD new line for each reason)	0	0	0	0	
a. Electric				0	
b. Natural Gas				0	
W. Discontinuations prevented or restored due to "medical emergency"	107	120	74	301	
X. Discontinuations prevented or restored due to "critical care"	35	27	22	84	
Y. Total number of seniors identified	846,958	848,910	850,711		
Restoration Information					
Z. Total number of customers restored	15,898	16,144	15,971	48,013	
a. Electric	15,798	16,082	15,870	47,750	
b. Natural Gas	100	62	101	263	
AA. Total restored due to receiving assistance	452	408	325	1,185	
a. Electric	444	402	316	1,162	
b. Natural Gas	8	6	9	23	
Electric Only - Customer Service					
BB. Average customer call answer time (seconds)	46	60	57		All customer types, and all products, electric, gas or combination
CC. Percentage of the call blockage factor	0%	0%	0%	0	All customer types, and all products, electric, gas or combination
DD. Percentage of the complaint response factor	100%	100%	100%	1	

MPSC Case No: U-21291

Requester: FLO

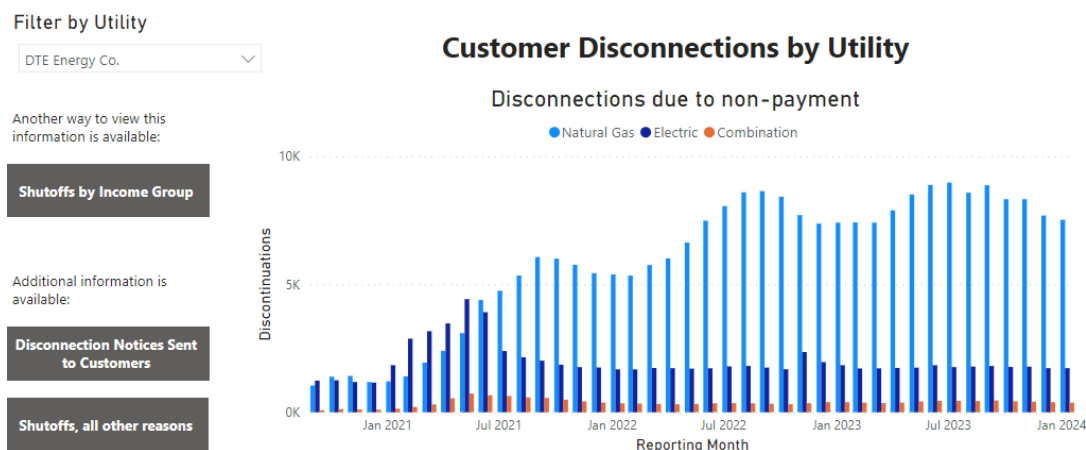
Question No.: FLODG-1.3

Respondent: J. E. Sparks

Page: 1 of 3

Question: 3. The MPSC aggregates disconnection and shutoff notice information on its “Utility Customer Data” webpage, using data provided by DTE and other utilities. Utility Customer Data, MICH. PUB. SERV. COMM’N, <https://www.michigan.gov/mpsc/regulatory/reports/other/utility-customer-data>. According to the data (reproduced below in Figure 1), it appears that gas-only disconnections have increased each year since September 2020. At the same time, according to the data (reproduced below in Figure 2), it appears that gas-only shutoff notices have remained relatively consistent each year since September 2020, following a seasonal pattern that does not appear to exceed 25,000 disconnection notices in a given month. Please explain why shutoff notices have remained relatively consistent during this period while actual shutoffs have increased each year. In this description, please list factors the Company believes relevant to account for the higher rate in actual shutoffs relative to shutoff notices received.

Figure 1: Customer Disconnections by Utility (DTE)



<https://www.michigan.gov/mpsc/regulatory/reports/other/utility-customer-data>

MPSC Case No: U-21291

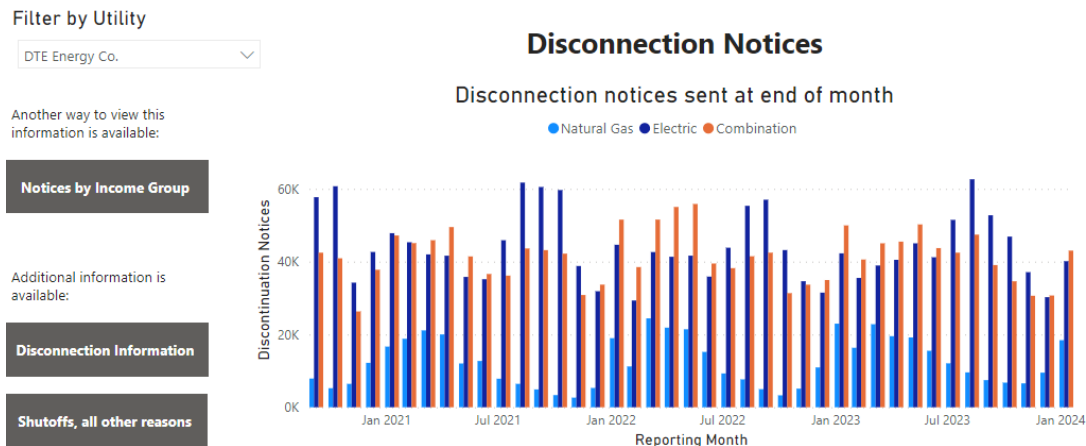
Requester: FLO

Question No.: FLODG-1.3

Respondent: J. E. Sparks

Page: 2 of 3

Figure 2: Customer Disconnection Notices (DTE)



<https://www.michigan.gov/mpsc/regulatory/reports/other/utility-customer-data>

Answer: The Utility Customer Data website displays information as provided in the Company's monthly U-20757. The gas disconnects information referenced is a total number of residential premises that were disconnected from 11/1/2019 to the last day of the reporting month that have not been restored. It is not the number of residential disconnects for any given month. The displayed screenshot from the website will align with the January 2024 report submitted by the Company. See attachment for the U-20757 report submitted for January 2024 and explanations of the data.

MPSC Case No: U-21291

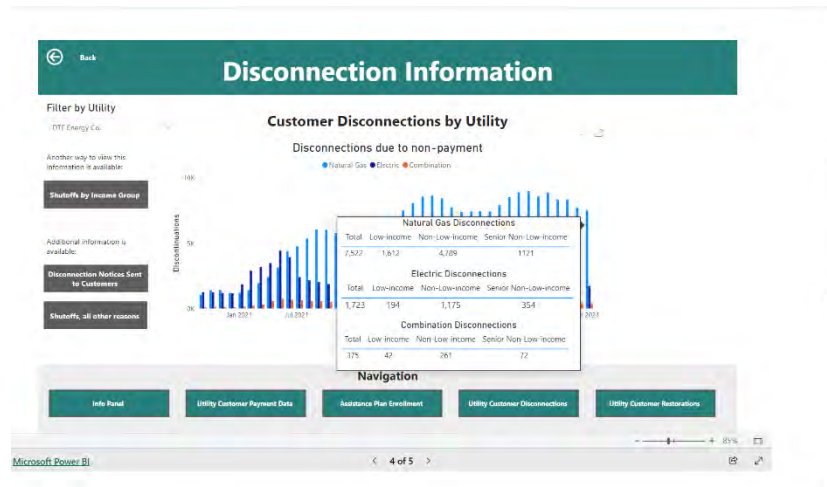
Requester: FLO

Question No.: FLODG-1.3

Respondent: J. E. Sparks

Page: 3 of 3

Figure 1 MPSC Customer Disconnections by Utility (DTE)



Attachment: U-21291 FLODG-1.3-01 U-20757 January 2024 2-12-24 Report



Co-published with **Outlier Media**

*This article was produced for ProPublica's Local Reporting Network in partnership with **Outlier Media**. [Sign up for Dispatches](#) to get stories like this one as soon as they are published.*

During the early stages of the pandemic, Michigan's largest power company leaned in to a chance to show its charitable side, helping buy laptops for Detroit's public school children and publicizing that it would not disconnect the gas and electric service of people who could not pay their bills. DTE Energy said it was on "high alert to help those customers whose lives are being disrupted."

But the relief from the threat of a shut-off ended quickly for DTE's customers, who pay some of the highest electricity rates in the country. DTE's moratorium on disconnections lasted just over three months.

An analysis by ProPublica and Outlier Media shows the extent to which one of the nation's poorest cities and other communities across Southeast Michigan have been impacted by electric service disconnections since the COVID-19 pandemic began. DTE disconnected customers 80,600 times in 2020 and more than doubled that number in 2021. Its 178,200 disconnections for nonpayment last year were its highest annual total since 2016.

The shut-offs reflect an unrelenting reality in Detroit and surrounding areas, where low-income residents have long struggled to keep their lights on while avoiding crushing debt tied to a basic service. It's a problem rarely discussed except among activists and advocates, as regulators and legislators have focused on other issues, like reliability of service.

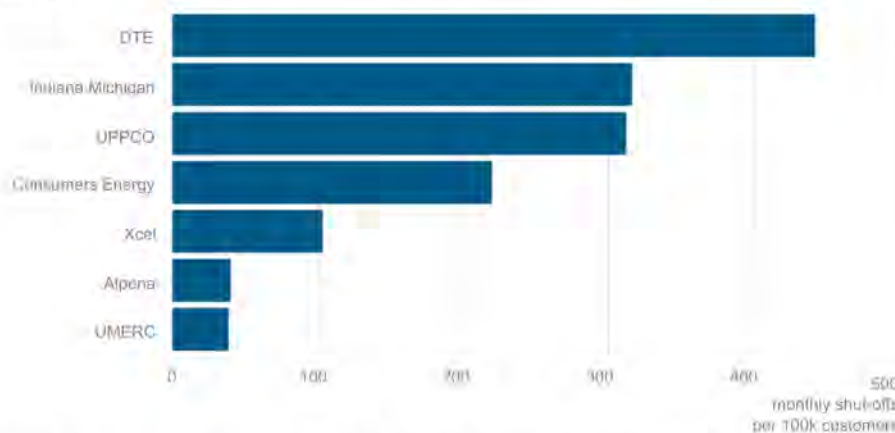
DTE has more than 2 million customers, but size alone does not explain its shut-off numbers, nor does the level of poverty within the company's service area. The analysis by ProPublica and Outlier is the first to examine DTE's disconnections and compare them to shut-offs by other Michigan utilities.

During the pandemic, DTE's rate of electricity shut-offs — disconnections as a proportion of customers — outpaced the six other utilities in Michigan that are owned by private investors and have their prices regulated by the state. DTE's rate was twice as high as the state's second largest utility, Consumers Energy, which serves areas with a similar share of low-income residents, according to an analysis of U.S. Census Bureau data.

Prior to the COVID-19 emergency, from 2013 — the earliest year for which data was available — through 2019, DTE disconnected electric accounts 1.2 million times. That represented 47% more shut-offs than Consumers during those years, adjusted for the number of customers each utility had. (Both utilities also provide gas service and combine those costs into one bill for many customers, but electricity is the more expensive of the two.)

DTE's Rate of Shut-offs Outpaced Others During Pandemic

From April 2020 to December 2021, DTE's average monthly shut-offs for nonpayment per 100,000 customers far outpaced Michigan's other investor-owned electricity providers.



Agnel Philip/ProPublica. Source: Michigan Public Service Commission.

DTE responded to the findings of Outlier and ProPublica in interviews and through email. The utility said that in most cases, customers have service restored within 48 hours. DTE spokesman Christopher Lamphear stressed that the utility works with customers to help arrange affordable payment plans or get financial assistance and contributes millions of dollars annually to a range of programs for low-income communities and customers. He said DTE forgave \$2.6 million in debt for struggling customers in 2020.

But DTE, which told state regulators it has half a million customers living in poverty, has acknowledged the struggles faced by customers who can't afford electricity. In recent testimony before state regulators, DTE described how some people build up significant debt on their monthly bills and then see the problem exacerbated by late fees, shutoffs and security deposits required for reconnection.

Many of the customers who experience shut-offs "are stuck in a repeated cycle of disconnects and reconnects" and must "make tough choices about which monthly bills get paid, and which ones don't," a company representative testified.





or ProPublica

Outlier Media helps Detroit residents access useful and verified information via an automated text messaging system monitored by reporters who will follow up with them. This winter, Outlier heard from hundreds of DTE customers who were looking for resources to help pay their bills. Of those, 136 said they had had their power shut off or owed money to DTE. Another 343 said they needed help to pay their current DTE bill. Among their comments:

“I was diagnosed with covid and stuck in bed so I missed my notice.”

“Insurmountable debt owed to DTE. I live in an apartment which has very little insulation, thereby causing my heating charges to be extreme.”

“My service was shut off due to nonpayment just last month. I had to come up with \$135 to get my service restored.”

One Detroit man who responded to Outlier was shut off earlier this year and reconnected the same day. His bill shows he currently owes more than \$2,500 to DTE. In an interview, the recent widower described the stress of not knowing if he could keep the electricity on for his children so they could use the internet for school.

“I open the door and I’m just hoping that my service is not off,” said the man, who didn’t want to be named in the story to protect his family’s privacy. “When the power is off, that stops the kids from being able to go to school.” DTE confirmed that his account had been shut off.

Even though many customers routinely scramble to pay their bills, the state’s utility regulators are not empowered by state law to directly consider affordability when setting prices. Echoing a dynamic seen across the country, Michigan’s regulators focus primarily on keeping utilities profitable enough to satisfy investors and on ensuring customers receive power without unexpected blackouts.

“There’s not sort of a clear place in Michigan law where it gets to ‘And also can customers afford to pay for it?’” said Dan Scripps, chair of the entity charged with overseeing utilities, the Michigan Public Service Commission.

Over the last decade, the MPSC has granted DTE a regular series of price hikes worth billions of dollars in revenue to the company.

The state has rules prohibiting shut-offs during extreme weather and requiring notices before disconnection, but it’s often up to utilities to decide how much leniency to show customers.

DTE’s Lamphear said in an email that it has “an obligation to all customers” to manage unpaid bills in a cost-effective way, so that lost revenue doesn’t result in higher costs for all.

“Given these challenges we continue to advocate for additional financial support from federal and state sources to provide a safety net for the most vulnerable people we serve,” Lamphear wrote.

Federal data shows that DTE’s price, as measured in cost per kilowatt-hour, is the second highest among investor-owned utilities in Michigan, behind the Upper Peninsula Power Company, a utility with only about 50,000 customers in Northern Michigan.

Consumers’ rate, meanwhile, is about 10% lower than DTE’s.

DTE’s price per kilowatt-hour is also higher than the price charged by the largest utility in each of the other Great Lakes states of Illinois, Indiana, Minnesota, Ohio and Wisconsin.

Despite the rate it charges, DTE said, its average monthly bill is on par with the national average, in large part because Michigan residential customers use less electricity than the average American customer.

Outlier and ProPublica employed the same methodology used by DTE to compare its average bills to those of the largest utilities in those five Great Lakes states. DTE’s average bill turned out to be the second most expensive among that group in 2020, the most recent year with full data.

Researchers have developed another way to measure affordability called “energy burden,” which accounts for price and income by calculating the share of customers’ monthly earnings that goes toward utility costs. A recent study of 25 large metropolitan regions determined that the burden for low-income Detroit residents was particularly severe.



or ProPublica



Rebecca Mock for ProPublica

Michigan regulators don’t require utilities to disclose where shut-offs happen or which communities are most affected, and DTE declined to provide that information to an Outlier reporter. But advocates in Detroit’s low-income neighborhoods and researchers say Black communities are significantly impacted. The percentage of Black residents in DTE’s service area is nearly three times as high as Consumers’, according to a ProPublica and Outlier analysis of census data. Jeremy Lark of Greenpath Financial Wellness, a nonprofit that helps customers to access payment plans for DTE debt, said more than 60% of people working with Greenpath to manage their DTE debt are Black.

“The customers that come to us,” he said, “it’s pretty common that past due bills are in the thousands of dollars.”

High Prices and Oversight That Favors Utilities

Thomas Edison grew up in Port Huron, Michigan, before going on to help develop electric power generation. One of his first licensees for generating electricity was the Detroit Edison Company; it was reorganized into DTE Energy in 1996.

In the early part of the 20th century, as industry and ordinary households demanded more electricity, governments across the country didn’t have the funds, expertise or will to build a brand new electric grid. Instead, they struck deals with large power companies to supply and distribute power; the utilities would be subject to government oversight but also would be insulated from future competition.

These “investor-owned utilities” — some, like DTE, with publicly traded stock — provide utility service for the majority of Americans and often need government approval to set prices.

The Michigan Public Service Commission, which negotiates these rates through an administrative proceeding, is not empowered to reject rates on the grounds they’re too expensive for low-income customers. Instead, it “has an obligation under Michigan law to set rates based on whether the investments proposed are reasonable and prudent and then allowing for the opportunity to earn a profit on those that are,” said Scripps, chair of the commission.

He added: “Affordability is always a front-of-mind issue, but it’s not tied to how we evaluate utility investments.”

Similar dynamics are at play across the country. Two recent exceptions can be found in Oregon and Massachusetts, where recent legislation gave regulators power to take customers’ ability to pay into consideration when setting gas or electric rates.

Since 2011, the MSPC has approved six rate increases for DTE, each for amounts that were about half of what the company had requested. Over that same time period, according to the commission, DTE’s revenues have increased by several billion dollars, due in part to those rate increases. DTE is currently asking for a seventh rate increase, worth an additional \$388 million in annual revenue.

Nationally, the rate DTE charges residents ranks in the top 5 percent of all investor-owned, public and cooperative electric suppliers, according to government data analyzed by Outlier and ProPublica.

In DTE’s service area, the increases in residential rates stand in contrast to what’s happened with businesses and industry. The commercial rates businesses pay have been relatively stable in recent years, while industrial users saw their rates decline between 2010 and 2019, according to federal data analyzed by the Citizens Utility Board of Michigan, a state-funded consumer advocate. Amy Bandyk, executive director for CUB of MI, said her organization — and by extension residential ratepayers — is outspent by the utility companies, which can afford more lawyers and experts to argue their side in rate cases.

“DTE and Consumers have lots of lobbyists and lawyers and analysts all focused on getting a better return for their shareholders,” she said. “I like to think our arguments are good, but the utilities are just very well-funded.”

She’d like to see the state move toward a billing structure that caps bills at a percentage of income for those who might otherwise struggle to pay, a reform that is popular with advocates nationally.

The MPSC has urged DTE and Consumers Energy to take some steps in this direction, and both companies have taken steps to test this approach. DTE’s pilot program, which began in January, caps bills at 10% of income for some households who use DTE for both gas and electric service, with the company absorbing the rest of the cost. The program will last two years for no more than 2,000 customers living at or below 200% of poverty.

Even as Bandyk observes what’s happening with the MPSC, she would like to see more urgency.

“There are so many people that need help right now,” she said. “High utility rates affect everyone, and, obviously, there are specific groups of customers hit especially hard.”

Donald Lutas is one of those customers. A retiree on a fixed income, he has tried to make his 105-year-old Detroit home more energy-efficient by adding insulation in its attic and replacing windows. But his house is still large and drafty, and he has problems keeping up with his gas and electric bills, especially in winter when he’s seen monthly charges of more than \$500.



the entry hallway of his home in Detroit Nick Hagen for ProPublica

“Right now I have to make a choice between paying my part of Medicare or paying for utilities,” said Lutas, who used to run a residential care facility for people with mental health challenges. “I couldn’t afford both. I had multiple shut-off notices last winter, and I couldn’t allow myself to get disconnected.”

Lutas said he chose to forgo his primary care visits and only keep his hospitalization insurance in order to afford to pay DTE. As he struggles to make payments, Lutas can’t help but think about how DTE continues to thrive financially.

“It is a problem which is more glaring considering that DTE is constantly posting a profit, a major profit,” he said.

Even as the pandemic upended lives in the Detroit area, DTE saw strong earnings in 2020 and 2021. Cash dividends paid out to investors in the electric company, bolstered by rate hikes, rose 76% from 2010 to 2020, to \$539 million. DTE’s financial success is important to everyone in the region, the utility argues, because it allows DTE to attract additional investors and borrow money at a lower financing cost.

Beyond its investor dividends, the health of the company’s finances is reflected in the pay of its top executive. CEO Jerry Norcia received a salary of \$1.2 million as part of total compensation of \$9.7 million in 2020, his first full year on the job. In every other year since 2017, the company’s compensation package for its CEO has topped \$10 million.

DTE Shut-offs Outpace Other Utilities’

When the pandemic began in 2020, causing a wave of medical and financial hardship, 34 states directed utilities to stop shutting off customers’ service, according to the National Association of Regulatory Utility Commissioners. But Michigan was not one of those, relying instead on voluntary pauses by the state’s utilities.

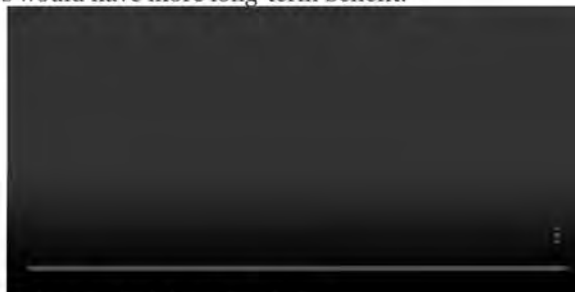
DTE’s shut-off moratorium was shorter than those put in place by the largest utilities in Illinois, Indiana, Minnesota, Ohio and Wisconsin.

MPSC chair Scripps defended the utility’s decision to limit its self-imposed moratorium to only three months in a [commentary](#) published in the Detroit Free Press in December 2020. Citing experience from Michigan’s recession in the early 2000s, Scripps said people who stop paying their bills during a longer moratorium might be unlikely to ever catch up. He argued that focusing instead on aggressively distributing assistance dollars would have more long-term benefit.

Consumers Energy, meanwhile, voluntarily extended its shut-off moratorium to eight months for most residential customers, through October 2020. The longer moratorium did not lead to more shut-offs once it ended, according to data filed by the company with the MPSC. Consumers’ shut-offs in 2021 were the third fewest for any year since 2013. Only 2016 and 2020 had fewer.

Looking back on its moratorium, Consumers said it did the right thing for its customers. “We believe our approach was the right one,” the utility said in an email, “as we did not want to add additional stress onto our customers during an already stressful time.”

The MPSC has required utilities to [file frequent reports](#) on shut-off numbers during COVID-19, every two weeks for the first few months of the pandemic and then every month since. But



Rebecca Mock for ProPublica

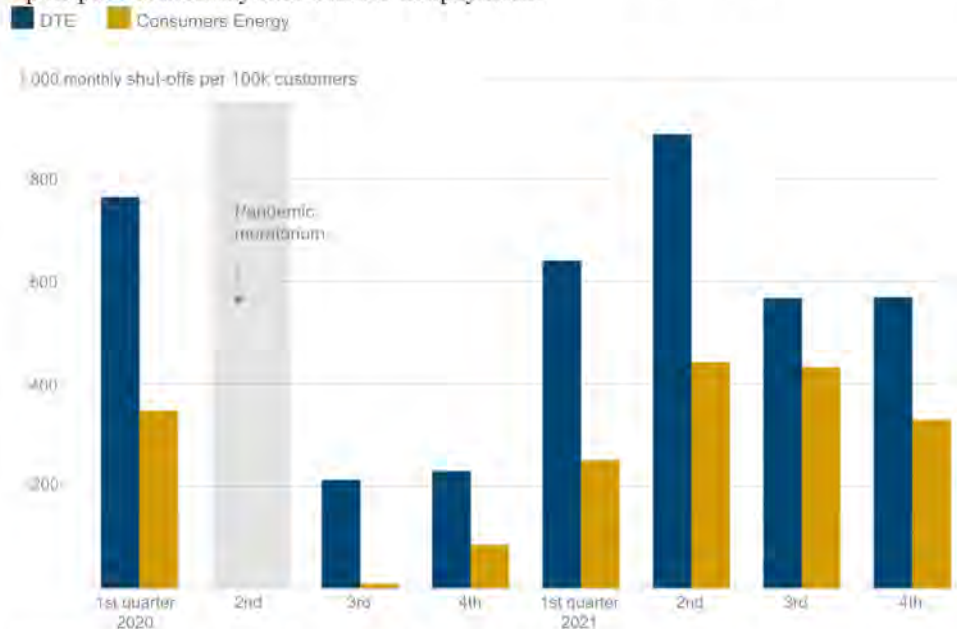
those reports only tally the number of people who remain shut off from electric, gas or both services at the end of each month-long period. Because these reports don't account for shut-offs where service was later reconnected, they underrepresent the true problem.

But Michigan utilities also file quarterly reports with the MPSC tallying every disconnection for nonpayment. Through examining these, a more complete picture of the breadth of shut-offs during the pandemic emerges.

The analysis by ProPublica and Outlier found that from April 2020 through December 2021, the last month for which data is available, DTE disconnected accounts 208,000 times for nonpayment. These reports contain numbers for both residential and commercial disconnections, but the preponderance are residential.

DTE Ramped Up Shut-offs Quickly After Moratorium End

Compared to the next biggest utility in the state, Consumers Energy, DTE quickly picked up its pace of monthly shut-offs for nonpayment.



Agnel Philip/ProPublica. Source: Michigan Public Service Commission.

Because of the way the MPSC collects its data, the analysis could calculate the total number of shut-offs, not the number of customers affected. A single customer might be disconnected more than once during a period of time. DTE, for instance, said that its 80,600 shut-offs in 2020 “represented approximately 66,000 unique customers.”

ProPublica and Outlier asked both DTE and Consumers for their company policies on what triggers a shut-off notice. Again, there was a clear difference.

DTE said it can begin the shut-off notification process after customers miss just one payment and fall more than \$100 behind on a bill. State law requires a shut-off notice be sent at least 10 days before an account is disconnected. In order to avoid shut-off, customers can pay their entire past due balance, agree to a payment plan or apply for assistance, which includes a shut-off hold during the application process.

“We offer them a range of options based on their circumstances: affordable payment plans, senior protections, medical holds and low-income assistance,” DTE said in an email. It added: “DTE acts leniently wherever possible within the MPSC’s rules.”

Consumers Energy said it also can start its notification process after customers miss just one bill, but only if they have fallen at least \$200 behind. If a late customer gets their balance owed below \$75, Consumers said, it won’t go through with the disconnection.

Both companies require customers who get disconnected for nonpayment to provide a deposit before getting reconnected. The deposit can be significant. Under Michigan regulations, the deposit can equal up to twice a customer’s average monthly bill; the fee is waived for anyone receiving utility assistance from the state to help them reconnect.

In 2020, aided by an influx of federal COVID-related assistance, the state helped more than 341,000 people across Michigan with energy costs ranging from bills to furnace repairs.

However, more than 40% of individuals who applied that year were rejected, usually because of income requirements, when they applied for that help. Some of the state’s relief programs also require a shut-off notice to qualify.

Detroit’s Heavy Burden

Cassia Haywood, who lives on Detroit’s West Side with her 11-year-old daughter, is quite familiar by now with what DTE shutoff notices look like: a letter marked by several thick red lines and plenty of bold red type.

For years, those letters have forced her to scramble to avoid losing electricity and gas-powered heat. In that very basic sense, her efforts were a success in 2021.

Thanks to payment plans with DTE and intermittent help from social service agencies, Haywood has managed to keep her electricity on. Payment plans can give people more time to pay off money owed to the company in affordable chunks, but some plans still allow the total debt to grow.

Her debt to DTE, built up over several years of gas and electric charges, now totals \$8,000, part of which will be added to her bill each month until she has paid it all down. It’s a debt she fears she may never pay off.

Haywood has an auto-assembly job but is only getting sporadic hours. “I’m just not getting ahead with it,” she said.

The financial pressures bearing down on Haywood and others reflect the energy burden faced by many Detroit residents: a household's energy costs, both electric and gas, divided by its income. Researchers and policy makers largely agree that an energy burden over 6% is unaffordable.

Haywood said she uses about \$200 of energy each month, making her burden about 10%. Because she also needs to pay hundreds of dollars toward her debt with DTE each month, the actual burden of her DTE bill is about 34% of her income. Sometimes a DTE bill for electricity and gas can rival housing costs.

"We pay so much, even on the payment plan," said Germaine Iwu, who lives with her husband and four children on the East Side of Detroit. Their typical monthly bill this year has been \$326 through their plan. "Our mortgage is only like \$400," she said.

A recent study by the American Council for an Energy Efficient Economy, a national nonprofit, put the median energy burden in the Detroit metro area at 10% for low-income families. That's higher than the national average and the third-highest among the metropolitan areas it studied, behind Baltimore and Birmingham.

This research found that 43% of Black and 38% of Latinx households in the Detroit metro area have an unaffordable energy burden. Researchers cite a combination of factors for these percentages, including higher energy usage because of older housing stock that is not energy-efficient.

A separate survey of more than 350 Detroit families — conducted over the winter of 2020 by Detroit nonprofit We Want Green Too and Kate Hutchens, a University of Michigan researcher— found their average energy burden was close to 16%, higher than that of the overall metro area.



her home in Detroit. Lowe runs We Want Green Too, a nonprofit that studied the energy burden in Detroit. Nick Hagen for ProPubl
Addressing the problem in Detroit won't be easy.

The National Consumer Law Center, which has extensively studied utility prices and regulation, advocates that states develop payment plans that are based on a percentage of income, eliminate deposits for reconnection and prohibit shut-offs for low-income households that include infants or people who are elderly or disabled. To get a clearer view of who is being impacted, the center also wants utility companies to provide more data about who is affected by shut-offs.

In Michigan, the MPSC has pushed utilities to experiment with percentage-of-income plans for some, but there seems to be little momentum for bigger changes. State Sen. Jeff Irwin, a Democrat from Ann Arbor, said regulators and legislators have been overly responsive to the utilities' desires for reliable investor payouts. For instance, Democrats have pushed legislation limiting shut-offs of water but not electricity.

Irwin said the legislature is too responsive to industry and "blind to the needs of residential affordability.

"The very specific conversation about helping people who can't pay their bills does not get a lot of play," he said.

DTE is currently pushing a different idea: a prepaid option it said would help low-income customers. Its reference in state filings to the struggles of customers who face shut-offs came as it urged the MPSC to endorse that proposal.

Under DTE's plan, people would prepay into an energy account, and if that account runs dry, the company would then use a "remote disconnect feature." Customers would need to make a minimum payment of \$40 to get their power restored, and the process would begin again.

"That is the thing that brings me closest to feeling like I'm living in a post-apocalyptic world," said Margrethe Kearney, a lawyer with the Environmental Law & Policy Center, which opposes the plan and has intervened in the still-undecided MPSC case.

"DTE has lots of reasons for wanting to do this. And they say, 'Well, you know, it'll help people manage their energy use. It'll keep people from racking up these \$3,000 bills.' But at the same time, it's like, what happens when it's the middle of a heatwave? And



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you don't have any money to put in your account?" Some activists want to fundamentally challenge the way low-income communities must rely on DTE. Advocacy from Soulardarity, an environmental justice group, has led to a pilot program, endorsed by MPSC, that will give hundreds of low-income residents in Highland Park, Detroit and River Rouge access to solar power and credits on their bills. Shimekia Nichols, the group's executive director, considers that a small step, if an insufficient one, toward a larger goal of independence from DTE's monopoly. "That is what energy democracy is about," she said. "It's what we have to do, because otherwise people are just going to keep needing help."

About the Data: How We Analyzed Shut-off Rates and Service Area Demographics

Outlier Media and ProPublica collected quarterly reports from the Michigan Public Service Commission that cataloged total disconnections of electric customers for nonpayment by month since 2013. The shut-off numbers do not separate out residential and non-residential customers. The news organizations then calculated average monthly shut-off rates during the pandemic by averaging the disconnections from April 2020 through the end of 2021, which was the most recent data available, and divided that by the average number of electric customers (residential and non-residential) reported by Michigan's investor-owned utilities to MPSC for 2020. Customer counts for 2021 were not available at the time of publication. We followed a similar method for calculating the average shut-off rate from 2013 through 2019, averaging the monthly customer count figures reported for each year as our base.

For our analysis of the customer demographics for Michigan's largest two utilities, we re-created an MPSC map of the electric service areas for DTE and Consumers Energy at the Census tract level, using 2010 boundaries. We then matched these tracts to Census data and calculated the percent of residents in each service area who are Black and the percent who are low-income, using the 2015-2019 five-year American Community Survey. We defined low-income percentage as the number of people at or below the poverty line divided by the total population, for each service area. We excluded tracts where the utilities appeared to only serve a portion of the total area.

Comparisons of average bills and rates per kilowatt-hour were based on data from the U.S. Energy Information Administration. Erin Smith, Alyssa Johnson and Alex Mierjeski contributed research.

Update, March 18, 2022: This story was updated to include the name of Chris Lamphear, a DTE spokesman.

PROPUBLICA
Ten Years After the Flint Water Crisis, Distrust and Anger Linger

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NOVEMBER 18, 2021

FACT SHEET: Biden Administration Deploys American Rescue Plan Funds to Protect Americans from Rising Home Heating Costs; Calls on Utility Companies to Prevent Shut Offs This Winter

*Unprecedented Funding and Partnerships with State, Local and Tribal
Governments to Protect Vulnerable Homeowners and Renters*

Today, the Biden-Harris Administration called on states, localities and tribes to plan early and coordinate across programs to effectively use historic American Rescue Plan resources to address home energy costs this winter. The White House also called on utility companies that receive public dollars to prevent devastating utility shut-offs this winter and help expedite the delivery of unprecedented federal aid.

The American Rescue Plan provides critical resources that states, localities and tribes can use to address home energy costs:

- **More than doubling available Low Income Home Energy Assistance Program (LIHEAP) funding:** The recent average annual funding for LIHEAP is \$3-4 billion, which typically serves 5 million households. The American Rescue Plan provided an additional \$4.5 billion available until September 2022.
- **Delivering Emergency Rental Assistance—unavailable in previous winters—to help cover utility bills:** First established last December—and provided an additional \$21.5 billion in funding by the American Rescue Plan—Emergency Rental Assistance (ERA) programs provide help with past-due utility bills or ongoing assistance with energy costs to help distressed renters avoid shut-offs and keep current on expenses. Even as most programs were just beginning to ramp up between January and June 2021, grantees made over 200,000 payments to support households with utility arrears and over 140,000 prospective utility payments.
- **Providing state, local and tribal governments additional resources to help energy-burdened middle-class families, including through the \$350 billion State & Local Fiscal Recovery Fund:** States and localities have the flexibility to use Fiscal Recovery Funds to help deliver energy relief to families, including for middle-class households that may not be eligible for programs directed to the lowest income consumers.

Today the White House called on Utilities and Energy Providers to Commit to Proactively Use Their Resources to Help

The Administration welcomed initial commitments from seven major utility companies including **DTE Energy, Eversource, Green Mountain Power, National Grid, NorthWestern Energy, Portland General Electric** and

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Vermont Gas, as well as the delivered fuel trade association **NEFI**, that all agreed to the following:

- **Identify Eligible Recipients:** Many utility companies already offer programs to help families in need. Utilities should proactively identify those who may be eligible for public benefits, such as LIHEAP and ERA, using financial hardship and other customer data. In order to help identify and prequalify customers for benefits, utilities can also use third-party data – such as whether a home is rented or owned and which census tract it is in – and data through partnership with government agencies including income or proxies, like eligibility for other programs. For example, in Connecticut, utilities are using third-party data to pre-qualify and contact customers, and share the results with state agencies to expedite energy assistance payments.
- **Directly Screen and Notify Potentially Eligible Recipients:** Utilities and energy providers should inform customers of energy assistance programs, screen customers for benefits eligibility, and facilitate referrals to available benefits programs prior to any shut-offs.
- **Expedite Assistance to Vulnerable Households:** Energy providers should be critical partners by proactively working to establish the processes and data-sharing relationships needed to speed benefits to their eligible customers as quickly as possible. For example, in Michigan, utilities work in partnership with the state to receive bundled payments on behalf of many customers at once, speeding processing and helping benefits quickly reach their customer's accounts. In South Carolina, utility companies receive a bulk payment from the state prior to the full satisfaction of application and documentation requirements that they can use to apply benefits to customers quickly.
- **No Shutoffs for Customers Applying for Financial Hardship Assistance:** Beyond state or local shut-off moratoria requirements, when utility companies are notified that a customer is applying for financial hardship assistance, including energy assistance benefits, they should commit to restore service or delay shut-off. For example, in Michigan, once a household applies for ERA utility benefits, the utility company places a hold on utility shut off. Utilities should also commit to provide at least 30 days' notice to all customers before a shut-off.
- **Facilitate Assistance to Delivered Fuel Customers:** In order to expedite benefits, providers of delivered fuels should commit to proactively notify families in distress of how to contact a state and local agency for assistance. Fuel providers with capacity should set up processes to facilitate referrals with customer permission. Fuel providers should prioritize deliveries to households approved for benefits, particularly where providers receive direct deposits credited to customer accounts prior to or immediately following delivery. Fuel providers with capacity should go even further by agreeing to deliver fuels to approved households through deferred payment or budgeting agreements.

Today the Administration also called on States, Localities and Tribes to:

Prepare Early to Distribute Expanded LIHEAP to More Families

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- **Strong and Effective Winter Plans**: The Administration is providing technical assistance to LIHEAP grantees to speed up state and local planning and program implementation for winter.
- **Quick and Automatic Distribution of Benefits**: HHS is urging grantees to consider expediting payments to households that have benefitted from LIHEAP in previous years and simplifying eligibility verification. This option will not be appropriate for all grantees, but some states have already shown it can work. For example, Maine and New York are providing automatic payments to households who have received benefits in the past.
- **Expanded Outreach to Newly Eligible Households**: HHS is urging grantees to consider additional outreach to households who need energy assistance for the first time this year. A significant number of households receive LIHEAP year after year, but as a result of the economic disruption of the pandemic and rising energy prices additional households are expected to need help. These households may be unfamiliar with how to access benefits, and grantees can help these families access the unprecedented LIHEAP resources available as well as refer to other benefits.
- **Coordination between LIHEAP, ERA and Other Programs**: Given differences in eligibility, HHS and Treasury are clarifying how grantees of LIHEAP and ERA can coordinate to quickly provide benefits to eligible households. Coordination ensures support can reach a greater number of households, including those who do not qualify for LIHEAP due to their household incomes, people on fixed incomes, the elderly, and others in need. These best practices include coordinating outreach to households, establishing regular communication with program leaders and energy providers, streamlining intake, and referring across programs as appropriate. For example, rental households not fully served by LIHEAP could be referred to ERA, and homeowners could be referred to LIHEAP. Where available, the Homeowners Assistance Fund may be able to serve middle-class homeowner households.

Use Emergency Rental Assistance to Aid Renters with Utility Costs

- **Provide Forward-Looking Assistance to Low-income Renters Facing High Energy Costs**: The Treasury Department is encouraging grantees to take advantage of the flexibility to provide forward-looking utility assistance payments over the next several months to low-income families facing high heating costs, including for those renters who rely on delivered fuels to heat their homes. ERA grantees may also cover arrears and related fees for utility bills dating back to the start of the pandemic.
- **Lower Burdens and Speed Assistance to Distressed Renters Through Collaboration between ERA Program Administrators and Utility Providers**: The Administration is facilitating cooperation between state and local governments and utility providers to identify customers at risk of energy insecurity and confirm household eligibility. To support this effort, the Treasury Department has issued guidance encouraging grantees to establish data sharing agreements and bulk payment methods with utility providers.

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- *Expedite Payments Through Partnerships with Non-Profits to Prevent the Loss of Utility Services:* When the rapid delivery of a payment could reasonably be necessary to prevent the loss of utility services, Treasury has provided grantees flexibility to partner with nonprofit organizations for the purpose of making immediate payments while a household's application is still being processed.
- *Increased Home Heating Costs Can Qualify Income-Eligible Households for Needed Assistance this Winter:* The Treasury Department is clarifying that elevated energy costs may be a form of COVID-19-related hardship that puts distressed renters at-risk of housing instability qualifying them for assistance with their utilities. Households can self-attest to experiencing both a COVID-related hardship and risk of housing instability based on significant increases in their home heating costs.

Use All Available Tools to Help Working and Middle-Class Families

- *State and Local Fiscal Recovery Fund Can Help Families Ineligible for Other Support:* States, localities and tribes can tap the \$350 billion allocated by the American Rescue Plan to provide additional relief on home heating costs, particularly to middle-class households. For example, Louisville has supported a utility relief fund that provides residents who have fallen behind on gas or electric bills a one-time credit of up to \$1,000.
- *\$10 Billion Homeowners Assistance Fund to help Distressed Homeowners Keep Up with Utility Bills:* Treasury is encouraging states, tribes and territories to utilize funds from this American Rescue Plan program to help cover home energy costs or prevent the loss of utilities this winter, including for hard-pressed middle-class families.
- *\$1 Billion Pandemic Emergency Assistance Fund:* The American Rescue Plan also created a new fund for states, territories and tribes of which a substantial portion remains and is available to provide cash or utility-specific assistance to needy families.

The Administration also Highlighted Additional Financial Support Helping Hard-Pressed Families with Energy Costs:

- *1/3 of Families Using Child Tax Credit for Utility Bills:* Thanks to the American Rescue Plan, the families of more than 61 million children are receiving expanded monthly Child Tax Credit payments up to \$300 per child and nearly a third used it to pay for utilities –including home energy costs – between July and October 2021.
- *Weatherization Assistance to Reduce Energy Costs:* The bipartisan Infrastructure Investment and Jobs Act invests a historic \$3.5 billion in the Department of Energy's Weatherization Assistance Program, reducing energy costs for more than 700,000 low-income households by increasing the energy efficiency of their homes.
- *\$100 million to Cover Rent and Utilities in Hard-Hit Rural Areas:* The American Rescue Plan is providing financial support through September 2022 to over 26,000 overburdened rural households living in multi-family housing financed by the U.S. Department of Agriculture.

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- *Preventing Families from Choosing “Heat or Eat”*: More low-income children and families face hunger when energy prices rise during winter as higher home heating costs eat up family budgets. The Biden-Harris Administration increased Supplemental Nutrition Assistance Program (SNAP) benefits on October 1 by an average of \$36.24 per month, which will help to prevent this cruel tradeoff between heat and food this winter.

###

customer_grp	date	enrollments
total	1/1/2020	419
total	2/1/2020	400
total	3/1/2020	332
low_income	1/1/2020	315
low_income	2/1/2020	311
low_income	3/1/2020	257
seniors	1/1/2020	119
seniors	2/1/2020	95
seniors	3/1/2020	84
total	4/1/2020	230
total	5/1/2020	144
total	6/1/2020	105
low_income	4/1/2020	167
low_income	5/1/2020	91
low_income	6/1/2020	63
seniors	4/1/2020	57
seniors	5/1/2020	43
seniors	6/1/2020	35
total	7/1/2020	88
total	8/1/2020	74
total	9/1/2020	71
low_income	7/1/2020	48
low_income	8/1/2020	28
low_income	9/1/2020	24
seniors	7/1/2020	31
seniors	8/1/2020	29
seniors	9/1/2020	29
total	10/1/2020	58
total	11/1/2020	80
total	12/1/2020	138
low_income	10/1/2020	16
low_income	11/1/2020	26
low_income	12/1/2020	71
seniors	10/1/2020	26
seniors	11/1/2020	45
seniors	12/1/2020	57
total	1/1/2021	205
total	2/1/2021	226
total	3/1/2021	206
low_income	1/1/2021	124
low_income	2/1/2021	162
low_income	3/1/2021	145
seniors	1/1/2021	80
seniors	2/1/2021	62
seniors	3/1/2021	52
total	4/1/2021	107

total	5/1/2021	105
total	6/1/2021	82
low_income	4/1/2021	79
low_income	5/1/2021	75
low_income	6/1/2021	53
seniors	4/1/2021	24
seniors	5/1/2021	24
seniors	6/1/2021	21
total	7/1/2021	64
total	8/1/2021	54
total	9/1/2021	46
low_income	7/1/2021	40
low_income	8/1/2021	31
low_income	9/1/2021	23
seniors	7/1/2021	17
seniors	8/1/2021	16
seniors	9/1/2021	16
total	10/1/2021	43
total	11/1/2021	97
total	12/1/2021	117
low_income	10/1/2021	20
low_income	11/1/2021	47
low_income	12/1/2021	69
seniors	10/1/2021	16
seniors	11/1/2021	50
seniors	12/1/2021	47
total	1/1/2022	242
total	2/1/2022	293
total	3/1/2022	301
low_income	1/1/2022	159
low_income	2/1/2022	198
low_income	3/1/2022	170
seniors	1/1/2022	70
seniors	2/1/2022	80
seniors	3/1/2022	114
total	4/1/2022	282
total	5/1/2022	234
total	6/1/2022	195
low_income	4/1/2022	141
low_income	5/1/2022	108
low_income	6/1/2022	83
seniors	4/1/2022	128
seniors	5/1/2022	114
seniors	6/1/2022	105
total	7/1/2022	153
total	8/1/2022	121
total	9/1/2022	101

low_income	7/1/2022	59
low_income	8/1/2022	42
low_income	9/1/2022	34
seniors	7/1/2022	88
seniors	8/1/2022	74
seniors	9/1/2022	60
total	10/1/2022	82
total	11/1/2022	337
total	12/1/2022	952
low_income	10/1/2022	26
low_income	11/1/2022	232
low_income	12/1/2022	766
seniors	10/1/2022	48
seniors	11/1/2022	104
seniors	12/1/2022	181
total	1/1/2023	1256
total	2/1/2023	1305
total	3/1/2023	961
low_income	1/1/2023	997
low_income	2/1/2023	1033
low_income	3/1/2023	731
seniors	1/1/2023	232
seniors	2/1/2023	233
seniors	3/1/2023	196
total	4/1/2023	690
total	5/1/2023	525
total	6/1/2023	425
low_income	4/1/2023	497
low_income	5/1/2023	355
low_income	6/1/2023	269
seniors	4/1/2023	143
seniors	5/1/2023	121
seniors	6/1/2023	107
total	7/1/2023	332
total	8/1/2023	275
total	9/1/2023	237
low_income	7/1/2023	188
low_income	8/1/2023	144
low_income	9/1/2023	103
seniors	7/1/2023	83
seniors	8/1/2023	75
seniors	9/1/2023	55
total	10/1/2023	214
total	11/1/2023	149
total	12/1/2023	270
low_income	10/1/2023	77
low_income	11/1/2023	102

low_income	12/1/2023	184
seniors	10/1/2023	47
seniors	11/1/2023	47
seniors	12/1/2023	46

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-1.2b

Respondent: J. E. Sparks

Page: 1 of 1

- Question:** 2. Please provide copies of no less than ten (10) but no more than thirty (30) actual shutoff notices sent to residential customers of DTE since June 2023, with any personally identifiable information redacted as necessary. Indicate on these documents which information is generic to all customers who receive a notice and which information is specific to individual customers. To the extent that DTE issues shutoff notices to customers under different facts or circumstances pertaining to the individual customer, please ensure that the documents provided are illustrative of these differences. Of these documents, please provide at least three from the months of December 2023 or January 2024.
- b. For each shutoff notice, please explain what the specific customer could have done to avoid shutoff.

Answer: Residential customer bills contain information on what customers can do to avoid any pending shut off including pathways to energy assistance as shown below, in compliance with the Billing Practice Rules. See attachment for sample invoices: "U-21291 FLODG-1 2.a 10 Sample Residential Invoices"

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.1a

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please refer to the Company's webpage on BudgetWise billing. (available at https://www.dteenergy.com/us/en/business/billing-and-payments/payment-programs/bwb.html#:~:text=Our%20free%20BudgetWise%20Billing%C2%AE,re%20not%20already%20logged%2Din.)).

a. On the BudgetWise webpage, the Company appears to calculate customers' Estimated Monthly Payment by taking the annual bill from the previous year and divide it by 12. Is this how the Company calculates monthly payments under the BudgetWise program? If yes, does this methodology change when a customer enrolls in the middle of the year? If so, how?

Answer: Yes, that is how the Company calculates monthly BudgetWise Billing Program payments. The calculation is consistent regardless of the time of program enrollment. If the customer has not been at the same premise for 12 months, see answer to question 4.1c for the protocol.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.1b

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please refer to the Company's webpage on BudgetWise billing. (available at <https://www.dteenergy.com/us/en/business/billing-and-payments/payment-programs/bwb.html#:~:text=Our%20free%20BudgetWise%20Billing%C2%AE,re%20not%20already%20logged%2Din.>).

b. Please describe how this program is advertised to customers.

Answer: The BudgetWise Billing Program is advertised in the Rights and Responsibilities guide which is distributed as part of the new customer welcome mailing. On occasion, BudgetWise Billing may also be included in eBlasts or Customer Connection emails when advertising other company-offered programs. See attached examples from previous mailings.

Attachment: U-21291 FLODG-4.1b 01 Rights and Responsibilities Brochure _BWB insert
U-21291 FLODG-4.1b 02 New Customer Eblast

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.1c

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please refer to the Company's webpage on BudgetWise billing. (available at <https://www.dteenergy.com/us/en/business/billing-and-payments/payment-programs/bwb.html#:~:text=Our%20free%20BudgetWise%20Billing%C2%AE,re%20not%20already%20logged%2Din.>).

c. May a customer that is new to DTE Gas enroll in BudgetWise? If yes, please describe which sample twelve (12) months the Company would use to calculate that new customer's bill or otherwise how the Company would calculate a new customer's bill.

Answer: Yes, all new customers that meet eligibility are eligible to enroll in the BudgetWise Billing Program. However, if the customer has not established 12 months of premise history, the customer is advised that the previous premise history will be utilized to establish a budget plan amount for that customer, which could be lower or higher than what their actual usage may be. Therefore, we encourage the customer to establish 12 months of history at the premise based on their own usage history for a more accurate plan amount.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.1d

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please refer to the Company's webpage on BudgetWise billing. (available at <https://www.dteenergy.com/us/en/business/billing-and-payments/payment-programs/bwb.html#:~:text=Our%20free%20BudgetWise%20Billing%C2%AE,re%20not%20already%20logged%2Din.>).

d. On the BudgetWise webpage, the Company states "We review your energy usage every three months to determine if your monthly amount needs to be adjusted." What formula or methodology does the Company use to determine adjustments to a bill during quarterly review?

Answer: Every three months, the Company uses the last rolling-12 months of the customer's energy usage to determine if they are using more or less energy as compared to the last quarterly adjustment amount. If their average usage has increased or decreased by 10%, the customer's BudgetWise Billing plan amount will be adjusted accordingly.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.1e

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please refer to the Company's webpage on BudgetWise billing. (available at <https://www.dteenergy.com/us/en/business/billing-and-payments/payment-programs/bwb.html#:~:text=Our%20free%20BudgetWise%20Billing%C2%AE,re%20not%20already%20logged%2Din.>).

e. How does the methodology of determining any overcharge or undercharge during the settlement month differ from quarterly review?

Answer: The quarterly adjustment review process reviews the customer's premise usage for the last rolling-12 months to establish the plan amount for the upcoming 3 months. During the settlement process, a calculation is made to compare the difference between the customer's actual usage in the last 12 months and what they paid during the last 12 months of their plan.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.1f

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please refer to the Company's webpage on BudgetWise billing. (available at <https://www.dteenergy.com/us/en/business/billing-and-payments/payment-programs/bwb.html#:~:text=Our%20free%20BudgetWise%20Billing%C2%AE,re%20not%20already%20logged%2Din.>).

f. What happens to a customer who is enrolled in the BudgetWise program but is unable to meet the settled difference if the program undercharged?

Answer: During the settlement month, if the customer has a debit balance owing, the balance will have to be paid by the settlement due date. If the customer is unable to pay the balance by the due date, the customer will not automatically be re-enrolled in the BudgetWise Billing Program.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.2

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please provide a copy of any emails, flyers, transcripts of phone calls, billboards, or any other means of advertisement the Company uses to inform customers about BudgetWise billing.

Answer: The Company does not make outbound marketing calls to customers to promote the BudgetWise Billing Program. See response to FLODG-4.1b.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.3a

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please enumerate all means by which a customer may:
a. Enroll in the BudgetWise program.

Answer: The customer can enroll by calling the Contact Center or by enrolling in the Web or Mobile App.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.3b

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please enumerate all means by which a customer may:
b. Opt-out of the BudgetWise program.

Answer: The customer can un-enroll by calling the Contact Center or by unenrolling in the Web or Mobile App.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.4a

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please provide a copy of all recordings, transcripts, and all other documentation of phone calls placed to DTE's customer service department in the last 6 months wherein:

a. A customer inquired about the amount owed after a quarterly adjustment.

Answer: DTE Gas objects for the reason that the request is unduly burdensome and overly broad as the information does not exist in the form requested and would take a disproportionate amount of time to compile. DTE Gas further objects to the extent that the information requested is not relevant or proportional to the needs of the case. Without waiving said objection and subject thereto, the Company's ability to categorize calls to our Contact Center is currently designed to categorize customer calls at the BudgetWise Billing Program level in an automated and consistent way; however, our automated call categorization process does not categorize calls at the level of granularity requested.

Attachment: None.

Co-Respondent(s): Legal

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.4b

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please provide a copy of all recordings, transcripts, and all other documentation of phone calls placed to DTE's customer service department in the last 6 months wherein:

b. A customer complained about the amount owed after a quarterly adjustment.

Answer: DTE Gas objects for the reason that the request is unduly burdensome and overly broad as the information does not exist in the form requested and would take a disproportionate amount of time to compile. DTE Gas further objects to the extent that the information requested is not relevant or proportional to the needs of the case. Without waiving said objection and subject thereto, the Company's ability to categorize calls to our Contact Center is currently designed to categorize customer calls at the BudgetWise Billing Program level in an automated and consistent way; however, our automated call categorization process does not categorize calls at the level of granularity requested.

Attachment: None.

Co-Respondent(s): Legal

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.4c

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please provide a copy of all recordings, transcripts, and all other documentation of phone calls placed to DTE's customer service department in the last 6 months wherein:

c. A customer inquired about the amount owed after a settlement month.

Answer: DTE Gas objects for the reason that the request is unduly burdensome and overly broad as the information does not exist in the form requested and would take a disproportionate amount of time to compile. DTE Gas further objects to the extent that the information requested is not relevant or proportional to the needs of the case. Without waiving said objection and subject thereto, the Company's ability to categorize calls to our Contact Center is currently designed to categorize customer calls at the BudgetWise Billing Program level in an automated and consistent way; however, our automated call categorization process does not categorize calls at the level of granularity requested.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.4d

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please provide a copy of all recordings, transcripts, and all other documentation of phone calls placed to DTE's customer service department in the last 6 months wherein:

d. A customer complained about the amount owed after a settlement month.

Answer: DTE Gas objects for the reason that the request is unduly burdensome and overly broad as the information does not exist in the form requested and would take a disproportionate amount of time to compile. DTE Gas further objects to the extent that the information requested is not relevant or proportional to the needs of the case. Without waiving said objection and subject thereto, the Company's ability to categorize calls to our Contact Center is currently designed to categorize customer calls at the BudgetWise Billing Program level in an automated and consistent way; however, our automated call categorization process does not categorize calls at the level of granularity requested.

Attachment: None.

Co-Respondent(s): Legal

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.5a

Respondent: J. E. Sparks

Page: 1 of 1

Question: Refer to the Company's Discovery Response in FLODG-1.2a. There, the Company provided examples of shutoff notices. On the shutoff notices provided, the Company included the following disclaimer: "NOTICE: In accordance with MPSC rule 460.111a, you may be required to pay a deposit to continue energy service if two or more shut-off notices are issued in a 12-month period. Paying your bill by the due date will avoid the assessment of a deposit."

a. What is DTE's process for determining the amount of deposit required for a customer to reconnect to service once the minimum payment, reconnection, and late fees have been paid?

Answer: The Company refers to the MPSC Rules to determine the amount of deposit required for a customer. The specific rules for residential deposits in section "R460.111 General deposit conditions for residential customers." are listed below:

- Rule 11(1)(a)
- Rule 11 (1)(b)
- Rule 11 (3)
- Rule 11(4)

Attachment: None

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.5b

Respondent: J. E. Sparks

Page: 1 of 1

Question: Refer to the Company's Discovery Response in FLODG-1.2a. There, the Company provided examples of shutoff notices. On the shutoff notices provided, the Company included the following disclaimer: "NOTICE: In accordance with MPSC rule 460.111a, you may be required to pay a deposit to continue energy service if two or more shut-off notices are issued in a 12-month period. Paying your bill by the due date will avoid the assessment of a deposit."

b. Does DTE ever require new customers to pay a deposit? Please answer for both customers that have never had an account with DTE as well as customers that have had an account but have moved to a different address.

Answer: The Company considers customers who have not had previous service with DTE to be new customers. An applicant that requests service for the first time may be assessed a deposit if the following conditions exist:

- Applicant declines to provide at least 1 acceptable form of Positive ID at the time of application
- Applicant misrepresents their identity at the time of application, or Applicant has engaged in and was found to be the responsible party for unauthorized use of utility service or unauthorized use of another person's personal identification without their permission to obtain utility service

The Company does not consider customers who have had previous service and have moved to a different address to be new customers. If these customers have an unpaid balance at the previous address and the balance remains unpaid after the due date on the final bill, the Company will ask for payment of that balance as well as a deposit before service can be turned on.

Attachment: None

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.5c

Respondent: J. E. Sparks

Page: 1 of 1

Question: Refer to the Company's Discovery Response in FLODG-1.2a. There, the Company provided examples of shutoff notices. On the shutoff notices provided, the Company included the following disclaimer: "NOTICE: In accordance with MPSC rule 460.111a, you may be required to pay a deposit to continue energy service if two or more shut-off notices are issued in a 12-month period. Paying your bill by the due date will avoid the assessment of a deposit."

c. If the answer to question 5b is yes, what is DTE's process for determining the amount of any deposit required for new customers, and how is it distinct (if at all) from the Company's process for customers with a history of, for example, twelve (12) or more months of gas service with the Company?

Answer: Refer to the answer in question FLODG-4.5a.

Attachment: None

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.5d

Respondent: J. E. Sparks

Page: 1 of 1

Question: Refer to the Company’s Discovery Response in FLODG-1.2a. There, the Company provided examples of shutoff notices. On the shutoff notices provided, the Company included the following disclaimer: “NOTICE: In accordance with MPSC rule 460.111a, you may be required to pay a deposit to continue energy service if two or more shut-off notices are issued in a 12-month period. Paying your bill by the due date will avoid the assessment of a deposit.”

d. Michigan Administrative Code Rule 460.111a(4) states: “A utility may retain a deposit for nonresidential service until the customer accrues a record of 12 continuous months of bill payment on or before the due date.” Please provide the number of residential customers for which DTE retained a deposit for each year between 2020 and 2023.

Answer:

Year	Residential Gas Customer Deposits
2020	15,208
2021	21,994
2022	30,182
2023	23,088

Attachment: None

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.5e

Respondent: J. E. Sparks

Page: 1 of 1

Question: Refer to the Company's Discovery Response in FLODG-1.2a. There, the Company provided examples of shutoff notices. On the shutoff notices provided, the Company included the following disclaimer: "NOTICE: In accordance with MPSC rule 460.111a, you may be required to pay a deposit to continue energy service if two or more shut-off notices are issued in a 12-month period. Paying your bill by the due date will avoid the assessment of a deposit."

e. What is the total dollar value of the residential customer deposits that DTE retained for each year between 2020 and 2023?

Answer:

Year	Gas Residential Gas Customer Deposits
2020	\$2,886,183
2021	\$5,014,252
2022	\$6,129,200
2023	\$5,119,436

Attachment: None

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.5f

Respondent: J. E. Sparks

Page: 1 of 1

Question: Refer to the Company's Discovery Response in FLODG-1.2a. There, the Company provided examples of shutoff notices. On the shutoff notices provided, the Company included the following disclaimer: "NOTICE: In accordance with MPSC rule 460.111a, you may be required to pay a deposit to continue energy service if two or more shut-off notices are issued in a 12-month period. Paying your bill by the due date will avoid the assessment of a deposit."

f. Michigan Administrative Code Rule 460.105 states: "A utility may adopt additional rules governing relations with its customers that are reasonable and necessary and that are consistent with these rules. The utility's rules shall be an integral part of its tariffs . . ." Please provide a copy of the text of the Company's tariff that specifically addresses any rules or guidelines related to residential customer deposits or credits.

Answer: DTE Gas's rate book incorporates the administrative code rules by reference in section B of its rate book. DTE does not provide any other information about residential customer deposits in its tariffs. The reference can be found on Sheet No. B-4.00 of DTE Gas's rate book.

[Link to DTE Gas's Rate Book](#)

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.6a

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please provide a breakdown of the distribution of residential customer deposit amounts for each year between 2020 and 2023. Please provide all of the following information that is available:
a. Median deposit;

Answer:

Year	Median dollar of deposits
2020	\$156
2021	\$181
2022	\$138
2023	\$147

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.6b

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please provide a breakdown of the distribution of residential customer deposit amounts for each year between 2020 and 2023. Please provide all of the following information that is available:
b. Deposit amounts by decile;

Answer: See table below for the requested dollar value of deposits broken out by deciles. In reading the table, please note the deciles indicate the volume of deposits in each year that were less than or equal to the dollar amounts shown by decile. For example, at the 1st decile, 90% of deposits in 2020 were less than or equal to \$347.

Decile / Mean	Description	2020	2021	2022	2023
1	90% of deposits	≤\$347	≤\$418	≤\$414	≤\$440
2	80% of deposits	≤\$274	≤\$328	≤\$325	≤\$360
3	70% of deposits	≤\$210	≤\$272	≤\$266	≤\$300
4	60% of deposits	≤\$174	≤\$219	≤\$194	≤\$226
5	50% of deposits	≤\$157	≤\$181	≤\$138	≤\$147
6	40% of deposits	≤\$137	≤\$155	≤\$96	≤\$102
7	30% of deposits	≤\$115	≤\$127	≤\$89	≤\$98
8	20% of deposits	≤\$89	≤\$98	≤\$74	≤\$91
9	10% of deposits	≤\$49	≤\$47	≤\$42	≤\$69
Mean	Mean dollar amount of deposits	\$190	\$228	\$203	\$229

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.6c

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please provide a breakdown of the distribution of residential customer deposit amounts for each year between 2020 and 2023. Please provide all of the following information that is available:
c. Deposit amounts by quintile; and

Answer: Quintile data can be obtained in the response to question FLODG-4.6b. It would be Deciles 2, 4, 6 and 8 in the table.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.6d

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Please provide a breakdown of the distribution of residential customer deposit amounts for each year between 2020 and 2023. Please provide all of the following information that is available:
d. Deposit amounts by quartile.

Answer: See table below for the requested dollar value of deposits broken out by quartiles. In reading the table, please note the quartiles indicate the volume of deposits in each year that were less than or equal to the dollar amounts shown by quartile. For example, at the 1st quartile, 75% of deposits in 2020 were less than or equal to \$238.

Quartile / Mean	Description	2020	2021	2022	2023
1	75% of deposits	≤\$238	≤\$300	≤\$298	≤\$226
2	50% of deposits	≤\$156	≤\$181	≤\$138	≤\$102
3	25% of deposits	≤\$103	≤\$112	≤\$86	≤\$91
Mean	Mean dollar amount of deposits	\$190	\$228	\$203	\$229

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.7

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Michigan Administrative Code Rule 460.111a governs “[g]eneral deposit conditions for residential customers” as part of Michigan’s “Consumer Standards and Billing Practices for Electric and Gas Residential Service.” Under Rule 460.111a, the Company may “require a deposit as a condition of restoring service” within certain limits. See Mich. Admin. Code R. 460.111a(7). The Company must also abide by certain deposit requirements “within the last 6 years.” See Mich. Admin. Code R. 460.111a(5). Please provide the number and total value of interest payments DTE has paid, by year, on these deposits, between January 2018 and December 2023.

Answer: The Company has total value paid:

Gas Residential Service:

- 2018: \$259,985
- 2019: \$298,759
- 2020: \$206,436
- 2021: \$242,764
- 2022: \$358,445
- 2023: \$408,232

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.8ai

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Regarding residential customer deposits and interest payments:
a. Does DTE track customer deposits and interest payments by any of the following characteristics?
i. Location (e.g., county, zip code, census tract);

Answer: The Company does not track deposits by location.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.8a

Respondent: M. J. Hatsios

Page: 1 of 1

- Question:** Regarding residential customer deposits and interest payments:
- a. Does DTE track customer deposits and interest payments by any of the following characteristics?
 - ii. Enrollment in:
 - 1. Energy assistance programs;
 - 2. Energy waste reduction programs (EWR);
 - 3. Affordable payment programs (APP); or
 - 4. Other rates or credits specifically available to low-income customers;

Answer: The Company does not track deposits by energy assistance programs, EWR, APP, or other rates or credits specifically available to low-income customers.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.8aiii

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Regarding residential customer deposits and interest payments:
a. Does DTE track customer deposits and interest payments by any of the following characteristics?
iii. Low-income status; or

Answer: The Company does not assess deposits and interest payments for low-income customers.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.8aiv

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Regarding residential customer deposits and interest payments:
a. Does DTE track customer deposits and interest payments by any of the following characteristics?
iv. Whether customers are ages sixty-five (65) or older.

Answer: The Company does not track deposits by the customer's age.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.8b

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Regarding residential customer deposits and interest payments:
b. If the answer to any of the above questions in 8a is yes, please provide associated data and reports for each year between 2020 and 2023.

Answer: Not applicable since the answers to the previous responses are, No.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.9ai

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Regarding DTE's analysis of any deposits and interest payments resulting from a disconnection:

- a. Can DTE's existing software produce reports to assess deposits and interest payments by a customer's:
 - i. Location (e.g., county, zip code, census tract);

Answer: No, current reports that exist do not report deposits and interest payments by location.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.9aⁱⁱ

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Regarding DTE's analysis of any deposits and interest payments resulting from a disconnection:

a. Can DTE's existing software produce reports to assess deposits and interest payments by a customer's:

ii. Enrollment in:

1. Energy assistance programs;
2. Energy waste reduction programs (EWR);
3. Affordable payment programs (APP); or
4. Other rates or credits specifically available to low-income customers;

Answer: No, current reports that exist do not report deposits and interest payments by energy assistance, EWR, APP, or other rates and credits specifically available to low-income customers. Additionally the Company does not assess deposits on low-income customers.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.9aⁱⁱⁱ

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Regarding DTE's analysis of any deposits and interest payments resulting from a disconnection:

- a. Can DTE's existing software produce reports to assess deposits and interest payments by a customer's:
- iii. Low-income status; or

Answer: The Company does not assess deposits on low-income customers.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.9aiv

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Regarding DTE's analysis of any deposits and interest payments resulting from a disconnection:

- a. Can DTE's existing software produce reports to assess deposits and interest payments by a customer's:
- iv. Whether customers are ages sixty-five (65) or older.

Answer: No, current reports that exist do not report deposits and interest payments by a customer's age.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.9b

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Regarding DTE's analysis of any deposits and interest payments resulting from a disconnection:
b. If the answer to question 9a is yes, please provide a copy of any reports or data analysis completed by the Company in the last five (5) years.

Answer: Not applicable.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.10

Respondent: M. J. Hatsios

Page: 1 of 1

Question: As required by Michigan Administrative Code Rule 460.111a(13), utilities must provide an applicant or customer with a “receipt for the deposit and instructions regarding how a person who is entitled to the return of his or her deposit may obtain the deposit.” Please provide no less than ten (10) and no more than thirty (30) examples of written customer receipts for deposits and the instructions regarding how a customer who is entitled to a return of their deposit may obtain the deposit. Any confidential customer information should be redacted as necessary.

Answer: See attachment for response.

Attachment: U-21291 FLODG-4.10 Receipts for Deposits

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.11a

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Michigan Administrative Code Rule 460.111a(5) states: "A utility shall pay interest at the rate of 5% per annum on all deposits for nonresidential service. A utility shall credit interest semiannually to the customer's service account or pay it upon the return of the deposit, whichever occurs first." Michigan Administrative Code Rule 460.111(a)(9) also states: "The utility shall make reasonable efforts to locate customers due unclaimed deposits and credits for nonresidential service."

a. Describe the Company's efforts to locate customers with unclaimed credits.

Answer: After an account is closed and the final bill is produced, the Company will wait 60 days before issuing a refund in case the customer moves into a new address. If the customer moves into a new address within the 60 days, we will balance transfer the credit to their new account. If the 60 days have gone by and the customer has not moved into a new address, DTE will issue a refund check and send it to the mailing address on record. If the check is returned, the credit will be re-instated to the customer's account and the escheatment team will manage the next steps as it relates to unclaimed deposit credits.

The Michigan Uniform Unclaimed Property Act includes the escheatment rules for uncashed checks/credits on accounts for non-municipal utility refunds. When credits approach the 3-year dormancy period, a letter is sent to customers to try to verify mailing address as part of external due diligence, and for those customers that reply and verify their information, a check is issued. For those that do not reply, the funds are escheated to the State of Michigan.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.11b

Respondent: M. J. Hatsios

Page: 1 of 1

Question: Michigan Administrative Code Rule 460.111a(5) states: "A utility shall pay interest at the rate of 5% per annum on all deposits for nonresidential service. A utility shall credit interest semiannually to the customer's service account or pay it upon the return of the deposit, whichever occurs first." Michigan Administrative Code Rule 460.111(a)(9) also states: "The utility shall make reasonable efforts to locate customers due unclaimed deposits and credits for nonresidential service."

b. Provide the number and dollar amount of unclaimed credits that DTE is holding, organized by the year in which DTE recorded them as unclaimed.

Answer: The Company does not track deposits separately from other recorded unclaimed credit types, so this information is not available.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.12a

Respondent: J. E. Sparks

Page: 1 of 1

Question: In Discovery Response FLODG-1.16, Witness Sparks states that “Grad Percentage” is equal to the number of “Graduates” divided by those “Eligible for Graduation.”

a. Refer to the table titled “Table 2 LSP Graduate Metrics,” which was also provided in Discovery Response FLODG-1.16. Please describe the meaning of the column “Enrolled”?

Answer: “Enrolled” refers to customers who were actively participating in the Low-Income Self Sufficiency Plan (LSP).

Attachment: None

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.12b

Respondent: J. E. Sparks

Page: 1 of 1

Question: In Discovery Response FLODG-1.16, Witness Sparks states that “Grad Percentage” is equal to the number of “Graduates” divided by those “Eligible for Graduation.”

b. Based on “Table 2 LSP Graduate Metrics” in FLODG-1.16, it appears that 26,097 customers were enrolled in Low-Income Self-Sufficiency Plan (LSP) in 2021-22 and that 7,578 were eligible for graduation. What is the status of the remaining 18,519 customers who are not included as “Eligible for Graduation”?

Answer: The 18,519 customers not eligible for graduation would be customers defined as any of the following:

- new enrollments,
- carryovers from the previous fiscal year that have more than 12 months remaining on their plan,
- enrollments that may have fallen off before graduation.

Attachment: None

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.13

Respondent: J. E. Sparks

Page: 1 of 1

Question: In Discovery Response FLODG-1.2a FLO requested a minimum of ten (10) residential shutoff notices. However, it appears that the Company provided only five (5) residential shutoff notices (and five (5) commercial notices). Please provide five additional residential shutoff notice examples.

Answer: See attachment for response.

Attachment: U-21291 FLODG-4.13 Updated Sample Residential Invoices

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.14

Respondent: E. D. Janness

Page: 1 of 1

Question: Regarding the Company's Gas Renewal Program (GRP), the Company states in its Gas Delivery Plan that it's "beginning to look at how it can be more intentional about prioritizing EEJ throughout this work, by considering EEJ as a factor for project selection." Exhibit A-12, Schedule B5.6, at 39. Please provide a spreadsheet or another relevant data file type showing line replacements completed by the GRP between 2011–2023 by zip code (or similar geographic unit) and year.

Answer: All historical GRP data from 2011-2023 can be found in our annual IRM reports filed with the MPSC and digitally available on their website. The main renewal section of the report will detail main replacements and services by project and municipality.

Attachment: None

FLO JS Workpaper 7

Year	# Residential Gas Deposits	\$ Residential Gas Deposits	Median Deposit / Customer	Average (Mean) Deposit / Customer	Total annual bill	80th percentile deposit	Annual bill	# customers	% all deposits (\$)	90th percentile deposit	Annual bill	# customers	% all deposits (\$)
2020	15,208	\$2,886,183	\$156	\$189.78	\$1,138.68	\$274	\$1,644	3042	28.9%	\$347	\$2,082	1521	18.3%
2021	21,994	\$5,014,252	\$181	\$227.98	\$1,367.90	\$328	\$1,968	4399	28.8%	\$418	\$2,508	2199	18.3%
2022	30,182	\$6,129,200	\$138	\$203.07	\$1,218.45	\$325	\$1,950	6036	32.0%	\$414	\$2,484	3018	20.4%
2023	23,088	\$5,119,436	\$147	\$221.74	\$1,330.41	\$360	\$2,160	4618	32.5%	\$440	\$2,640	2309	19.8%
AVERAGE	22,618	\$4,787,267.75	\$155.50	\$210.64	\$1,263.86	\$321.75	\$1,956.53	4524	30.4%	\$404.75	\$2,462.07	2262	19.1%
% Inc, 2020-23	51.8%	77.4%	-5.8%	16.8%	16.8%	31.4%	31.4%	51.8%	12.5%	26.8%	26.8%	51.8%	8.5%
Avg % Inc / Yr	17.3%	25.8%	-1.9%	5.6%	5.6%	10.5%	10.5%	17.3%	4.2%	8.9%	8.9%	17.3%	2.8%

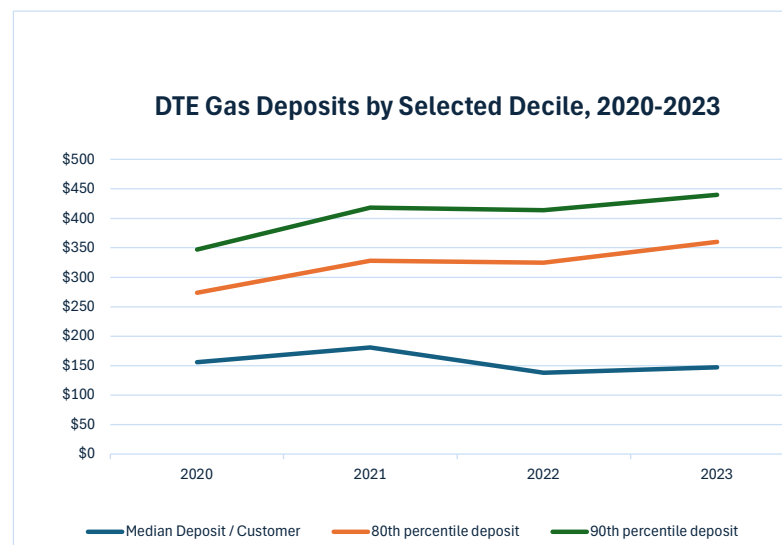
Year	Interest Returned	Deposit returned	vs deposit collected
2018	\$259,985	\$5,199,700	
2019	\$298,759	\$5,975,180	
2020	\$206,436	\$4,128,720	\$1,242,537
2021	\$242,764	\$4,855,280	(\$158,972)
2022	\$358,445	\$7,168,900	\$1,039,700
2023	\$408,232	\$8,164,640	\$3,045,204

Data Sources:

U-21291 DTE Responses to Frontline Organizations Fourth Discovery Request -- FLODG

FLODG-4.5d, 4.5e, 4.6a, 4.6b, 4.7

29-Apr-24



Federal Po	Total Avg.	Electricity	Gas Avg.	A Other Avg.	Electric sh	Gas share	Total Hous	Total Energy Expense	Total Gas Expense	Total Electric Expense	Average gas share of energy burden share, all income levels
0%-100%	\$2,259	\$1,399	\$847	\$13	61.90%	37.50%	238,924	\$539,729,316	\$202,368,628	\$334,254,676	37.30%
100%-150%	\$2,217	\$1,380	\$821	\$16	62.20%	37.00%	150,952	\$334,660,584	\$123,931,592	\$208,313,760	

Data source:

DOE LEAD Tool; most recent version; filtered for State of Michigan

<https://www.energy.gov/scep/slsc/lead-tool>

DOE LEAD Raw Dataset

<https://data.openet.org/submissions/573>

See DOE LEAD Tool documentation for methodology

<https://lead.openet.org/docs/LEAD-Tool-Methodology.pdf>

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-4.8a

Respondent: M. J. Hatsios

Page: 1 of 1

- Question:** Regarding residential customer deposits and interest payments:
- a. Does DTE track customer deposits and interest payments by any of the following characteristics?
 - ii. Enrollment in:
 - 1. Energy assistance programs;
 - 2. Energy waste reduction programs (EWR);
 - 3. Affordable payment programs (APP); or
 - 4. Other rates or credits specifically available to low-income customers;

Answer: The Company does not track deposits by energy assistance programs, EWR, APP, or other rates or credits specifically available to low-income customers.

Attachment: None.

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-1.9

Respondent: J. E. Sparks

Page: 1 of 1

Question: 9. What is the finest geographic resolution of data that has been aggregated about customer arrearages that DTE possesses for each of the years 2022 and 2023? Examples of units of geographic resolution include zip code, census tract, census block group, and circuit. Please provide this data, organized by number of residential customers and amount (in dollars) of customer arrearages.

Answer: The Company does not track arrears by zip code, census tract, census block group, and circuit.

Attachment: None

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-6.1

Respondent: H. J. Decker

Page: 1 of 1

Question: 1. Refer to the table in DTE Ex. A-26, Schedule P1, showing total “Gas DR Expenses” of \$2,500,658 for 2021–2023. Please produce a breakdown of the yearly and total costs by both expense type (labor, contractors/outside service, other non-labor) and program type (Smart Savers Gas pilot, Energy Action Days program, and large customer pilot).

Answer: Costs were not tracked by program type.

Attachment: None

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-6.2a

Respondent: H. J. Decker

Page: 1 of 1

Question: 2. Witness Decker states that, on January 27, 2019, the Company met with MPSC Staff and stakeholders over Microsoft Teams to “explain the Company’s plans for the [Demand Response (DR)] pilots and collect input from stakeholders.” Decker Direct at 79.

a. Please list all non–MPSC Staff stakeholders who participated in this meeting.

Answer: This meeting referred to above was on January 27, 2020, and was coordinated by the MPSC Staff. We do not have a complete list of Staff or Stakeholders who participated in the meeting.

Attachment: None

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-6.2c

Respondent: H. J. Decker

Page: 1 of 1

- Question:** 2. Witness Decker states that, on January 27, 2019, the Company met with MPSC Staff and stakeholders over Microsoft Teams to “explain the Company’s plans for the [Demand Response (DR)] pilots and collect input from stakeholders.” Decker Direct at 79.
- c. Approximately how many non–MPSC Staff stakeholders did the Company contact to invite them to participate in the January 27, 2019 meeting?

Answer: This meeting referred to above was on January 27, 2020, and was coordinated by the MPSC Staff. We do not have a complete list of Staff or Stakeholders who participated in the meeting.

Attachment: None

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-6.3

Respondent: H. J. Decker

Page: 1 of 1

Question: 3. When the Company was designing its residential DR pilots, did the Company define what a “successful” outcome would be for the pilots? If so, please describe the Company’s description of a successful outcome for each pilot, including any quantitative or qualitative measures, thresholds, or key performance indicators (KPIs) the Company identified.

Answer: No, the Company did not define what a “successful” outcome would be for the pilots outside of any observed gas reduction during events and customer engagement.

Attachment: None

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-6.5a

Respondent: H. J. Decker

Page: 1 of 1

Question: 5. Witness Decker describes the Company's Smart Savers Gas pilot. Decker Direct at 79.

- a. Did DTE use a control group to evaluate the savings of the Smart Savers pilot? If yes, provide the change in usage for the control group (total and per device / participant) for the same dates reported by Witness Decker in Table 10 (Smart Savers Gas Event Results) of his direct testimony. See Decker Direct at 81.

Answer: No, a control group was not used to evaluate the savings of the Smart Savers pilot.

Attachment: None

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-6.8a

Respondent: H. J. Decker

Page: 1 of 1

- Question:** 8. Witness Decker states that “[u]sage from [Energy Action Days pilot] customers on an event day was compared to the forecast to calculate load reductions during events.” Decker Direct at 81.
- a. Please provide the methodology for forecasting load reductions.

Answer: Load reductions were not forecasted.

Attachment: None

MPSC Case No: U-21291

Requester: FLO

Question No.: FLODG-6.9a

Respondent: H. J. Decker

Page: 1 of 1

Question: 9. Refer to Table 12 (Energy Action Days Event Results – Gas Only) of Witness Decker’s testimony. Decker Direct at 82. Please provided an updated version of Table 12 that includes:

a. The number of customers who participated in the Energy Action Days pilot for each row; and

Answer: The following table summarizes the number of customers who participated in the Energy Action Days pilot by event date. The number of gas-only customers, specifically at the system level, who participated in the Energy Action Days pilot is not available.

Date	Gas and Electric Combination Customer Count	Gas-only Customer Count
2/4/2022	50,830	54,897
3/3/2022	50,353	52,596
1/31/2023	53,140	53,106
2/3/2023	52,936	52,849

Attachment: None

Methane and NO_x Emissions from Natural Gas Stoves, Cooktops, and Ovens in Residential Homes

Eric D. Lebel,* Colin J. Finnegan, Zutao Ouyang, and Robert B. Jackson



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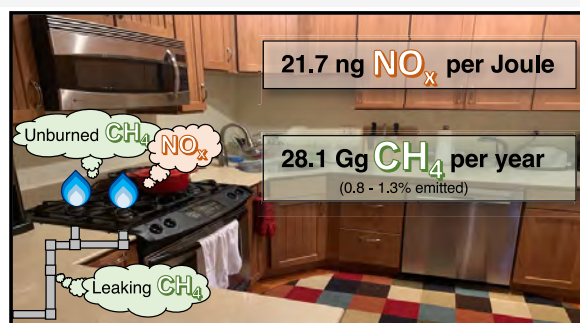
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Supporting Information



ABSTRACT: Natural gas stoves in >40 million U.S. residences release methane (CH₄)—a potent greenhouse gas—through post-meter leaks and incomplete combustion. We quantified methane released in 53 homes during all phases of stove use: steady-state-off (appliance not in use), steady-state-on (during combustion), and transitory periods of ignition and extinguishment. We estimated that natural gas stoves emit 0.8–1.3% of the gas they use as unburned methane and that total U.S. stove emissions are 28.1 [95% confidence interval: 18.5, 41.2] Gg CH₄ year^{−1}. More than three-quarters of methane emissions we measured originated during steady-state-off. Using a 20-year timeframe for methane, annual methane emissions from all gas stoves in U.S. homes have a climate impact comparable to the annual carbon dioxide emissions of 500 000 cars. In addition to methane emissions, co-emitted health-damaging air pollutants such as nitrogen oxides (NO_x) are released into home air and can trigger respiratory diseases. In 32 homes, we measured NO_x (NO and NO₂) emissions and found them to be linearly related to the amount of natural gas burned ($r^2 = 0.76$; $p \ll 0.01$). Emissions averaged 21.7 [20.5, 22.9] ng NO_x J^{−1}, comprised of 7.8 [7.1, 8.4] ng NO₂ J^{−1} and 14.0 [12.8, 15.1] ng NO J^{−1}. Our data suggest that families who don't use their range hoods or who have poor ventilation can surpass the 1-h national standard of NO₂ (100 ppb) within a few minutes of stove usage, particularly in smaller kitchens.

KEYWORDS: cooking, climate, combustion, pollutants, post-meter emissions, appliances, houses

INTRODUCTION

Since 1750, methane (CH₄) has contributed about one-quarter of the world's radiative forcing,¹ and its concentration continues to rise.² Methane is a shorter-lived gas than carbon dioxide (CO₂) but is nevertheless 34–86 times more potent than carbon dioxide on 100 and 20 year timescales, respectively.³

Leaks of natural gas (>90% methane) across the ~3 million miles of pipeline in the United States' supply chain⁴ have been studied extensively.⁵ However, comparatively little work has been done on emissions inside homes and buildings, so-called “post-meter” emissions. The United States Environmental Protection Agency (USEPA) Inventory of U.S. Greenhouse Gas Emissions and Sinks only documents leaks from residential gas meters and incomplete combustion from residential gas appliances, but more information is needed on methane leaks from transitory on–off phases and quiescent steady-state-off emissions, particularly from gas stoves.⁶ Previous work found

that appliances in Boston and Indianapolis—excluding pilot light emissions—were estimated to emit 0.038% of the natural gas they consumed.⁷ A separate study in California found that whole-home post-meter residential emissions totaled 0.5% of residential natural gas consumption in the state.⁸

Natural gas is a popular fuel choice for home cooking. Nationally, over one-third of households (>40 million homes) cook with gas.⁹ In some states, the proportion is substantially higher; over 60% of households in California cook with gas, for instance.¹⁰ People interact more directly with their stove than with other gas appliances, increasing potential exposure to any

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natural gas constituents and compounds formed during combustion, including formaldehyde (CH_2O), carbon monoxide (CO), and nitrogen oxides (NO_x). Here, we define NO_x as the sum of nitric oxide (NO) and nitrogen dioxide (NO_2). Among all gas appliances, the stove is unique in that the byproducts of combustion are emitted directly into home air with no requirement for venting the exhaust outdoors. In fact, some kitchens have “ductless” hoods that recirculate fumes through activated charcoal filters, which are generally less effective at cleaning the air.¹¹ Vented hoods have a range of effectiveness and function best when overhanging the stove.^{12,13} Because exhaust hoods are separate from the stove and must be operated manually, vented hoods in practice are used only 25–40% of the time.^{14–16}

To date, the majority of research concerning gas stoves has focused on their effect on indoor air quality.^{17,18} In particular, research has measured long-term averaged indoor concentrations of NO_x and CO ,^{19,20} with limited direct measurements of emission rates. NO_2 is a respiratory irritant and can lead to asthma, coughing, wheezing, and difficulty breathing, occasionally resulting in hospitalization.^{21,22} Chemically, NO forms NO_2 indoors upon interaction with ozone (O_3), and NO_2 concentrations will decrease through interactions with interior surfaces.²³ Concentrations of NO_x and other indoor pollutants depend greatly on the turnover rate of air in homes; over time, outside air will enter the house through ventilation and infiltration, reducing any gradient between indoor and outdoor concentrations.

There are currently no U.S.-based indoor exposure guidelines or standards for NO_2 ; however, Canada has a maximum residential exposure limit of 90 parts per billion (ppb) over a 1 h exposure and 11 ppb over the long term (>24 h).²⁴ In 2010 the EPA set a 1 h outdoor exposure limit of 100 ppb for NO_2 which was retained in 2018; the annual standard of 53 ppb was established in 1971 and has not been updated.²⁵ Recently, in 2021, the WHO set the outdoor standard for NO_2 to be approximately 13 ppb over 24 h.²⁶ NO_2 concentrations of 100 ppb are regularly exceeded if stoves are used without adequate indoor ventilation, either due to a low capture efficiency of the exhaust hood or the hood not being activated by the user.¹⁷

We measured methane emissions from stoves during all phases of operation (steady-state-off, turning on and off, and during combustion), with additional measurements quantifying NO_x emissions during combustion. We used a kitchen chamber approach to take measurements with a measured kitchen volume, sealed using a plastic partition. For cooktops, we focused our measurements on emissions from individual burners at different intensities to gain a fuller picture of total emissions. We quantified steady-state-off emissions from stoves because they were not included in most previous cooktop emissions studies and because, previously, we found steady-state-off emissions to be a substantial, sometimes dominant, component of total methane emissions from storage water heaters.²⁷

MATERIALS AND METHODS

We define a “cooktop” as a flat surface with individual burners, typically four or five per stove, and an occasional “griddle” element. The “oven” is an enclosed heated space, usually containing two burners: a “bake” burner below the bottom steel plate and a “broil” burner typically exposed and affixed to the oven’s roof. A “stove” (also referred to as a “range”) is a freestanding unit that contains both a cooktop and an oven,

typically both using gas, although some combine a gas cooktop with an electric oven.

Site Selection. We measured methane emissions from stoves in 53 homes in 7 California counties between January 2020 and May 2021 (Table S1). Our sample set included private homes, properties for sale or rent by real estate agents, and, because of the constraints of COVID-19, Airbnb rentals. We measured methane emissions from gas cooktops (18 unique brands) at all 53 homes and tested gas ovens and broilers in 40 and 31 homes, respectively. For stoves with information available, we found the ages of stoves ranged between 3 and 30 years. Cooktop burners ranged in heat output from 4500 to 25 000 British thermal units (BTU) h^{-1} , and most oven burners ranged between 16 000 and 19 000 BTU h^{-1} , as per product specifications.

We additionally measured NO , NO_2 , and NO_x emissions from 32 cooktops and 24 ovens of the stoves tested for methane emissions (Table S1). The NO , NO_2 , and NO_x emission rates are important because—coupled with circulation, ventilation, infiltration, and room size—they determine the concentration of NO_x pollutants that build up in kitchens.

Sampling Overview. We measured each stove burner using a static flux chamber (“room chamber”) method (Figure S1), which we tested in the lab and in homes before initiating the study. The stove was contained in an airtight portion of the room of known volume (average of 20 m^3 , range of 8–83 m^3 , Figure S2) by hanging plastic sheets (4–6 mil thickness) to partition the kitchen from surrounding space using a ZipWall Dust Barrier System (zipwall.com) with 8 or 10 ft tension poles. Clear plastic sheets were sealed along the ceiling, walls, and floor using a combination of ZipWall foam bars, painter’s tape, and/or 3 kg sandbags. We used one or two Lasko 3300 Wind Machine Fans on low or medium to circulate the air within the space. We took care in selecting fan speed, position, and direction to minimize any disruptions to burners (Figure S1). An additional fan or two circulated the air outside the chamber to ensure that the “background air” was homogenous. We collected concentration measurements of methane (CH_4), ethane (C_2H_6), and CO_2 at a rate of <1 Hz on a Picarro cavity ring-down spectrometer (model G-2210i). In addition, we used one of two analyzers to measure concentrations of NO_x , including direct measurements of NO and NO_2 : a Teledyne model 200A chemiluminescence analyzer and a Thermo Fischer Scientific 42iQ analyzer. Kitchen temperature was recorded using an Onset HOBO Logger (UX100-23A).

General Sampling Scheme. After partitioning the kitchen with plastic sheets, we set up two inlet hoses to the analyzers, one near the center of the enclosed kitchen area about 4–6 ft off the ground and a second in a space outside the enclosed area at a similar height for background measurements. We took background measurements of methane and NO_x for at least 2 min before collecting stove measurements.

To test the size and seal quality of the room chamber, we briefly entered the enclosed kitchen through a zipper door and released a 300–500 mL aliquot of ethane with a glass syringe (“ethane inject”) to estimate the room volume by dilution. We found this method to be more straightforward for estimating kitchen volume than taking measurements of chamber dimensions, which proved challenging with cabinetry and nonstandard configurations of many modern kitchens, although both methods agreed well (Figure S2). Ethane was chosen for the dilution measurements because the Picarro measured it and there were no additional sources of ethane in

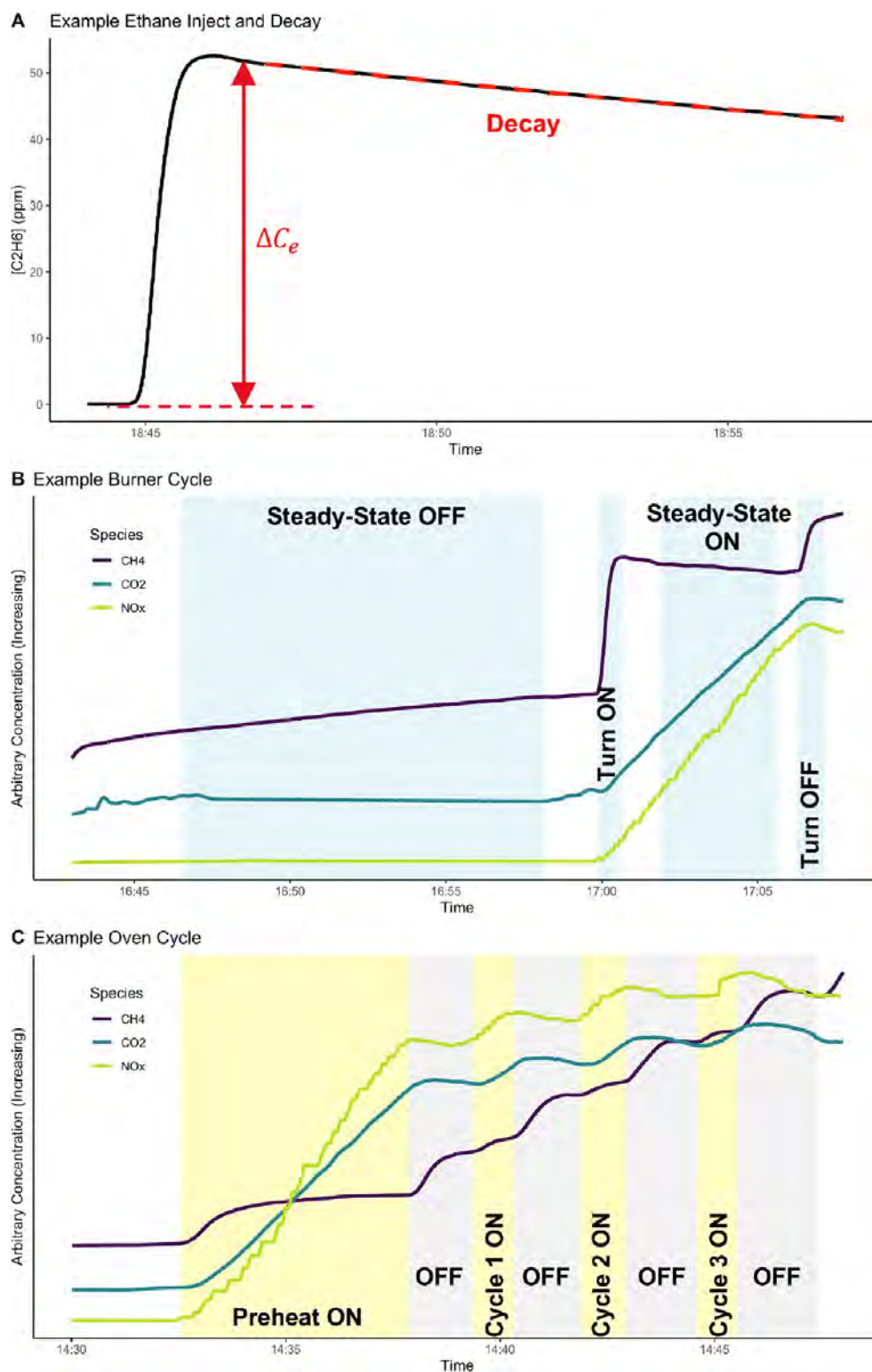


Figure 1. Example concentration plots for various measurement events using data from actual measurements in our study. (A) Ethane injection and decay: first, we injected 500 mL of ethane into the space created by the plastic wall to determine its volume based on dilution. ΔC_e is the change in ethane concentration, which resulted from our injection of ethane. Then, we allowed the elevated ethane to exponentially decay over time (dotted red line) to measure the air changes per hour (ACH) in the space created by the chamber. This value was used to correct CH₄, NO_x, and CO₂ values measured during other test phases. (B) Cooktop burner measurement cycle: “steady-state-off” before the burner is ignited, “turn on” for the pulse of gas emitted when the burner is ignited, “steady-state-on” for the emissions while the burner is on a steady state, and “turn off” for the pulse of emissions observed when the burner is extinguished; (C) oven measurement cycle: “preheat” for the increase in concentrations while the oven is reaching the set temperature and “cycling” for the on/off behavior of the oven while it maintains the set temperature.

the kitchen while the stove was off beyond small emissions of ethane co-emitted in the natural gas from the stove or nearby pipes and fittings, which were at most 2 orders of magnitude lower than the amount of ethane we injected (Figure 1A; details and calculations in the Supporting Information (SI)). After leaving the kitchen, we measured the “ethane decay”, which we used to calculate the diffusion and exchange of air outside the partitioned space through unavoidable, small gaps in the plastic and through leaky doors, windows, and vents (Figure 1A).

Simultaneously with ethane decay, “steady-state-off” measurements of methane from the stove were taken for 5–10 min (Figure 1B). Emissions from steady-state-off are not attributable to a specific source within the stove or piping but capture all emissions from the stove and piping within the chamber volume. Ethane injection/decay and steady-state-off measurements were repeated throughout sampling for a total of two to seven independent measurements of volume, air exchange, and steady-state-off methane emissions per stove.

To begin combustion measurements of methane and NO_x (NO and NO₂), we entered the kitchen and ignited one burner on the cooktop, which initiated the “on pulse”. Because NO_x is a byproduct of combustion, we never observed pulses of NO_x while turning burners on or off. We left the burner on, and after the pulse was completely mixed in the room, typically 90 s after ignition, we exited the kitchen and collected a “steady-state-on” measurement of both methane and NO_x for at least 3 min while vacant. We then returned inside, waited 30 s, and turned off the burner (Figure 1B). After 90 s, another single burner was lit. We measured burners individually on some combination of low, medium, or high for both methane and NO_x emissions. We aired out the kitchen chamber volume whenever the concentration of methane inside approached the limit of the Picarro (~30 ppm CH₄). Details of the calculations, including correction for the measured air exchange rate, are presented in the SI.

We tested ovens similarly for methane and NO_x emissions using our kitchen chamber system. We used the oven’s bake setting to set the temperature between 350 and 425 °F. We observed a distinct “preheat” phase of emissions as the oven warmed to temperature and a “cycling” phase as the oven maintained temperature, which we saw in the CH₄, CO₂, and NO_x data output (Figure 1C). We allowed the bake burner to preheat the oven and cycle at least three times, taking ~20–30 min. We tested broiler burners using the same method but only while preheating.

Scaling Methane Emissions. We scaled our appliance measurements to national estimates of total emissions using activity data from Chan et al.²⁸ and Zhao et al.,¹⁸ assuming that stove usage does not vary substantively across the United States with climate the way that furnace usage does (Figure S7). Chan et al. and Zhao et al. report activity data from 80 residences, collectively, including the number and length of time that the occupants used individual burners on their stove and how often they used their ovens. We also obtained information on the numbers of appliances from the 2015 Residential Energy Consumption Survey.⁹ The total number of appliances was assumed to be the total number of stoves and any secondary cooktops, 43.4 million appliances (standard deviation: 1.3 million) nationally.

Using Chan et al., Zhao et al., 2015 RECS, and our measurements, we created an “expanded dataset” with one observation for every possible combination of stove i ($n = 53$)

and usage datapoint j ($n = 80$), creating 4240 unique observations of annual stove emissions. From here, we scaled our measurements using the number of appliances (43.3 million) reported in the RECS database for the United States.

For each pairing of stove i and usage datapoint j , we divided the time based on the selected usage environment into steady-state-off, steady-state-on, and oven usage periods, broken down into preheat and cycling phases. We calculated the total methane emissions that would be expected in a day given the selected stove’s emissions for the total length of these periods and the number of expected pulses using eq 1

$$\begin{aligned} \text{emissions (g day}^{-1}\text{)} &= \text{SS. On}_i \text{ (g h}^{-1}\text{)} \times \text{Hours. Cooktop}_j + \text{Oven}_i \text{ (g h}^{-1}\text{)} \\ &\times \text{Hours. Oven}_j + \text{SS. Off}_i \text{ (g h}^{-1}\text{)} \\ &\times (24 - \text{Hours. Cooktop}_j - \text{Hours. Oven}_j) \\ &+ \text{On/Off Pulse}_i \text{ (g)} \times \text{Burner. Ignitions}_j \end{aligned} \quad (1)$$

with emissions in total grams CH₄ per day, SS.On _{i} is the emission rate (g h^{−1}) during steady-state-on for stove i ; SS.Off _{i} is the emission rate (g h^{−1}) during steady-state-off for stove i ; Oven _{i} is the emission rate (g h^{−1}) for an oven set to 350–425 °F from kitchen i ; Pulse _{i} is the emission magnitude from each on/off pulse for stove i ; Hours.Cooktop _{j} is the total number of hours per day any burner from cooktop j was used, as reported by Chan et al. and Zhao et al.; Hours.Oven _{j} is the total number of hours per day oven j was used; and Burner.Ignitions _{j} is the total number of times a burner was ignited per day from stove j .

We calculated the mean estimate for a stove (burners plus oven) as the mean of the expanded dataset and the 95% confidence interval from a bootstrap using 25 000 replicates and sample sizes of 53 to capture the full uncertainty associated with our stove emissions dataset.^{29,30}

Total Volumetric Emissions. In total, previous inventories report that natural gas residential indoor cooking appliances use 113 billion cubic feet (bcf) of gas per year in the United States, the third most gas from residential appliances, after space heating (2677 bcf year^{−1}) and water heating (1019 bcf year^{−1}).⁹ We estimated the total percentage of gas emitted using eq 2

$$\%_{\text{leaked}} = \frac{\text{Vol}_{\text{CH}_4}}{\text{Vol}_{\text{NG}}} \quad (2)$$

where Vol_{CH₄} is the amount of methane emitted by the stoves and Vol_{NG} is the volume of natural gas used by the stoves.

We estimated the annual volume of natural gas used by stoves with two different methods: (1) using the natural gas reported by RECS and (2) calculating the natural gas emissions using our recorded CO₂ data combined with the usage data. For both methods, we used our estimate of total emissions from stoves as the numerator in eq 2. In the first method, we used 113 billion cubic feet, provided by RECS. In the second method, we calculated the volume of natural gas using our direct CO₂ emissions and using the first two terms of eq 1 (steady-state-on and ovens) to calculate the assumed total emissions given the usage patterns and total number of national appliances.^{9,18,28}

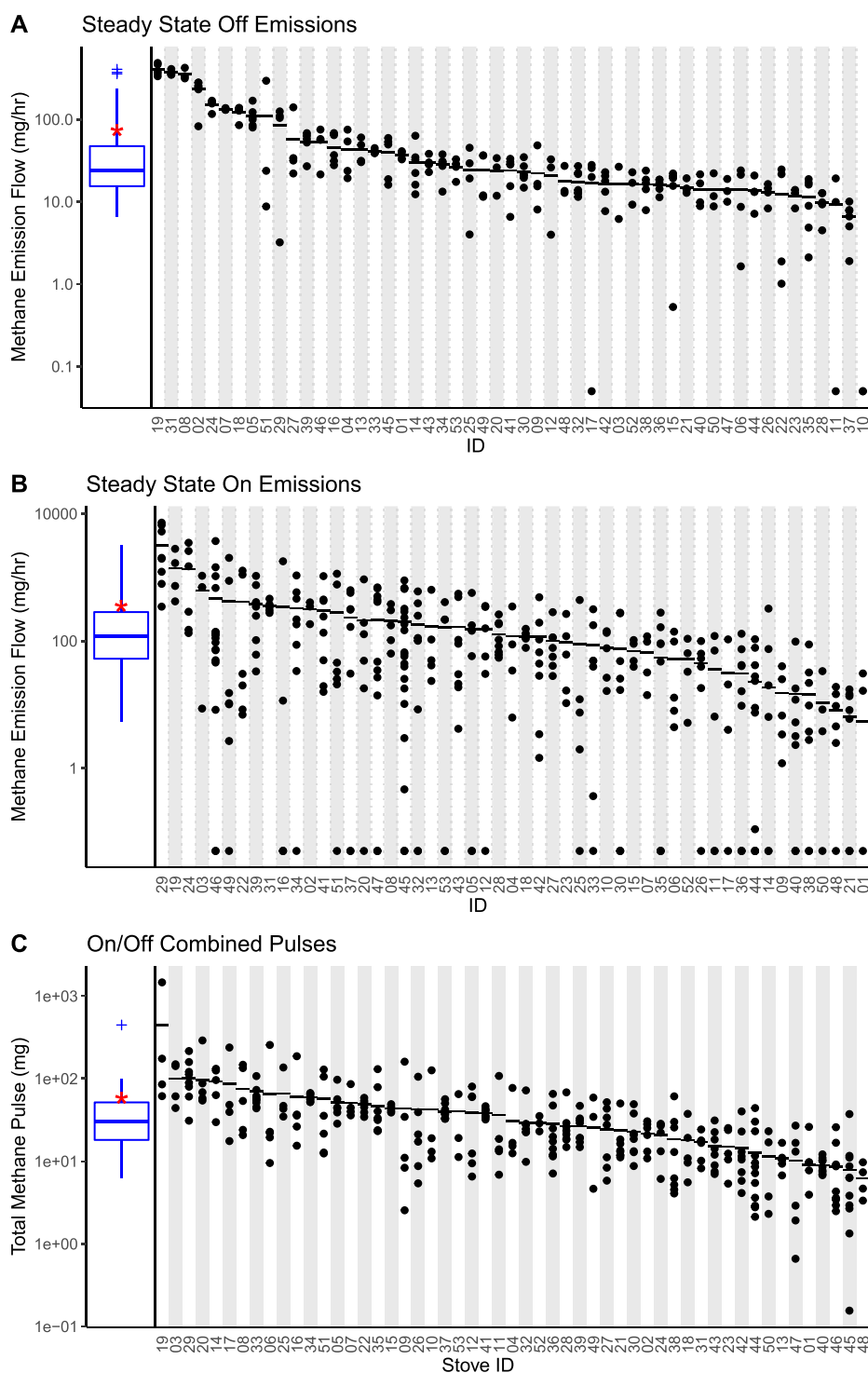


Figure 2. Stove emission components from each individual stove, represented on a log scale, from steady-state-off, steady-state-on, and the on/off pulses. The blue box-and-whisker plot on the left in each panel summarizes each component of stove emissions. The median, 25th, and 75th quartiles are shown, with blue + symbols denoting outliers. The red * represents the mean. On the right side of each plot, every “bin” above a stove ID represents either one measurement of steady-state-off as shown in (A) or a measurement of one burner’s emissions, as shown in (B) and (C). The small black horizontal line represents the average for each stove. (A) All steady-state-off emissions are reported for each stove that we measured—most stoves were measured three to five times. The mean ($58 \text{ mg CH}_4 \text{ h}^{-1}$) was higher than the median ($24 \text{ mg CH}_4 \text{ h}^{-1}$). Negative values were set to $0.05 \text{ mg CH}_4 \text{ h}^{-1}$. (B) Average steady-state-on emission was $259 \text{ mg CH}_4 \text{ h}^{-1}$, which is slightly higher than the median ($119 \text{ mg CH}_4 \text{ h}^{-1}$). Negative values were set to $0.05 \text{ mg CH}_4 \text{ h}^{-1}$. (C) Collective on/off pulses are represented by the individual black dots; one dot is the sum of the on-and-off pulse (if any) for an individual burner. The mean (46 mg CH_4) is again higher than the median (30 mg CH_4).

RESULTS AND DISCUSSION

Stove Steady-State-Off Emissions. During steady-state-off measurements, we found that stoves emitted 57.9 [95% CI from bootstrapping: 36.3, 84.0] mg CH₄ h⁻¹ on average (Figure 2A). The data for steady-state-off measurements were long-tail skewed, with the top 5 stoves (9% of sampled units) emitting half (49%) of all steady-state-off emissions. Interestingly, all but four stoves had steady-state-off emissions greater than 10 mg CH₄ h⁻¹, suggesting that most stoves and associated nearby piping leak some methane continuously. We never measured any NO_x emissions while the burners were off because NO_x is formed from the oxidation of nitrogen in the high temperatures of combustion.

Cooktop Steady-State-On Emissions. Total steady-state-on methane emission rates (per unit time) from a single cooktop burner during combustion, averaged over all measured burner sizes and intensities, were 259 [95% CI: 151, 408] mg CH₄ h⁻¹, approximately 4.5× more than steady-state-off emission rates from the entire stove when off (Figure 2B). More methane is therefore emitted instantaneously during combustion than when the cooktop is idle, although the length of time during the day when burners are idle is substantially longer in homes, where emissions occur continuously from steady-state-off leaks. Steady-state-on emission measurements were also long-tailed: the top 5 stoves (9%) emitted 51% of all steady-state-on emissions. Methane emission rates while on were not correlated with burner intensity or CO₂ emission rates (Figures S4 and S5).

During steady-state-on, we also estimated that volumetric-based total NO_x emissions were directly proportional ($p \ll 0.01$; $r^2 = 0.76$) to the rate of natural gas combustion (Figure 3). Therefore, we measured the energy output from the burner using the flow rate of CO₂ to calculate the Joules (J) of energy usage. Average emissions from stoves during steady-state-on ranged between 13.9 and 28.3 ng NO_x J⁻¹ (1.5–3.0 g NO_x Therm⁻¹), with an average value of 21.7 [20.5, 22.9] ng NO_x J⁻¹. The NO_x emission rate was comprised of 7.8 [7.1, 8.4] ng NO₂ J⁻¹ and 14.0 [12.8, 15.1] ng NO J⁻¹ (Figure 4B). Volumetrically, emissions were 15.8, 63.2, and 151.5 mL NO_x h⁻¹ for burners on low, medium, and high, respectively (Figure 4A), further demonstrating that more NO_x is emitted from burners during higher intensity usage.

Cooktop On/Off Pulse Emissions. Methane emissions from one combined on/off pulse (extra gas emitted while igniting and extinguishing a burner) from a single burner averaged 45.9 [95% CI: 33.1, 64.8] mg CH₄ (Figure 2C). This on/off methane pulse equaled the amount of gas emitted during ~10 min of average steady-state combustion.

Similar to the steady-state emissions, these on/off pulses exhibited a long-tail distribution driven predominantly by a few cooktops—even individual burners within cooktops—that emitted most of the methane. The highest emitters were the cooktops that ignited using a pilot light (total of eight burners); these burners had an average on/off pulse of 258 mg CH₄. One particularly large outlier—stove 19 (Figure 2C)—emitted on average 450 mg per pulse, nearly 4× higher than the second-highest emitter. This particular stove was one of the two stoves with a pilot light; on this specific unit, some burners took several seconds to ignite, while burners on other units with pilot lights took less time to ignite (thus releasing less methane), suggesting that delays in pilot light ignition may drive some emissions from on/off pulses.

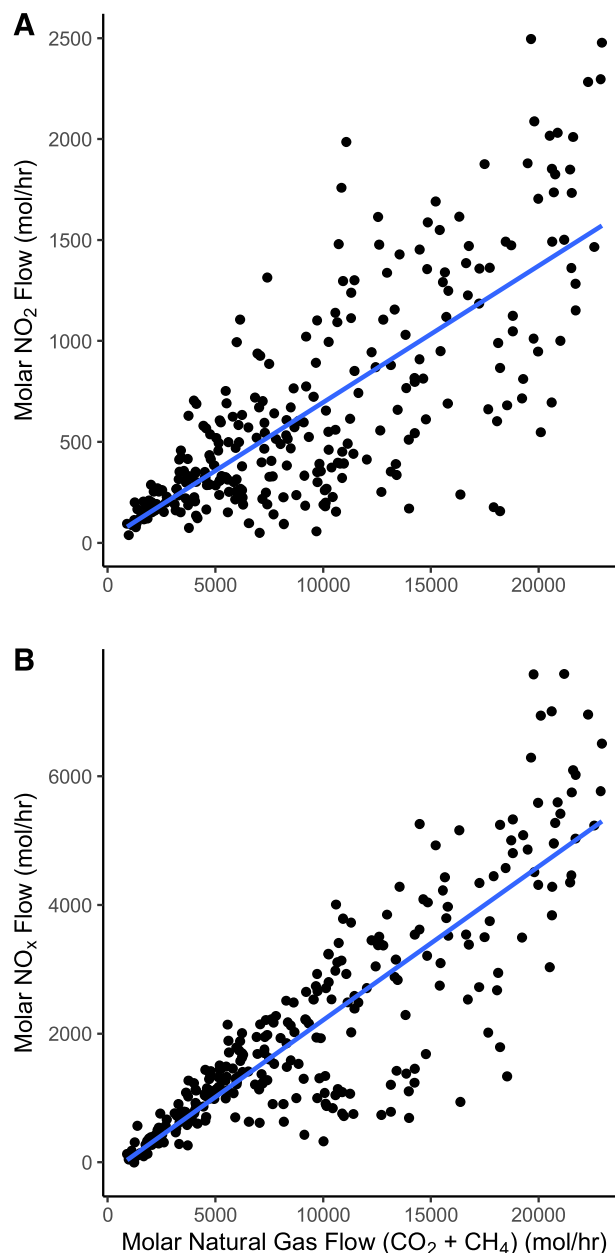


Figure 3. NO₂ and NO_x flows are linearly proportional to natural gas flow. Each black dot represents a measurement of steady-state-on, either for a cooktop burner, or for an oven broil or bake burner. (A) Emissions of NO₂ are plotted on the y-axis with the natural gas flow (i.e., emissions of CO₂ + CH₄) plotted on the x-axis. There is a clear correlation between the natural gas flow (estimated by summing the measured methane and carbon dioxide flow rates) and the NO₂ flow rate ($p \ll 0.01$; $r^2 = 0.59$). (B) Similarly, for NO_x (i.e., NO + NO₂), there is a correlation between natural gas flow and the NO_x flow rate ($p \ll 0.01$; $r^2 = 0.76$).

In contrast, 180 burners that were lit with a built-in operational electronic sparker emitted less methane, 38 mg CH₄. We also lit 22 burners with a match or lighter because their built-in electronic sparker did not work (but homeowners said they used them nonetheless). For these, we held a lit match next to the burner before turning the gas on. On average, these burners emitted 48 mg CH₄ per on/off pulse, similar to the burners with a functioning electric sparker. We

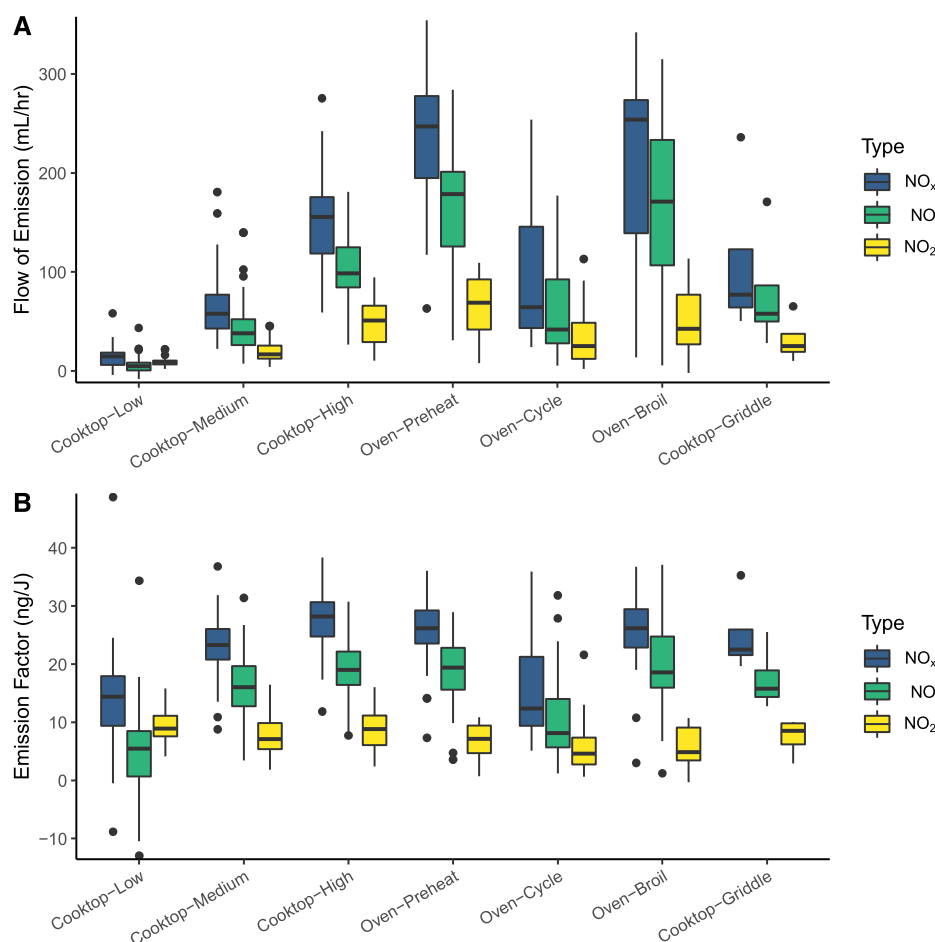


Figure 4. NO_x, NO, and NO₂ total emissions and normalized by energy output. NO_x emissions are shown in total emissions for various burner sizes and intensities and by constituents: NO and NO₂. We separate emissions into various phases of stove operation: cooktop emissions while burners are on low, medium, and high; oven emissions during preheat, cycling (maintaining temperature), and from the oven's broil burner; and emissions from those cooktops that had a griddle element. (A) Emissions are reported as a flow, in mL h⁻¹. These emissions were directly measured using our chamber-based approach, with concentrations measured on the real-time analyzer. (B) The emissions are normalized for the energy output of the burner, reported in Joules (J), and calculated from the total CO₂ emissions we simultaneously measured from each burner. The molecular weight of NO_x was assumed to be 46 g mol⁻¹, as is convention. For direct comparison, emission factors of NO also used 46 g mol⁻¹ as the molecular weight.

analyzed these samples in our overall on/off pulse estimate because ignition with the match or lighter simulated "typical operation" for these burners according to the homeowners.

Oven Emissions. We measured the baking (main) burner for 40 ovens and found that during the preheat phase (from room temperature to the setpoint between 350 and 425 °F), ovens emitted on average 117 [95% CI: 74, 178] mg CH₄ over a period of about 13 min, with an average rate of 663 [408, 1030] mg CH₄ h⁻¹. Once the ovens reached preheat temperature, they "cycled", where the burner periodically ignited and extinguished to maintain the setpoint temperature. During this period, it emitted on average 759 [435, 1310] mg CH₄ h⁻¹. In comparison, the broiler burner only emitted 112 [50, 186] mg CH₄ h⁻¹ while on. Unlike the bake burner, broil burners usually stayed lit and cycled on and off less often.

We also measured NO_x emissions from ovens and calculated them to be 25 ng NO_x J⁻¹. Volumetrically, this is equal to 232 mL NO_x h⁻¹ (broken down into 163 mL NO h⁻¹ and 69 mL NO₂ h⁻¹) during the preheat phase for the bake burner set to 350–425 °F, 92 mL NO_x h⁻¹ (58 mL NO h⁻¹ and 34 mL NO₂ h⁻¹) for the bake burner when it was in cycling mode, and 215

mL NO_x h⁻¹ (162 mL NO h⁻¹ and 53 mL NO₂ h⁻¹) for the broil burners. We found that ovens could produce enough NO₂ to exceed the 1-h ambient standard (100 ppb) within a few minutes (Figure S11). We also found that NO₂ and NO_x emissions were correlated with the size of the burner for both cooktops and ovens (Figure 3).

Cumulative Methane Emissions. For our methane emission measurements, we scaled our measurements to calculate the total amount of methane emitted from stoves overall, employing the usage patterns reported by Chan et al. and Zhao et al.^{18,28} (see the Materials and Methods section). We estimated that an average stove (burners plus oven) emitted 649 [95% CI: 427, 949] g CH₄ year⁻¹ (Figure S5). When scaled to total U.S. emissions, and taking into account uncertainty in the estimate of the number of appliances reported in RECS, we estimated total national methane emissions from stoves were 28.1 [18.5, 41.2] Gg CH₄ year⁻¹. Using a 20 year timescale for the lifetime of methane, these methane emissions were comparable in climate impact to the carbon dioxide emissions of approximately 500 000 gas-powered cars.³¹

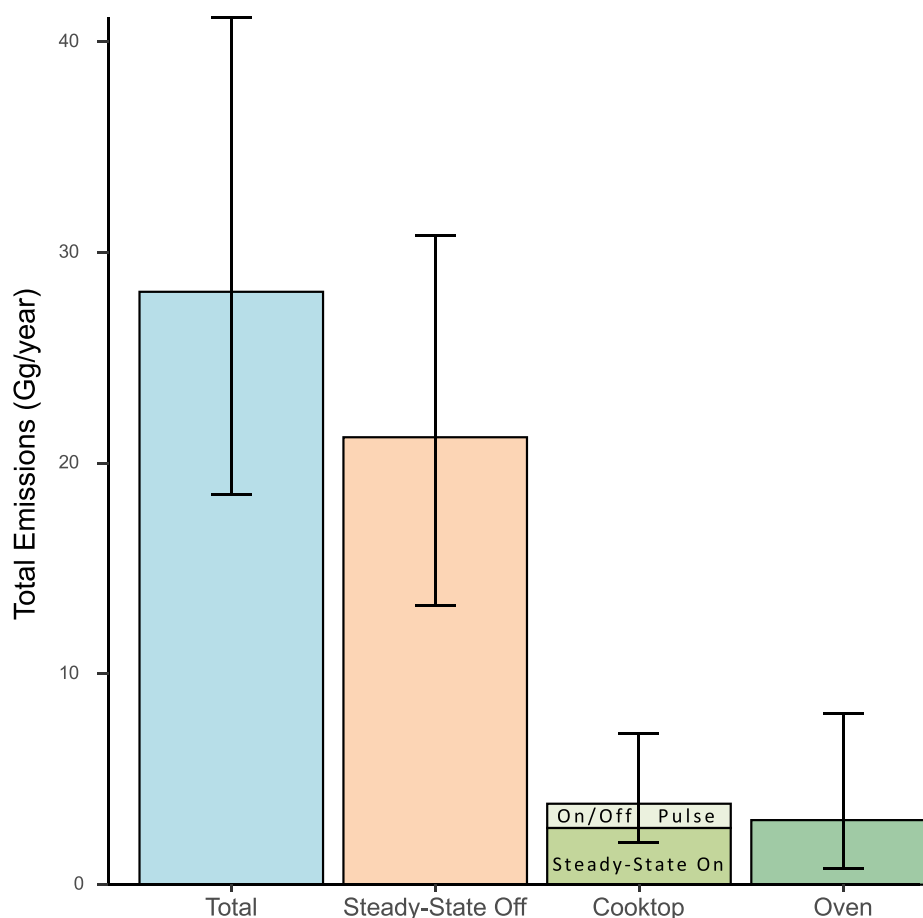


Figure 5. Total methane emissions by source. We report our scaled U.S. national estimates of methane emissions from stoves categorized into the various phases of emission sources: steady-state-off, cooktop emissions (broken down into steady-state-on and on/off pulses), and oven emissions. Bar height and error bars (95% confidence intervals) show the total methane emissions expected from each category. We found that 76% of the total methane emissions from stoves originated during steady-state-off.

Similar to our previous measurements in homes and to the results of other researchers,^{7,8,27} our results were long-tail skewed. Considering our expanded dataset, a plot of the cumulative count of measurements vs fraction of emissions showed that the top 10% of all observations in the expanded dataset were responsible for emitting 47% of total emissions (Figure S6). These data approached the “5/50 rule” where the top 5% of emitters typically emit 50% of all emissions.³²

We also calculated the total emissions based on whether the stove was on or off. Including both emission and usage data, we estimated that total emissions were 21.2 [13.3, 30.8] Gg CH₄ year⁻¹ during steady-state-off (i.e., emissions over most of the day); 2.7 [1.3, 5.3] Gg CH₄ year⁻¹ during steady-state-on from cooktops alone; and 1.1 [0.7, 1.9] Gg CH₄ year⁻¹ from the on/off pulses. For ovens alone, we only used emission data from the bake burner because we lacked comprehensive broil burner usage information but suspect it is small (~10%) based on user-reported datasets. Overall, we estimated that ovens emitted 3.1 [0.8, 8.1] Gg CH₄ year⁻¹ while on (Figure 5).

Volumetric Percentage Emissions. We used two methods to estimate the total percent methane emitted, the first using the report of gas used from the 2015 RECS survey and the second based on our CO₂ measurements combined with usage data (see the Materials and Methods section). From the first method, the volumetric fraction of our methane

emissions using the RECS data was 1.3% of gas consumed, assuming that the volume of natural gas was measured at standard pressure and 60 °F. In the second method, we estimated that the total volumetric fraction emitted was lower—0.8%—because the appliances we measured used more gas than the national average from RECS. This approach assumes that our usage data and selection of low/medium/high burner intensities approximated usage in all regions. For example, stove usage does not seem to vary regionally in the United States in the same way that furnace usage varies attributable to local climate (Figure S7).⁹

Comparison to National Inventories. In 2019, the United States emitted an estimated 158 million tons of carbon dioxide equivalent (MMT CO₂e) of methane from natural gas systems. Because the EPA used a 100 year global warming potential of 25 for methane, this is equivalent to 6.3 Tg CH₄ year⁻¹.⁶ The USEPA included specific emission sources such as residential and commercial meters and leaks from mains and services and also included a category for “stationary combustion” from various sectors (assumed to be incomplete combustion) but did not take into account leaks from appliances. While the USEPA did not report emissions from specific residential natural gas appliances, they reported methane emissions for residential stationary combustion from natural gas: 24 Gg CH₄ year⁻¹. From stoves alone, we

estimated total methane emissions to be about 28 Gg CH₄ year⁻¹, more than the emissions currently reported by the USEPA from stationary combustion from all appliances, suggesting that the USEPA substantially underestimated emissions from residential natural gas combustion. Our previous work estimated that water heaters alone emitted 82 Gg CH₄ year⁻¹ from leaks and incomplete combustion, further suggesting that the USEPA is underestimating emissions from stationary combustion.²⁷

We combined the total methane and carbon dioxide emissions from stoves and calculated that methane emissions add an extra one-third of CO₂e emissions to combustion-based CO₂ emissions from stove natural gas use. Using the estimate of natural gas consumption from RECS (113 billion cubic feet per year),⁹ we estimated that CO₂ emissions from gas stoves are 6.2 MMTCO₂ year⁻¹ as a direct result of combusting the natural gas they use. Over a 20-year timescale, the global warming potential of methane is 86 times greater than carbon dioxide.³ Using this scaling factor, we calculated the impact of methane over 20 years added an additional 2.4 MMTCO₂e from methane emissions, or 39% of the 6.2 MMTCO₂ year⁻¹. Reducing these short-term climate impacts due to methane emissions is important for achieving climate goals in the coming decades.

Comparison to Previous Methane Studies. We compared our methane results to past studies that measured residential methane emissions. Merrin and Francisco estimated that national U.S. methane emissions from cooktop use—including both steady-state-on and on/off pulses for burners (but without steady-state-off emissions from stoves)—were 2.7 Gg CH₄ year⁻¹.⁷ We estimated similar emissions nationally from the same sources, 3.8 Gg CH₄ year⁻¹ for burners (2.7 Gg CH₄ year⁻¹ for steady-state-on emissions and 1.1 Gg CH₄ year⁻¹ from on/off pulses). However, unlike Merrin and Francisco,⁷ we also measured steady-state-off emissions from stoves nationally and estimated their emissions to be 21.2 Gg CH₄ year⁻¹, far larger than estimates for burners during combustion and on/off pulses.

Another study, Fischer et al., estimated that emissions from cooking appliances during steady-state-on from California alone totaled 1.6 Gg CH₄ year⁻¹.⁸ In our work, we scaled our emissions to the number of stoves in California using the 2019 RASS data³³ and found that total methane emissions from stoves in California were 4.8 [95% CI: 3.1, 7.0] Gg CH₄ year⁻¹, of which 1.2 Gg CH₄ year⁻¹ comes from steady-state-on, on/off pulses, and ovens. Additionally, Fischer et al.⁸ measured steady-state-off measurements in their “whole-home quiescent” leakage rates, which accounts for steady-state-off emissions from all appliances as well as interior pipeline leaks. They estimated this source to be 23.4 Gg CH₄ year⁻¹ for California. We calculated steady-state-off emissions from stoves alone in California to be 3.6 Gg CH₄ year⁻¹. Applying previous work by our lab to the numbers of appliances in California, we estimated that water heaters emit an additional 12.9 Gg CH₄ year⁻¹ during steady-state-off alone.²⁷ Together with the estimate of quiescent emissions from Fischer et al.,⁸ our work provides strong evidence that steady-state-off emissions provide the largest source of natural gas leakage in homes.

Comparison to Previous NO_x Studies. Relatively little recent research has measured total NO_x flow rates from stoves, with the exception of Singer et al.,¹⁷ who estimated NO_x emissions to be ~40 ng NO_x J⁻¹ (ranged between 30 and 45 ng NO_x J⁻¹). Traynor et al. estimated that NO_x emissions from

stoves had a geometric mean of 32 ng NO_x J⁻¹,³⁴ and Singer et al. estimated NO_x emissions to be 30–36 ng NO_x J⁻¹.³⁵ Overall, these values are slightly higher than our estimate from cooktops: 21.7 [20.5, 22.9] ng J⁻¹. Previous modeling-based approaches suggest that residents are exposed to NO₂ levels above outdoor acute (1 h) exposure guidelines 62% of the time while using their stove but not using their range hoods,³⁶ and people use their range hoods only 28–36% of the time.¹⁵

Relationship between Emissions with Stove Age, Price, and Median Income. We also tested potential relationships among emissions and age, purchase price, and average income levels of where the stoves were located. For the stoves in our dataset with a known manufacturing date, we found no evidence of a relationship between either the age of the stove or purchase price of the stove with methane emissions nor with NO_x emissions normalized by burner energy (Figures S8 and S9; *p* values all >0.5). Finally, median income from census tracts where the stove was located had no relationship with methane emissions (Figure S10, *p* = 0.79).

STUDY LIMITATIONS AND RECOMMENDATIONS FOR FUTURE DIRECTIONS

To improve future home-appliance emissions research, we provide the following recommendations, building on suggestions from previous researchers:^{7,8,37}

1. A rapid technique such as a portable methane detector could be used to locate the largest emitters qualitatively during steady-state-off conditions. In this study, we estimated that emissions from steady-state-off were responsible for 76% of all methane emissions from gas stoves.
2. Because of sampling limitations from COVID-19, we were limited in where and how we could sample homes and could not include a representative selection of low-income, multifamily homes; future work should emphasize measurements within this demographic.
3. More comprehensive data on appliance usage and activity should be collected. Such information would help researchers scale the number of on/off pulses per day and average consumption periods. Having better information about the number of burners that are on simultaneously and their emissions during real-world use would also help inform estimates for indoor NO_x pollution and indoor air quality modeling projects.
4. Additional measurements of direct emission rates of other pollutants from stoves should be collected, such as CO and formaldehyde, as such data are currently lacking. Additionally, we recommend measuring NO_x emission rates from other gas appliances and from electric appliances for comparison (i.e., as a control for comparison). Our data and additional data collection on emission factors could be used for indoor air quality modeling to calculate concentrations of NO_x that home occupants are exposed to under various cooking and ventilation scenarios.

ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available free of charge at <https://pubs.acs.org/doi/10.1021/acs.est.1c04707>.

Details of calculations; photo of the setup; room volume estimates; volunteer information; methane emissions per

stove; correlation plots; methane cumulative emissions from stoves; gas usage per household; NO_x concentrations from the use of an oven (PDF)

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Notes

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REFERENCES

- (1) Etminan, M.; Myhre, G.; Highwood, E. J.; Shine, K. P. Radiative Forcing of Carbon Dioxide, Methane, and Nitrous Oxide: A Significant Revision of the Methane Radiative Forcing. *Geophys. Res. Lett.* **2016**, *43*, 12614–12623.
- (2) Saunio, M.; Stavert, A. R.; Poulter, B.; Bousquet, P.; Canadell, J. G.; Jackson, R. B.; Raymond, P. A.; Dlugokencky, E. J.; Houweling, S.; Patra, P. K.; Ciais, P.; Arora, V. K.; Bastviken, D.; Bergamaschi, P.; Blake, D. R.; Brailsford, G.; Bruhwiler, L.; Carlson, K. M.; Carrol, M.; Castaldi, S.; Chandra, N.; Crevoisier, C.; Crill, P. M.; Covey, K.; Curry, C. L.; Etiope, G.; Frankenberg, C.; Gedney, N.; Hegglin, M. I.; Höglund-Isaksson, L.; Hugelius, G.; Ishizawa, M.; Ito, A.; Janssens-Maenhout, G.; Jensen, K. M.; Joos, F.; Kleinen, T.; Krummel, P. B.; Langenfelds, R. L.; Laruelle, G. G.; Liu, L.; Machida, T.; Maksyutov, S.; McDonald, K. C.; McNorton, J.; Miller, P. A.; Melton, J. R.; Morino, I.; Müller, J.; Murguía-Flores, F.; Naik, V.; Niwa, Y.; Noce, S.; O'Doherty, S.; Parker, R. J.; Peng, C.; Peng, S.; Peters, G. P.; Prigent, C.; Prinn, R.; Ramonet, M.; Regnier, P.; Riley, W. J.; Rosentretter, J. A.; Segers, A.; Simpson, I. J.; Shi, H.; Smith, S. J.; Steele, L. P.; Thornton, B. F.; Tian, H.; Tohjima, Y.; Tubiello, F. N.; Tsuruta, A.; Viovy, N.; Voulgarakis, A.; Weber, T. S.; van Weele, M.; van der Werf, G. R.; Weiss, R. F.; Worthy, D.; Wunch, D.; Yin, Y.; Yoshida, Y.; Zhang, W.; Zhang, Z.; Zhao, Y.; Zheng, B.; Zhu, Q.; Zhu, Q.; Zhuang, Q. The Global Methane Budget 2000 – 2017. *Earth Syst. Sci. Data* **2020**, *12*, 1561–1623.
- (3) Myhre, G.; Shindell, D.; Bréon, F.-M.; Collins, W.; Fuglestad, J.; Huang, J.; Koch, D.; Lamarque, J.-F.; Lee, D.; Mendoza, B.; Nakajima, T.; Robock, A.; Stephens, G.; Takemura, T.; Zhang, H. Anthropogenic and Natural Radiative Forcing. In *Climate Change 2013—The Physical Science Basis: Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; Stocker, T. F.; Qin, D.; Plattner, G.-K.; Tignor, M.; Allen, S. K.; Boschung, J.; Nauels, A.; Xia, Y.; Bex, V.; Midgley, P. M., Eds.; Cambridge University Press: Cambridge, 2013; pp 659–740.
- (4) U.S. Energy Information Administration. Natural Gas Explained.
- (5) Alvarez, R. A.; Zavala-Araiza, D.; Lyon, D. R.; Allen, D. T.; Barkley, Z. R.; Brandt, A. R.; Davis, K. J.; Herndon, S. C.; Jacob, D. J.; Karion, A.; Kort, E. A.; Lamb, B. K.; Lauvaux, T.; Maasakkers, J. D.; Marchese, A. J.; Omara, M.; Pacala, S. W.; Peischl, J.; Robinson, A. L.; Shepson, P. B.; Sweeney, C.; Townsend-Small, A.; Wofsy, S. C.; Hamburg, S. P. Assessment of Methane Emissions from the U.S. Oil and Gas Supply Chain. *Science* **2018**, *361*, 186–188.
- (6) United States Environmental Protection Agency. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2018*; USEPA, 2020.
- (7) Merrin, Z.; Francisco, P. W. Unburned Methane Emissions from Residential Natural Gas Appliances. *Environ. Sci. Technol.* **2019**, *53*, 5473–5482.
- (8) Fischer, M. L.; Chan, W. R.; Delp, W.; Jeong, S.; Rapp, V.; Zhu, Z. An Estimate of Natural Gas Methane Emissions from California Homes. *Environ. Sci. Technol.* **2018**, *52*, 10205–10213.
- (9) EIA. *Residential Energy Consumption Survey (RECS)*; U.S. Energy Information Administration, 2015.
- (10) United States Census Bureau. *American Housing Survey—2019 California—Heating, Air Conditioning, and Appliances*; United States Census Bureau, 2021. https://www.census.gov/programs-surveys/ahs/data/interactive/ahstablecreator.html?s_areas=00006&s_year=2019&s_tablename=TABLE_3&s_bygroup1=1&s_bygroup2=1&s_filtergroup1=1&s_filtergroup2=1 (accessed Nov 4, 2021).
- (11) Seltenrich, N. Take Care in the Kitchen: Avoiding Cooking-Related Pollutants. *Environ. Health Perspect.* **2014**, *122*, A154–A159.
- (12) Delp, W. W.; Singer, B. C. Performance Assessment of U.S. Residential Cooking Exhaust Hoods. *Environ. Sci. Technol.* **2012**, *46*, 6167–6173.
- (13) Singer, B. C.; Delp, W. W.; Price, P. N.; Apte, M. G. Performance of Installed Cooking Exhaust Devices. *Indoor Air* **2012**, *22*, 224–234.
- (14) Singer, B. C.; Chan, W. R.; Kim, Y. S.; Offermann, F. J.; Walker, I. S. Indoor Air Quality in California Homes with Code-Required Mechanical Ventilation. *Indoor Air* **2020**, *30*, 885–899.
- (15) Zhao, H.; Chan, W. R.; Delp, W. W.; Tang, H.; Walker, I. S.; Singer, B. C. Factors Impacting Range Hood Use in California Houses and Low-Income Apartments. *Int. J. Environ. Res. Public Health* **2020**, *17*, No. 8870.
- (16) Sun, L.; Wallace, L. A. Residential Cooking and Use of Kitchen Ventilation: The Impact on Exposure. *J. Air Waste Manage. Assoc.* **2021**, *71*, 830–843.
- (17) Singer, B. C.; Pass, R. Z.; Delp, W. W.; Lorenzetti, D. M.; Maddalena, R. L. Pollutant Concentrations and Emission Rates from Natural Gas Cooking Burners without and with Range Hood Exhaust in Nine California Homes. *Build. Environ.* **2017**, *122*, 215–229.
- (18) Zhao, H.; Chan, W.; Cohn, S.; Delp, W. W.; Walker, I. S.; Singer, B. C. Indoor Air Quality in New and Renovated Low-income Apartments with Mechanical Ventilation and Natural Gas Cooking in California. *Dryad*, Dataset, 2020. <https://doi.org/10.7941/D1T050>. DOI: 10.7941/D1T050.
- (19) Hwang, S. H.; Park, W. M. Indoor Air Concentrations of Carbon Dioxide (CO₂), Nitrogen Dioxide (NO₂), and Ozone (O₃) in Multiple Healthcare Facilities. *Environ. Geochem. Health* **2020**, *42*, 1487–1496.
- (20) Alberts, W. M. Indoor Air Pollution: NO, NO₂, CO₂, and CO. *J. Allergy Clin. Immunol.* **1994**, *94*, 289–295.
- (21) Environmental Protection Agency (EPA). *Basic Information about NO₂*; EPA, 2021. <https://www.epa.gov/no2-pollution/basic-information-about-no2#Effects>.

- (22) Lin, W.; Brunekreef, B.; Gehring, U. Meta-Analysis of the Effects of Indoor Nitrogen Dioxide and Gas Cooking on Asthma and Wheeze in Children. *Int. J. Epidemiol.* **2013**, *42*, 1724–1737.
- (23) Jarvis, D. J.; Adamkiewicz, G.; Heroux, M. E.; Rapp, R.; Kelly, F. J. Nitrogen dioxide. In *WHO Guidelines for Indoor Air Quality: Selected Pollutants*. World Health Organization: Geneva, 2010, 5. ISBN: 978 92 890 0213 4. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK138707/>.
- (24) Health Canada. *Residential Indoor Air Quality Guideline: Nitrogen Dioxide*; Health Canada, 2021. <https://www.canada.ca/en/health-canada/services/publications/healthy-living/residential-indoor-air-quality-guideline-nitrogen-dioxide.html> (accessed Oct 19, 2021).
- (25) United States Environmental Protection Agency. Review of the Primary National Ambient Air Quality Standards for Oxides of Nitrogen. *Fed. Regist.* **2018**, *83*, 17226–17278.
- (26) World Health Organization. *WHO Global Air Quality Guidelines: Particulate Matter (PM_{2.5} and PM₁₀), Ozone, Nitrogen Dioxide, Sulfur Dioxide and Carbon Monoxide*; World Health Organization: Geneva, 2021.
- (27) Lebel, E. D.; Lu, H. S.; Speizer, S. A.; Finnegan, C. J.; Jackson, R. B. Quantifying Methane Emissions from Natural Gas Water Heaters. *Environ. Sci. Technol.* **2020**, *54*, 5737–5745.
- (28) Chan, W.; Kim, Y.-S.; Delp, W.; Walker, I.; Singer, B. Data from: Indoor Air Quality in California Homes with Code-Required Mechanical Ventilation. *Dryad*, Dataset, 2020. <https://doi.org/10.7941/D1ZS7X>.
- (29) Jung, K.; Lee, J.; Gupta, V.; Cho, G. Comparison of Bootstrap Confidence Interval Methods for GSCA Using a Monte Carlo Simulation. *Front. Psychol.* **2019**, *10*, No. 2215.
- (30) Efron, B. Better Bootstrap Confidence Intervals. *J. Am. Stat. Assoc.* **1987**, *82*, 171–185.
- (31) Bureau of Transportation Statistics. Estimated U.S. Average Vehicle Emissions Rates per Vehicle by Vehicle Type Using Gasoline and Diesel. <https://www.bts.gov/content/estimated-national-average-vehicle-emissions-rates-vehicle-type-using-gasoline-and-diesel>.
- (32) Brandt, A. R.; Heath, G. A.; Cooley, D. Methane Leaks from Natural Gas Systems Follow Extreme Distributions. *Environ. Sci. Technol.* **2016**, DOI: 10.1021/acs.est.6b04303.
- (33) DNV GL Energy Insights USA Inc. 2019 California Residential Appliance Saturation Study, Publication Number: CEC-200-2021-005-ES; DNV GL Energy Insights USA Inc., 2019.
- (34) Traynor, G. W.; Apte, M. G.; Chang, G.-M. Pollutant Emission Factors from Residential Natural Gas Appliances: A Literature Review. *J. Air Waste Manage. Assoc.* **1996**, 1–20.
- (35) Singer, B. C.; Apte, M. G.; Black, D. R.; Hotchi, T.; Lucas, D.; Lunden, M. M.; Mirer, A. G.; Spears, M.; Sullivan, D. P. Natural Gas Variability in California: Environmental Impacts and Device Performance: Experimental Evaluation of Pollutant Emissions from Residential Appliances. *LBNL* **2009**, 1–120.
- (36) Logue, J. M.; Klepeis, N. E.; Lobscheid, A. B.; Singer, B. C. Pollutant Exposures from Natural Gas Cooking Burners: A Simulation-Based Assessment for Southern California. *Environ. Health Perspect.* **2014**, *122*, 43–50.
- (37) Saint-Vincent, P. M. B.; Pekney, N. J. Beyond-the-Meter: Unaccounted Sources of Methane Emissions in the Natural Gas Distribution Sector. *Environ. Sci. Technol.* **2020**, 39–49.

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Cooking With Gas, Household Air Pollution, and Asthma: Little Recognized Risk for Children

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Abstract Cooking with a gas stove releases combustion-generated nitrogen dioxide and other pollutants into household air. Both nitrogen dioxide in household air and cooking with gas are associated with increased risk and severity of childhood asthma. The impact on children can be substantial because at least one third of households in the U.S. cook with gas stoves, children spend most of their time indoors, indoor air is unregulated, and asthma is the most common chronic disease in children. The association between gas cooking stoves, household air pollution, and childhood asthma is not widely appreciated. We propose a public information campaign, public policies addressing household air pollution risks associated with cooking with gas, requirement of warning labels on gas cooking stoves, and further research on the efficacy of available interventions.

Introduction

Burning fossil fuels in vehicles, furnaces, electricity plants, and for other uses generates nitrogen dioxide, particulate matter, carbon monoxide, and other compounds that pollute the air people breathe, all of which contribute to poor health. Air pollution increases the risk of asthma, the most common childhood chronic disease across all socioeconomic classes and the most frequent cause of hospitalization among children (Zahran et al., 2018). The impact of combustion-generated outdoor air pollution on asthma and other health outcomes is recognized and subject to environmental regulation. The association of combustion-generated household air pollution and asthma is less well known and household air pollution is not regulated.

Cooking with gas stoves increases household air pollution, which is associated with

asthma and increased asthma severity. Household air pollution is a particular concern for children, who spend a majority of their time in homes and who are biologically more susceptible to air pollution because of higher breathing rates, developing lungs, and immature immune systems (Bateson & Schwartz, 2007). The aim of this special report is to discuss the health effects on children of cooking with gas and to discuss policy changes that could reduce the risk of asthma in children.

Methods

We searched PubMed in 2017 for articles including U.S. populations using the search term “gas stoves” with a human-only filter. Following our review, we searched for studies of the biological plausibility of nitrogen dioxide increasing the risk of respiratory illnesses in children, the health impacts of out-

door nitrogen dioxide, and interventions to reduce the harms of cooking with a gas stove. We informally asked health workers and others in Massachusetts if they knew about the association between cooking with a gas stove and childhood asthma.

Discussion

Household Air Pollution Worse Than Outdoor Air Pollution

Even in large cities, household air can be more polluted than outdoor air (U.S. Environmental Protection Agency [U.S. EPA], 2020a). Household air pollution is associated with asthma and increased asthma morbidity (Breyse et al., 2010). This association is particularly worrisome because according to the National Human Activity Pattern Survey, a probability-based telephone survey ($n = 9,386$) in the U.S., children spend approximately 65% of their time in homes and more than 80% of their time indoors (Klepeis et al., 2001).

Gas Cooking Stoves: Source of Household Air Pollution

Cooking with a gas stove is a significant source of household air pollutants. According to the U.S. Environmental Protection Agency (U.S. EPA), both unburned and burned gas release toxic chemicals into household air. These chemicals include nitrogen dioxide (NO_2), $\text{PM}_{2.5}$, carbon monoxide (CO), benzene, and formaldehyde (U.S. EPA, 1998), all of which are associated with serious human health effects (Table 1). The effect of exposure to these chemical pollutants on childhood respiratory illnesses is not well understood. Nitrogen dioxide is an established marker for

TABLE 1

U.S. Environmental Protection Agency (U.S. EPA) Listed Health Effects of Chemicals Emitted From Burned Natural Gas

Chemical Name	Health Effect
Nitrogen dioxide (U.S. EPA, 2016)	Contributes to the development of asthma, aggravated asthma, and increases susceptibility to respiratory infections
PM _{2.5} (U.S. EPA, 2020b)	- Aggravates asthma, decreases lung function, and increases respiratory symptoms - Nonfatal heart attacks and irregular heartbeat - Premature death in people with heart or lung disease
Carbon monoxide (U.S. EPA, 2020c)	- Neurological effects including fatigue, impaired vision, reduced brain function, dizziness, confusion, nausea, and coma - Chest pain in people with heart disease - Death
Benzene (U.S. EPA, 2012)	- Neurological effects including drowsiness, dizziness, headaches, and unconsciousness - Aplastic anemia, excessive bleeding, and damage to the immune system - Leukemia
Formaldehyde (U.S. EPA, 2020d)	- Irritation of the skin, eyes, nose, and throat - Cancer

fossil fuel combustion-generated air pollution, including from natural gas (Jarvis et al., 2010).

Cooking With Gas Increases Household Nitrogen Dioxide Levels

Levels of NO₂ are significantly higher in homes with gas stoves than homes with electric stoves. U.S. EPA estimates that homes with gas cooking appliances have approximately 50% to >400% higher NO₂ levels than homes with electric cooking stoves (U.S. EPA, 2008). In a study of children with active asthma, NO₂ levels were measured in homes with electric and gas cooking stoves. The mean NO₂ levels were 8.6 ppb in homes with electric ranges and 3 times higher in homes with gas stoves (25.9 ppb) (Belanger et al., 2006).

A study of 1,400 homes in Albuquerque, New Mexico, analyzed the impact of housing characteristics, occupant behaviors, and weather on indoor NO₂ levels. Higher NO₂ levels in bedrooms were predominantly associated with the presence of gas cooking ranges with continuously burning pilot lights (10 ppb higher than gas cooking stoves without pilot lights), the use of the gas cooking stove for space heating, and fewer square feet of living space (Spengler et al., 1996).

A study of NO₂ levels in 352 homes in California found median kitchen NO₂ lev-

els were highest in homes with gas cooking stoves with pilot lights (gas stove with pilot, 22 ppb; gas without pilot, 15.4 ppb; and electric stoves, 6 ppb). Levels of NO₂ were higher in homes that cooked with gas ≥4 hr/week (gas >8 hr/week, 24 ppb; gas >4 hr/week, 19 ppb; gas <4 hr/week, 18 ppb; electric >8 hr/week, 6.5 ppb) and that reported not using over-the-stove exhaust fan hoods that vented outdoors, hereafter referred to as exhaust fans (gas stove with exhaust fan never used, 34 ppb; gas with exhaust fan used one half of the time, 22 ppb; gas with exhaust fan used most/all the time, 16 ppb; and electric, 6.6 ppb) (Mullen et al., 2016).

Nitrogen Dioxide May Cause Asthma and Aggravate Symptoms

Associations between higher outdoor NO₂ levels and increased risk of asthma are well established (Guarnieri & Balmes, 2014). In 2016, the U.S. EPA *Integrated Science Assessment for Oxides of Nitrogen* upgraded its assessment of the relationship of short periods of NO₂ exposure to aggravated respiratory diseases, particularly asthma, from “likely causal” to “causal,” and longer exposures to elevated levels of NO₂ to “likely causal” of respiratory effects, including asthma (U.S. EPA, 2016).

Indoor studies find associations between higher NO₂ levels and risk of asthma symptoms. A meta-analysis found that higher levels of household NO₂ were associated with a 15% (95% confidence interval [CI] [1.06, 1.25]) increased risk of current wheeze in children (Lin et al., 2013). A prospective study of 1,342 children with asthma between the ages of 5 and 10 years found that above a 6 ppb threshold, every 5 ppb increase in NO₂ levels was associated with a dose-dependent increase in risk of wheeze (1.49, 95% CI [1.09, 2.03]), night symptoms (1.52, 95% CI [1.16, 2.00]), and need for rescue medication (1.78, 95% CI [1.33, 2.38]) (Belanger et al., 2013). A prospective study of children ages 2–6 with asthma in Baltimore, Maryland, found each 20-ppb increase in NO₂ levels was associated with significant increases in risk of both cough (1.10, 95% CI [1.02, 1.18]) and nocturnal symptoms (1.09, 95% CI [1.02, 1.16]) (Hansel et al., 2008).

Cooking with gas is associated with increased risk of asthma. A meta-analysis showed that children living in a home with a gas cooking stove have a 42% increased risk of current asthma (95% CI [1.23, 1.64]) and a 24% increased lifetime risk of asthma (95% CI [1.04, 1.47]) (Lin et al., 2013).

Children’s Exposure to Gas Cooking Stoves Is Substantial

Approximately one third of households in the U.S. cook with gas stoves, with regional variability (U.S. Census Bureau, 2011). A Lawrence Berkeley National Laboratory modeling study of homes in Southern California estimated that during winter, when ventilation in homes is lowest, 51–64% of homes using natural gas cooking stoves regularly experienced household NO₂ levels that exceeded health-based outdoor air standards (Logue et al., 2014). Current efforts to reduce energy consumption in homes and other buildings by reducing air flow into and out of buildings will increase household air pollution. A modeling study estimated that tightening building envelopes without repairing kitchen exhaust fans or eliminating gas stoves would lead to 20% more childhood asthma events (Fabian et al., 2014).

Exhaust Fans Can Decrease Household Nitrogen Dioxide Levels, With Limitations

Exhaust fans that are vented to the outdoors can reduce household air pollution. A study

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of NO₂ levels in 352 homes in California found median NO₂ levels in the kitchen were significantly lower in homes where people reported cooking with gas and using exhaust fans all the time (16 ppb) compared with those who never used them (34 ppb) (Mullen et al., 2016). Many people, however, do not turn on exhaust fans when they cook with gas stoves. Respondents to a California web-based survey reported using exhaust fans only one third of the time when cooking dinner and less for other meals (Klug et al., 2011). Exhaust fans that do vent to the outdoors might not capture all the pollutants generated by gas cooking stoves. It depends, in part, on the amount of air the exhaust fan can capture and move to the outdoors (Singer et al., 2017). Exhaust fans that recirculate air inside the home and that are not vented to the outdoors remove very little NO₂ and other pollutants from household air.

Other Interventions That Can Reduce Household Nitrogen Dioxide Levels

A randomized study evaluating three interventions to lower household NO₂ levels in homes with gas cooking stoves found that replacing gas cooking stoves was the most effective way to lower household NO₂ levels. Median NO₂ levels were 42% lower when electric cooking stoves replaced gas cooking stoves and 27% lower when air purifiers with high-efficiency particulate air (HEPA) and activated carbon filters (hereafter referred to as air purifiers) were placed in the homes. Levels of NO₂ were not significantly lower in homes where new exhaust fans were installed over gas stoves (Paulin et al., 2014). It is not known why NO₂ levels were not reduced by the exhaust fans. Perhaps the fans were not turned on or the exhaust fans were used but did not expel enough of the NO₂ coming from the gas cooking stove. A study of commonly used exhaust fans in the U.S. found that exhaust fans captured <30% of the pollutants coming from the front stove burners (Delp & Singer, 2012).

Cooking With Gas Is an Unrecognized Risk

In Massachusetts, informal questioning of more than 100 parents, health professionals, staff of local health departments, and local boards of health, among others, found that most did not know about the association

TABLE 2

Recommendations to Families With Gas Cooking Stoves and Children With Asthma

Recommendation	Explanation
Reduce use of the gas stove	Use electric appliances instead of the gas stove. Alternative appliances include microwaves, toaster ovens, rice cookers, crockpots, and portable single electric induction burners.
Remove gas cooking stove-related pollution from household air	If there is an exhaust fan above the gas stove that pushes gas fumes out of the home, turn it on when cooking with the gas stove and consider leaving it on after turning the stove off. When possible, use the back burners because the exhaust hood captures more pollutants from back burners. If the gas stove does not have a working exhaust fan or the fan does not exhaust to the outdoors, use a HEPA air purifier with a carbon filter to remove pollution, or open a window.
Replace the gas cooking stove with an electric stove	Consider replacing the gas stove with an electric or electric induction stove.

between cooking with gas stoves, household air pollution, and increased risk of asthma among children living in the home (T.S. Jones, personal communication, April 30, 2019).

Implications for Public Health Practice

1. **Inform healthcare professionals, health departments, families, and others that gas cooking stoves are associated with childhood asthma.** The association between gas cooking stoves, household NO₂ levels, and childhood asthma is not widely known and has been insufficiently addressed in public policy. Information that cooking with gas is associated with increased asthma risk and severity should be widely disseminated to parents, healthcare professionals, public health staff, and government agencies that fund new housing, set safe housing standards, and inspect homes.

Healthcare professionals could ask families whose children have asthma what kind of stove is used for cooking and encourage families who cook with gas stoves to: reduce use, improve ventilation, and replace gas stoves with electric or electric induction stoves (Table 2). These interventions could include assessing the presence of gas cooking stoves as part of multi-trigger, multifaceted, home-based interventions for asthma recommended by the Community Preventive Services Task Force (Crocker et al., 2011).

2. **Healthcare organizations should invest in population health programs to prevent**

asthma and reduce asthma-related healthcare costs. Many families whose children have asthma have limited resources to address the multiple factors that contribute to their children's asthma, including gas cooking stoves. Healthcare organizations, including accountable care organizations, should implement population health policies to address the root causes of asthma, and thereby, reduce healthcare expenditures. As part of multifaceted, home-based interventions, these organizations could provide families with 1) electric induction burners to reduce the use of gas cooking stoves and 2) air purifiers to reduce household air pollution to improve health and reduce asthma-related healthcare expenditures.

3. **Government agencies that set safe home standards, plumbing standards, and inspect homes should review and revise existing standards and procedures to help reduce children's exposure to air pollution generated by gas cooking stoves.** State health departments issue safe housing standards. Staff from local health departments frequently inspect apartments and homes to ensure that residences meet existing safe housing standards. State plumbing boards issue codes for installation of gas appliances. These agencies should review and revise existing standards and procedures to help reduce children's exposure to air pollution generated by gas cooking stoves.

4. **Inform consumers that gas cooking stoves are associated with childhood asthma.**

Warning labels could be required on gas cooking stoves stating the stoves are associated with childhood asthma and should be used only with exhaust fans that vent to the outdoors and/or air purifiers.

5. **Further research.** Additional randomized trials to determine the impact of gas cooking stove interventions on asthma can help guide intervention implementation. The studies could evaluate the affect on childhood asthma of reducing gas stove use, using exhaust fans, using air purifiers, and replacing gas cooking stoves with electric or electric induction stoves.

Conclusion

Household air pollution is not monitored or regulated and is often overlooked as a pol-

lution exposure for children. Cooking with gas increases combustion-related household air pollutants, such as NO₂, and increases the risk of both childhood asthma and asthma severity. Cooking with gas has widespread potential impact on childhood health because 1) more than one third of homes in the U.S. cook with gas, 2) children are more susceptible to the effects of air pollution, and 3) children spend the majority of their time in homes.

Household air pollution generated by gas cooking stoves can be reduced by simple interventions: reducing the use of the stove, improving and using ventilation, and replacing the gas stove with an electric one. These interventions are likely to improve childhood health because exposure to gas cook-

ing stoves is common and asthma is the most common childhood disease in the U.S.

The risks of household air pollution and cooking with gas are not widely recognized and should be considered when developing policies for reducing children's exposure to air pollution. We recommend a public information campaign, warning labels on gas cooking stoves, population health policies addressing the risks of gas cooking stoves, and further research on the efficacy of interventions. ■■■

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References

- Bateson, T.E., & Schwartz, J. (2007). Children's response to air pollutants. *Journal of Toxicology and Environmental Health, Part A*, 71(3), 238–243. <https://doi.org/10.1080/15287390701598234>
- Belanger, K., Gent, J.F., Triche, E.W., Bracken, M.B., & Leaderer, B.P. (2006). Association of indoor nitrogen dioxide exposure with respiratory symptoms in children with asthma. *American Journal of Respiratory and Critical Care Medicine*, 173(3), 297–303. <https://doi.org/10.1164/rccm.200408-1123OC>
- Belanger, K., Holford, T.R., Gent, J.F., Hill, M.E., Kezik, J.M., & Leaderer, B.P. (2013). Household levels of nitrogen dioxide and pediatric asthma severity. *Epidemiology*, 24(2), 320–330. <https://doi.org/10.1097/EDE.0b013e318280e2ac>
- Breyse, P.N., Diette, G.B., Matsui, E.C., Butz, A.M., Hansel, N.N., & McCormack, M.C. (2010). Indoor air pollution and asthma in children. *Proceedings of the American Thoracic Society*, 7(2), 102–106.
- Crocker, D.D., Kinyota, S., Dumitru, G.G., Ligon, C.B., Herman, E.J., Ferdinands, J.M., Hopkins, D.P., Lawrence, B.M., & Sipe, T.A. (2011). Effectiveness of home-based, multi-trigger, multicomponent interventions with an environmental focus for reducing asthma morbidity: A community guide systemic review. *American Journal of Preventive Medicine*, 41(2, Suppl. 1), S5–S32. <https://doi.org/10.1016/j.amepre.2011.05.012>
- Delp, W.W., & Singer, B.C. (2012). Performance assessment of U.S. residential cooking exhaust hoods. *Environmental Science & Technology*, 46(11), 6167–6173. <https://doi.org/10.1021/es3001079>
- Fabian, M.P., Adamkiewicz, G., Stout, N.K., Sandel, M., & Levy, J.I. (2014). A simulation model of building intervention impacts on indoor environmental quality, pediatric asthma, and costs. *The Journal of Allergy and Clinical Immunology*, 133(1), 77–84. <https://doi.org/10.1016/j.jaci.2013.06.003>
- Guarnieri, M., & Balmes, J.R. (2014). Outdoor air pollution and asthma. *Lancet*, 383(9928), 1581–1592. [https://doi.org/10.1016/S0140-6736\(14\)60617-6](https://doi.org/10.1016/S0140-6736(14)60617-6)
- Hansel, N.N., Breyse, P.N., McCormack, M.C., Matsui, E.C., Curtin-Brosnan, J., Williams, D.L., Moore, J.L., Cuhnan, J.L., & Diette, G.B. (2008). A longitudinal study of indoor nitrogen dioxide levels and respiratory symptoms in inner-city children with asthma. *Environmental Health Perspectives*, 116(10), 1428–1432. <https://doi.org/10.1289/ehp.11349>
- Jarvis, D.J., Adamkiewicz, G., Héroux, M.-E., Rapp, R., & Kelly, E.J. (2010). Nitrogen dioxide. In *WHO guidelines for indoor air quality: Selected pollutants* (pp. 201–287). World Health Organization Regional Office for Europe. <https://apps.who.int/iris/handle/10665/260127>
- Klepeis, N.E., Nelson, W.C., Ott, W.R., Robinson, J.P., Tsang, A.M., Switzer, P., Behar, J.V., Hern, S.C., & Engelmann, W.H. (2001). The National Human Activity Pattern Survey (NHAPS): A resource for assessing exposure to environmental pollutants. *Journal of Exposure Analysis & Environmental Epidemiology*, 11, 231–252. <https://doi.org/10.1038/sj.jea.7500165>
- Klug, V.L., Lobscheid, A.B., & Singer, B.C. (2011). *Cooking appliance use in California homes—Data collected from a web-based survey* [Technical report]. Lawrence Berkeley National Laboratory. <https://doi.org/10.2172/1050839>
- Lin, W., Brunekreef, B., & Gehring, U. (2013). Meta-analysis of the effects of indoor nitrogen dioxide and gas cooking on asthma and wheeze in children. *International Journal of Epidemiology*, 42(6), 1724–1737. <https://doi.org/10.1093/ije/dyt150>
- Logue, J.M., Klepeis, N.E., Lobscheid, A.B., & Singer, B.C. (2014). Pollutant exposures from natural gas cooking burners: A simu-

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References *continued from page 17*

- lation-based assessment for Southern California. *Environmental Health Perspectives*, 122(1), 43–50. <https://doi.org/10.1289/ehp.1306673>
- Mullen, N.A., Li, J., Russell, M.L., Spears, M., Less, B.D., & Singer, B.C. (2016). Results of the California Healthy Homes Indoor Air Quality Study of 2011–2013: Impact of natural gas appliances on air pollutant concentrations. *Indoor Air*, 26(2), 231–245. <https://doi.org/10.1111/ina.12190>
- Paulin, L.M., Diette, G.B., Scott, M., McCormack, M.C., Matsui, E.C., Curtin-Brosnan, J., Williams, D.L., Kidd-Taylor, A., Shea, M., Breyse, P.N., & Hansel, N.N. (2014). Home interventions are effective at decreasing indoor nitrogen dioxide concentrations. *Indoor Air*, 24(4), 416–424. <https://doi.org/10.1111/ina.12085>
- Singer, B.C., Pass, R.Z., Delp, W.W., Lorenzetti, D.M., & Madalena, R.L. (2017). Pollutant concentrations and emission rates from natural gas cooking burners without and with range hood exhaust in nine California homes. *Building and Environment*, 122, 215–229. <https://doi.org/10.1016/j.buildenv.2017.06.021>
- Spengler, J.D., Schwab, M., McDermott, A., Lambert, W.E., & Samet, J.M. (1996). *Nitrogen dioxide and respiratory illness in children. Part IV: Effects of housing and meteorologic factors on indoor nitrogen dioxide concentrations* (Research report 58). Health Effects Institute. <https://www.healtheffects.org/system/files/Research-Report-58-Part-4.pdf>
- U.S. Census Bureau. (2011). *American housing survey for the United States: 2009. Current housing reports* (Series H150/09). U.S. Government Printing Office. <https://www.census.gov/prod/2011pubs/h150-09.pdf>
- U.S. Environmental Protection Agency. (1998). 1.4 Natural gas combustion. In *Compilation of Air Pollutant Emissions Factors* (AP-42, 5th ed., Vol. 1). <https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-fifth-edition-volume-i-chapter-1-external-0>
- U.S. Environmental Protection Agency. (2008). *Integrated Science Assessment (ISA) for oxides of nitrogen—Health criteria (Final report, Jul 2008)* (EPA/600/R-08/071). <https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=194645>
- U.S. Environmental Protection Agency. (2012). *Benzene: Hazard summary* (71-43-2). <https://www.epa.gov/sites/production/files/2016-09/documents/benzene.pdf>
- U.S. Environmental Protection Agency. (2016). *Integrated Science Assessment for oxides of nitrogen—Health criteria* (EPA/600/R-15/068). https://cfpub.epa.gov/si_public_file_download.cfm?p_download_id=526855&Lab=NCEA
- U.S. Environmental Protection Agency. (2020a). *The inside story: A guide to indoor air quality*. <https://www.epa.gov/indoor-air-quality-iaq/inside-story-guide-indoor-air-quality>
- U.S. Environmental Protection Agency. (2020b). *Particulate matter (PM) pollution: Health and environmental effects of particulate matter (PM)*. <https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm>
- U.S. Environmental Protection Agency. (2020c). *Carbon monoxide's impact on indoor air quality*. <https://www.epa.gov/indoor-air-quality-iaq/carbon-monoxides-impact-indoor-air-quality>
- U.S. Environmental Protection Agency. (2020d). *Facts about formaldehyde*. <https://www.epa.gov/formaldehyde/facts-about-formaldehyde>
- Zahran, H.S., Bailey, C.M., Damon, S.A., Garbe, P.L., & Breyse, P.N. (2018). *Vital Signs: Asthma in children—United States, 2001–2016. Morbidity and Mortality Weekly Report*, 67(5), 149–155. <https://doi.org/10.15585/mmwr.mm6705e1>



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Detroit: The Current Status of Asthma Burden

2021 Update



Prudence Kunyangna
Beth Anderson

<http://www.michigan.gov/asthma>

[MDHHS - Michigan Asthma Surveillance, Data and Reports](#)

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Data Sources

- United States Census Bureau
- Michigan Behavioral Risk Factor Survey (MIBRFS), MDHHS
- Michigan Inpatient Database, MDHHS/Michigan Health and Hospital Association
- Michigan Health Data Warehouse, MDHHS
- Michigan Death Files, MDHHS

What is Asthma?

- Asthma is a chronic lung disease that inflames and narrows the airways. Asthma causes recurring periods of wheezing, chest tightness, shortness of breath, and coughing. The coughing often occurs at night or early in the morning.¹
- Asthma has no cure. However, with today's knowledge and treatments, most people who have asthma are able to manage the disease.
- Michigan's efforts to address asthma are coordinated through the Michigan Department of Health and Human Services Asthma Program and partners.

Executive Summary/Key Findings

2021 Report

The asthma burden in Detroit was found to be greater than the overall asthma burden in Michigan.

- The prevalence of current asthma among Detroit adults was 46% higher than in Michigan as a whole.
- The rate of hospitalizations for asthma was at least four times greater for Detroit residents than for Michigan residents as a whole, from 2016-2019.
- In 2019, the rate of asthma hospitalizations for Black residents in Detroit was more than three times the rate for white persons.
- The rate of emergency department visits among children covered by Michigan Medicaid was twice as high in Detroit as the rate for the state as a whole.
- Reliance on the emergency department for asthma care was over 50% higher for children enrolled in Medicaid with persistent asthma in Detroit as compared with their counterparts in the state as a whole from 2016-2019.
- Rates of asthma hospitalization, emergency department use, and persistent asthma tended to be lower in the southwestern parts of the city.

Executive Summary/Key Findings

2021 Report, Cont'd

- “Detroit: The Current Status of Asthma Burden-2016 Update” report showed the prevalence of current asthma among adults being 29% higher than Michigan, and this update shows that has increased to 46%.
- There now is a significant difference between the prevalence of asthma among children in Detroit (14.6%) compared to Michigan (8.4%), where there wasn’t one in 2016.
- Unfortunately, due to a change in the International Classification of Diseases (ICD) from version 9 to version 10, asthma hospitalization and Medicaid data can not be compared between the last report (2016) and this version (2021).

1. Population demographics¹ of Detroit, Michigan, July 1, 2019

Measure	Detroit Population Estimate
Total population	670,031
% less than 18 years	25.0%
% Black	78.3%
% of those 25 years and older with less than high school diploma	19.0%
Persons without health insurance, under age 65 years	9.6%
Median household income	\$30,894
% in poverty	35.0%
% of housing units that were vacant	25.7%

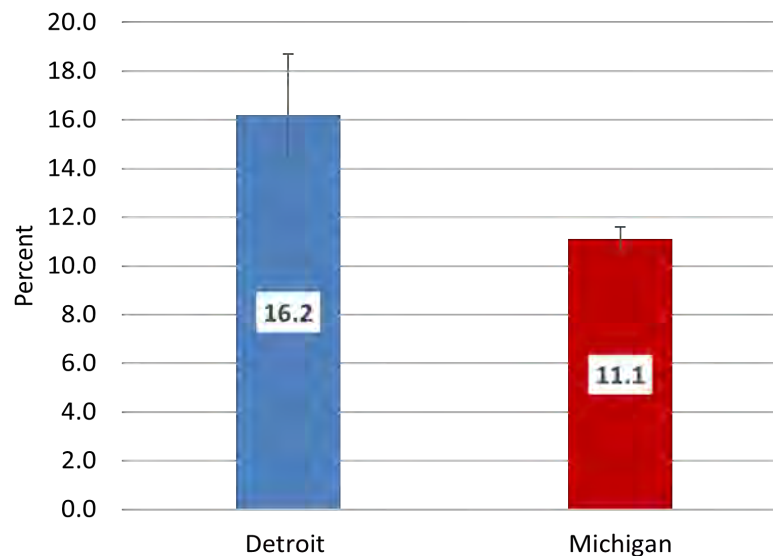
- The total resident population of Detroit, Michigan, in 2019 was over 670,000; 78.3% of this population was Black.
- In 2019, the median household income was \$30,894, with 35.0% of the population living in poverty.
- Of the population <65 years of age, 9.6% did not have health insurance in 2019.
- Among the population ≥25 years of age, 19.0% had not earned a high school diploma.
- The prevalence of vacant housing units was 25.7% in 2019.

Data Notes:

1. Source: United States Census Bureau

Current Asthma Prevalence

2. Prevalence of Current Asthma¹ for Adults (≥18 Years), Detroit and Michigan, 2017-2019

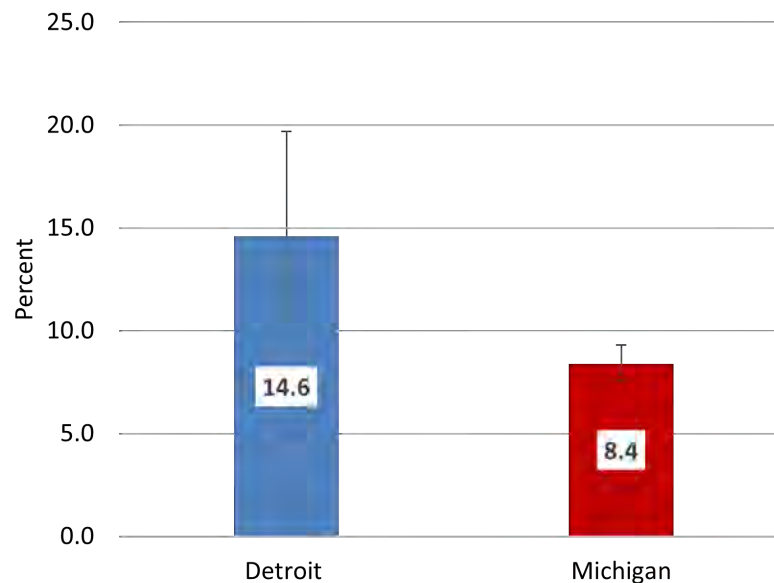


- From 2017-2019, 16.2% of Detroit adults and 11.1% of Michigan adults had current asthma.
- There was a significant difference in current asthma prevalence rates between Detroit and Michigan adults. Detroit had a 46% higher prevalence of current asthma among adults compared to adults in Michigan as a whole.

Data Notes:

1. Source: 2017-2019 Michigan Behavioral Risk Factor Surveys, MDHHS.

3. Prevalence of Current Asthma¹ for Children (<18 Years), Detroit and Michigan, 2017-2019



- From 2017-2019, 14.6% of Detroit children and 8.4% of Michigan children had current asthma.
- There was a significant difference in current asthma prevalence rates between Detroit and Michigan children. Detroit had a 74% higher prevalence of current asthma among children compared to children in Michigan as a whole.

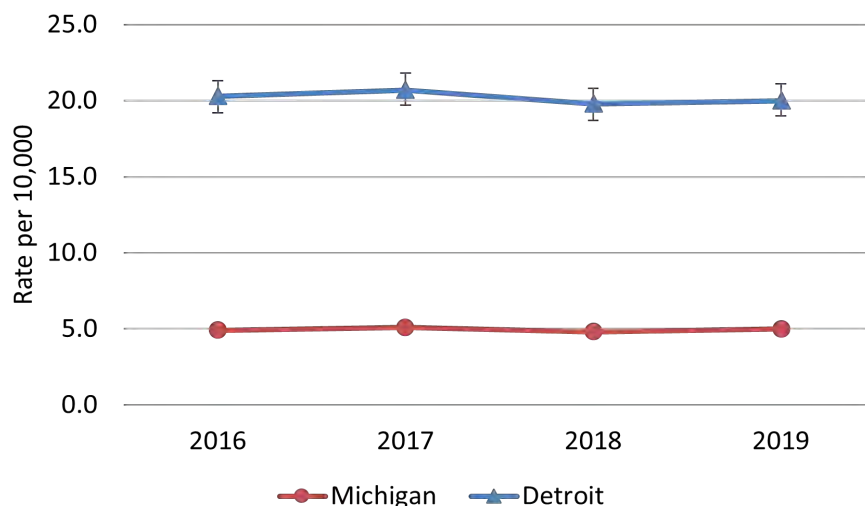
Data Notes:

1. Source: 2017-2019 Michigan Behavioral Risk Factor Surveys, MDHHS

Asthma Hospitalization

Due to a change in International Classification of Diseases (ICD) for asthma hospitalizations in 2015 from version 9 to version 10, asthma hospitalization data in this report should not be compared to estimates in the previous 2016 Detroit Report.

4. Rates¹ of Asthma Hospitalization², Detroit and Michigan, 2016-2019



- In 2019, there were 1,458 asthma hospitalizations for Detroit residents. The rate of asthma hospitalizations was 20.3 per 10,000 population.

- The asthma hospitalization rate in Detroit in 2019 was four times the rate in Michigan as a whole.

- Between 2016 and 2019, the rates of asthma hospitalization in Detroit and Michigan did not change significantly ($p > 0.05$).³

Data Notes:

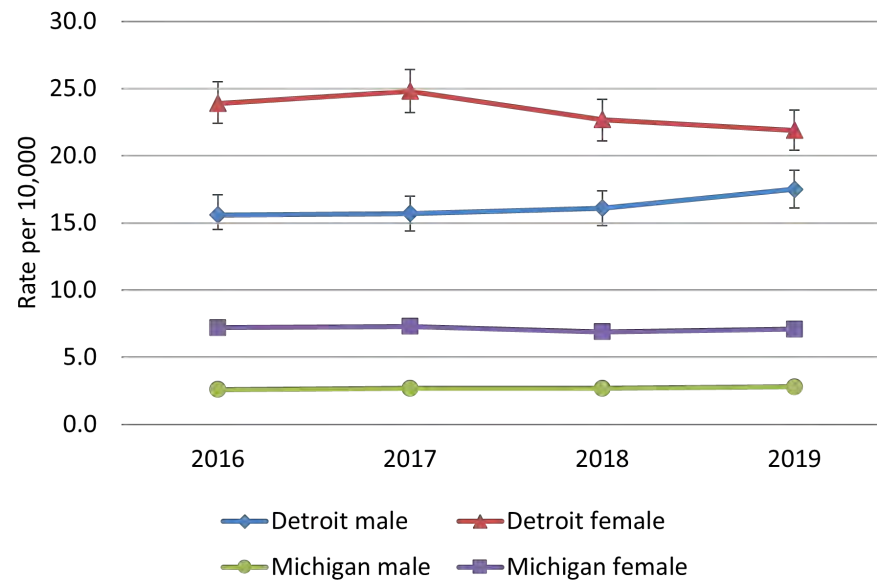
Source: Michigan Inpatient Database, 2016-2019, MDHHS

1. Age-adjusted to the 2000 US Standard Population

2. Asthma as primary diagnosis ICD-10 –CM=J45.XX

3. Spearman's correlation and rank correlation test

5. Rates¹ of Asthma Hospitalization² by Sex, Detroit and Michigan, 2016-2019



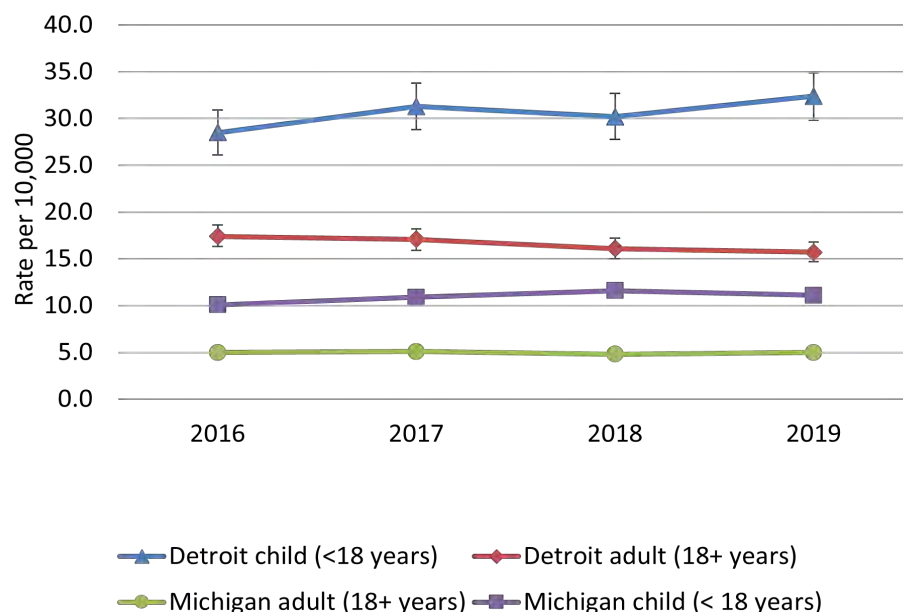
- In 2019, the rate of asthma hospitalizations among Detroit females was 21.9 per 10,000. Among males in Detroit, the rate was 17.5 per 10,000. Females in Detroit had a 25% higher rate of asthma hospitalization compared to males.
- In Michigan as a whole, the rate was 153.6% higher among females than among males (male rate was 2.8 and female rate was 7.1).
- For each respective sex, asthma hospitalization rates in Detroit were over three times higher than that in Michigan as a whole.
- Between 2016 and 2019, the rate of asthma hospitalizations for males and females in Detroit and Michigan as a whole did not change significantly ($p > 0.05$).³

Data Notes:

Source: Michigan Inpatient Database, 2016-2019, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Asthma as primary diagnosis, ICD-10-CM=J45.XX
3. Spearman's correlation and rank correlation test

6. Rates¹ of Asthma Hospitalization² by Age Group, Detroit and Michigan, 2016-2019



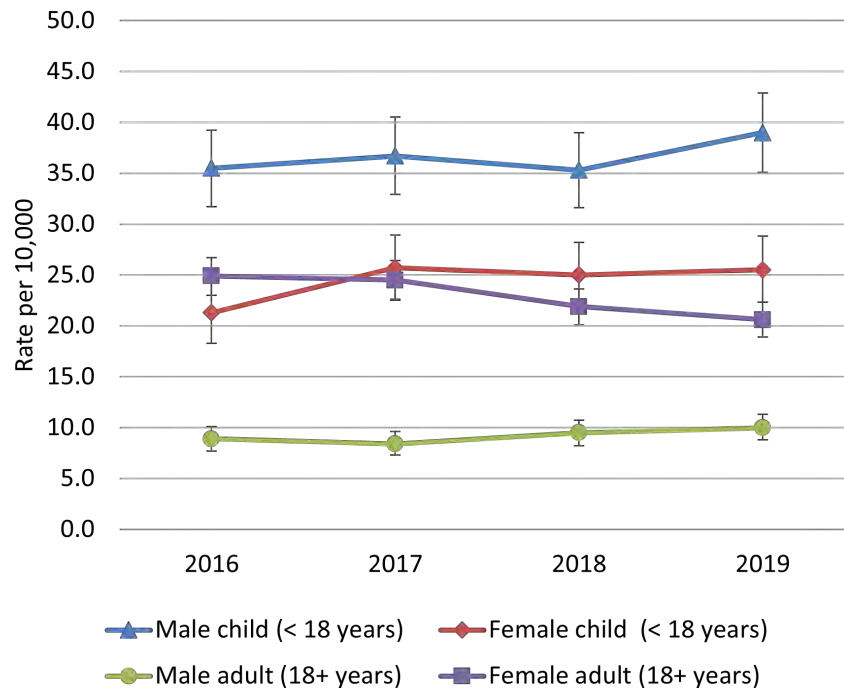
- In Detroit, the rate of child asthma hospitalization was consistently higher compared to adults from 2016 to 2019; likewise in Michigan, child hospitalization rates were consistently higher than that of adults for all four years.
- In 2019, the rate of asthma hospitalizations among Detroit children was 32.4 per 10,000. Among adults, the rate was 15.7 per 10,000.
- Asthma hospitalizations rates in Detroit were at least two times higher among Detroit children than Michigan children and three times higher than that in Michigan as a whole for adults and for all four years.
- Between 2016 and 2019, adult and child hospitalization rates for Detroit and Michigan did not change significantly ($p > 0.05$).³

Data Notes:

Source: Michigan Inpatient Database, 2016-2019, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Asthma as primary diagnosis ICD-10 –CM=J45.XX
3. Spearman's correlation and rank correlation test

7. Rates¹ of Asthma Hospitalization² by Sex-Age Group, Detroit, 2016-2019



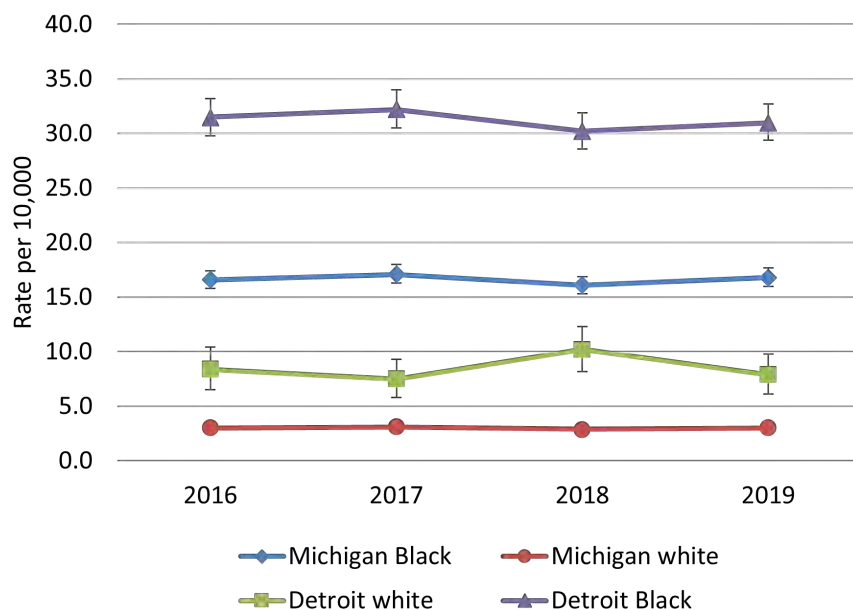
Data Notes:

Source: Michigan Inpatient Database, 2016-2019, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Asthma as primary diagnosis ICD-10 –CM=J45.XX
3. Spearman's correlation and rank correlation test

- In 2019, the rate of asthma hospitalization among Detroit male children was 39.0 per 10,000. The rate among female Detroit children was 25.5 per 10,000.
- In 2019, the rate of asthma hospitalization among Detroit male adults was 10.0 per 10,000. Among Detroit female adults, the rate was 20.6 per 10,000.
- Asthma hospitalization rates were over 100% higher among adult females than males in 2019. Among Detroit children, the male rate was about 50% higher than females.
- From 2016 to 2019, the rates of asthma hospitalization for female adult decreased by 20.8%. Male child, male adult and female child rates did not change significantly ($p>0.05$).³

8. Rates¹ of Asthma Hospitalization² by Race, Detroit and Michigan, 2016-2019



- In 2019, the rate of asthma hospitalization among Black persons in Detroit was 31.0 per 10,000. The rate among white persons in Detroit was 7.9 per 10,000.

- Asthma hospitalization among Detroit Blacks were over three times that of Detroit whites. Michigan Blacks had over five times the hospitalization rate of Michigan whites.

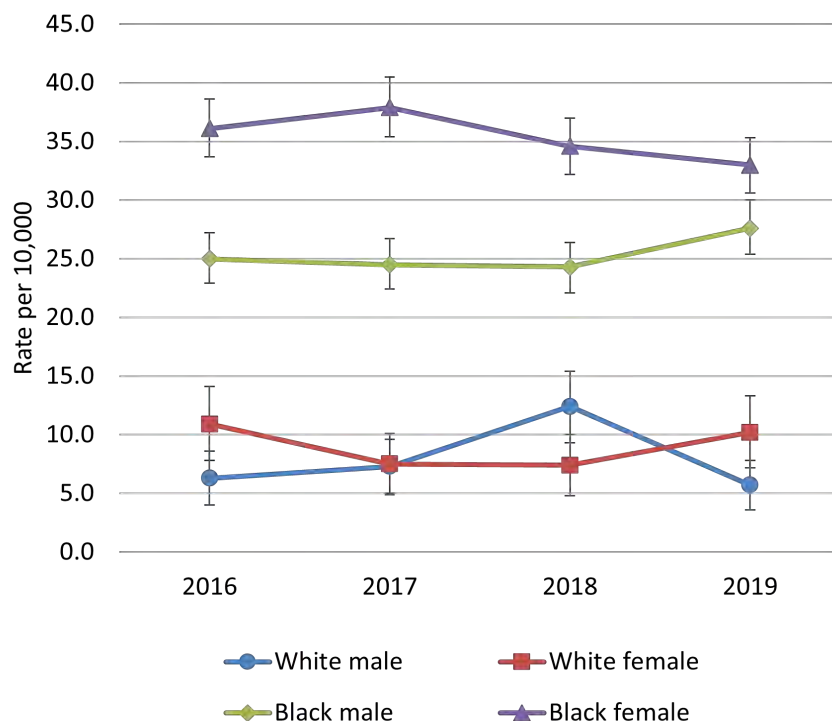
- Between 2016 and 2019, the rates of asthma hospitalization for Black persons and white residents in Michigan and Detroit did not change significantly ($p > 0.05$).³

Data Notes:

Source: Michigan Inpatient Database, 2016-2019, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Asthma as primary diagnosis, ICD-10-CM=J45.XX
3. Spearman's correlation and rank correlation test

9. Rates¹ of Asthma Hospitalization² by Sex-Race Group, Detroit, 2016-2019



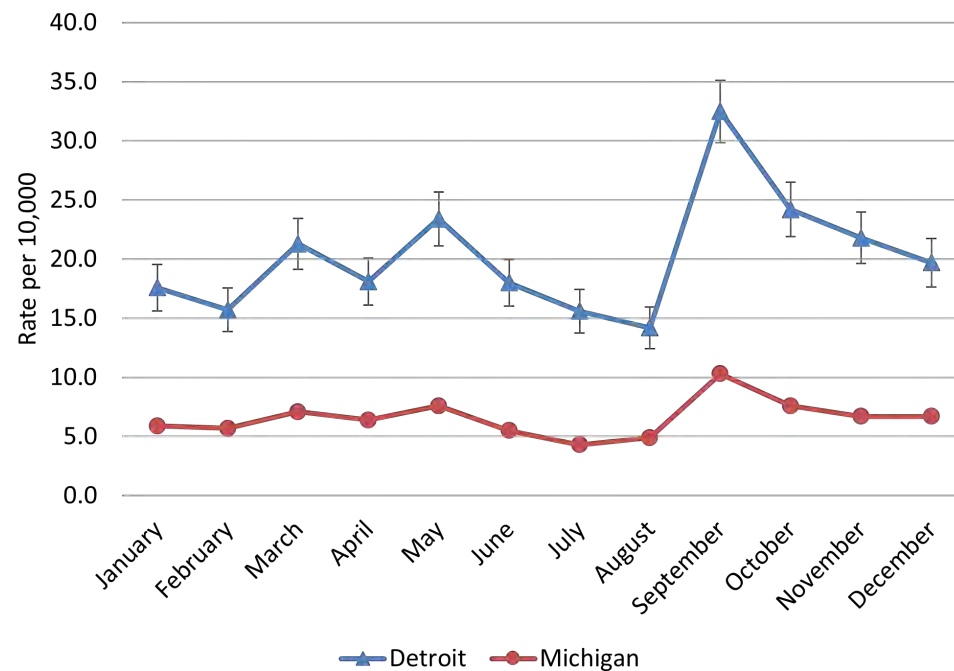
- In 2019, the rate of asthma hospitalizations among Detroit white males was 5.7 per 10,000. The rate among Detroit white females was 10.2 per 10,000.
- In 2019, the rate of asthma hospitalizations among Detroit Black males was 27.6 per 10,000. Among Detroit Black females, the rate was 33.0 per 10,000.
- Between 2016 and 2019, rates of asthma hospitalizations for Black males and females did not change significantly ($p > 0.05$)³. The rate for white males declined by 50% from 2018-2019 while the rates for white females did not change significantly ($p > 0.05$).³

Data Notes:

Source: Michigan Inpatient Database, 2016-2019, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Asthma as primary diagnosis, ICD-10 –CM=J45.XX
3. Spearman's correlation and rank correlation test

10. Rates¹ of Asthma Hospitalization² by Month of Admission, Detroit and Michigan, 2017-2019



- Rates of asthma hospitalization in Detroit were approximately three to four times the rates for Michigan as a whole, throughout the year.
- Seasonal trends in asthma hospitalization for Detroit and Michigan followed a similar pattern throughout the year. The lowest rates in July and August were immediately followed by an increase in September. The highest rates for both Detroit and Michigan were in September.

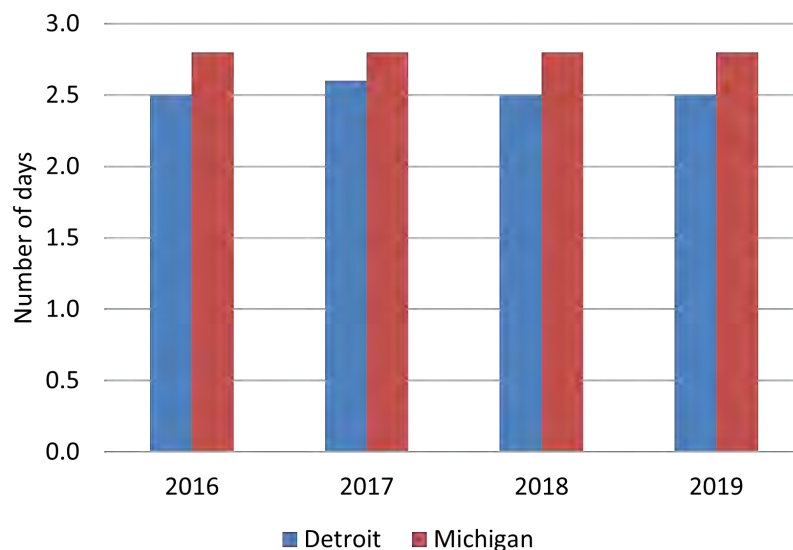
Data Notes:

Source: Michigan Inpatient Database, 2016-2019, MDHHS

1. Age-adjusted to the 2000 US Standard Population

2. Asthma as primary diagnosis, ICD-10 –CM=J45.XX

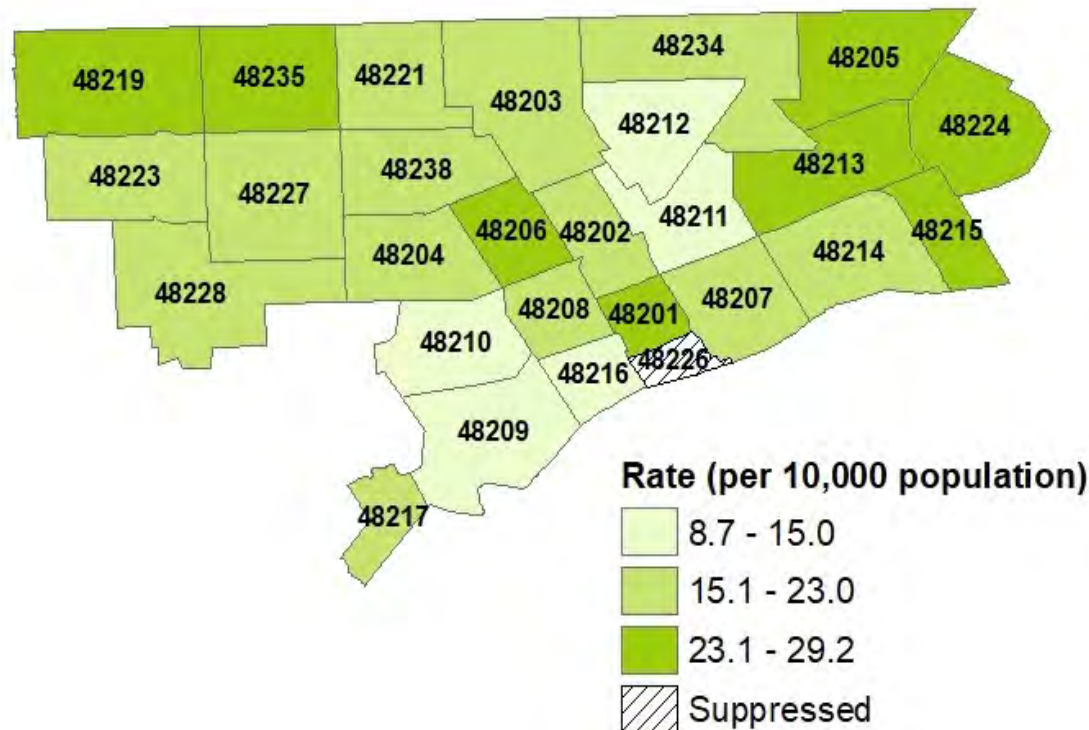
11. Average Length of Stay for Asthma Hospitalization¹, Detroit and Michigan, 2016-2019



- In 2019, the average length of asthma hospitalization in Detroit was 2.5 days and that for Michigan was 2.8 days.
- From 2016-2019, the average length of asthma hospitalization in Detroit was generally shorter compared to that for Michigan.
- The average length of hospital stay did not change significantly from 2016-2019 for both Detroit and Michigan.

Data Notes:
Source: Michigan Inpatient Database, 2016-2019, MDHHS
1. Asthma as primary diagnosis, ICD-10—CM=J45.XX

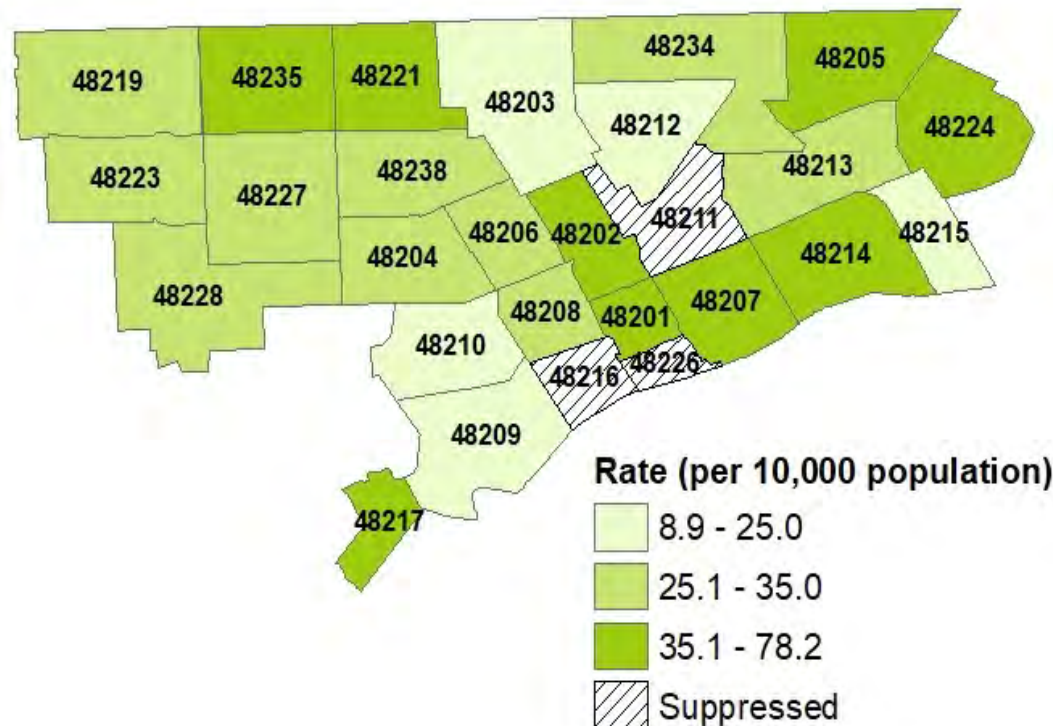
12. Rates¹ of Asthma Hospitalization² by ZIP Code of Residence, Detroit, 2016-2019



- ZIP codes 48201 and 48206 in central Detroit, 48219 and 48235 in western Detroit and 48205, 48213, 48224, and 48215 in eastern Detroit had the highest asthma hospitalization rates (all ages) in the city.
- Lower rates of asthma hospitalization occurred in ZIP codes 48212 and 48211 in the central part of Detroit and three other ZIP codes in the southwestern and part of the city.
- Data was suppressed for ZIP codes with asthma hospitalization counts less than 20.

Data Notes:
Source: Michigan Inpatient Database, 2016-2019, MDHHS
1. Age-adjusted to the 2000 US Standard Population
2. Asthma as primary diagnosis, ICD-10 –CM=J45.XX

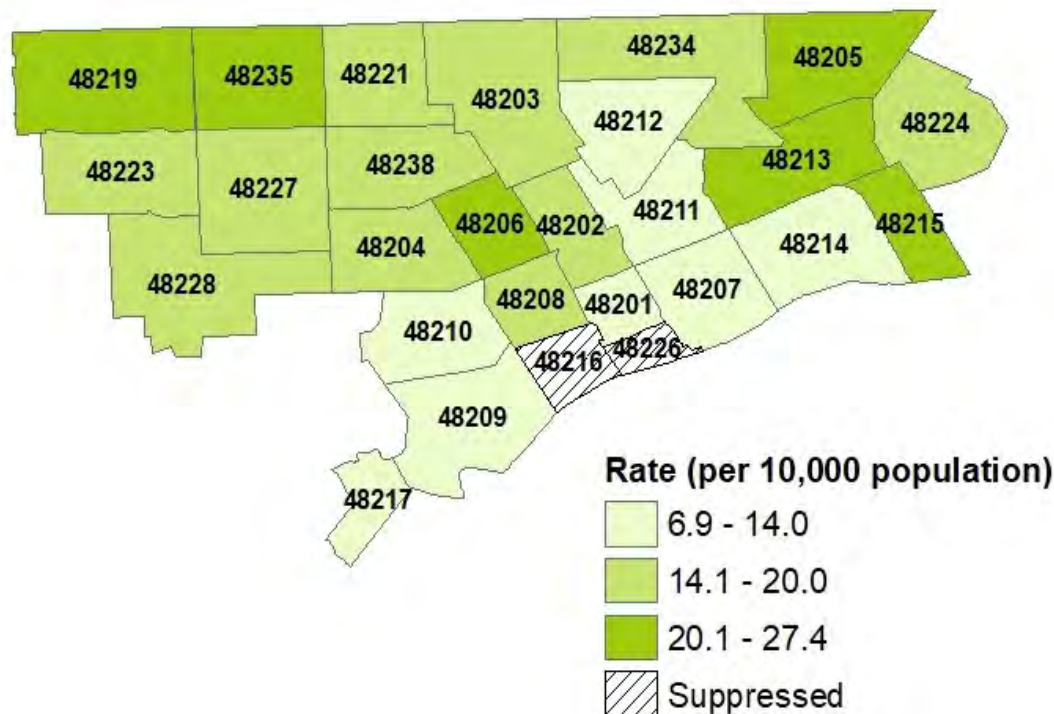
13. Rates¹ of Asthma Hospitalization² by ZIP Code of Residence for Children (<18 Years), Detroit, 2016-2019



- ZIP codes with the highest child asthma hospitalization rates tended to occur in the central, western and eastern parts of the city.
- Lower child asthma hospitalization rates mostly concentrated in ZIP codes in the northcentral and southwestern parts of the city.
- Data was suppressed for ZIP codes with asthma hospitalization counts less than 20.

Data Notes: Source: Michigan Inpatient Database, 2016-2019, MDHHS
1. Age-adjusted to the 2000 US Standard Population
2. Asthma as primary diagnosis, ICD-10-CM=J45.XX

14. Rates¹ of Asthma Hospitalization² by ZIP Code of Residence for Adults (≥18 Years), Detroit, 2016-2019



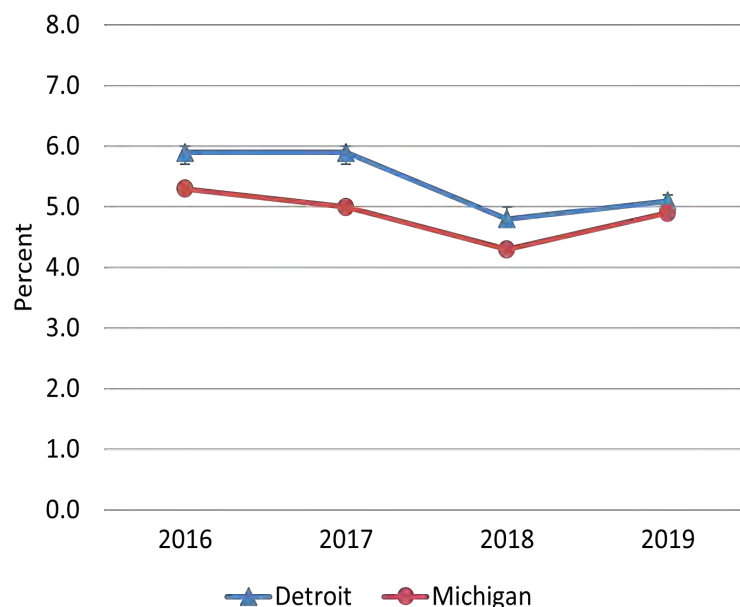
- Higher adult asthma hospitalization rates were concentrated in western and eastern Detroit.
- Lower rates occurred in ZIP codes in central Detroit, southeastern and southwestern parts of the city.
- Data was suppressed for ZIP codes with asthma hospitalization counts less than 20.

Data Notes:
Source: Michigan Inpatient Database, 2016-2019, MDHHS
1. Age-adjusted to the 2000 US Standard Population
2. Asthma as primary diagnosis, ICD-10 –CM=J45.XX

Medicaid Rates

Due to a change in International Classification of Diseases (ICD) for asthma Medicaid rates in 2015 from version 9 to version 10, asthma Medicaid data in this report should not be compared to estimates in the previous 2016 Detroit Report.

15. Prevalence¹ of Persistent Asthma², Children (5-17 Years) on Medicaid³, Detroit and Michigan, 2016-2019



Data Notes:

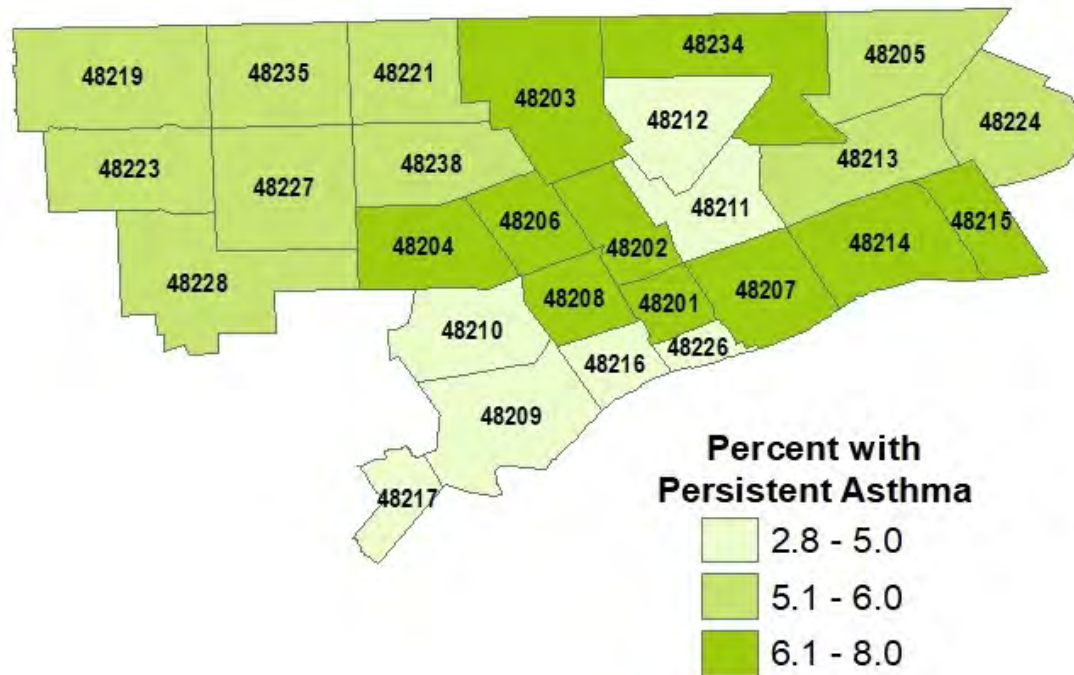
Source: Michigan Health Data Warehouse, MDHHS
 1. Age-adjusted to the 2000 US Standard Population
 2. Based on annual NCQA HEDIS definition
 3. Medicaid population of children 5-17 years is restricted to those who are continuously enrolled in Medicaid with full coverage and no other insurance

For the following analyses, the Medicaid study population of children 5-17 years was restricted to those who were continuously enrolled in Medicaid (11+ months) with full coverage and no other insurance.

Not included in this data are children with asthma who:

- Were younger than five years.
 - Were not enrolled in Medicaid continuously.
 - Did not have a paid Medicaid health utilization claim from 2016 through 2019.
- The prevalence of asthma in Detroit has been consistently higher than in Michigan as a whole. The difference between prevalence in Detroit and Michigan as a whole decreased from 2016 to 2019.
 - More than 4,000 Detroit children aged 5-17 years covered by Medicaid have health care utilization consistent with persistent asthma.

16. Prevalence¹ of Persistent Asthma² by ZIP Code of Residence, Children (5-17 Years) on Medicaid³, Detroit, 2016-2019



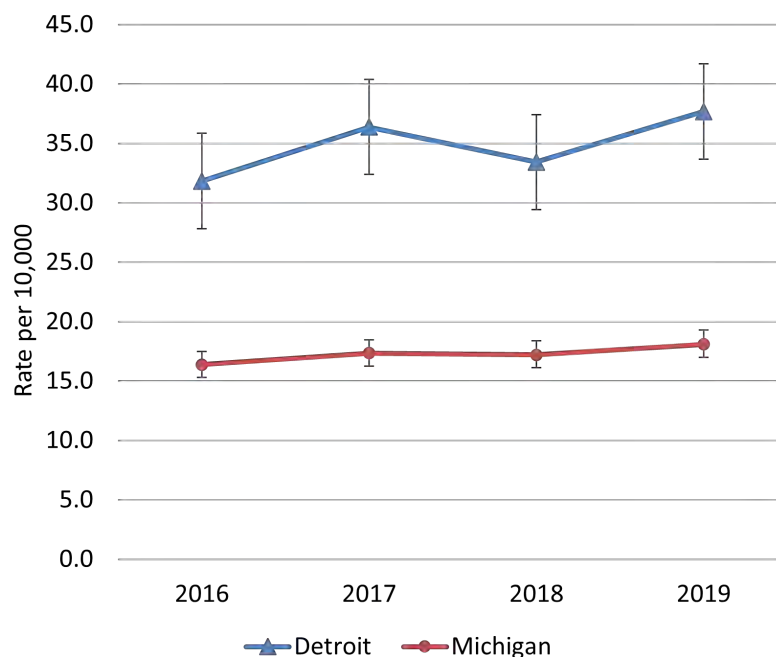
- The highest rates of persistent asthma among children in Detroit occurred around the center and the eastern parts of the city.
- The ZIP codes of lowest prevalence were primarily located in the southwestern parts of the city and two other ZIP codes in central Detroit, 48212 and 48211 .

Data Notes:

Source: Michigan Health Data Warehouse, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Based on annual NCQA HEDIS definition
3. Medicaid population of children 5-17 years is restricted to those who are continuously enrolled in Medicaid with full coverage and no other insurance

17. Rate¹ of Asthma² Hospitalizations, Children (5-17 years) on Medicaid³, Detroit and Michigan, 2016-2019



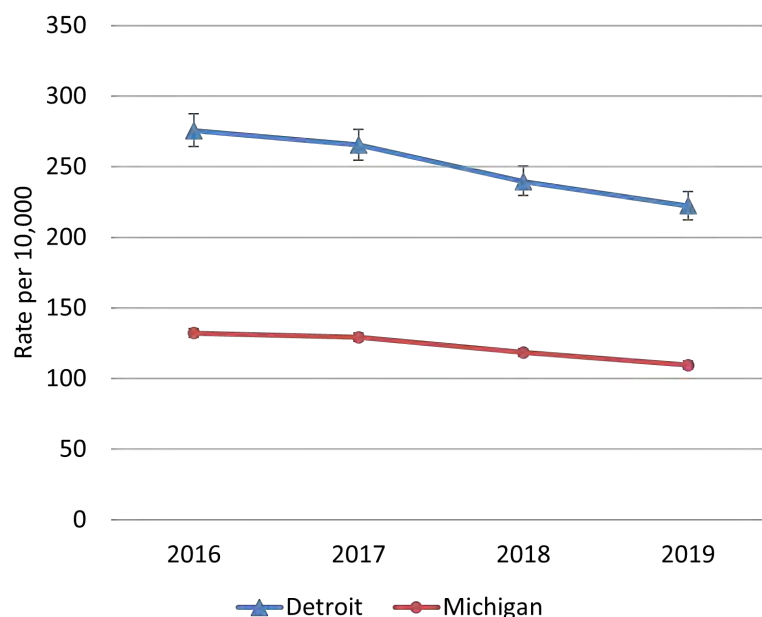
Data Notes:

Source: Michigan Health Data Warehouse, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Based on annual NCQA HEDIS definition
3. Medicaid population of children 5-17 years is restricted to those who are continuously enrolled in Medicaid with full coverage and no other insurance
4. Spearman's correlation and rank correlation test

- In 2019, the total number of hospitalizations for Detroit children covered by Medicaid was about 305. The rate was 38.0 hospitalization visits per 10,000 children on Medicaid in Detroit.
- The rate for Michigan was 18.1 per 10,000 children on Medicaid. There was a total of 926 hospitalizations in Michigan children covered by Medicaid.
- The rate of asthma hospitalization visits for children in Detroit in 2019 was over twice the rate for children in Michigan.
- Rates did not change significantly ($p > 0.05$)⁴ for both Detroit and Michigan from 2016-2019.

18. Rate¹ of Asthma² Emergency Department Visits, Children (5-17 Years) on Medicaid³, Detroit and Michigan, 2016-2019



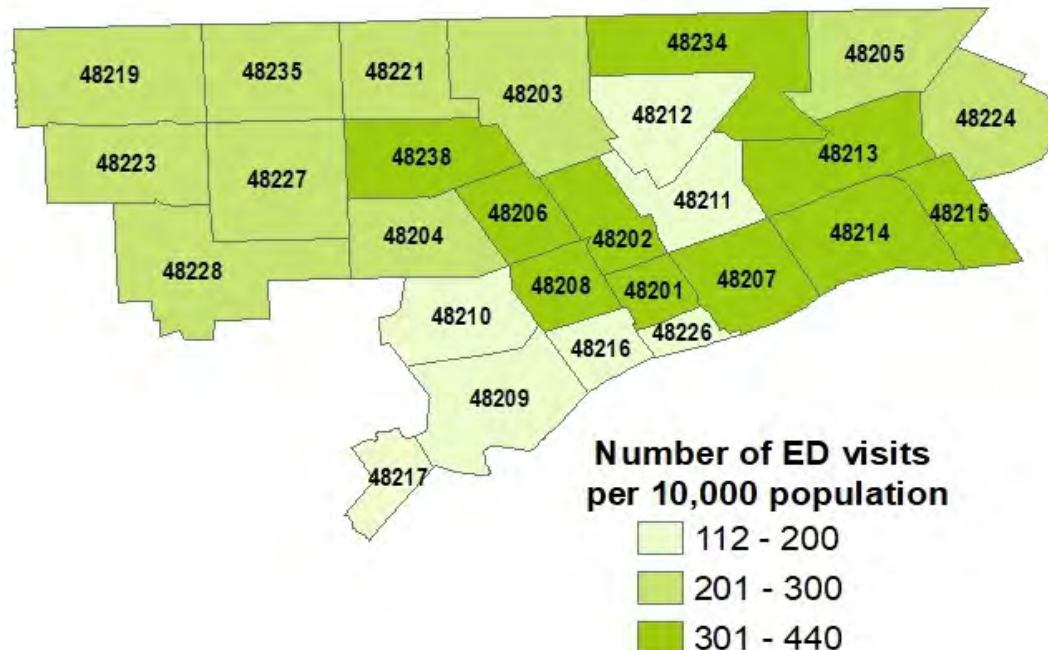
Data Notes:

Source: Michigan Health Data Warehouse, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Asthma as primary diagnosis ICD-10 –CM=J45.XX
3. Medicaid population of children 5-17 years is restricted to those who are continuously enrolled in Medicaid with full coverage and no other insurance

- In 2019, the total number of emergency department (ED) visits for Detroit children covered by Medicaid was about 1,800. The rates for Detroit and Michigan were 222 and 110 ED visits per 10,000 children on Medicaid, respectively.
- The rate of asthma emergency department visits for children in Detroit in 2019 was about twice the rate for children in Michigan.
- From 2016 to 2019, the disparity between Detroit and Michigan in the asthma emergency department (ED) visit rate decreased, from 143 to 112 per 10,000.

19. Rate¹ of Asthma² Emergency Department Visits by ZIP Code of Residence, Children (5-17 Years) on Medicaid³, Detroit, 2016-2019



- With few exceptions, ZIP codes in the center and eastern parts of Detroit tended to be the ZIP codes with the highest emergency department visit rates for asthma in the city.

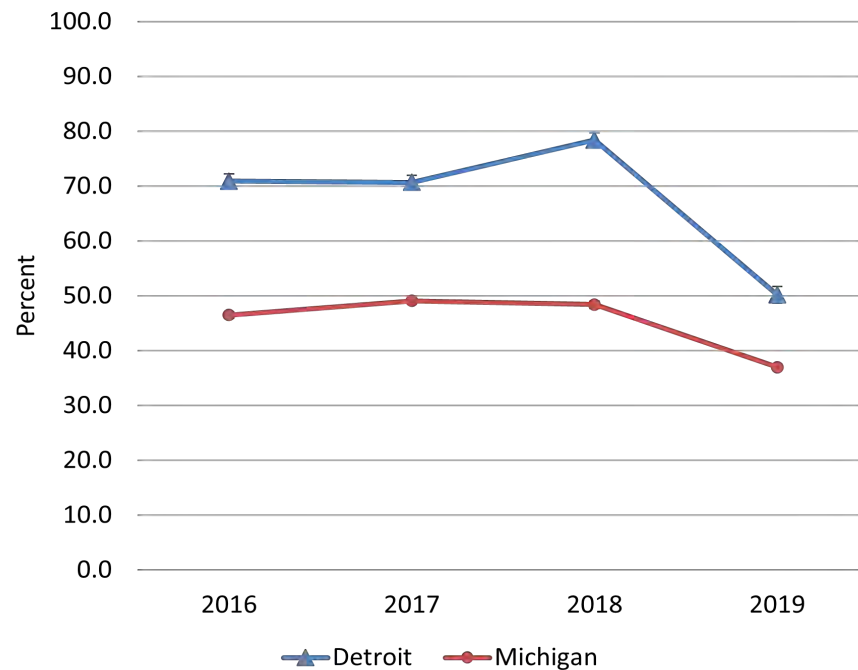
Data Notes:

Source: Michigan Health Data Warehouse, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Asthma as primary diagnosis ICD-10 –CM=J45.XX
3. Medicaid population of children 5-17 years is restricted to those who are continuously enrolled in Medicaid with full coverage and no other insurance

The following asthma statistics are
among children in Medicaid with
asthma, not the entire child
Medicaid population.

20. Percent¹ of Children (5-17 Years) with Asthma² with ≥ 2 Outpatient Visits for Asthma on Medicaid³, Detroit and Michigan, 2016-2019



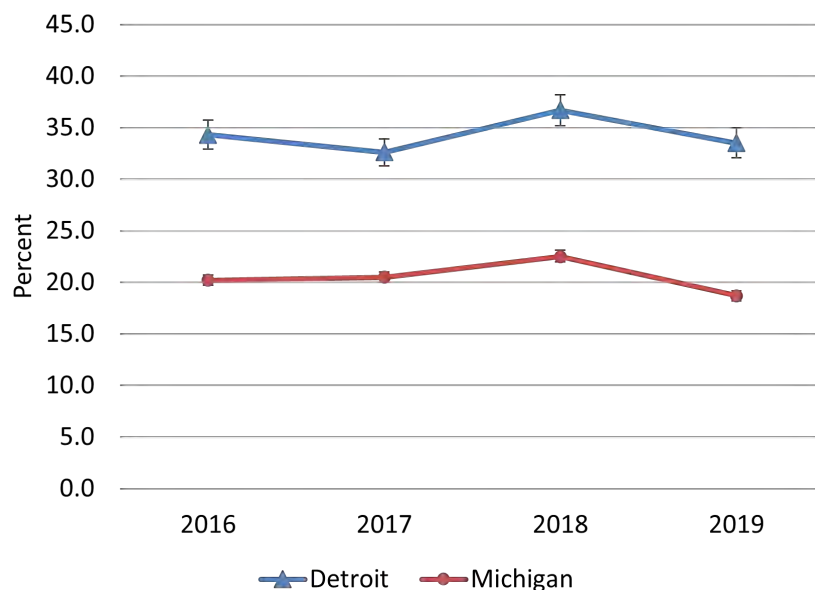
- In 2019, 50.2% of Detroit children covered by Medicaid and 37% of Michigan children with persistent asthma had at least two outpatient visits for asthma.
- There was a significant decline in the rates of two or more outpatient visits from 2016-2019 among both Detroit and Michigan children with asthma under Medicaid.
- The proportion of Detroit children covered by Medicaid with persistent asthma with at least two office visits for asthma was significantly higher ($p < 0.05$)⁴ compared to that for the state as a whole.

Data Notes:

Source: Michigan Health Data Warehouse, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Asthma as primary diagnosis ICD-10—CM=J45.XX
3. Medicaid population of children 5-17 years is restricted to those who are continuously enrolled in Medicaid with full coverage and no other insurance
4. Spearman's correlation and rank correlation test

21. Percent of Reliance on Emergency Department for Primary Care¹ among Children (5-17 Years) with Asthma² on Medicaid³, Detroit and Michigan, 2016-2019



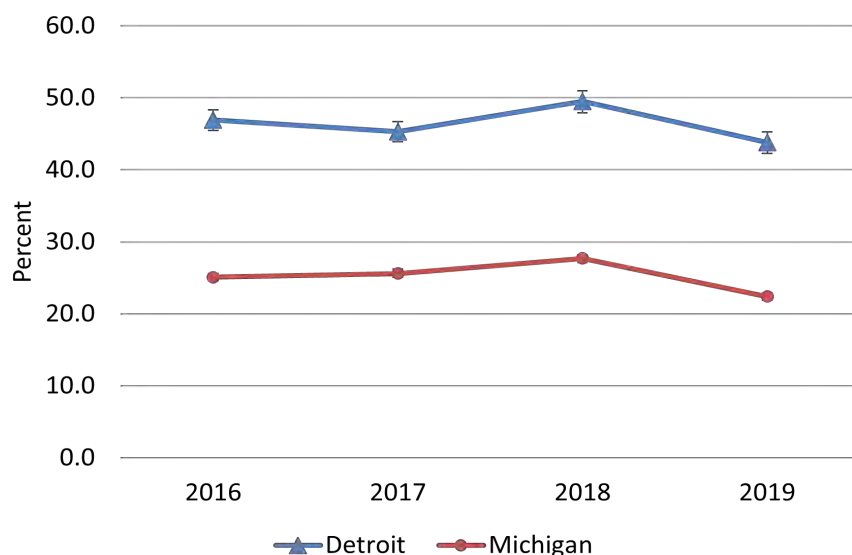
- Reliance on the emergency department for primary care is a measure of the proportion of all outpatient visits for asthma that are emergency department visits.
- In 2019, the proportion of outpatient visits for asthma that occurred in the emergency department for Detroit and Michigan children covered by Medicaid with persistent asthma was 33.5% and 18.7%, respectively.
- Emergency department reliance for primary care was about 79% higher among children in Detroit compared to the state as a whole in 2019.
- From 2016 to 2019, emergency department reliance dropped in Michigan by 8%, but did not change significantly ($p>0.05$)⁴ in Detroit.

Data Notes:

Source: Michigan Health Data Warehouse, MDHHS

1. Proportion of all outpatient visits for asthma that are emergency department visits (Asthma as primary diagnosis, ICD-10-CM=J45.XX), age-adjusted to the 2000 US Standard Population
2. Based on annual NCQA HEDIS definition
3. Medicaid Population of children 5-17 years is restricted to those who are continuously enrolled in Medicaid with full coverage and no other insurance.
4. Spearman's correlation and rank correlation test

22. Percent¹ of Children (5-17 Years) with Asthma² with ≥ 1 Emergency Department Visits for Asthma³, Medicaid⁴, Detroit and Michigan, 2016-2019



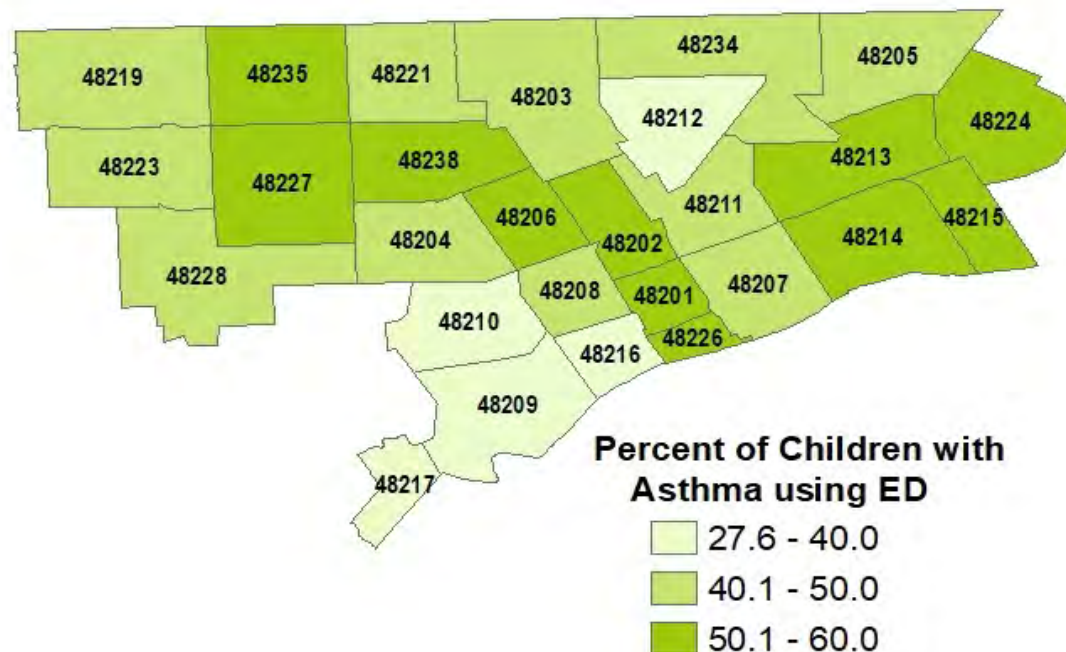
Data Notes:

Source: Michigan Health Data Warehouse, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Based on NCQA HEDIS Definition
3. Asthma as primary diagnosis ICD-10 –CM=J45.XX
4. Medicaid population of children 5-17 years is restricted to those who are continuously enrolled in Medicaid with full coverage and no other insurance.
5. National Heart, Lung, and Blood Institute. *Guidelines for the Diagnosis and Management of Asthma: Expert Panel Report 3*. National Institutes of Health Publication Number 09-5846. October 2007.

- It is the goal of asthma therapy that persons with asthma experience minimal or no emergency department visits for asthma.⁵
- In 2019, 43.8% of Detroit children enrolled in Medicaid with persistent asthma had one or more emergency department visits for asthma.
- The proportion of Detroit children covered by Medicaid with persistent asthma with at least one emergency department visit for asthma in 2019 was almost two times the rate for Michigan as a whole.

23. Percent¹ of Children (5-17 Years) with Asthma² with ≥ 1 Emergency Department Visits for Asthma³ by ZIP Code of Residence, Medicaid⁴, Detroit, 2016-2019



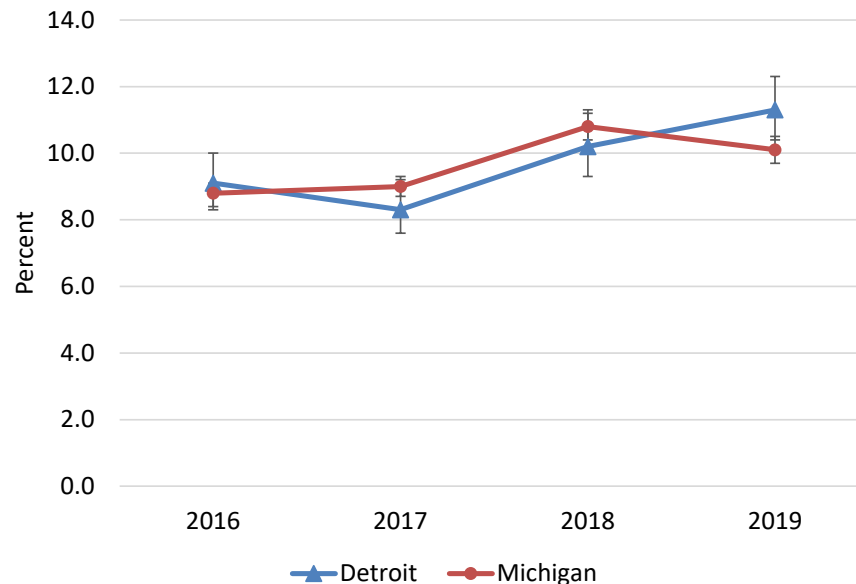
- ZIP codes with the lowest rates were concentrated in the southwestern part of the city. One ZIP code 48212 in the central part of the city also recorded lowest rate.

Data Notes:

Source: Michigan Health Data Warehouse, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Based on NCQA HEDIS Definition
3. Asthma as primary diagnosis, ICD-10 –CM=J45.XX
4. Medicaid Population of children 5-17 years is restricted to those who are continuously enrolled in Medicaid with full coverage and no other insurance.

24. Percent¹ of Overuse of Short-Acting β -Agonist Medication among Children (5-17 Years) with Persistent Asthma², Medicaid³, Detroit and Michigan, 2016-2019



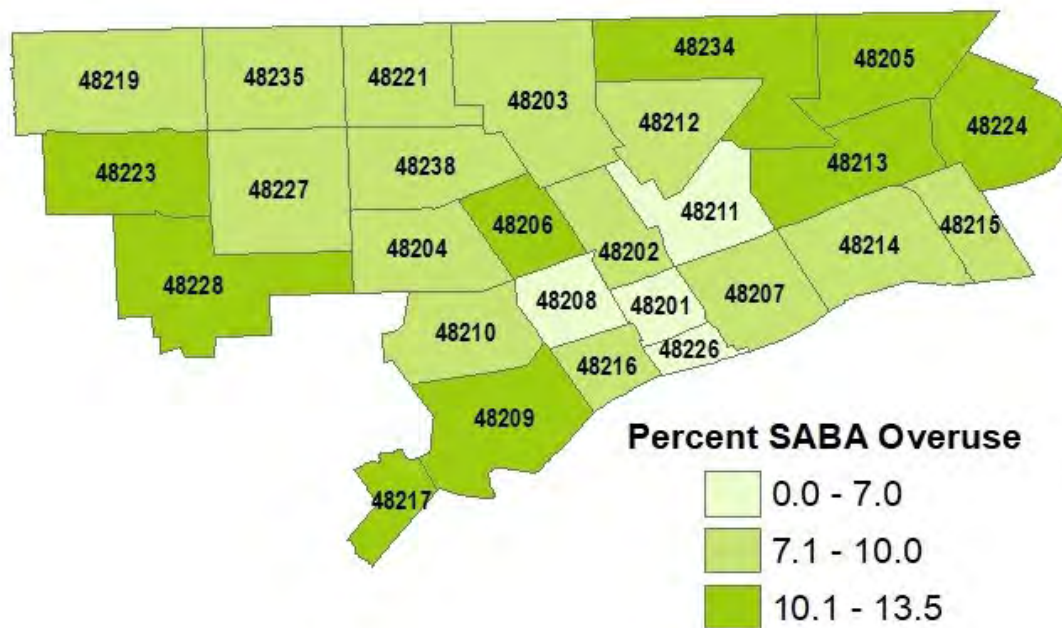
Data Notes:

Source: Michigan Health Data Warehouse, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Based on NCQA HEDIS Definition
3. Medicaid Population of children 5-17 years is restricted to those who are continuously enrolled in Medicaid with full coverage and no other insurance.
4. National Heart, Lung, and Blood Institute. *Guidelines for the Diagnosis and Management of Asthma: Expert Panel Report 3*. National Institutes of Health Publication Number 09-5846. October 2007.

- It is the goal of asthma therapy that there be minimal use of short-acting β -agonist medication⁴ – less than one canister per month. For this indicator, overuse is defined as filling seven or more prescriptions for short-acting β -agonist in a year.
- In 2019, the prevalence of short-acting β -agonist medication overuse among Detroit children and Michigan children covered by Medicaid with persistent asthma was 11.3% and 10.1% respectively.

25. Percent¹ of Overuse of Short-Acting β -Agonist (SABA) Medication among Children (5-17 Years) with Asthma² by ZIP Code of Residence, Medicaid³, Detroit, 2016-2019



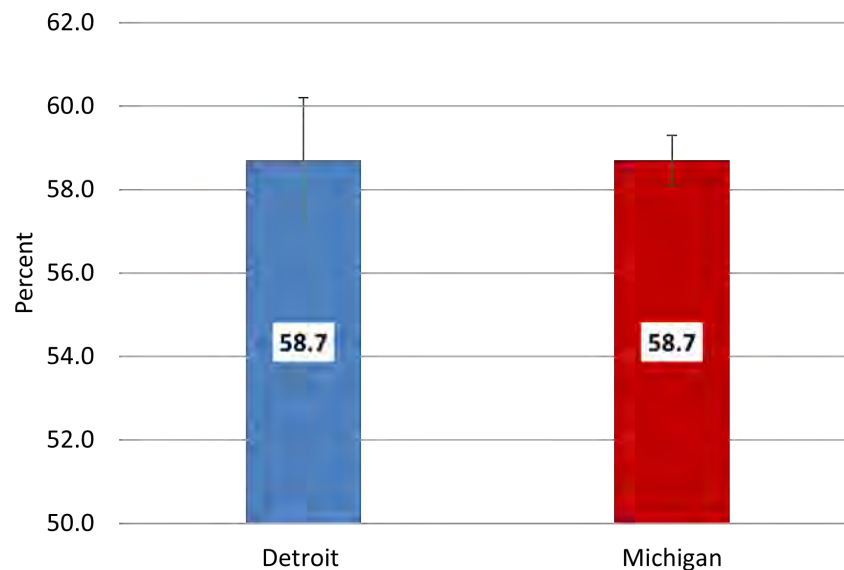
- Highest rates of SABA overuse were mostly concentrated in the northeastern, western and southwestern parts of the city.
- ZIP codes 48208, 48201, 48226 and 48211 had the lowest rates of SABA overuse.

Data Notes:

Source: Michigan Health Data Warehouse, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Based on NCQA HEDIS Definition
3. Medicaid population of children 5-17 years is restricted to those who are continuously enrolled in Medicaid with full coverage and no other insurance.

26. Percent¹ of Children (5-17 Years) with Asthma² with ≥1 Inhaled Corticosteroid Medication, Medicaid³, Detroit and Michigan, 2019



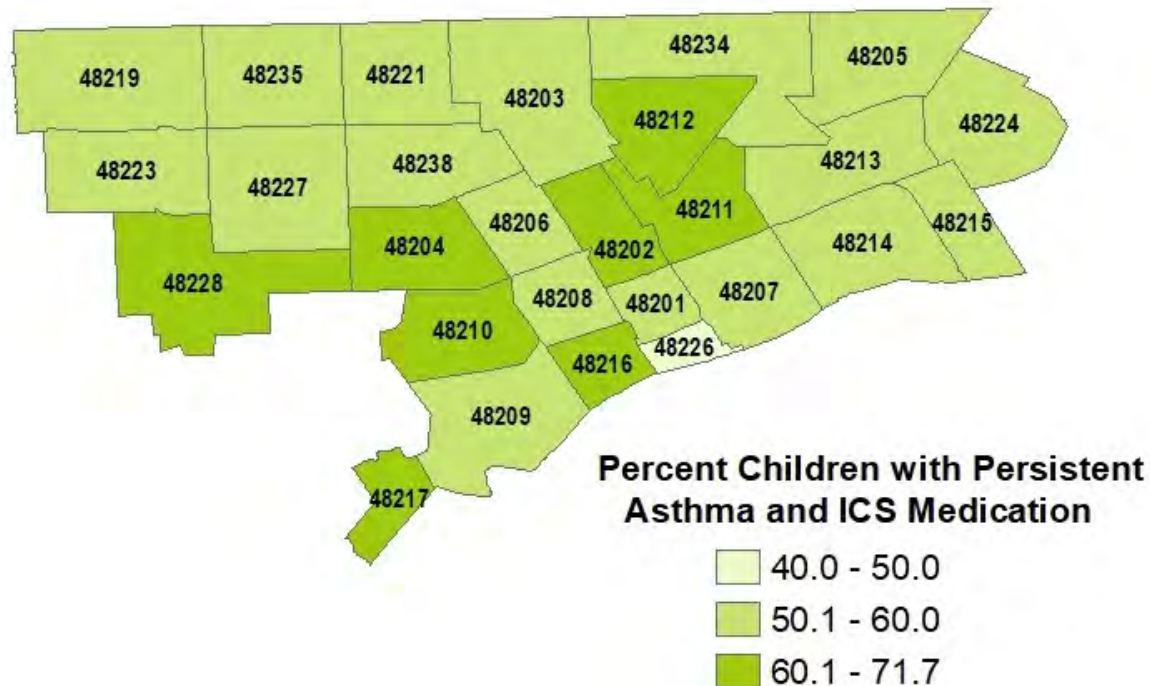
- Long-term asthma control medications, such as inhaled corticosteroids, are recommended for children with persistent asthma.⁴
- 58.7% of children in Detroit and Michigan in 2019 filled a prescription for inhaled corticosteroids.
- There was no statistical difference between the rate for Detroit and Michigan in 2019.

Data Notes:

Source: Michigan Health Data Warehouse, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Based on NCQA HEDIS Definition
3. Medicaid Population of children 5-17 years is restricted to those who are continuously enrolled in Medicaid with full coverage and no other insurance.
4. National Heart, Lung, and Blood Institute. *Guidelines for the Diagnosis and Management of Asthma: Expert Panel Report 3*. National Institutes of Health Publication Number 09-5846. October 2007.

27. Percent¹ of Children (5-17 Years) with Asthma² with ≥1 Inhaled Corticosteroid Medication by ZIP Code of Residence, Medicaid³ Detroit, 2016-2019



- ZIP codes with the highest percent of children filling inhaled corticosteroids tended to be in the southwestern and central areas of Detroit. Only one ZIP code 48226 recorded the lowest rate.

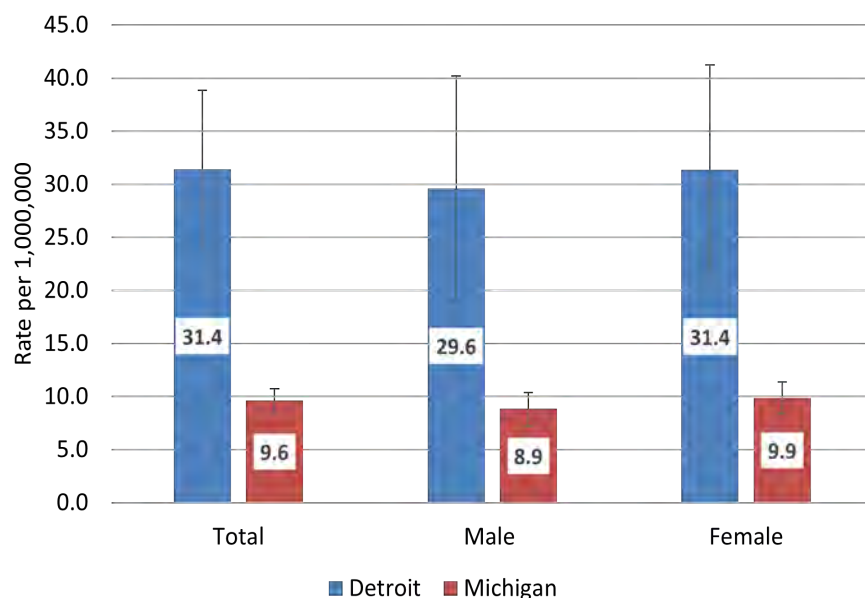
Data Notes:

Source: Michigan Health Data Warehouse, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Based on NCQA HEDIS Definition
3. Medicaid Population of children 5-17 years is restricted to those who are continuously enrolled in Medicaid with full coverage and no other insurance.

Asthma Mortality

28. Rates¹ of Asthma Death² by Sex, Detroit and Michigan, 2017-2019



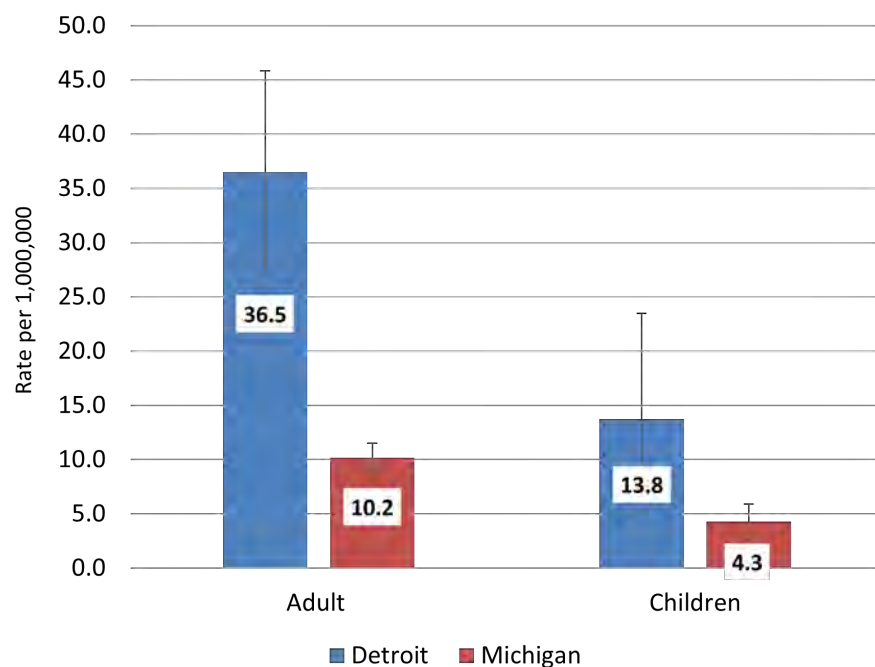
Data Notes:

Source: Michigan Death Files, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Asthma as the underlying cause of death, ICD-10:J45-J46

- Between 2017 and 2019, 71 Detroit residents died due to asthma. The rate of asthma mortality among Detroit residents was 31.4 per 1,000,000 population.
- The rate of asthma mortality in Detroit in 2017-2019 was about three times the rate for Michigan as a whole.
- Between 2017 and 2019, the rate of asthma mortality among Detroit males was 29.6 per 1,000,000 and the rate for Detroit females was 31.4 per 1,000,000.
- The rates of asthma mortality for Detroit males and females were not significantly different during this time period.

29. Rates¹ of Asthma Mortality² by Age Group, Detroit and Michigan, 2017-2019



Data Notes:

Source: Michigan Death Files, MDHHS

1. Age-adjusted to the 2000 US Standard Population
2. Asthma as primary cause of death, ICD-10:J45-J46

- The rate of asthma mortality for Detroit children between 2017 and 2019 was 13.8 per 1,000,000. The rate of asthma mortality among children in Detroit was not significantly different than rates for children in Michigan but was three times higher.
- Among Detroit adults, the rate of asthma mortality between 2017 and 2019 was 36.5 per 1,000,000.
- The rate of asthma mortality for Detroit adults was over three times the rate for adults in Michigan as a whole.

Conclusion

- The disparity in the asthma burden in Detroit warrants continued attention. Public health efforts should continue to be directed to persons with asthma in Detroit to improve asthma control and prevent severe outcomes.
- MDHHS will share this update with its partners in the City of Detroit and across the state.

Methods

Prevalence of Asthma

Michigan prevalence estimates for asthma were based on self-reporting from the Michigan Behavioral Risk Factor Survey (MiBRFS) using two questions:

1. Have you ever been told by a doctor, nurse, or health professional that you had asthma?
(lifetime asthma)
2. Do you still have asthma? (current asthma)

“Lifetime asthma prevalence” was the percentage of respondents who reported “yes” to question #1. “Current asthma prevalence” was the percentage of respondents who reported “yes” to both questions #1 and #2.

MiBRFS data were collected by telephone interview of a sample from both cell phone and landline telephone numbers (visit https://www.michigan.gov/documents/mdhhs/2019-MiBRFS-Standard-Tables_711893_7.pdf, page 3 for more information). All measures of asthma prevalence were accompanied by 95% confidence intervals. Annual estimates of asthma prevalence for adults (≥ 18 years) were provided by MiBRFS, by sex, race/ethnicity, education, and household income. The MiBRFS was also the source for estimates of prevalence of asthma among children (< 18 years) by asking the adult respondent to act as the proxy for a selected child in the household. Annual estimates of prevalence for children were provided for by sex, race/ethnicity, proxy’s education, and household income.

Methods continued

Asthma Hospitalization

An asthma hospitalization was defined as an inpatient stay with a primary discharge diagnosis of asthma (ICD-10 –CM=J45.XX). These data represent the number of hospitalizations for asthma, not the number of persons with a hospitalization for asthma.

Age-adjusted asthma hospitalization rates were calculated and presented per 10,000 population. Rates were age-adjusted, using the 2000 US standard population, so that valid comparisons could be made between populations of different age distributions. All hospitalization rates were accompanied by 95% confidence intervals. In addition to asthma hospitalization rates, the average length of stay and hospitalization rates by month of admission were calculated.

Asthma hospitalization rates were calculated for demographic and geographic subgroups, including ZIP codes of residence (for Detroit), age, race, sex, and month of admission, to identify disparities and patterns. Maps generated using geographic information systems (GIS; ArcGIS™) were used to visually display the data and to identify areas of high burden. Census data from 2010 were used to calculate the Detroit hospitalization rates. Yearly bridged-race population estimated provided by the National Vital Statistics System maintained by the Centers for Disease Control and Prevention were used to calculate Michigan's rates.

Temporal trends in asthma hospitalization rates were statistically evaluated using the Spearman correlation coefficient and its accompanying rank correlation test. A p-value of <0.05 for this test was considered statistically significant.

The data source for these analyses was the Michigan Inpatient Database, which includes virtually all hospital discharges for Michigan residents during the study period.

Methods continued

Asthma Management for Children Covered by Medicaid

- From the Michigan Medicaid beneficiary and administrative claims data (2016-2019), the study population was identified by the following parameters within each year: children 5-17 years of age who had continuous Medicaid enrollment (11+ months), full Medicaid coverage, and no other insurance. Both fee-for-service and managed care beneficiaries were included, but Title V beneficiaries were excluded.
- By using these restrictions, these data undercount the number of children with asthma covered by Medicaid. Not included were children with asthma who: 1) were not enrolled in Medicaid continuously or 2) did not have a paid Medicaid health utilization claim from 2016 through 2019.

Within this population, the following indicators of total asthma burden were measured:

- *Persistent asthma prevalence*: Utilization consistent with the diagnosis of asthma was defined according to HEDIS® specifications; in the year of the prevalence measurement, having (1) ≥ 4 asthma medication dispensing events OR (2) ≥ 1 emergency department visits for asthma OR (3) ≥ 1 hospitalization for asthma OR (4) ≥ 4 outpatient visits for asthma and ≥ 2 asthma medication dispensing events (National Committee for Quality Assurance. Appropriate Medications for People with Asthma. HEDIS® 2003, Volume 2: Technical Specifications. Washington, DC; 2003). Prevalence of persistent asthma was the percentage of beneficiaries in the study population who meet the HEDIS definition of persistent asthma.
- *Rate of asthma emergency department visits*: An asthma emergency department visit was defined as a visit occurring in a hospital emergency department with a primary diagnosis of asthma (ICD-10 –CM=J45.XX). These data represent the number of persons visiting the emergency department for asthma. The number of asthma emergency department visits, divided by the study population then multiplied by 10,000, generated this measure.

Methods continued

Asthma Management for Children Covered by Medicaid, continued

- Children with utilization consistent with persistent asthma, as defined above, formed the annual study population upon which indicators of asthma management are measured within that year, including:
- *Percentage with an emergency department visit:* The percentage of children covered by Medicaid with persistent asthma who have had one or more annual asthma emergency visits (ICD-10 – CM=J45.XX).
- *Emergency department reliance:* The percentage of all ambulatory asthma visits (ICD-10 –CM=J45.XX, outpatient and emergency department) among children covered by Medicaid with persistent asthma that occur in the emergency department. It estimates the reliance on the emergency department for primary care.
- *Short-acting β -agonist overuse:* The percentage of children with persistent asthma in Medicaid who have filled seven or more prescriptions for short-acting β -agonists in a year – an indicator of overuse of this medication.
- *Proportion using an inhaled corticosteroid medication:* The proportion of children with persistent asthma in Medicaid who filled one or more prescriptions for an inhaled corticosteroid medication in a year – inhaled corticosteroids are the preferred, first-line medication recommended for persons with persistent asthma. For this metric, inhaled corticosteroid medication includes bronchodilator combination therapy

Methods continued

Asthma Management for Children Covered by Medicaid, continued

For all of the above, indicators were age-adjusted using the 2000 US standard population and were accompanied by a 95% confidence interval. Both geographic (ZIP Code) and demographic (age, race, and sex) subpopulation analysis were conducted to identify disparities. Maps generated using geographic information (GIS; ArcGIS™) systems were used for visual display of the data and to identify areas of high burden.

Asthma Death

An asthma death was defined by the underlying cause of death (ICD-10=J45 or J46). Asthma mortality rates were calculated for the three-year period 2017-2019 and were presented per 1,000,000 population. Rates were age-adjusted, using the 2000 US standard population, so that valid comparisons could be made between populations of different age distributions. Rates were calculated by age, race, and sex, to identify disparities and patterns. All mortality rates were accompanied by 95% confidence intervals.

The data source for these analyses was the Michigan Death Files, which included all deaths for Michigan residents during the study period.

Methods continued

Defining Detroit

- The definition of Detroit was slightly different for each data type presented in this report. The definitions were as follows:
 - Current asthma prevalence from survey: On the MiBRFS, Detroit adults were identified by their affirmative response to the question, “Do you live in the city of Detroit?”
 - Hospitalization and Medicaid data: Detroit was defined by ZIP code tabulation areas (ZCTAs) for the city. These areas included Highland Park and Hamtramck.
 - Mortality: Detroit was defined by the Detroit minor civil division, which excluded Highland Park and Hamtramck.

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The Michigan Department of Health and Human Services will not exclude from participation in, deny benefits of, or discriminate against any individual or group because of race, sex, religion, age, national origin, color, height, weight, marital status, gender identification or expression, sexual orientation, partisan considerations, or a disability or genetic information that is unrelated to the person's eligibility.

STATE OF ILLINOIS
ILLINOIS COMMERCE COMMISSION

Ameren Illinois Company	:	
d/b/a Ameren Illinois	:	
	:	23-0067
Proposed general increase in rates and	:	
revisions to other terms and conditions	:	
of service. (tariff filed January 6, 2023)	:	

ORDER

November 16, 2023

spread to more of Ameren's low-income customers under Staff's proposal. PIOs' two-tier proposal is based on the SMI, which does not allow the Company to utilize existing programs (i.e. LIHEAP and PIPP) to streamline administrative processes and minimize costs as directed in the Low-Income Discount Rate Study Report. Staff's proposal strikes an appropriate middle ground between using existing processes and innovating to provide more benefits to customers who need it most.

Staff further argues that the Commission should approve Staff's proposed reporting requirements (5) and (6). Staff Ex. 14.0 (COR) at 22; see *also* Staff Ex. 14.0, Sch. 14.06 at 4-5. Staff proposes reporting requirements (5) and (6) to obtain data on Staff's proposed Tier 3 customers. If the Commission approves Staff's three-tiered proposal for Rider LICA eligibility, Staff also recommends the Commission approve these additional reporting requirements.

Staff recommends the Commission adopt Staff's proposed Rider LICA for the purpose of recovering LICs associated with the Company's low-income discount program. Staff Ex. 14.0, 22; see *also* Staff Ex. 14.0, Sch. 14.06 at 1. The AG proposes that the recovery mechanism for the program costs be a volumetric charge. AG Ex. 8.00 at 33. Staff supports Rider LICA, as presented in Staff Schedule 14.06, because it is consistent with the cost recovery mechanisms Staff supports for other large gas utilities in Illinois.

Staff notes that the Company offers to submit a compliance filing to reflect the Commission's Final Order. Staff does not object to the Company's proposal to provide a draft for feedback following the Commission's Final Order. However, Staff objects to the Company filing a compliance Rider LICA tariff more than 30 days before its effective date because doing so could confuse customers by leading them to believe that the low-income discount program is available before it becomes effective. In other words, the Company's proposal does not take into consideration the time required to implement the low-income discount program. Therefore, Staff recommends that the Commission direct the Company to file a final version of Rider LICA no more than 30 days before Rider LICA's effective date.

c. AG's Position

The AG asks the Commission to approve the low-income discount rate proposed by PIO witness Schott, as modified by AG witness Larkin-Connolly, because it provides the most equitable and effective discount for low-income ratepayers.

Mr. Larkin-Connolly testified that both Staff's proposal and PIOs' proposal were improvements to Ameren's proposal, but ultimately supported PIOs' proposal, with some modifications. AG Ex. 8.00 at 16-17. Specifically, Mr. Larkin-Connolly recommended that the low-income discount be based on FPL, rather than SMI, that costs be recovered on a per-therm basis (rather than through a fixed charge), and that the discount be split into five tiers, consistent with the low-income discount program proposed by Legal Action Chicago ("LAC")/Community Organizing Family Issues ("COFI") witness Colton in the ongoing rate cases for Nicor, Peoples Gas, and North Shore. *Id.*; AG Ex. 8.00 at 18: Table 3; see *also* AG Init. Br. at 61.

While Ameren and Staff's proposals offer fixed discounts, regardless of usage, the AG's modified PIO proposal applies a percentage of the total bill that correlates the

discount with the customers' income, providing a discount that reflects need. In addition, because the discount applies to the entire bill (not just the customer charge), the AG contends that their proposal benefits all low-income customers, regardless of usage. The AG argues that their modified PIO proposal would provide a meaningful discount to *all* low-income customers, rather than the subset of low-income, low-usage customers. AG Ex. 8.00 at 25-26. According to the AG, this discount, coupled with its proposed residential rate design could lead to a meaningful bill reduction for all low-income customers, and all residential customers generally, except for the highest usage customers. In combining these two proposals, the AG avers that the Commission could ensure that Ameren's rate design is consistent with the state's clean energy policies (e.g., ensuring that those who use more natural gas pay more), while protecting high-usage, low-income customers who may have higher bills due to larger families or inefficient housing.

Mr. Larkin-Connolly found that this proposal would result in approximately a \$0.0258 per therm charge. *Id.* at 30. For a median usage residential customer, who uses 745 therms per year, this would result in approximately \$19.25 per year in charges. *Id.* at 30.

In addition, the AG argues that the recovery of these costs from both residential and non-residential customers is justified because commercial and industrial customers may have employees or customers who would be eligible for these discounts, and local businesses would also benefit from the increased affordability of gas services because low-income households will have more financial security and might have more disposable income available to spend on other goods and services. *Id.* at 31-32. The AG asks the Commission to approve their modified PIO low-income discount program, coupled with their proposed rate design, to ensure transformational change for low-income customers at a reasonable cost to other ratepayers. See AG Ex. 8.00 at 11.

The AG also requests the Commission adopt certain reporting requirements proposed by the Staff, to track the progress of the program. Staff Ex. 5.0 at 33-34.

The Company suggests the Commission adopt its proposal, which would (1) only allow customers with incomes up to 200% of the FPL to participate in the low-income program, (2) only apply the discount to the delivery portion of customers' bills, and (3) collect the costs of the program through a monthly fixed charge. The AG refutes each of the Company's suggestions.

First, the AG argues that the Commission should adopt the 300% FPL eligibility threshold proposed by the AG and Staff. Ameren proposes that the Commission cap eligibility at the income limit for LIHEAP and PIPP participation (currently 200% FPL). The AG asserts that its proposal incorporates more customers than Ameren's proposal by design. The record evidence shows that Ameren's ratepayers are struggling to pay their bills. For example, in March 2023, 1,995 residential Ameren customers had payment agreements that failed (38% of those who had DPAs as of the beginning of the month), while only 639 customers completed their DPAs during that month. AG Ex. 4.00 at 8. A total of 86,165 (12%) residential customers were assessed late payment fees or charges in March. *Id.* According to the AG, "when evaluating proposals for a low-income discount program, the focus should first be on the potential effectiveness of the program to improve

affordability for low-income customers, and then the corresponding bill impacts of program costs on other customers.” AG Ex. 8.00 at 20 (emphasis in original). The AG maintains that expanding income eligibility beyond 200% FPL is preferable because a higher eligibility threshold would provide a meaningful benefit to a greater number of struggling ratepayers. AG witness Larkin-Connolly found that the cost of the program for the medium-usage residential household that consumes 745 therms per year would be around \$19.25 per year, which the AG asserts is justified given the transformational support the discount would provide to low-income households in Ameren’s service territory. *Id.* at 30-31.

Ameren claims that it would not be able to leverage existing programs and processes if the Commission were to adopt the AG’s proposal. The AG argues that this is a misleading argument because the Company would still be able to use LIHEAP and PIPP to verify the incomes of customers up to 200% FPL. According to the AG, AIC would just need to allow customers from 201% FPL to 300% FPL to self-certify their eligibility. Ameren argues that this process would “provide no accountability” for those customers, but the AG argues that AIC provides no evidence to demonstrate the likelihood that customers would abuse the program—or that the auditing process proposed by Staff would not minimize or outright eliminate this concern. The AG asks the Commission to approve their proposed discount rate with an income eligibility limit of 300% FPL.

Second, the AG asks the Commission to reject the Company’s suggestion to only apply the discount to the delivery portion of customers’ bills and adopt the recommendation by the AG and PIO to apply the low-income discount to participating customers’ entire bills. The AG and PIO recommend that the low-income discount apply as a percentage of participating customers’ entire bills because this would provide a more significant benefit to low-income customers without overburdening other ratepayers. Ameren and Staff proposed fixed dollar discounts applied only to the delivery portion of customers’ bills. Ameren complains that the AG and PIOs’ proposals do not align with Conclusion Number 2 in the Low-Income Discount Rate Study Report, which placed certain parameters on the low-income discount programs that utilities should propose. However, the AG highlights that the Low-Income Discount Rate Study Report noted that its conclusions were “tentative” and stated it would open a separate docket to consider broader issues related to low-income discounts. See AIC Ex. 1.0R at 16, *citing* the Low-Income Discount Rate Study Report at 63. The AG avers that the Low-Income Discount Rate Study Report was not the Commission’s final word on discount rates, but a first step toward enacting low-income discounts. The AG adds that the Commission did not address the issues that other parties could raise, nor did it limit what type of programs the Commission could consider in a docketed proceeding or adopt in an evidentiary proceeding like this one. The AG iterates that nothing in the Low-Income Discount Rate Study Report or the Act limits the Commission’s authority to adopt a discount program that applies to customers’ entire bills.

Third, the AG asks the Commission to adopt their proposed volumetric per-therm recovery mechanism, and to reject the Company’s suggestion to collect the costs of the program through a monthly fixed charge. Ameren complains that the AG’s proposal does not align with Conclusion Number 3 in the Low-Income Discount Rate Study Report,

which states that “[a]ll such utility low-income discount rate proposals should include a cost recovery mechanism that is consistent with Illinois law and Commission practice.” AIC Init. Br. at 182–183. The Company claims that its proposal of a monthly fixed charge is consistent with the fixed Energy Assistance Charge used to collect supplemental LIHEAP and PIPP funds. *Id.* The AG disagrees. The AG argues that nothing in the Act or the Low-Income Discount Rate Study Report mandates that the low-income discount rate must, or even should, be collected in the same manner as the Energy Assistance Charge or through a fixed charge. The AG argues that its proposal to collect the costs of the program through a volumetric charge is a better approach because it spreads the cost over more units, which limits the impact on low-use customers and is most consistent with the State’s clean energy and affordability goals, including Governor Pritzker’s proposal in his *Chicago Sun Times* op-ed, in which he recommended policies where customers who use more gas pay more. See AG Ex. 4.00.

Ameren further complains that the AG’s proposal “would have significant bill impacts for GDS-4 customers” who would potentially “see a monthly Rider LICA charge between \$704 and \$54,724” under the AG’s proposal. AIC Init. Br. at 183. But the AG points out that—as shown in the surrebuttal testimony of Ameren witness Kilhoffer — this group of customers uses an average of 1,488,862 therms per month in Ameren’s Rate Zones I and II, and an average of 2,121,104 therms per month in Ameren’s Rate Zone III. AIC Ex. 43.0 at 17. As a result, these customers’ average monthly bills under Ameren’s proposed rates (without including Rider LICA) would be \$1,789,714 in Rate Zones I and II and \$2,557,587 in Rate Zone III. *Id.* The AG notes that using their estimated \$0.0258 per therm charge, Rate Zones I and II customers would pay \$38,129 per month toward the low-income discount, while Zone III customers would pay \$54,724 per month toward the low-income discount, both amounting to about 2% of the customers’ average monthly bill. *Id.* The AG adds that Ameren indicated that only 20 customers fall into this category (3 in its Rate Zone I, 9 in Rate Zone II, and 8 in Rate Zone III). AG Cross Ex. 2. By Ameren’s own estimate, the AG’s proposed discount could benefit as much as 37% of Ameren’s residential customer class. According to the AG, that the Company’s 20 highest-use customers might be required to pay an additional 2% toward the program is not a tenable ground for the Commission to reject the AG’s proposed per therm charge.

For the reasons set forth by the AG, the AG asks the Commission to adopt its modified PIO low-income discount. The AG avers that its modified proposal, along with its proposed rate design, and other recommendations are most consistent with the state’s emphasis on rate affordability, are supported by the findings in the Commission’s low-income discount report, and will result in cost-based, equitable, and affordable rates for both low-income and non-low-income residential customers.

d. PIOs’ Position

PIO propose a 60% discount to the lowest-income customers (below 30% SMI), and a 20% discount to customers between 30% and 60% of SMI. AG Ex. 8.00 at 16.

PIO note that the fundamental difference between the proposals offered in this proceeding is that PIO and the AG’s proposals are designed to ensure all gas bills are affordable for Ameren’s customers, whereas the limited nature of Staff and the Company’s proposals are not. Importantly, whereas the PIO and AG’s proposals would

apply a discount to a customer's total bill, Staff's and the Company's proposals would apply a discount only to delivery charges. PIO state that Ameren's low-income customers struggle to pay their bills under existing rates, and the Company's proposed rate increase — coupled with the impacts of electrification—will make it even tougher for low-income customers to do so in the future (even if the Commission were to adopt PIOs' recommended disallowances and reduced customer charge). PIO thus assert that Ameren's low-income customers require a robust discount to make their gas bills affordable, not a band-aid. For that reason, the Commission should adopt the PIOs' proposed low-income discount rate, or the AG's proposal in the alternative.

PIO note AG witness Larkin-Connolly's testimony: "the objective in designing the new low-income discount program should be to provide benefits that do not only just provide some support to low-usage low-income ratepayers, but also make gas services more affordable for all low-income customers." AG Ex. 8.00 at 25-26. Despite this directive that the low-income discount rate ensures affordability, the Company proposes a low-income discount rate that falls well-short of this objective.

PIO witness Schott testified a household is "energy insecure" if it pays more than 3% of its gross household income on its gas bills. PIO Ex. 4.0REV at 4. PIO note that Ameren has a high prevalence of energy insecure customers in its service territory with 854 of its 901 zip codes having a median income at or below 60 % SMI for a household of two. PIO Ex. 2.0 at 6. Energy insecurity disproportionately impacts low-income households, Black and Hispanic households, and households with children. PIO Ex. 2.0 at 5. When energy insecure individuals are unable to pay their bills, they risk disconnection, which can lead to a series of negative effects. PIO Ex. 2.0 at 6.

PIO assert that, given the risks of disconnection, an effective low-income discount rate should seek to make gas bills affordable by limiting customers' total gas bill payments to 3% of household income. PIO maintain that Ameren's proposal, however, does not meet these criteria. The bill savings that Ameren proposes to offer would still leave households below 30% SMI with a gas burden of 7.5%, 2.5 times higher than the threshold for affordability. PIO Ex. 4.0REV at 7. The proposals from the Company and Staff fail to produce the discounts needed to make the lowest income customers energy secure because their discount is a flat dollar amount and only discounts delivery charges. PIO Ex. 4.0REV at 7. The steepest discounts under the Ameren and Staff proposals would leave the lowest income customers with gas burdens of 7.1% and 8.3%, respectively, more than double the 3% energy security threshold. PIO Ex. 4.0 at 7. PIO argue that Ameren and Staff's proposals only produce energy security for wealthier customers who, by definition, will have more disposable income to pay for their gas bills than the lowest income customers.

PIO assert that Ameren and Staff's proposals are also not likely to substantially reduce disconnections because they will not make gas bills affordable for Ameren's low-income customers. Monthly data from May to November 2022 shows that 94% of Ameren's customers on DPAs failed to successfully complete their DPAs. PIO Ex. 2.0 at 6-7. During this same period, Ameren issued 202,175 disconnections notices and executed 36,511 disconnections. PIO Ex. 2.0 at 7. PIO explain that, in fact, Ameren (including its Missouri and Illinois affiliates) ranks among the most aggressive utilities in the country when it comes to disconnections — Ameren ranked fifth in the country for

most disconnections last year (data through October) and increased disconnections by 3,750% in 2022. PIO Ex. 2.0 at 7. Between 2020 and 2021, Ameren accelerated disconnections six times faster than any other gas utility in the country. PIO Ex. 2.0 at 7. PIO note that Ameren now proposes a weak discount that will continue to leave many of lowest income customers at risk for disconnection.

In its rebuttal testimony, the Company states it is planning its SARP pilot to provide further assistance to its low-income customers and proposes a \$1 million customer assistance program to assist customers until SARP is active. Ameren Ex. 16.0 at 29. PIO assert that while those programs may be helpful to those customers who are able to participate, the availability of those programs should not substitute for a comprehensive low-income discount rate that helps make bills affordable for Ameren's customers. They maintain that Ameren has not demonstrated the SARP and a \$1 million customer assistance program, in tandem with its proposed low-income discount rate, will comprehensively address its customers' energy burdens. PIO Ex. 4.0REV at 3. For example, the Company has not explained how the programs would affect disconnections and proposes no enrollment cap or goal. PIO Ex. 4.0REV at 3. One-time bill assistance would also not address the root causes of energy insecurity in Ameren's service territory—growing rates over time. In contrast, PIO recommend a low-income discount specifically designed to ensure customers do not spend more than 3 % of their household income on gas bills.

PIO thus request that the Commission adopt PIOs' proposal, or the AG's proposal in the alternative. PIOs' proposal would provide significant savings for the 34% of Ameren customers who are below 60% of SMI. PIO Ex. 4.0REV 5. PIOs' proposal also significantly reduces the risk of disconnection by providing steep bill discounts for customers toward the lower-end of the income scale.

PIO further explain that the Commission has the authority to adopt PIOs' low-income discount rate pursuant to Section 9-241. While the Commission's Low-Income Discount Rate Study Report concludes discounts "are applicable only to the delivery service charges", nothing in Section 9-241 limits the Commission's discretion to flat rate discounts or discounts that apply only to delivery charges. Importantly, the PIO and the AG have shown in this proceeding that a discount that applies only to delivery service charges—like Ameren's and Staff's proposals—would not ensure affordable gas bills for Ameren's low-income customers.

In his testimony, Ameren witness Bodi argued that a discount structured as a percentage of a customer's total bill would reduce that customer's incentive to conserve energy. Ameren Ex. 30.0 at 17; Ameren Ex. 46.0 at 6. However, PIO propose to apply the discount to the total gas bill, meaning that fixed and volumetric charges would decrease by the same percentage. PIOs' proposal would simply scale the same ratio of fixed to volumetric charges (i.e., the total bill) downward to correspond with a customer's income level, which is wholly appropriate in the interest of advancing equity. PIO maintain that given the affordability crisis Ameren's low-income customers already face, and the acute affordability pressures that Ameren's proposed rate increase, coupled with accelerating electrification and gas price volatility, will impose those low-income customers, the Commission should adopt a discount rate that helps Ameren's most vulnerable customers achieve affordability.

e. Commission Analysis and Conclusion

The Commission's Low-Income Discount Rate Study Report directed certain electric and gas utilities to offer a tariffed low-income discount rate. Accordingly, AIC proposed its Rider LICA with this rate case filing. With the fully developed record, there are currently four low-income discount rate proposals for the Commission's consideration.

AIC proposes a two-tiered, fixed amount discount system based on LIHEAP/PIPP eligibility, wherein any customer whose income does not exceed 200% of federal poverty level would receive a monthly \$10 credit. For any customer whose household income is 50% or less of the LIHEAP qualifying metric (e.g., 100% of the FPL), the fixed monthly credit would increase to \$20. Staff's proposal modifies AIC's proposed Rider LICA, creating a third tier, proposing different fixed amounts that should apply to each tier, and allowing third tier customers to self-report their eligibility for the program. Under Staff's proposal, Rider LICA would provide a \$30 fixed credit to the lowest income customers, a \$20 fixed credit to customers between 100%-200% of the FPL, and a \$10 fixed credit to customers between 200%-300% of the FPL.

PIO propose a two-tiered discount system based on SMI rather than FPL, wherein the lowest-income customers (below 30% SMI) would receive a 60% discount, and customers between 30% and 60% of SMI would receive a 20% discount. Importantly, PIO propose this discount would apply to the customer's entire bill, rather than only to delivery charges, as AIC and Staff propose.

The AG's proposal is a modified version of PIOs' proposal that is based on FPL rather than SMI. Moreover, the AG's proposal includes five tiers, as opposed to PIOs' two tiers. The Tiers consist of 0-50% of FPL for Tier 1, 50%-100% of FPL for Tier 2, 100%-150% of FPL for Tier 3, 150%-200% of FPL for Tier 4, and 200%-300% of FPL for Tier 5. The discounted amounts for eligible Ameren customers are Tier 1: 75%; Tier 2: 55%; Tier 3: 25%; Tier 4: 10% and Tier 5: 5%. Both the AG and PIO advocate for a discount that is a percentage to be applied to the entire bill, rather than to just the delivery charges.

After thoroughly considering the four proposals, the Commission adopts the AG's proposal and directs the Company to implement it by October 1, 2024. In reviewing the record, the Commission concludes that the AG's proposal is consistent with the Commission's report to the General Assembly on low-income rates and would provide significant discounts to low-income customers, while mitigating the adverse impacts to non-participants. The Commission's study report "tentatively" recommended that low-income programs should apply to delivery services only, pending specific proposals in a formalized proceeding. See ICC, Low-Income Discount Rate Study Report to the Illinois General Assembly, at 8-9, 62-63 (Dec. 15, 2022). The record evidence on the total bill discount presented by the AG and PIO swayed the Commission to alter that determination and approve the AG's proposed full bill discount. The Commission recognizes applying the discount to the entire bill will increase the amount to be paid by non-eligible customers, but also notes this program introduces potential utility system benefits and encourages the Company to prioritize energy efficiency programming to reduce bills overall.

The Commission finds that the AG's five-tiered system is more expansive than both AIC's two-tiered system and Staff's three-tiered system and will provide more

targeted relief to the lowest-income customers. Significantly, the AG's proposal will benefit low-income customers who are not LIHEAP or PIPP eligible, while AIC's proposal will not. The AG's proposal also appropriately leverages the existing LIHEAP processes to determine eligibility for Rider LICA while allowing a fifth tier of customers to self-certify for eligibility. The Commission finds that this both reduces the administrative costs of the program and increases the program's effectiveness in delivering credits to eligible customers. Accordingly, the Commission concludes the AG's proposal will provide the transformative support necessary for Ameren's lowest-income customers to achieve an affordable energy burden.

The Commission adopts the AG's recommendation for customers to self-report Tier 5 eligibility and for the Company to annually audit LIQCs enrolled for Tier 5 discounts to verify eligibility. The audit will provide future information regarding the success or potential misuse of the program going forward. The Commission understands the Company's concerns regarding misuse of this program. However, considering the newness of this program, and the lack of any direction or process for customers to challenge being removed from the program, the Commission does not approve the Company's request that ineligible customers should be removed from the program as a result of the audit. Depending on the results of the audit as presented in a future rate case proceeding, or another applicable proceeding, the Commission may revisit or revise this decision. The issue of misuse and self-reporting should be discussed in the LIDR workshops described below.

As the Commission approves the AG's five-tiered proposal for Rider LICA eligibility, the Commission further approves Staff's recommended reporting requirements (5) and (6). They will require AIC to collect and report data on processing time for Tier 5 eligibility from initial request to approval under each of the options available to customers requesting the Tier 5 credit (online, by phone, or by mail), and a detailed description of the sampling technique used to verify eligibility of Tier 5 discounts/credits using the 5% threshold specified in the tariff and results of the review/audit including, but not limited to, the number of customers within the 5% of customers sampled that were unable to meet the income requirement or the income verification requirement. The Commission adopts the AG's proposed discount and Staff's proposed Rider LICA (as presented in Staff Schedule 14.06 but adjusted to reflect the Commission's approval of the AG's discount) for the purpose of recovering LICs associated with the Company's low-income discount program because it is consistent with the cost recovery mechanisms Staff supports for other large gas utilities in Illinois.

While the Commission adopts the AG's Rider LICA proposal in this proceeding, the Commission directs Staff to work with the Company and stakeholders to commence workshops no later than January 15, 2026, to further consider the questions raised in this docket and the Low-Income study report, including but not limited to:

- (1) should Rider LICA, or another cost recovery mechanism, be limited to residential customers only;
- (2) should the LIDR program incorporate seasonal differences in costs to customers and enable the Company to discount either the distribution

charge or the whole bill depending on the maximum potential discount to eligible customers;

- (3) should additional low-income levels be added to the program;
- (4) should the Commission consider approving a uniform LIDR program across all regulated gas utilities in Illinois;
- (5) is customer self-reporting income sufficient;
- (6) what other income reporting methods could be used in determining customer eligibility; and
- (7) what effect the approved LIDR has on the AGS market and issues of competitive neutrality.

Staff shall present a report to the Commission 60 days after the workshops conclude synthesizing the workshops and any recommended steps the Commission or the Company should take going forward.

While the Commission expects the AG's proposal to increase affordability across eligible customers, the Commission anticipates the Company could realize system benefits associated with reduced collections and customer service-related costs. The LIDR could also reduce uncollectibles and related disconnections tied to arrearages. In order to capture these various savings that could benefit all customers, AIC will need to track the LIDR's utility system impacts. AIC, Staff, and stakeholders shall use system savings information when evaluating and estimating the value LIDR provides for the Company. The Commission intends these system savings to be quantified and incorporated into Rider LICA reconciliations to adjust the under-recovery amounts consistent with AIC's realized LIDR-related system benefits. For the system savings to be included in future Rider LICA reconciliations, the Commission directs AIC to track the following information (to the extent possible):

- (1) the dollar amount of uncollectibles costs that have been reduced on an annual basis subsequent to the implementation of the AG LIDR;
- (2) the dollar amount of credit and collections costs, and any other Company costs that have been reduced on an annual basis subsequent to the implementation of the AG LIDR;
- (3) the aggregated Tier 1 (0%-50% FPL) and Tier 2 (51%-100% FPL) customer billing and arrearage data from the two years prior to LIDR implementation to assess how LIDR impacts the customer and utility system benefit analysis (prioritizing past data from only Tier 1 and Tier 2 now, but eventually tracking this information for all tiers as the discount program matures);
- (4) how AIC has marketed the availability of the LIDR to populations who might qualify for the discount;
- (5) what improvements can be made in those marketing efforts to reach more eligible customers; and
- (6) other information Staff identifies as needed for incorporating system savings into a Rider LICA reconciliation.

AIC shall present a report with the above information to the Commission within twelve months from the date the LIDR goes into effect and every year thereafter. The report shall clearly document the level of reduced uncollectibles, credit, and collections costs, and any other reduced Company costs attributed to the LIDR. After the initial report, Staff will review and make a recommendation to the Commission as to when such system savings should be included in the Rider LICA reconciliation accounting.

The Company shall have 60 days after the Final Order is entered to develop a final estimated timeline to make the necessary changes to its system. The Company must implement these changes and its LIDR program by October 1, 2024. The report must include, but shall not be limited to the following: 1) identification of specific system changes necessary to implement the LIDR program; 2) any logistical, IT, or system barriers to implementing the program; 3) how the system changes to accommodate the LIDR program are prioritized among other existing IT and/or system upgrades and changes; and 4) implementation timelines for each discount tier, if they vary. The Commission believes that implementing the program by October 1, 2024, is imperative to ensure that Ameren's most financially vulnerable customers receive assistance as the 2024/2025 winter heating season begins. The Commission further requires the Company to submit status reports to the Commission every three months after the date of this Order until the discount program is fully implemented. These status reports shall be filed as compliance filings in this docket.

5. Rider PGA

a. AIC's Position

AIC's Rider PGA is the long-established mechanism for the recovery of all costs for gas supply services without markup. Ameren Ex. 13.0 at 4. AIC proposed no changes to Rider PGA in its direct case, which, as it relates to Rider PGA, only proposed to remove PGA revenues and PGA expenses from the test year revenues and expenses as discussed in Section IV.A.1 and in Schedule C-2.1. However, Ameren Illinois addresses PIOs' recommendation that the Commission direct the Company to propose a risk-sharing mechanism in the Company's "fuel cost adjuster docket" to provide an incentive for the Company to control the costs of gas supply. PIO Ex. 1.0 at 91.

AIC contends PIO conceded that this proposal is inappropriate to consider in the current case by recommending that it be discussed in the "fuel cost adjuster docket." *Id.* AIC further posits that it is not clear in which "docket" the Company would propose such a risk-sharing mechanism. While PIO referred to "the Company's fuel cost adjuster docket," Ameren Illinois explains that the only docket (other than a rate case) in which the Commission addresses Rider PGA is the annual reconciliation proceeding provided for by Section 9-220(a) of the Act and the language of the Commission-approved tariff. See 220 ILCS 5/9-220(a); Ill. C. C. No. 2, 2nd Revised Sheet No. 23.010. According to Ameren Illinois, given the clearly defined scope of the Commission's review in the Rider PGA reconciliation proceeding, that proceeding is not an appropriate setting in which to "thoughtfully develop[] a risk-sharing proposal for the fuel cost adjuster" as suggested by PIO. PIO Ex. 1.0 at 91.

AIC urges the Commission to reject PIOs' proposal on its merits. PIO suggest that a change to Rider PGA is needed because there is no incentive in Rider PGA "to minimize



Summary of State Utility Shut-off Moratoriums

States and utilities moved quickly to suspend utility shut-offs due to nonpayment as low-income households struggle with the loss of income due to illness and job loss as a result of COVID-19 pandemic. State-mandated suspensions on utility shut-offs due to nonpayment as a result of COVID-19 are now in place in 29 states and the District of Columbia. Four states issued moratoriums that have recently expired: Kansas, Michigan, Mississippi, and Montana. Utilities in the other 17 states have issued voluntary moratoriums.

Note: This is a list of all utility actions that NEADA is aware of at the time of release. Questions: Please contact Mark Wolfe: mwolfe@neada.org or Cass Lovejoy: Cllovejoy@neada.org. Please send additions or updates with source documentation to Elizabeth Eagles: eeagles@neada.org.

Statewide suspensions (29 states & D.C.):

- *State-ordered Suspensions of Gas, Electric, and Water (29 states & DC):* Alaska, Arkansas, California, Colorado, Connecticut, District of Columbia, Hawaii, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, Washington, Wisconsin, Wyoming
- *Expired State-ordered Suspensions of Gas, Electric, and Water (4 states):* Kansas, Michigan, Mississippi, Montana
- *State-ordered Suspensions of Telecom (13 states & DC):* Alaska, California, District of Columbia, Hawaii, Indiana, Kentucky, Louisiana, Maine, Maryland, New Hampshire, Pennsylvania, Vermont, Washington, Wyoming
- *Expired State-ordered Suspensions of Telecom (2 states):* Kansas, Montana

States without suspensions/with voluntary suspensions (17 states):

- *States Without Mandatory Suspensions (17 states):* Alabama, Arizona, Delaware, Florida, Georgia, Idaho, Minnesota, Missouri, Nebraska, Nevada, North Dakota, Ohio, Oklahoma, Oregon, South Dakota, Utah, West Virginia
Note: Though these states have no official moratorium, all 17 of them have some form of voluntary moratorium which varies depending on the state and the specific utility provider
- *Voluntary Individual Utility Suspensions (50 states):* The Edison Electric Institute (EEI) has announced that all its member companies will voluntarily suspend disconnections in response to the pandemic. A full list of EEI member utilities is available [here](#). The American Gas Association (AGA) has announced that its member companies are committed to working with state public utility commissions to “appropriately suspend disconnecting customers from their natural gas service.” A full list of AGA members is available [here](#).

The calendar of moratorium expiration dates are as follows:

Table 1: State-ordered Utility Shut-off Moratoriums on Gas, Electric, and Water

Moratorium end date	Count of states	States
Expired	4	Kansas, Michigan*, Mississippi, Montana
27-Jun	1	Illinois
30-Jun	2	Indiana, Hawaii
1-Jul	2	Iowa**, Maryland
12-Jul	1	Colorado***
17-Jul	1	Rhode Island
25-Jul	1	Wisconsin
28-Jul	1	Washington
29-Jul	1	North Carolina
30-Jul	1	New Mexico
31-Jul	1	Vermont
31-Aug	2	Virginia, Texas
15-Nov	1	Alaska
Until end of emergency or further announcements	14	Arkansas, California, Connecticut, Kentucky, Louisiana, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, South Carolina, Tennessee, Wyoming
Until 15 days after end of emergency	1	District of Columbia
States without state-ordered moratorium	17	Alabama, Arizona, Delaware, Florida, Georgia, Idaho, Minnesota, Missouri, Nebraska, Nevada, North Dakota, Ohio, Oklahoma, Oregon, South Dakota, Utah, West Virginia
Total	51	

*Only had a shutoff moratorium on water

**Municipal utilities/electric cooperatives resumed disconnections on May 28; investor-owned utilities rate-regulated by IUB resume disconnections on July 1

***Executive order waves reconnection fees and orders payment assistance plans

Table 2: Proportion of U.S. Population Covered by Gas, Electric, and Water Moratoriums

	# of U.S. population	% of U.S. population
With state-ordered moratorium	220,956,276	67.3%
Without state-ordered moratorium/ with expired moratorium	107,283,247	32.7%



LARA MPSC

Low-Income Energy Policy Board

Low-Income Energy Policy Board

The Low-Income Energy Policy Board (LIEP Board) was formed after the Commission's directive to establish an advisory committee ([Case No. U-20757 order](#)) to guide and coordinate the work of the Energy Affordability and Accessibility Collaborative ([EAAC](#)) and Energy Waste Reduction Low-Income Workgroup ([EWR-LI](#)). It broadens participation of historically marginalized communities and coordinates efforts with the Governor's task forces to develop cohesive policies across state agencies. The LIEP Board functions to cross-pollinate policy and provide coordination, communication, decision making, and planning that is informed by the work of the EAAC and EWR-LI subcommittees.

The purpose of the LIEP Board is to guide the process of assessing energy affordability and accessibility holistically, especially through linking energy waste reduction services and energy assistance programs. It does this by focusing on three policy pillars including: Customer Centered Engagement & Coordination, Affordability & Customer Protections, and Low-Income Energy Waste Reduction With an overarching goal of **reducing the number of households with unsustainable energy burdens**, the LIEP Board has embraced the following values:

- We value affordability and inclusion in policy actions that create measurable impact.
- We achieve positive outcomes that impact home energy security, health, housing, and a healthy climate.
- We build solutions through collaboration and diversity of representation, input, experience, and knowledge.
- We act with respect, transparency, and integrity.

Low-Income Energy Policy Summit

The Commission also approved a low-energy policy summit which was held November 3, 2022. To encourage additional stakeholder input into these strategies, the MPSC held virtual report-out sessions on January 17 and 19, 2023. Thank you to those who provided comments and feedback.

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Low-Income Energy Policy Board

[Plenary Session Recording](#)

[Affordability and Customer Protections slide deck](#)

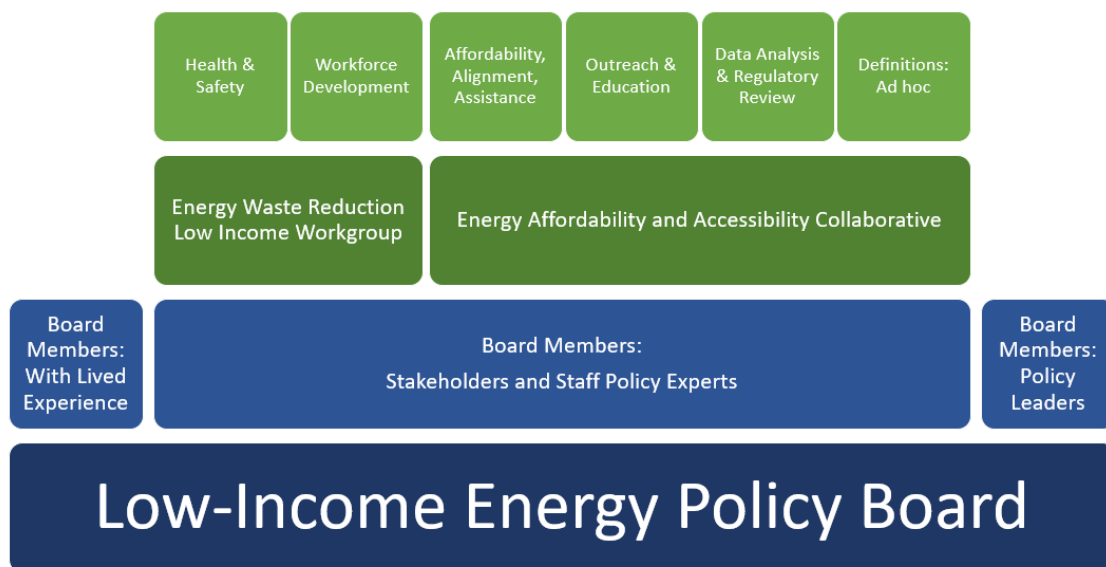
[Affordability and Customer Protections Session Recording](#)

[Customer Centered Engagement and Coordination Strategies slide deck](#)

[Customer Centered Engagement and Coordination Strategies Session Recording](#)

[Energy Waste Reduction and Weatherization Strategies slide deck](#)

[Energy Waste Reduction and Weatherization Strategies Session Recording](#)



Board Members

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Low-Income Energy Policy Board

Led by:

- Armstrong, Anne – MPSC, EAAC leader
- McNeally, Andrew – Energy Efficiency Program Administrator, Upper Peninsula Power Company (UPPCO)

Centered on stakeholder leaders of the EWR Low-income Steering subcommittee and EAAC subcommittees:

- Bunch, Rick – 5 Lakes Energy; Michigan Municipal Association for Utility Issues (MI-MAUI)
- Blizman, Alexis – Ecology Center
- DuBose, Briana – EcoWorks Detroit
- Kushler, Martin – ACEEE (American Council for an Energy Efficient Economy)
- Leahy, Patrick – SEMCO Energy Gas Company
- Grieco, Kasey – Superior Watershed
- Parker, Briana – Elevate
- Randall, Wende – Kent County Essential Needs Task Force (ENTF)

Inclusive of those with lived experience:

- Gant-Jordan, Synia
- Touré, Marie

Enhanced with policy leaders from agencies and task forces:

- Connolly, Cory – Department of Environment, Great Lakes, and Energy
- Denson-Sogbaka, Nicole – Department of Health and Human Services
- Eubanks, Rachael A. – Department of Treasury
- Guilfoyle, Jeff – Department of Treasury
- Hammoud, Hassan – Michigan Association of United Ways and Michigan 2-1-1
- Rose, Kelly – Michigan State Housing Development Authority
- Sasy, Ninah – Department of Health and Human Services -Social Determinants of Health Strategy

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Low-Income Energy Policy Board

- Schoenow, Kris – Bureau of Community Action and Economic Opportunity, Department of Health and Human Services”
- Slaughter, Derrell – National Resource Defense Council; Governor’s Council on Climate Solutions

Supported by Commission staff resource experts:

- Braunschweig, Elaina – Analyst, Regulated Energy Division
- Curtis, Jamie – Grant Administrator, Michigan Energy Assistance Program
- Forist, Christina – Manager, Compliance and Investigation Section
- Gould, Karen – Manager, Energy Waste Reduction
- Holley - Voelker, Reka – Manager, Communications Section
- Jones, Shatina – Diversity, Equity, and Inclusion Officer
- Rittenhouse, Amy – Communications Specialist
- Thelen, Jake – Departmental Specialist, Compliance and Investigation Section
- Wilkins, Mary – Departmental Specialist, Customer Assistance Division

Meeting Dates

The regular cadence of meetings takes place on the fourth Monday of the month from 10:00 -11:30 AM. Meetings will be conducted via teleconference unless otherwise stated. Please find remote access information for upcoming meetings on our [calendar of events](#).

December 4, 2023

[Agenda](#) | [Presentation](#) | [Recording](#)

September 25, 2023

[Agenda](#) | [Presentation](#) | [Recording](#)

August 28, 2023

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Low-Income Energy Policy Board

[Agenda](#) | [Presentation](#) | [Recording](#) | [Intersectionality of Housing and Weatherization/EWR Presentation](#) | [Intersectionality of Housing and Weatherization/EWR Recording](#)

July 24, 2023

[Agenda](#) | [Presentation](#) | [Recording](#) | [Energy Equity Gap Presentation](#)

June 26, 2023

[Agenda](#) | [Presentation](#) | [Recording](#) | [Equity and Reliability Panel Discussion](#)

May 22, 2023

[Agenda](#) | [Presentation](#) | [Recording](#)

April 24, 2023

[Agenda](#) | [Presentation](#) | [Recording](#) | [MI Healthy Climate Plan Recording](#)

March 27, 2023

[Agenda](#) | [Presentation](#) | [Recording](#) | [Energy and the Social Determinants of Health Presentation](#)

February 27, 2023

[Agenda](#) | [Presentation](#) | [Energy Equity Framework Presentation](#) | [Energy Equity Framework Recording](#)

January 30, 2023

[Agenda](#) | [Presentation](#)

December 5, 2022

[Agenda](#) | [Presentation](#)

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Low-Income Energy Policy Board

November 28, 2022

No Meeting

October 24, 2022

[Agenda](#) | [Presentation](#)

September 26, 2022

Working Session

August 22, 2022

[Agenda](#) | [Presentation](#)

July 25, 2022

[Agenda](#) | [Recording](#) | [Presentation](#)

June 27, 2022

[Agenda](#) | [Recording](#) | [Presentation](#)

May 23, 2022

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April 29, 2022 Kickoff

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Low-Income Energy Policy Board

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MPSC kicks off implementation of changes made to Michigan's energy laws in 2023

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Affordability, Alignment, and Assistance Subcommittee 10/3/2023

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*Meeting presentations, recordings, and materials are shared on the EAAC website in the [AAA section](#)

Agenda

1

**Review
Subcommittee
Charge and Goals**

2

**Objective 2:
Consumers
Energy
Presentation on a
Low-Income Cost-
of-Service-Study
Subclass**

3

**Discussion/Q & A
on the
Presentation**

4

Next Steps

Overarching Charge of the Energy Policy Board

1

The overall goal of the work of the EAAC is to define and ensure energy affordability, accessibility, and security/self-sufficiency in collaboration with the EWR-LI and the LIEPB (its advisory organization) as stated by the Commission through Case No. U20757.

2

To build on these directives, the LIEPB set their primary purpose as “guiding the process of assessing energy affordability and accessibility holistically, especially through linking EWR services and energy assistance programs.”

3

They set as their overarching goal “to reduce the number of households with unsustainable energy burdens.” All work of the Board, EAAC, and EWR-LI Workgroup flowed from this purpose and goal.

Shared Goals of the Subcommittee



To promote energy affordability.



To support program alignment for ease of access and use, effectiveness of administration, and evaluation.



To evaluate and improve systems of energy assistance.

Guiding Principles

The ideal system/program design should achieve this while also:

- **Ensuring equitable distribution** in the access to, use of, and outcomes from energy affordability and assistance policies/programs
- **Centering impacted community priorities** and participation in policy/program development, accountability, and assessment
- **Treating customers with dignity**, enabling them to live comfortably, and not penalizing customers for an inability to pay their bills
- **Coordinating and communicating clearly** with relevant state agencies to integrate state policy goals, including those related to healthy homes and climate change

Proposed 2023-2024 AAA Charge p. 58— Awaiting Commission Approval

Initiate a stakeholder discussion of DTE's report on the enrollment of customers in the LIA credit program and submit a report and recommendations to the Commission.

Discuss the LIA/RIA enrollment assignment, enrollment cap, and best use/program pairings.

Evaluate the feasibility of a low-income customer subclass in the Cost-of-Service-Study (COSS)

Develop a proposal for an energy affordability standard and how the standard can be integrated into the regulatory environment.

Evaluate and make recommendations regarding PIPPs. (2024)

Objective 2

Evaluate the feasibility of a low-income customer subclass in the Consumers Energy Electric Cost-of-Service Study ("COSS")

Purpose of this Presentation

- ❑ The AAA has been reviewing ways to fulfill MCL 460.11 (2), which authorizes low-income rates (Appendix 1), by means of analyzing the current RIA and LIA credits.
- ❑ Another directive from the Commission was to evaluate the feasibility of a Consumers Energy cost-based low-income electric cost of service study, which is relevant to the above legislation.
- ❑ After this presentation, we will have outlined different possibilities to fulfill this legislation and can make an informed recommendation to the Commission on RIA/LIA credit reform.

Consumers Energy Low Income COSS

Overview for EAAC, AAA Subcommittee
October 3, 2023



Agenda

- 1) Background
- 2) Ratemaking Process
- 3) Study Design
- 4) Study Results
- 5) Summary of Key Findings

Background

“The Commission agrees with the ALJ that all parties made valid points and ultimately the Commission agrees that a COSS with a low-income customer subclass may be beneficial and recommends the company include a low-income customer subclass in the COSS for the EAAC in Case No. U-20757, but does not require it for the company’s next general electric rate case.”

Case No. U-20963 December 22, 2021 Final Order (Page 402-403)

Ratemaking Process



Revenue Requirement

Determines the utility's total cost to serve in a test year



Cost of Service Study (COSS)

Assigns costs to rate classes based on how they contribute/drive those costs.

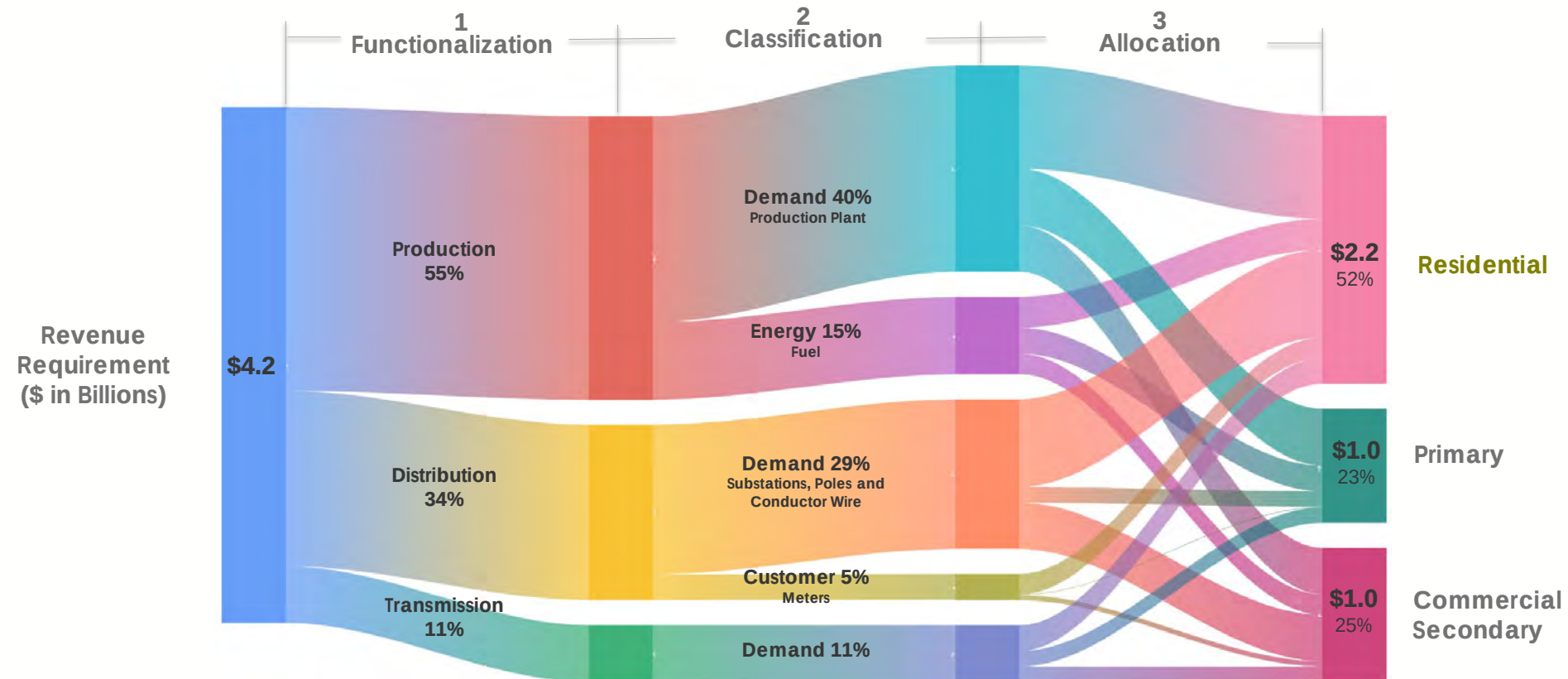


Rate Design

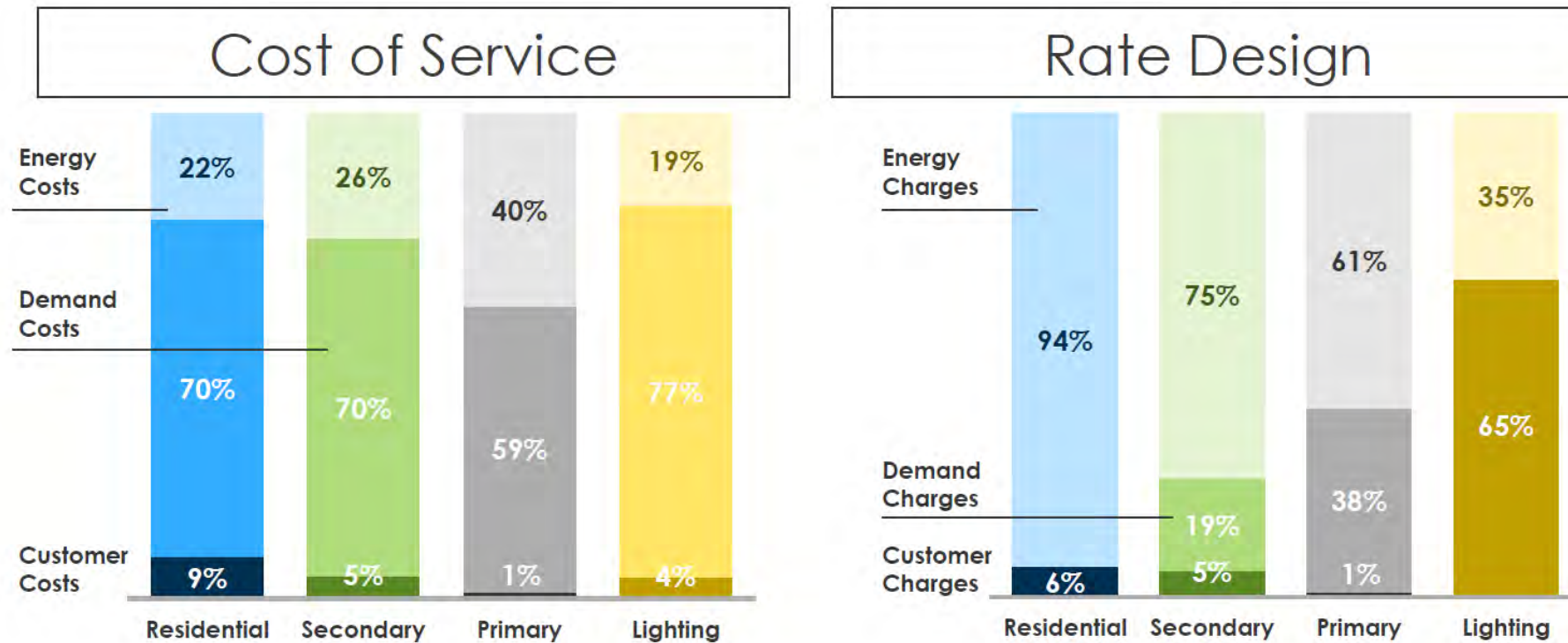
Determines how the costs should be recovered (e.g. fixed or energy charge etc.)



What is a COSS?



Differences exist in how costs are allocated in the COSS and how rates are designed



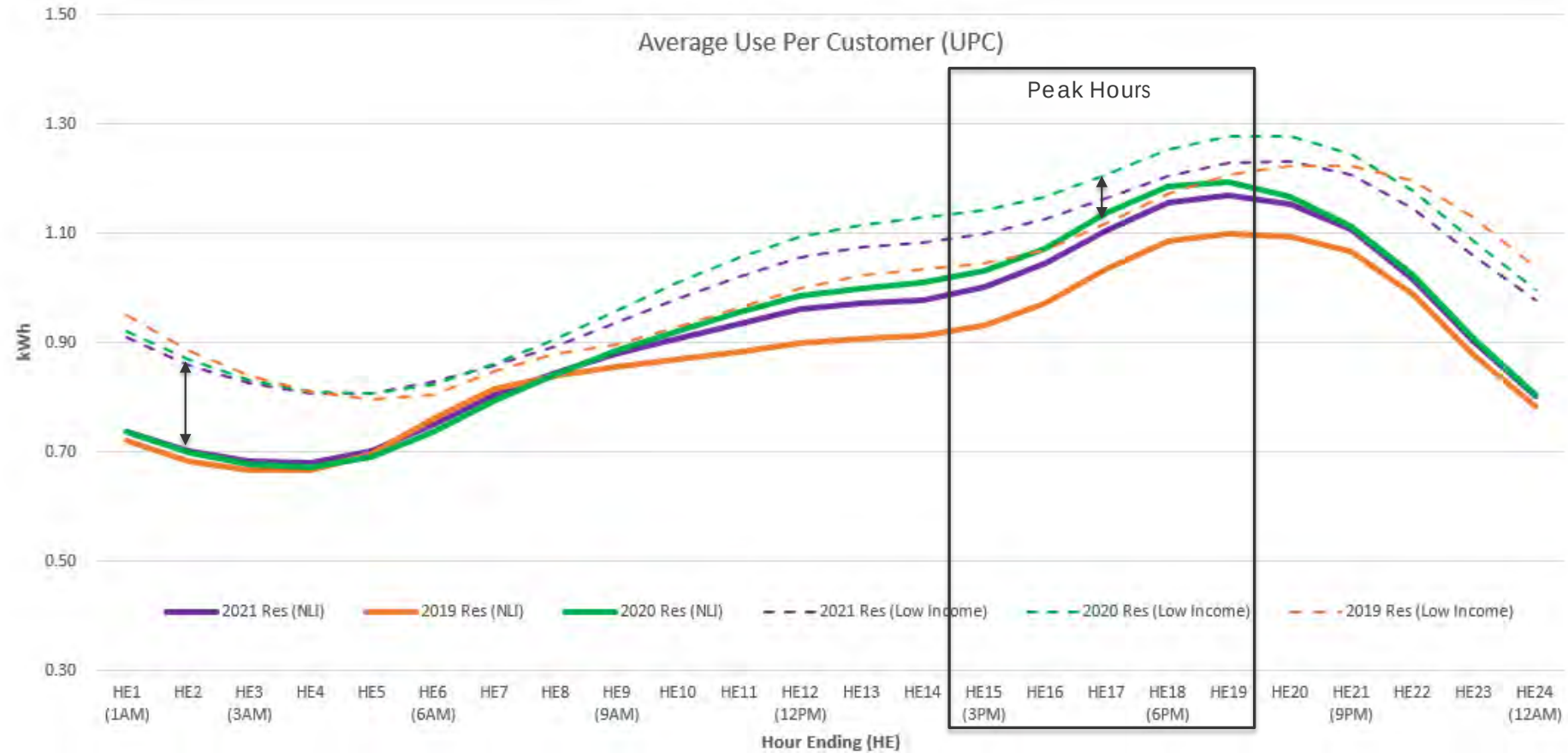
Residential Rate Design

- Four residential rate options – RSP, RSH, RPM, RSM
 - **Summer Peak (RSP)** is the default rate with summer on-peak period, 2pm-7pm
 - **Smart Hours (RSH)** has the same on-peak period as RSP, but year round
 - **Nighttime Savers (RPM)** is the same as RSH, but adds a super off-peak period from 11pm-6am
 - **Non-Transmitting Meters (RSM)** is the former default rate and is now used for smart meter opt-out or non-transmitting locations
- Life Line Credits – senior citizen and low-income monthly credits
 - \$30/month for Low-Income Assistance Credit (LIAC) and \$8/month for Residential Income Assistance (RIA) credit
 - \$11.5M total (as filed) for low-income credits in pending case allocated to all rate schedules using the total COSS results

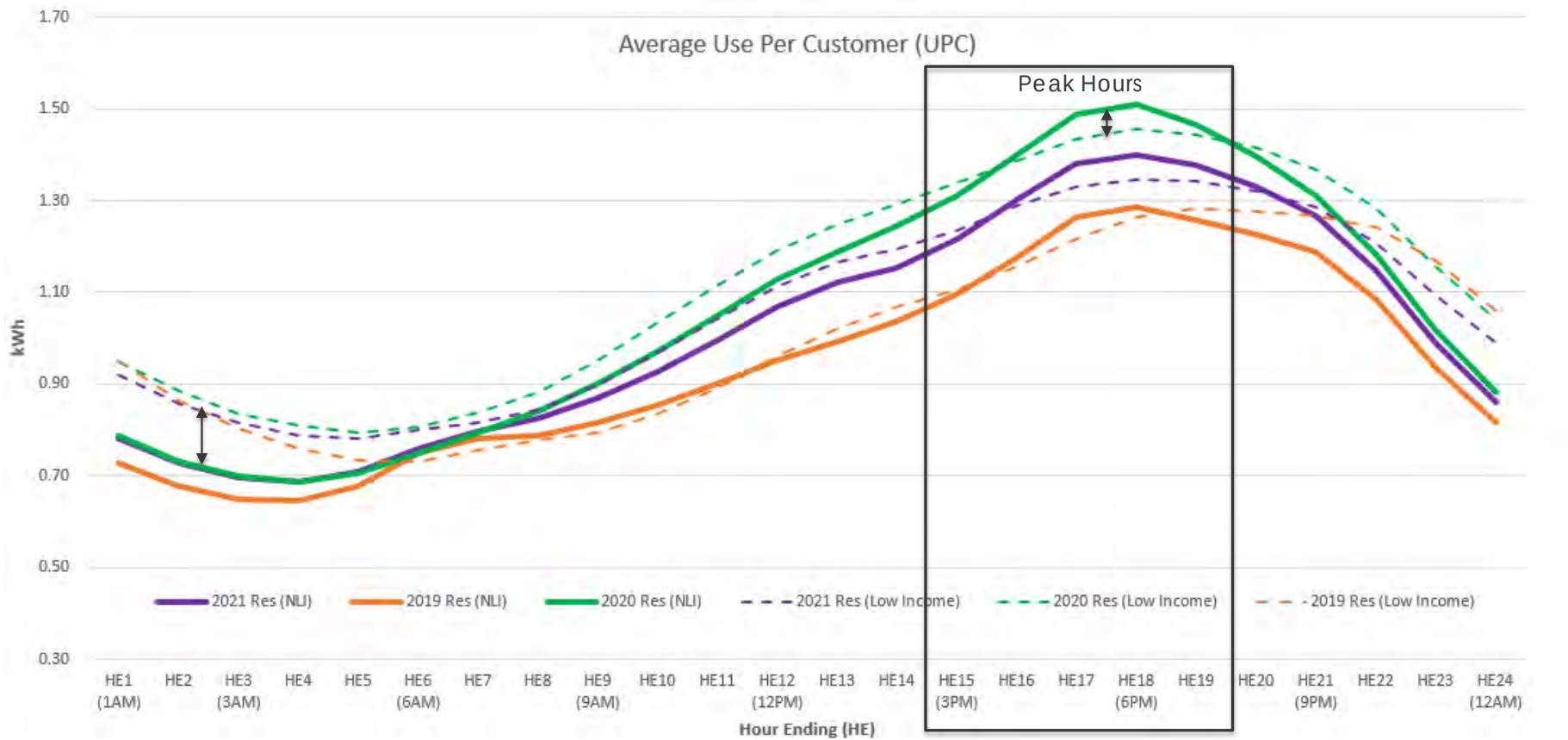
Low Income COSS: Study Design

- Started with COSS filed in Case No. U-21389
 - Load Study Years: 2019-2021
 - Test Year: March 1, 2024 - February 28, 2025
- Worked with Load Study Vendor (DNV) to develop Load Profiles (2019-2021) for Residential Low Income and Non-Low Income (NLI).
- Low Income defined as customers taking RIA or LIAC

Load Study Results: Total



Load Study Results: Summer Weekday



* Non-Low Income (NLI)

Load Study Results: Key Allocators

Production	Primary Cost Type	Non-Low Income				Low Income				VAR
		2019	2020	2021	AVG	2019	2020	2021	AVG	
4CP Demand	75% Production (Generation) Capacity	6.8	7.5	7.1	7.1	6.3	7.1	6.6	6.7	-7%
Total Energy	25% Production (Generation) Capacity	7,703	8,138	8,024	7,955	8,787	9,157	8,899	8,948	12%
12CP Demand	Transmission Expense	15.6	16.9	16.7	16.4	16.4	17.5	17.2	17.0	4%
Seasonal Energy	Fuel and Purchased Power Expense									
Off-Peak Hours (Summer)		1,393	1,468	1,483	1,448	1,530	1,590	1,566	1,562	8%
On-Peak Hours (Non-Summer)		2,403	2,467	2,452	2,441	2,819	2,856	2,797	2,824.2	16%
Off-Peak Hours (Non-Summer)		2,504	2,535	2,527	2,522	3,018	2,999	2,953	2,990	19%
Critical On-Peak Hours (Summer)		405	496	455	452	399	489	447	444.9	-2%
Mid-Peak Hours (Summer)		997	1,172	1,108	1,092	1,023	1,223	1,135	1,127	3%
Distribution	Primary Cost Type									
Customer	Meter/Service Plant & Customer Service Expense	1,563,438	1,558,119	1,545,479		47,882	71,911	97,163		
Class Peak	Nearly all Other Distribution Plant and Exp	2.1	2.4	2.2	2.2	2.0	2.1	1.9	2.0	-11%
SIMD	NOT USED	5.7	6.0	6.6	6.1	5.9	5.8	6.3	6.0	-2%

Summary of COSS Results

Filed U-21398

	Total Residential	Non-Low Income	Low Income
Distribution: Demand Related Cost	\$ 929,150	\$ 874,068	\$ 52,321
Distribution: Customer Related Cost	\$ 179,947	\$ 168,633	\$ 11,274
Production Cost	\$ 1,190,785	\$ 1,112,273	\$ 76,461
Total Cost (000)	\$ 2,299,882	\$ 2,154,974	\$ 140,057

Full Service MWH Sales	12,559,141	11,698,027	861,114
Customers	1,662,850	1,557,791	105,059
MWH Use Per Customer	7.553	7.509	8.196

					Annual	Monthly
Total Cost Per Customer	\$	1,383	\$	1,383	\$ 1,333	\$ 50
Total Cost Per MWH	\$	183	\$	184	\$ 163	\$ 22

LIAC Credit (Per Customer)	\$	360	\$	30
RIA Credit (Per Customer)	\$	96	\$	8

On a per customer basis low-income customers cost \$50 (4%) less to serve...
but are given a \$96 (RIA) to \$360 (LIAC) credit

Low Income COSS: Rate Design

- Used proposed rate design in pending case
- Designed low income RSP rate
- Removed low income credits from Non-Low Income rate design
- No impact for the Non-Low Income Customer
 - \$125/month average bill under proposed rates and low income COSS
- \$5/month lower average bill for the Low Income Customer than the average residential customer (excluding credits)
 - \$120/month average bill with low income COSS
- With proposed rates, the average Low Income Customer bill is \$135/month (excluding credits)
 - Higher average total energy consumption for low income customers offsets slightly lower on-peak usage

Key Findings & Conclusions

- Low Income customers are larger energy users but consume less during summer peak times.
- COSS results (and resulting rates) could materially change based on chosen allocators and load study results.
- The Company does not believe that COSS should be the basis for determining low Income credits.

Appendix: Acronyms

COSS: Cost of Service Study

RD: Rate Design

RIA: Residential Income Assistance

RSP: Residential Summer On-Peak Basic Rate

LIAC: Low Income Assistance Credit

LI: Low-Income

NLI: Non-Low Income

TOU: Time of Use rates

Appendix: MCL 460.11

460.11 Establishment of electric rates; establishment of eligible low-income customer or senior citizen customer rates; public and private schools, universities, and community colleges rate schedules.
Sec. 11.

(1) Except as otherwise provided in this subsection, **the commission shall ensure the establishment of electric rates equal to the cost of providing service to each customer class.** In establishing cost of service rates, the commission shall ensure that each class, or sub-class, is assessed for its fair and equitable use of the electric grid. If the commission determines that the impact of imposing cost of service rates on customers of an electric utility would have a material impact on customer rates, the commission may approve an order that implements those rates over a suitable number of years. The commission shall ensure that the cost of providing service to each customer class is based on the allocation of production-related costs based on using the 75-0-25 method of cost allocation and transmission costs based on using the 100% demand method of cost allocation. The commission may modify this method if it determines that this method of cost allocation does not ensure that rates are equal to the cost of service.

(2) Notwithstanding any other provision of this act, the commission may establish eligible low-income customer or eligible senior citizen customer rates. Upon filing of a rate increase request, a utility shall include proposed eligible low-income customer and eligible senior citizen customer rates and a method to allocate the revenue shortfall attributed to the implementation of those rates upon all customer classes. As used in this subsection, "eligible low-income customer" and "eligible senior citizen customer" mean those terms as defined in section 10t.

Reminders Before our Discussion



Use the raise hand function
in Teams to speak



Be respectful of diverse
input



Voice dissent in a
productive and respectful
manner

Next Steps



Next Meeting:

Discuss how today's presentation impacts our current objectives.



Data:

RIA/LIA data collection will soon take place to support recommendations to the Commission.



Goals:

We are currently working on directives that have been directed to the EAAC through Commission orders.



Leadership:

Come to us with any concerns or ideas!

Appendix 1: Authorizing Legislation: MCL 460.11 (2)

“Notwithstanding any other provision of this act, the commission may establish eligible low-income customer or eligible senior citizen customer rates. Upon filing of a rate increase request, a utility shall include proposed eligible low-income customer and eligible senior citizen customer rates and a method to allocate the revenue shortfall attributed to the implementation of those rates upon all customer classes. As used in this subsection, ‘eligible low-income customer’ and ‘eligible senior citizen customer’ mean those terms as defined in [section 10t](#).”

RIA Enrollment Process

MDHHS: Customer at or below 150% FPL applies for and receives a SER after receiving a past due energy bill notice.

Treasury: Customer at or below 110% FPL fills out the supplemental tax form to receive the HHC

Customer info and bill payment assistance amount is sent to the customer's utility to apply a payment/credit to their bill.

All SER/HHC customers with participating utilities automatically receive additional RIA bill reduction equal to the amount of the monthly service charge (~\$5-\$16) for the next 12 months.

• After 12 months, the customer will need to either receive a new SER/HHC or self-attest to being income-eligible to continue receiving the credit.

For select utilities, a limited number of company-selected customers are chosen to receive the LIA instead of the RIA to provide greater payment assistance (\$30-\$40/month).

RIA Self-Attestation Process

Customer reaches out to their participating utility and requests the RIA.

Participating utilities are required to offer a self-attestation form and may request eligibility proof.

- 150% or below the FPL, Medicaid, SNAP, SER, HHC, MEAP

Approved customers with participating utilities receive RIA bill reduction equal to the amount of the monthly service charge (~\$5-\$16) for the next 12 months.

- After 12 months, the customer will need to either receive a SER/HHC or self-attest to being income-eligible to continue receiving the credit.

For select utilities, a limited number of company-selected customers are chosen to receive the LIA instead of the RIA to provide greater payment assistance (\$30-\$40/month).

Key Takeaways:

- ❑ Anyone who is identified as eligible for the RIA receives it
- ❑ RIA eligibility determination is simple if a customer already applied for and received SER or HHC.
 - Data release/privacy prevents auto-enrollment for Medicaid and SNAP recipients.
 - Some SER applicants are RIA-eligible but not SER-eligible
- ❑ Utility personnel costs are greater when RIA/LIA customer eligibility is confirmed through self attestation.
 - Self-attestation increases accessibility and decreases customer application burden
 - Many customers do not want utilities to hold personal data
- ❑ How are customers being notified when their RIA is about to expire? And do they know how to handle that?

Category	Pain Point/Inefficiency	Recommendation/Proposed Solution	Current Status: Already exists/In process/Needs implementation	Mechanism for Change i.e. policy, legislative, administrative rules
Accessibility	Asset limits for SER creates a system of households that are denied, yet still may be eligible for other programs.	Capture denied SER households and refer them to RIA and EWR; how can MEAP be leveraged for this purpose without SER eligibility	Partially in December Report	MEAP/DHHS process
Accessibility	A lot of additional information/documentation required for DHHS application			
Accessibility	"Home energy assessment" might be an intimidating term for customers	Changing the term "home energy assessment" to "energy insight report" can increase uptake—less intimidating	Utilities have not noticed difference in uptake. Recommendation is likely unnecessary.	Utilities
Accessibility	Different forms of assistance have different applications	Standard application for assistance	Brought up at Policy Board Summit--have to see where this recommendation would lie	Low-Income Energy Policy Board: DHHS and Treasury need coordination. Need attestation form at end of SER, Medicaid, and SNAP applications
Accessibility	Some people are embarrassed of their homes or do not trust someone to enter to perform a home energy assessment	Utilities handle virtual assessments for EWR since some people are not comfortable with others in their home	December Report 2022	Process change--division of labor
Accessibility	Customers and Energy Assistance providers may not know how to access assistance or what is available. The utilities work from a list of those who receive other public benefits. Not all low-income households actively seek out public benefits, leaving the potential for missing low-income households who need the assistance and are eligible to receive credits.	Utilities should advertise assistance options on their website in a uniform fashion with a link to the MPSC assistance page	December Report 2022	Website reworking
Accessibility	Customers with disabilities are not properly accommodated or given all protections they need especially during power outages. Some of these issues are related to landlords			
Accessibility	Reaching underserved communities	In outreach group's priorities	In outreach group's priorities	
Accessibility	utility credits (mostly LIA) do not have equity framework, but could. Currently given to those receiving APPs or used to subsidize MEAP		U-20836 Commission order decision	
Accessibility	Customers denied SER have found it difficult to find resources they need or instructions on what to do after the denial	MI Bridges should have a more specialized resource site/information about what to do after a SER denial based on the reason for the customer's denial. Ensure MEAP grantee referral is one option.	December Report 2022	
Affordability	Arrearage management			
Affordability	Fixed payment programs		Already exists: APPs and PIPP pilots. Constrained by funding	
Affordability	Streamline design			
Affordability	Customers with medical equipment cannot always qualify for APPs because they cannot reduce usage under a certain point	Need more flexibility in program requirements for customers who have to have higher usage for medical equipment. Need to also get MEAP grantees to put these customers on other assistance	PIPP In progress--Staff	
Affordability	Need more forms of propane assistance	Staff has met with the MI propane association to coordinate better		
Alignment	Difficulty in identifying and auto-referring across programs to benefit low-income energy assistance programs.	Align the income eligibility for the different programs		Legislative
Alignment	FPL is antiquated method of determining need. Newer data suggests using Area Median Income or ALICE criteria.	FPL/AMI/ALICE – aligning criteria	In progress--Staff	Some legislative. Few programs allow AMI
Alignment				

Eligibility	Household income fluctuates and is not always representative of income households readily have available consistently.	Eligibility lookback periods (90 days, 30 days, others 3 months)	Already exists for SER--DHHS projects next month of income instead of just looking back and have no categorical eligibility. HHC is based on tax year and is more restrictive. Needs more discussion	HHC would have to have a non-tax return option
Eligibility	"Prevention may cost less than assisting in crisis". Requiring households to be in crisis means that households may sacrifice other basic needs to pay for energy. These households, while averting a utility crisis, is now slipping through the safety net of services designed to protect basic needs. Additionally, from a self-sufficiency perspective, crisis is the worst time to engage households in longer term prevention.	Eligibility prior to crisis	Discussions among Staff	Either legislative change, reallocating more funds to prevention, or invasive to privacy
Eligibility	Households in Michigan have high energy burdens (greater than 6% of household income). Many Asset Limited Income Constrained Empoloyed (ALICE) households can't afford utilities.	Expanding what defines low-income; opportunity for going further		Legislative
Eligibility	Verification Simplification			
Eligibility	Customers who are on protection plans accrue high arrears and are not allowed to receive a SER, since the are not at risk of shutoff	DHHS should redefine crisis for their energy programs (SER & MEAP) to include critical care or medical hold customers with accruing arrears or those with documented health and safety EWR deferrals.	December Report 2022	
Eligibility		Consider HHC approval for MEAP eligibility	December Report 2022	
Eligibility		Define crisis within DHHS to be income-based instead of crisis-based		DHHS
Eligibility	Customers with old bills or no billing history cannot always qualify for assistance and MEAP grantees struggle to assist these customers.	Assist customers with old bills or no billing history to obtain housing and new utilities at a new address by considering a client (not a concurrent customer) eligible for assistance with establishing service per a documented referral from the Housing Assessment and Resource Agency (HARA – per MSHDA criteria).		
Process	Customers and Energy Assistance providers do not know about or how to enroll in utility credits, which limits accessibility.	1. improve website information and link to MPSC Get Help page. 2. Notify MEAP grantees of utility credits and MPSC assistance website. 3. When DHHS provides utilities with a list of SER/HHC recipients, they should provide a second list of confirmed income-qualified customers (≤150% FPL) who were denied SER for non-income reasons (and refer those customers to MEAP grantees). And/or add a standardized utility self-attestation form to the end of Medicaid, SNAP, and SER applications (or after the approval stage) to facilitate a more automatic RIA enrollment for Medicaid and SNAP and for those who may be approved for SER (or are income qualified) but did not receive a payment so they do not appear in utility systems as income-qualified.	December Report 2022	Training caseworkers and customer service reps to triage customers better-- give them a better roadmap of assistance options
Process	Utilities and MEAP grantees cannot see if each other have performed EWR services/outreach to a customer, which can lead to wasted, overlapping efforts	Need central platform between MEAP and utilities to see services performed/assistance offered to a customer	December Report 2022	IT upgrades

Process	Non-MEAP/SER/HHC customers are not receiveing EWR outreach	Customers who self-attest to RIA should receive an EWR referral and be treated the same as SER & HHC recipients (from a utility perspective) in terms of outreach and services offered where applicable.	December Report 2022	Process change
Process	Sometimes those in need wait until they are in crisis to seek out access to low-income programs, since they may not know about non-crisis assistance.	Proactive outreach to past recipients by MEAP grantees and utilities	December Report 2022	Process change
Process	MEAP grantees and other agencies are not aware of all protection and assistance offerings	MPSC website		Need to notify 211 and MEAP grantees of new website
Process	How do we increase uptake of EWR services?	Schedule customers in crisis for EWR right on the phone—or institute an online scheduler	December Report 2022	Process change
Process	Some caseworkers might not be passionate about EWR being effective, and if they don't believe in its effect, then they might not convince customers of its importance	Train caseworkers/staff to believe in EWR—can increase quality of referrals. Have them do an energy assessment on their home or see one happen	December Report 2022	Process change
Process	Debt is being sold to collection agencies. This is unregulated. Look into cost benefit of this--Jackson Koeppl/Gloria Lowe with Soulardarity			
Process	People need to be able to monitor their usage to manage it	Apps to track usage		
Process	People have to wait for their SER to expire after 30 days and reapply just to get energy/EWR services through SER because getting the energy assistance is often dependent on paying co-pays for other services ----angela sterner and Kasey Mcneally	Eliminate co-pays for non-income reasons for SER denial & don't make energy-assistance co-pays dependent on water, roof, window or other co-pays if the bills are separated out. Try to eliminate co-dependency within SER	December Report 2022	DHHS
Process	EWR referrals are sometimes made to the incorrect utility	There is an issue with MEAP/utility communication when referring EWR services to the correct utility/place. There is a training opportunity to collect as much information about an appliance/EWR need as possible potentially with a questionnaire checklist, so the referral is made correctly		
Process	SER interview scheduling is slow and doesn't assist customers fast enough	Communicate/track the approval stage better and allow customers to choose their appointment time	December Report 2022	

Recommendations based on the following categories:

a.Short-term policies or procedures that can be put into place within the next 3-6 months that will help those in poverty to help access programs that can benefit them;

b.Medium- and – longer term policies or procedures that can help to positively affect the ALICE rate within the next 6-18 months. These may include longer term goals that need legislative approval; and

Level of Difficulty to Change	Timeframe for Completion - Short-term, Medium-term or Long-term	Specific timeframe (in months)	Next Steps	Budget Costs	Potential Barriers/Challenges to Implementation
Low					
low					
Medium					
Not difficult					
High					
High--SER was chosen to use 150% FPL instead of 60% AMI to align with MEAP for a streamlined design. Would have to change other legislation for other programs					
					Requires legislative change?

-----					Resources to implement
High					Federal requirements.
High					Limited funding and assuring that assistance goes to the households that need it most
Low					
Medium					Funding

Potential Positive Impacts	Potential Adverse Impacts	Stakeholders: who may support, oppose, who is affected, etc.	Other States/Programs to Learn From
Improved access to all benefits low-income households may be eligible for.			
Potential to ensure 100% of low-income households take advantage of this credit.			
Low-income households have improved access to beneficial programs.			
"more inclusive" access to low income programs for ALICE families that fall off the benefits cliff and are put into a cycle of crisis after crisis, without being eligible for assistance.			

More accurate reflection of household financial instability and the need for utility assistance programs.			
"May reduce costs"; May result in fewer disconnections			
Expanded eligibility			
Potential to ensure 100% of low-income households take advantage of this credit.			

Subcommittee	Category	Data Request	Goal of Data	Valid MPSC Use?	Granularity of Data--Zip Code, Census Tract, Circuit	Is this data already being reported?	Is the data shareable if it is already available?
AAA	Accessibility	SER denials--codes that show the person misunderstood the process	How can we improve the customer journey?	Yes	NA	Has been	Yes
AAA	Accessibility	Number of customers who receive HHC but not SER	Highlight accessibility gap & outreach gap	Yes	NA	No	Raw numbers--should be
AAA	Accessibility	Number of customers who receive SER but not MEAP	Highlight accessibility gap & outreach gap	Yes	NA	No	Raw numbers--should be
	Affordability	Level of energy burden for households enrolled in PIPPs	Understand the affordability impacts of PIPP programs (what energy burden is unaffordable)	Yes		Not yet, but may be included in PIPP reporting	
AAA	Affordability	Average cost per customer of Shut-Offs by utility. Also could we find out the cost for the customer?	Understand the cost of emergency programs; build a better preventative program	Yes--legislative change	By utility	Don't believe so	Should be
AAA	Affordability	Data on how PIPP is performing in other states	Find out if this is the most successful way to provide affordability	No--getting own data	NA	Unsure	
AAA	Affordability	Does energy consumption increase as affordability increases?	consumption behavior--effects of affordability	Yes	NA	Likely	Should be
AAA	Affordability	How do we need to measure disconnection? Currently as of last day of month. Likely need whole month	Better picture of affordability scope	Yes		Yes	yes
AAA	Affordability	How many one-time assistance/MEAP/APP customers get back on the next year after defaulting	Do customers successfully get off crisis/debt cycle?	Yes		Exists--not analyzed	Should be
AAA	Affordability	How many customers made late payments while receiving HHC and SER vs. when they weren't.	Analyze if SER and HHC work well			No	Energy burden data is available and shareable
AAA	Affordability	MEAP annual report to feds Utility raw data on APP success HHC data. Graduation rate data vs. cycling data--long vs. short term	Need to figure out how we measure success	Yes		Yes	Should be
AAA	Affordability	repeat SER customers YOY	Do customers successfully get off crisis/debt cycle?	Yes		No	Should be
AAA	Affordability	repeat HHC customers YOY	Do customers successfully get off crisis/debt cycle?	Yes		No	Should be
AAA	Alignment	Aligning eligibility criteria--increase in customers vs. sufficient funding	Find out the impact of aligning criteria-- NEED FURTHER DISCUSSION	?		Kind of	Yes
AAA	Alignment	SER denials for non-income reasons	How many more people can we get on RIA or PIPP?	Yes		No	Yes
AAA	Eligibility	Quantity of customers who qualify vs. apply for vs. receive assistance---SER, HHC, EWR, MEAP/APP	Find out certain groups who are not getting assistance	Yes		Yes--publically available info	Yes
AAA	EWR Referral Process	How many assistance recipients receive EWR referrals vs. services?	Potentially improve customer journey	yes		No	

[illegible]

Who Provides the Data? Can we collect this in a less intrusive way?	One-time data ask or long-term? Frequency of Data Reporting	Administrative/ Other Burden	Current Status	Timeframe for Completion - Short-term, Medium-term or Long-term	Specific timeframe (in months)	Next Steps
DHHS	One-time historical pool	NA	Obtained 2019 top denial codes. DHHS says they can't give current	Short-Term	Took minutes	Confer with DHHS
DHHS based on their report to LIHEAP, should be able to sort data	One-time historical pool		Would have to pay DTMB to pull DHHS data			Confer with DHHS
DHHS based on their report to LIHEAP, should be able to sort data	One-time historical pool		Would have to pay DTMB to pull DHHS data			Confer with DHHS
Utilities	Ongoing					
Utilities, look into studies from the customer perspective	one-time		Received from Utilities			Look into the customer perspective
PA, OH, IL, CO	one-time		NA---We'll get our own data on how it performs			
MEAP/utility/LIHEAP performance metrics (DHHS)	Historical data pool--one-time request					Confer with utilities and MEAP grantees
DARR Subcommittee/monthly shut-off data site, quarterly reports; Rule - 460.151			DARR will tackle this			Keeping up to date with DARR
(DTE reports this). Salesforce SER data---DHHS/Jamie	Historical data pool--one-time request		Jamie is trying to figure out if she can calculate this			Confer with utilities and MEAP grantees
Can find energy burden publically			Received from Utilities			
MEAP	Already Annually		Would have to pay DTMB to pull DHHS data			Confer with Tammy
DHHS	One-time historical pool		Would have to pay DTMB to pull DHHS data			Confer with DHHS
Treasury/DHHS	One-time historical pool		Would have to pay DTMB to pull DHHS data			Confer with DHHS/Treasury
Roger Colton has analyses	One-time					
DHHS	One-time		Would have to pay DTMB to pull DHHS data			confer with DHHS
DHHS (presented monthly to MEAP workgroup)--approved/denied for SER, Census data/LEAD tool/Roger Colton/NEUAC to see how many we're missing---get input from community organizations about people who can't qualify for SER	One-time historical pool		Would have to pay DTMB to pull DHHS data			Find information
Utilities, MEAP, DHHS	ongoing periodic		Utilities do not track			Confer with Brad

[illegible]

[illegible]



Program	Avg Annual Households Served 2019-2021	Avg Annual Funding	Cost per customer	Benefit per customer	Income Threshold	Crisis Needed?
LIHEAP	340,000	\$164,000,000.00	10% DHHS administrative and planning costs			
<i>LIHEAP-State Emergency Relief</i>	80,000	39%		\$879.00	150%	Yes
<i>LIHEAP-Home Heating Credit</i>	290,000	39%		\$183.00	110%	No
<i>LIHEAP-Weatherization</i>	500-1,500	7%		15-40% reduction in fuel usage	200%	No
MEAP (2022)	56,047	\$50,000,000.00	\$892.11			
<i>MEAP One-time</i>	17,075	\$15,746,475.68		\$922.19	150%	Yes
<i>MEAP Assurance 16 (LIHEAP)</i>	43,000	\$5,000,000.00	\$116.28	Services provided	150%	No (currently yes)
<i>MEAP APP</i>	30,153	\$24,904,921.71		\$825.95	150%	Yes
RIA	233,000 accounts	Uncapped	unknown	\$8-15 per month equal to the monthly customer charge	150%, Medicaid, SNAP	No
LIA	78,000 accounts	apped based on utility	unknown	\$30-40 per month	150%, Medicaid, SNAP	No
PIPP Pilots		1.5 million CE			150% CE 200% DTE	No
Winter Protection Program		N/A				
Shut-off Protection Program		N/A				
Medical Emergency Shut-off Protection		N/A				
Critical Care Shut-off Protection		N/A				
Winter Senior Protection Program		N/A				
Military Protection Plan		N/A				

LIHEAP Performance Measures

Benefit Targeting Index - Demonstrates whether your state is giving higher benefits to higher burden households.

Burden Reduction Targeting Index - Shows how burden reduction for your high burden households compares to the burden reduction for the average recipient.

Service Restoration - How many clients had service restored by LIHEAP

Service Loss Prevention - Shows the number of clients who would have lost service if not for your intervention with LIHEAP funds.

Authorizing Legislation/Order/More information	Process (Easy - Challenging)	Stated Goal	Meets stated goal/purpose	Cycling Rate	Equity
LIHEAP Statute and Regulations Energy Policy Act of 2005					
	Somewhat easy; barriers include additional eligibility documentation requirements	Provide immediate help to individuals and families facing conditions of extreme hardship or for emergencies that threaten health and safety	For many households, yes, but households are excluded	67-80%	First-come first served
	Somewhat challenging-requires submission of a tax form and issued as an energy draft	A way to help pay some of your heating expenses if you are a qualified Michigan homeowner or renter	Yes	25-58%	Equality
	Referrals are provided to every SER recipient; but capacity to provide wx is limited and deferrals are common	Provides energy conservation and related health & safety services for eligible low-income households	Yes		
PA 615 of 2012 and PA 95 of 2013 and U-17377	Easy; need SER approval	Become or move toward becoming self-sufficient, including assisting participants in paying their energy bills on time, assisting participants in budgeting for and contributing to their ability to provide for energy expenses, and assisting participants in utilizing energy services to optimize on energy efficiency.	Unknown		
	Easy; need SER approval	Self-Sufficiency	Unknown	60-74%	First-come first served
	Easy; need SER approval	Self-Sufficiency	Unknown	Not reported-- not monetary	First-come first served
	Easy; need SER approval	Self-Sufficiency	Crisis cycling rate is not promising	65%-78%	First-come first served
PA 3 Section 460.10t-11 and Orders	Medium. Easy for SER & HHC recipients. Unclear	Provide assistance	Yes	SER and HHC	Equality
PA 3 Section 460.10t-11 and Orders	Challenging. Lack of clarity and transparency. No	Provide more meaningful assistance	Unclear. Is subsidizing MEAP	---	No
PA 3 Section 460.10t-11 and Orders	Challenging. Customers chosen. Can't choose	Affordability option	In Process	Premature	Premature

Centers Impacted communities	Excluded customer groups	Affordability	Dignity	Communication	Environmental Justice
	those outside asset limits, not behind on a bill, complicated co-pay process	No	Yes for online application. No for invasive documentation. Has improved	approval process isn't always well communicated	
	folks who don't file taxes	No	Highest because it's in taxes	Application separate from all other assistance	
	Those with expensive needs or trigger deferrals	Yes	Low because people are in your home and you might get a deferral	Not great in terms of waitlist	
	High usage, high arrears	Somewhat.			
No	Those unaware of program, tho	Does not address	Yes, for self-attestation--	No clear instructions	None
Has potential, but does not (CE) Those who can't qualify for APP or denied SER	Customers receiving the least ar	Does not address Industry ideal	No--can't choose to be or	Likely not great when	None

***Excluded group to consider: those with medical needs

****Incomplete utility data was removed from this sheet in order to not affect calculated percentages. Calculated percentages reflect reality, but totals don't necessarily include all utilities.**

Data Request	Combined				Electric			
	FY18 - C	FY19 - C	FY20 - C	FY21 - C	FY18 - E	FY19 - E	FY20 - E	FY21 - E
Non-Governmental Agency Assistance:	FY18 - C	FY19 - C	FY20 - C	FY21 - C	FY18 - E	FY19 - E	FY20 - E	FY21 - E
Total number of customers who received at least one agency payment (non-APP)	3,618	15,353	27,942	42,211	679	8,979	20,615	26,528
Late payment 1-12 billing months after payment	2,792	13,015	21,357	31,305	537	7,797	15,501	21,689
Late payment 13-24 billing months after payment	1,966	9,690	17,337	15,751	389	5,814	12,526	11,428
Shutoff notice 1-12 billing months after payment	2,490	8,659	15,390	25,118	360	5,050	11,640	17,997
Shutoff notice 13-24 billing months after payment	1,760	6,070	13,330	11,798	274	3,660	9,866	8,455
Affordable Payment Plans (MEAP or non-MEAP; e.g. CARE, LSP, MAP, and/or EASE):					FY18 - E	FY19 - E	FY20 - E	FY21 - E
Total number of customers who received at least one APP payment	45,014	56,136	21,671	20,850	33,917	38,185	13,254	10,269
Total number of APP customers who completed the plan without defaulting for non-payment	33,111	44,438	18,676	16,667	23,696	30,517	11,416	9,354
Total number of APP customers who successfully completed the plan who then sustained service (not been disconnected) for 12 billing months post-APP graduation without receiving any energy assistance	4,545	15,342	#VALUE!	#VALUE!	3,770	10,691	2,738	#VALUE!
Total number of APP customers who successfully completed the plan who then sustained service (not been disconnected) within 13-24 billing months post-APP graduation without receiving any energy assistance	10,634	21,542	#VALUE!	#VALUE!	9,612	16,715	#VALUE!	#VALUE!
Total number of APP customers who successfully completed the plan who then sustained service (not been disconnected) for 12 billing months post-APP graduation with support (e.g. SER, HHC, MEAP, or utility credits)	9,481	12,298	4,785	#VALUE!	8,480	9,648	2,827	#VALUE!
Total number of APP customers who successfully completed the plan who then sustained service (not been disconnected) within 13-24 billing months post-APP graduation with support (e.g. SER, HHC, MEAP, or utility credits)	3,632	5,908	#VALUE!	#VALUE!	2,811	3,546	#VALUE!	#VALUE!
Total number of APP customers who successfully completed the plan but have since been disconnected due to nonpayment	635	1,199	882	71	416	650	549	31
State Emergency Relief:	FY18 - C	FY19 - C	FY20 - C	FY21 - C	FY18 - E	FY19 - E	FY20 - E	FY21 - E
Total number of customers who received an SER payment	2,039	54,167	164,086	145,792	152	30,917	91,462	83,620
Late payment 1-12 billing months after payment	1,659	46,415	120,507	117,500	149	27,293	68,184	68,303
Late payment 13-24 billing months after payment	1,198	34,254	94,193	62,796	144	20,160	52,966	36,412
Shutoff notice 1-12 billing months after payment	1,579	33,031	93,284	98,905	131	19,313	53,700	57,612
Shutoff notice 13-24 billing months after payment	1,154	20,726	75,686	46,564	138	12,293	42,531	26,412
Home Heating Credit (HHC):	FY18 - C	FY19 - C	FY20 - C	FY21 - C	FY18 - E	FY19 - E	FY20 - E	FY21 - E
Total number of customers who received an HHC payment	22,537	126,328	166,322	119,035	530	39,212	34,099	25,405
Late payment 1-12 billing months after payment	12,068	91,933	97,390	69,473	294	31,427	26,697	19,550
Late payment 13-24 billing months after payment	11,212	75,226	91,914	38,919	218	25,425	23,210	10,944
Shutoff notice 1-12 billing months after payment	9,319	37,186	38,176	29,988	231	13,789	10,747	8,379

Shutoff notice 13-24 billing months after payment	8,433	27,154	44,546	16,287	140	10,511	11,323	4,248
RIA/LIA Recipients								
Total number of customers who received the RIA/LIA who were not auto-enrolled for receiving HHC or SER. This includes customers who self-					NOT TRACKED	NOT TRACKED	NOT TRACKED	NOT TRACKED
Energy Waste Reduction:								
Total number of assistance recipients (SER, HHC, or utility credits) who received EWR referrals					NOT TRACKED	NOT TRACKED	NOT TRACKED	NOT TRACKED
Total number of those EWR referrals that resulted in EWR services being performed for that household					NOT TRACKED	NOT TRACKED	NOT TRACKED	NOT TRACKED
In terms of shutoff for residential customers only (including low-income and non-low-income):	FY18 - C	FY19 - C	FY20 - C	FY21 - C	FY18 - E	FY19 - E	FY20 - E	FY21 - E
Total quantity of residential customers	559,003	3,824,229	6,969,563	7,033,108	155,586	1,767,043	3,806,724	3,836,161
Total quantity of customers who were shut off (include double-counted customers if they were shut off more than once)					#VALUE!	111,159	133,339	#VALUE!
The average cost of shutoff (for the utility) per shut off customer (including costs related to late payment, call costs, notices, reconnection costs etc.)					#VALUE!	#VALUE!	#VALUE!	#VALUE!
The average cost of shutoff (for the customer) per shut off customer--including fees related to shut off (deposits, late fees, other reconnection					#VALUE!	#VALUE!	#VALUE!	#VALUE!
Average customer cost relating to shutoff paid by the customer (including any assistance)					#VALUE!	#VALUE!	#VALUE!	#VALUE!
What quantity of residential customers are identified as low-income (150% FPL or less)?	27,111	308,651	555,365	559,719	2,845	136,176	347,258	361,923
Total quantity of unique residential customers who made at least one late payment in the year.	232,893	2,037,961	3,240,751	3,102,603	52,390	970,829	1,862,785	1,795,660
Of those in the above line, how many are identified as low-income (150% FPL or less)?	15,778	199,082	366,548	362,063	2,302	91,475	230,289	236,667
Total quantity of residential bills in the year.	6,377,189	45,733,466	69,796,266	78,261,169	957,769	20,599,673	39,161,762	45,677,584
Total quantity of residential bills in the year that were paid late.	1,048,352	8,080,724	13,471,477	13,530,313	268,968	3,893,703	7,499,951	7,777,598
Of those in the above line, how many are identified as low-income (150% FPL or less)?	81,525	904,673	1,697,477	1,818,415	15,108	430,668	995,872	1,150,793
Total quantity of unique residential customers who received a shutoff notice in the year.	132,711	816,685	1,030,627	1,208,653	20,694	396,558	647,517	788,133
Of those in the above line, how many are identified as low-income (150% FPL or less)?	15,321	119,182	197,594	239,075	1,673	60,011	136,187	173,614
Total quantity of residential bills in the year that led to a shutoff notice.	371,060	2,056,668	2,272,109	3,153,128	83,285	1,040,947	1,436,600	2,114,394
Of those in the above line, how many are identified as low-income (150% FPL or less)?	45,011	301,044	407,386	636,578	8,190	156,158	280,651	466,386
Program Overlap within the same fiscal year:	FY18 - C	FY19 - C	FY20 - C	FY21 - C	FY18 - E	FY19 - E	FY20 - E	FY21 - E
SER + MEAP	618	23,342	30,064	36,648	243	13,417	16,694	20,956
SER + HHC	589	11,264	25,182	15,079	44	5,239	11,195	6,892
SER + MEAP + HHC	152	5,600	5,855	4,597	40	2,660	2,638	2,167

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Natural Gas			
FY18 - NG	FY19 - NG	FY20 - NG	FY21 - NG
FY18 - NG	FY19 - NG	FY20 - NG	FY21 - NG
2,939	6,374	7,327	15,683
2,255	5,218	5,856	9,616
1,577	3,876	4,811	4,323
2,130	3,609	3,750	7,121
1,486	2,410	3,464	3,343
FY18 - NG	FY19 - NG	FY20 - NG	FY21 - NG
11,097	17,951	8,417	10,581
9,415	13,921	7,260	7,313
775	4,651	#VALUE!	#VALUE!
1,022	4,827	#VALUE!	#VALUE!
1,001	2,650	1,958	#VALUE!
821	2,362	#VALUE!	#VALUE!
219	549	333	40
FY18 - NG	FY19 - NG	FY20 - NG	FY21 - NG
1,887	23,250	72,624	62,172
1,510	19,122	52,323	49,197
1,054	14,094	41,227	26,384
1,448	13,718	39,584	41,293
1,016	8,433	33,155	20,152
FY18 - NG	FY19 - NG	FY20 - NG	FY21 - NG
22,007	87,116	132,223	93,630
11,774	60,506	70,693	49,923
10,994	49,801	68,704	27,975
9,088	23,397	27,429	21,609

Crisis Cycling Rate											
Combined				Electric				Natural Gas			
FY18	FY19	FY20	FY21	FY18	FY19	FY20	FY21	FY18	FY19	FY20	
77.17%	84.77%	76.43%	74.16%	79.09%	86.84%	75.19%	81.76%	76.73%	81.86%	79.92%	
54.34%	63.11%	62.05%	37.31%	57.29%	64.75%	60.76%	43.08%	53.66%	60.81%	65.66%	
68.82%	56.40%	55.08%	59.51%	53.02%	56.24%	56.46%	67.84%	72.47%	56.62%	51.18%	
48.65%	39.54%	47.71%	27.95%	40.35%	40.76%	47.86%	31.87%	50.56%	37.81%	47.28%	
COMBINED				Electric				Natural Gas			
FY18	FY19	FY20	FY21	FY18	FY19	FY20	FY21	FY18	FY19	FY20	
73.56%	79.16%	86.18%	79.94%	69.86%	79.92%	86.13%	91.09%	84.84%	77.55%	86.25%	
13.73%	34.52%	#VALUE!	#VALUE!	15.91%	35.03%	23.98%	#VALUE!	8.23%	33.41%	#VALUE!	
32.12%	48.48%	#VALUE!	#VALUE!	40.56%	54.77%	#VALUE!	#VALUE!	10.86%	34.67%	#VALUE!	
28.63%	27.67%	22.08%	#VALUE!	35.79%	31.62%	24.76%	#VALUE!	10.63%	19.04%	26.97%	
10.97%	13.29%	#VALUE!	#VALUE!	11.86%	11.62%	#VALUE!	#VALUE!	8.72%	16.97%	#VALUE!	
1.92%	2.70%	4.72%	0.43%	1.76%	2.13%	4.81%	0.33%	2.33%	3.94%	4.59%	
COMBINED				Electric				Natural Gas			
FY18	FY19	FY20	FY21	FY18	FY19	FY20	FY21	FY18	FY19	FY20	
81.36%	85.69%	73.44%	80.59%	98.03%	88.28%	74.55%	81.68%	80.02%	82.25%	72.05%	
58.75%	63.24%	57.40%	43.07%	94.74%	65.21%	57.91%	43.54%	55.86%	60.62%	56.77%	
77.44%	60.98%	56.85%	67.84%	86.18%	62.47%	58.71%	68.90%	76.74%	59.00%	54.51%	
56.60%	38.26%	46.13%	31.94%	90.79%	39.76%	46.50%	31.59%	53.84%	36.27%	45.65%	
COMBINED				Electric				Natural Gas			
FY18	FY19	FY20	FY21	FY18	FY19	FY20	FY21	FY18	FY19	FY20	
53.55%	72.77%	58.56%	58.36%	55.47%	80.15%	78.29%	76.95%	53.50%	69.45%	53.46%	
49.75%	59.55%	55.26%	32.70%	41.13%	64.84%	68.07%	43.08%	49.96%	57.17%	51.96%	
41.35%	29.44%	22.95%	25.19%	43.58%	35.17%	31.52%	32.98%	41.30%	26.86%	20.74%	

8,293	16,643	33,223	12,039
NOT TRACKED	NOT TRACKED	NOT TRACKED	NOT TRACKED
NOT TRACKED	NOT TRACKED	NOT TRACKED	NOT TRACKED
NOT TRACKED	NOT TRACKED	NOT TRACKED	NOT TRACKED
FY18 - NG	FY19 - NG	FY20 - NG	FY21 - NG
403,417	2,057,186	3,162,839	3,196,947
#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	#VALUE!
#VALUE!	#VALUE!	#VALUE!	#VALUE!
24,266	172,475	208,107	197,796
180,503	1,067,132	1,377,966	1,306,943
13,476	107,607	136,259	125,396
5,419,420	25,133,793	30,634,504	32,583,585
779,384	4,187,021	5,971,526	5,752,715
66,417	474,005	701,605	667,622
112,017	420,127	383,110	420,520
13,648	59,171	61,407	65,461
287,775	1,015,721	835,509	1,038,734
36,821	144,886	126,735	170,192
FY18 - NG	FY19 - NG	FY20 - NG	FY21 - NG
375	9,925	13,370	15,692
545	6,025	13,987	8,187
112	2,940	3,217	2,430

37.42%	21.49%	26.78%	13.68%	26.42%	26.81%	33.21%	16.72%	37.68%	19.10%	25.13%

*narrative responses can be found in the 10/10/22 AAA meeting presentation

% Res customers who are LI:

% Res customers who made late payments:
% of the above customers who are LI:

% of res bills paid late:

% of the above customers who are LI:
% of res customers who received a shutoff notice
% of the above customers who are LI:
% of total res bills that led to a shutoff notice:
% of the above customers who are LI:

COMBINED				Electric				Natural Gas		
FY18	FY19	FY20	FY21	FY 18	FY 19	FY 20	FY 21	FY18	FY19	FY20
5%	8%	8%	8%	2%	8%	9%	9%	6%	8%	7%
42%	53%	46%	44%	34%	55%	49%	47%	45%	52%	44%
7%	10%	11%	12%	4%	9%	12%	13%	7%	10%	10%
16%	18%	19%	17%	28%	19%	19%	17%	14%	17%	19%
8%	11%	13%	13%	6%	11%	13%	15%	9%	11%	12%
24%	21%	15%	17%	13%	22%	17%	21%	28%	20%	12%
12%	15%	19%	20%	8%	15%	21%	22%	12%	14%	16%
6%	4%	3%	4%	9%	5%	4%	5%	5%	4%	3%
12%	15%	18%	20%	10%	15%	20%	22%	--	14%	15%

Combined				Electric				Natural Gas		
FY18	FY19	FY20	FY21	FY18	FY19	FY20	FY21	FY18	FY19	FY20
24,482	170,450	306,734	250,642	1,133	66,109	115,874	103,027	23,349	104,341	190,860
3%	14%	10%	15%	21%	20%	14%	20%	2%	10%	7%
2%	7%	8%	6%	4%	8%	10%	7%	2%	6%	7%
1%	3%	2%	2%	4%	4%	2%	2%	0%	3%	2%

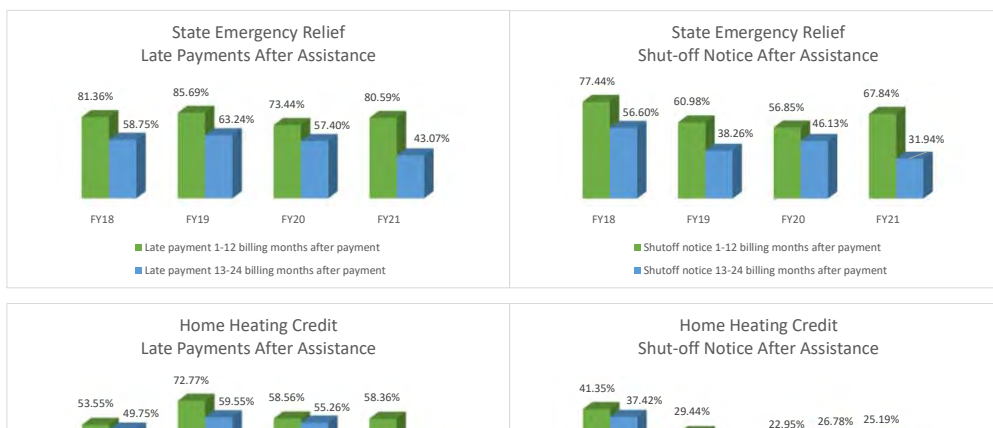
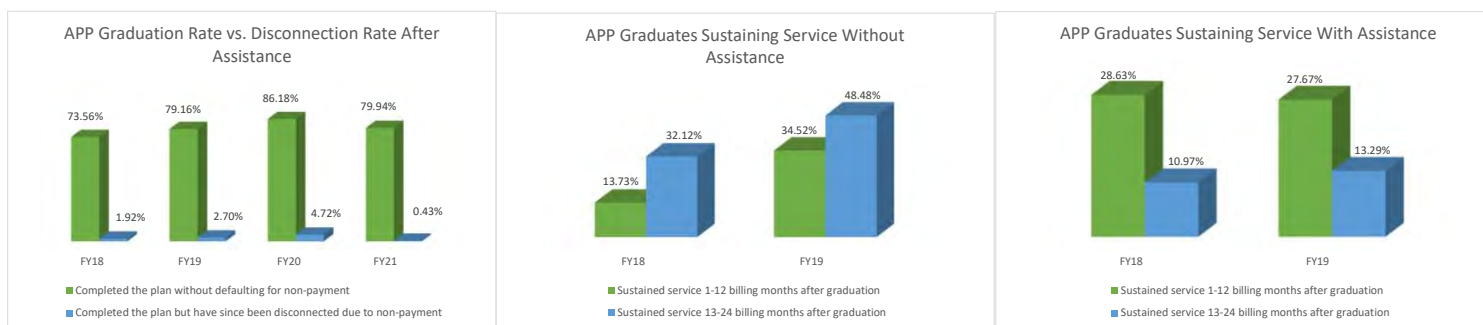
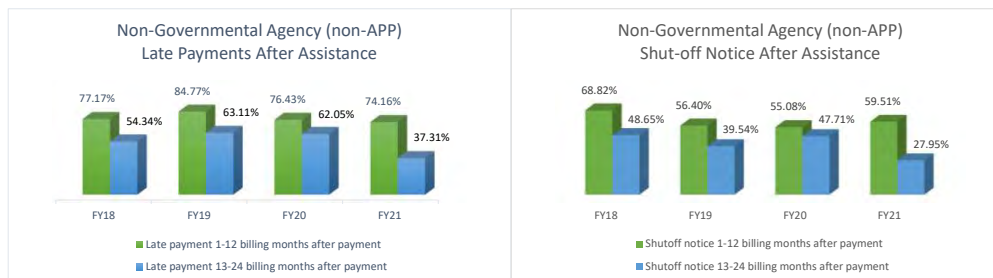
Unique SER+HHC recipients

of SER+HHC, % received SER+MEAP

of SER+HHC, % received SER+HHC
of SER+HHC, % received SER, MEAP, HHC



FY21
61.31%
27.56%
45.41%
21.32%
FY21
69.11%
#VALUE!
#VALUE!
#VALUE!
#VALUE!
0.55%
FY21
79.13%
42.44%
66.42%
32.41%
FY21
53.32%
29.88%
23.08%

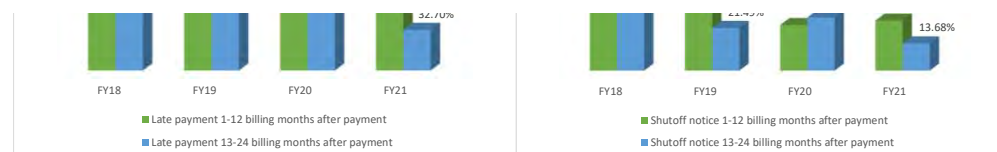


Home Heating Credit Late Payments After Assistance

Fiscal Year	Late payment 1-12 billing months after payment	Late payment 13-24 billing months after payment
FY18	53.55%	49.75%
FY19	72.77%	59.55%
FY20	58.56%	55.26%
FY21	58.36%	27.70%

Home Heating Credit Shut-off Notice After Assistance

Fiscal Year	Shutoff notice 1-12 billing months after payment	Shutoff notice 13-24 billing months after payment
FY18	41.35%	37.42%
FY19	29.44%	21.49%
FY20	22.95%	26.78%
FY21	25.19%	25.19%



FY21
6%
41%
10%
18%
12%
13%
16%
3%
16%

FY21	
147,615	
11%	
6%	
2%	

Data Request	Electric			
	Oct. 1, 2017- Sept 30, 2018	Oct. 1, 2018- Sept 30, 2019	Oct. 1, 2019- Sept 30, 2020	Oct. 1, 2020- Sept 30, 2021
State Emergency Relief (Energy-related, non-furnace)				
Total number of energy-based SER applications including denials				
Total number of unique energy-based SER cases				
Total number of energy-based State Emergency Relief cases	can get on trend report for fy20-22			
Total number of SER recipients who sought SER assistance in two consecutive fiscal years				
List of top 10 denial codes with the number of associated denied applications for each denial code				
Home Heating Credit				
Total number of households receiving the Home Heating Credit				
Total number of households who received HHC but not SER				
Total number of households who received an SER payment and an HHC payment				
Total number of households receiving any type of LIHEAP Assistance				
MI Bridges (for SER customers)				
Total number of households selecting referral for energy waste reduction/weatherization services				
Total number of households selecting referral for self-sufficiency services				
MEAP				
APPS--default and come back for SER following year	Don't know how we would collect this			
What do customers think of assistance after receiving it?/Are there glaring areas for improvement?				
MEAP EWR Referrals vs. EWR service performed--whatever data you have on this				
customers who received HHC, SER, and MEAP (if this data exists)				
customers who received SER but not MEAP				

[illegible]

[illegible]



SER Data for June 2022

	June 2020	June 2021	June 2022	Average
# of SER Applications Received	10,670	13,897	31,065	18,544
# of Approved Applications	6,613	6,506	19,2096	10,805
Approval Rate	62.80%	47.76%	62.97%	57.84%

1



SER Data for July 2022 MEAP Workgroup

	October-June FY 20	October-June FY 21	October-June FY 22	Average
# of SER Applications Received	185,973	179,377	261,638	190,452
# of Approved Applications	105,251	102,836	165,317	113,663
Approval Rate	57.16%	56.02%	63.47%	58.88%

2

Affordability, Alignment and Assistance Subcommittee Kick-Off

Tanya Paslawski (5 Lakes Energy) tanya@5lakesenergy.com

Amy Bandyk (CUB Michigan) amy.bandyk@cubofmichigan.org

Jamie Curtis (MPSC—MEAP administrator) CurtisJ14@michigan.gov

Elaina Braunschweig (MPSC—Rates and Tariff) Braunschweige@michigan.gov



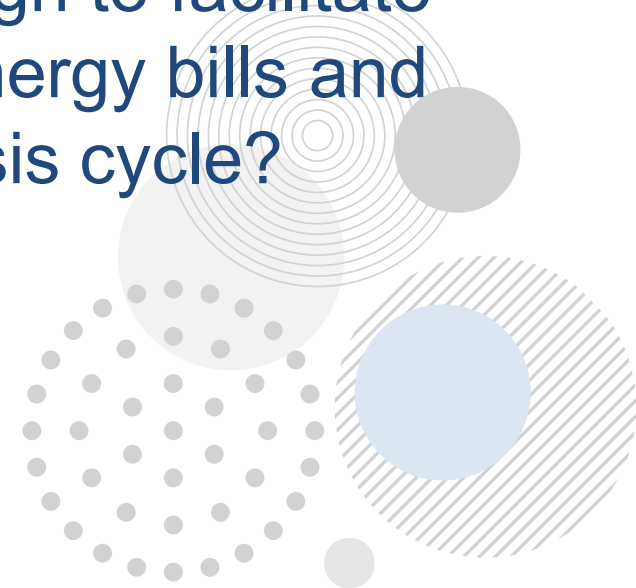
Meeting Overview

- Introductions
- Guiding question and subcommittee charge
- 2021 Timeline and logistics
- Suggested research topics and outputs
- Next steps and group goals
- Assign tasks and review next steps
- Questions and suggestions for other resources (*parking lot*)



Guiding question

What is the best system/program design to facilitate customers' sustainably paying their energy bills and avoiding the crisis-assistance-crisis cycle?

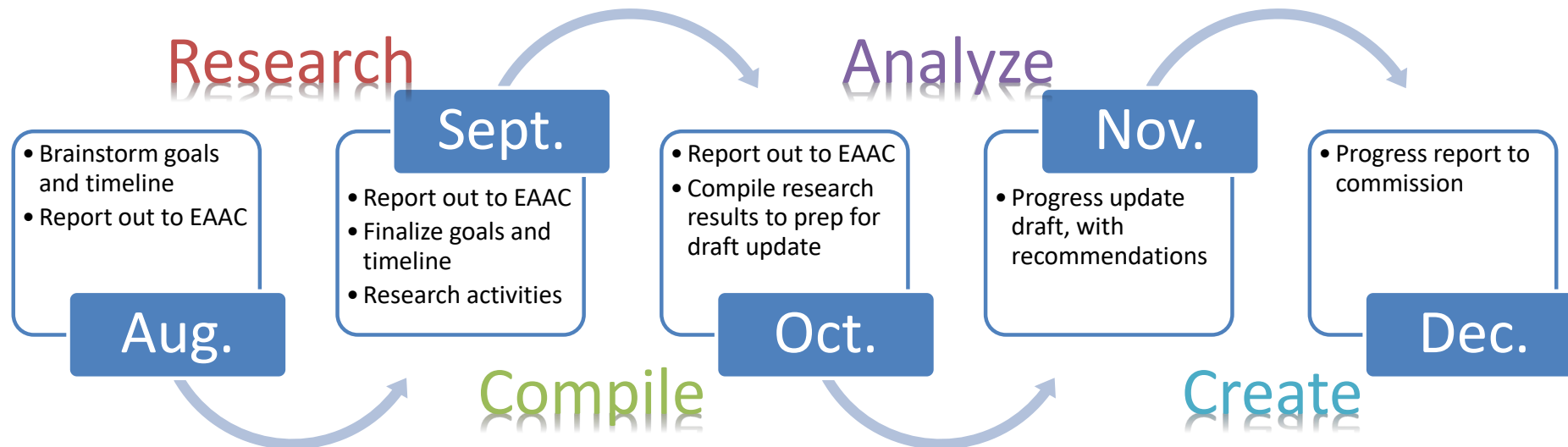


Subcommittee Charge

- *Streamlining and making more accessible* existing energy assistance programs
 - Improving upon existing energy assistance plans
- *Researching* next generation affordable payment plans
- *Analyzing* collections processes and disconnections
- *Integrating* with EWR, weatherization, and rate design



Projected 2021 Timeline



Beyond 2021

December 2022: Submit updated report with recommendations

2023: Continue collaborative as necessary and finalize work

Logistics

- File-sharing medium
- Best form of communication between meetings
- Delegating/check-ins
- Frequency and date/time of meetings
 - Does the 2nd Thursday of the month work well?



Suggested Research Topics

- Research

- Affordable Payment Plans (APPs)

- Work with MEAP Workgroup to understand MEAP APPs, including APP designs, metrics and the move toward energy security
 - Update on MEAP APP pilots (propane and below 20% FPL)
 - Update on 1st cohort of 2-year MEAP APP 'graduates'
 - Streamlining program design
 - Additional options

- Percentage of Income Payment Plan (PIPP)

- Other states' experiences
 - National research
 - Options for financing, including through the rate setting process such as with the Low-Income Assistance Credit

- Eligibility criteria, funding and application processes

- Energy assistance, low-income EWR programs and energy protections
 - Implications of expanding energy assistance/protections eligibility to 200% FPL

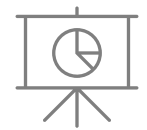
- Accessibility

- Collections processes and disconnections



Suggested Outputs

- Develop
 - Best practices for payment plan pilots (APP and/or PIPP)
 - Recommendations for:
 - Types of assistance plans for different customer groups (e.g. low-fixed income)
 - Streamlining the application process across funding streams (including EWR and energy protections)
 - Tying low-income EWR programs to energy assistance and customer protections



Next Steps and Group Goals



Assign tasks and review next steps

Task	Name	Timeframe

Suggestions/more info/resources on...



Affordability, Alignment, and Assistance Subcommittee

Elaina Braunschweig (MPSC—Rates and Tariff) Braunschweige@michigan.gov

Jamie Curtis (MPSC—MEAP administrator) CurtisJ14@michigan.gov

Agenda

1.

**Goals
Progress
And
Timeline
Review**

2.

**Progress Survey
Results**

3.

Discussion

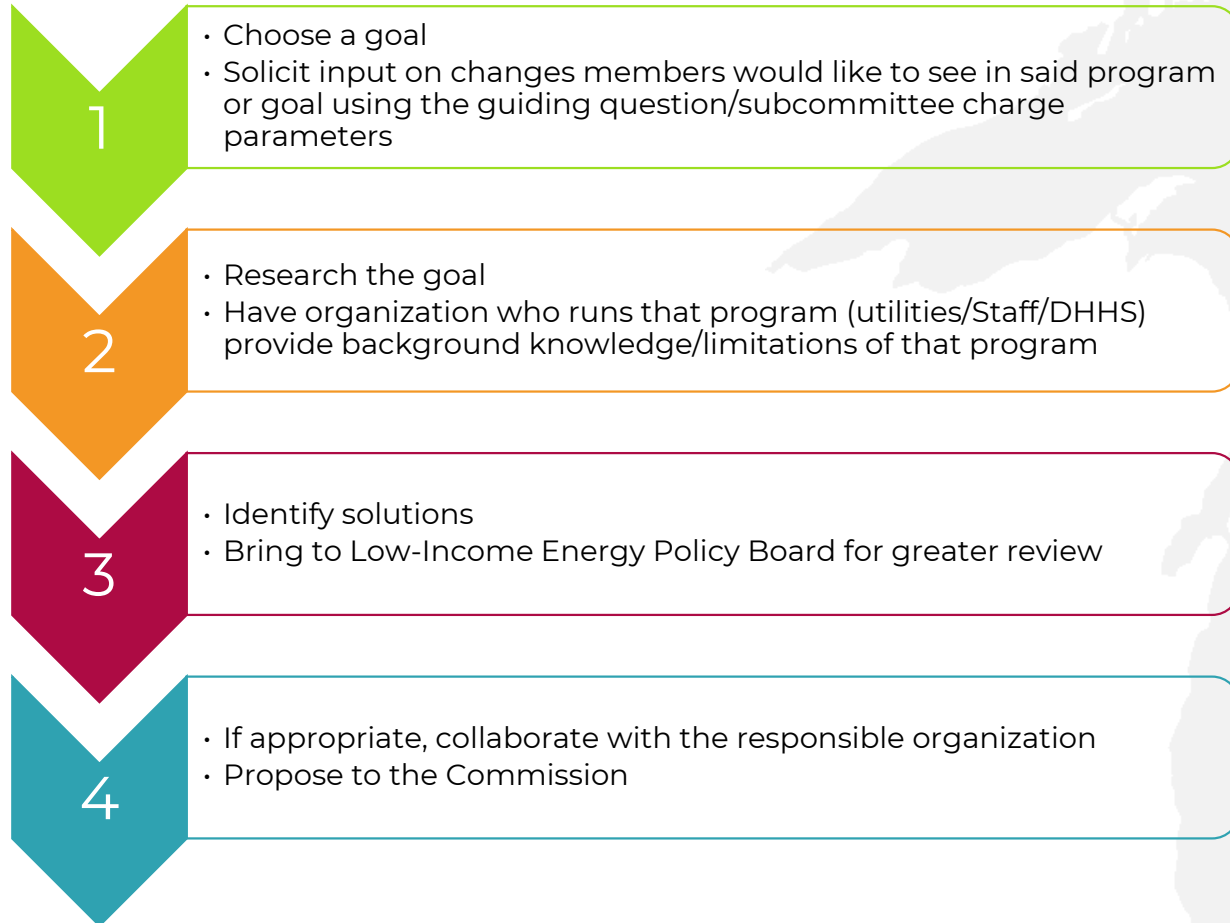
4.

**Next Steps
And Updates**

Potential topics for 2023

- ☐ Wrap up streamlining current assistance
- ☐ Why rates increase—special session with broader group?
- ☐ Topics sent to the EAAC from Commission Orders
- ☐ Reduce crisis cycling

Goals Structure



Progress

Goal: customer journey

- 20757 report coming Q1 2023
- Finalizing work Q1 2023

Goal: Do our assistance programs work?

- Data collected
- Recommendations sent to policy board
- improve system coming 2023?

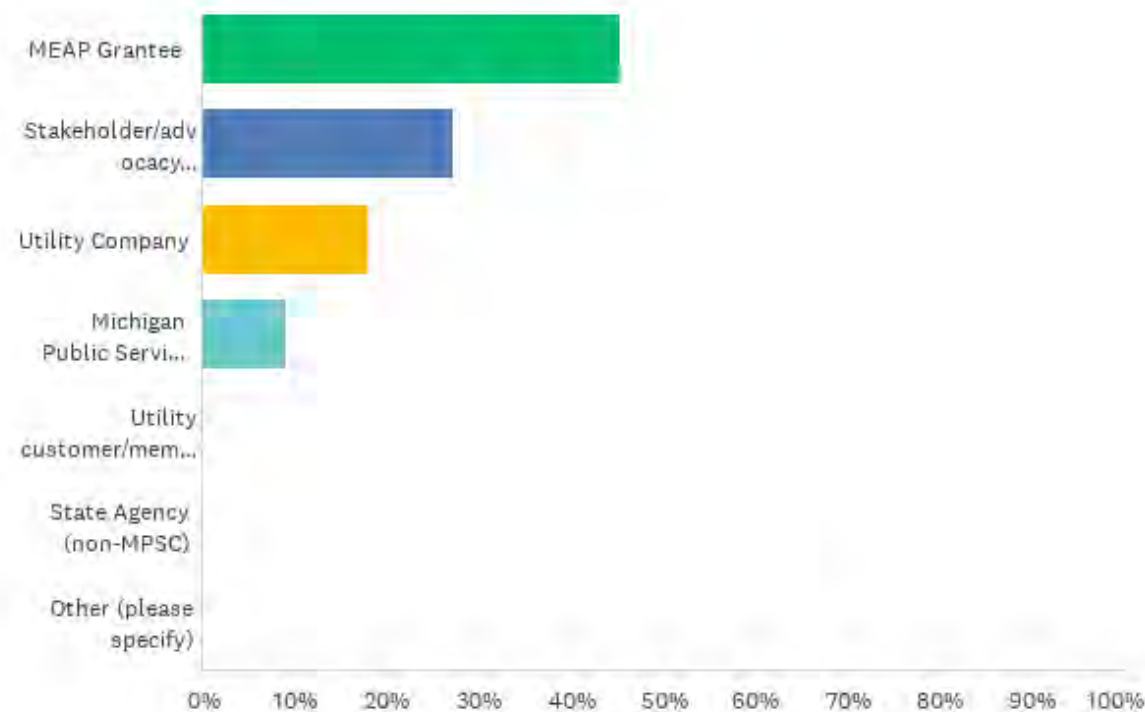
Progress Survey Results

If you participated in the Low-Income Energy Policy Board Summit, did your experience there affect how you would respond to the progress survey?



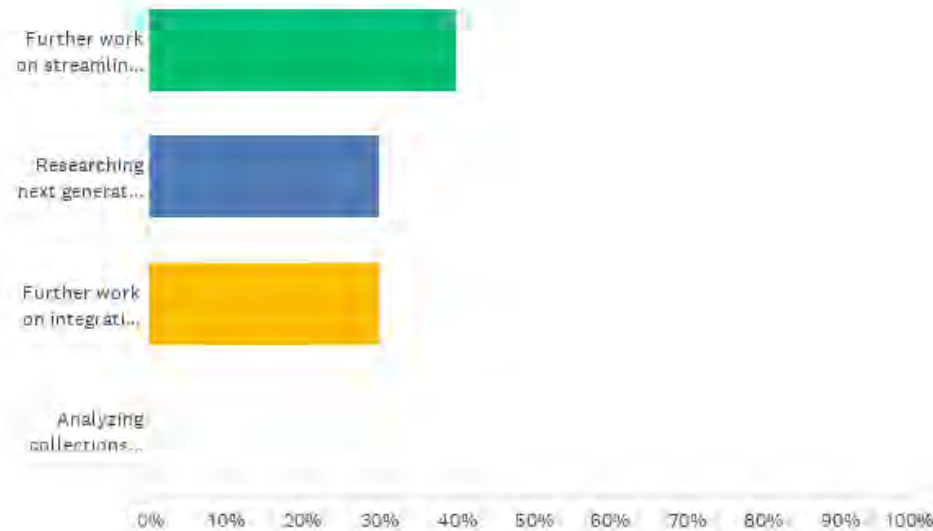
Survey Results: Question 1

Q1 What affiliation best describes your representation in this subcommittee?



Survey Results: Question 2

Q2 Select one of the following topic areas in the AAA subcommittee charge that the AAA should focus on in the coming year*: *Note this list includes items the subcommittee has already addressed: EWR integration recommendations and streamlining/improving accessibility of existing energy assistance programs, but please select if you feel the work is incomplete and provide additional context in the following question.



Survey Results: Question 3

Q3 What specifically about that focus area would you like to see improvement on ?

Answered: 8 Skipped: 3

#	RESPONSES	DATE
1	Connecting households with the available funding more easily	11/1/2022 12:20 PM
2	SER is still challenging and confusing to many who need to access it.	10/24/2022 4:01 PM
3	No comments at this time.	10/24/2022 10:50 AM
4	1. monitoring and tracking EWR/weatherization status of households receiving energy assistance; 2. increasing funding and provision of EWR/weatherization services to households receiving energy assistance	10/13/2022 10:03 PM
5	Affordability is key to most households and those who struggle typically are not just going through a hard time, rather the rates are just unaffordable and will remain that way for multiple years for that customer.	10/13/2022 3:42 PM
6	Collaboration between MEAP Grantees and utility companies with energy waste reduction services.	10/13/2022 2:38 PM
7	Customer's ability to be approved for SER when in need, but not currently past due. We force customers that do need help to create an emergency to get SER and into MEAP.	10/10/2022 4:24 PM
8	Affordability for all. Energy usage measuring (in-home/per plug). decrease tariffs required by utility, or consider these 'charges' as a whole. rate securities, lock in plans (like propane has).	10/10/2022 1:45 PM

Survey Results: Question 4

Q4 What presenters/education would you like to see to understand complexities of energy affordability (or other topics you're interested in)?

Answered: 5 Skipped: 6

#	RESPONSES	DATE
1	A presentation from EWR providers and some type of document we can use to steer households in the right way	11/1/2022 12:20 PM
2	1. Customer(s) explaining their energy affordability journey 2. Participants defining their ideal energy assistance programs 3. Someone from Civilla could present to the AAA subcommittee (and the Outreach & Education subcommittee) about the Project Cohere pilot.	10/24/2022 10:50 AM
3	1. Utilities to present on how they are increasing efforts to get EWR/weatherization services to households receiving energy assistance; 2. State government representative to present how they are taking advantage of federal funding opportunities for home energy efficiency and weatherization services (e.g., from the IRA and the Infrastructure legislation)	10/13/2022 10:03 PM
4	What other state's utilities are doing to manage the affordability. Bringing in those experts and comparing them to what our utilities are doing would be helpful.	10/13/2022 3:42 PM
5	Why is electric so expensive? How do the investors make money/how much? What is the elimination of coal going to do to the natural gas rate?	10/10/2022 1:45 PM

Survey Results: Question 5

Q5 Is there additional data you believe we need to analyze energy affordability? Are there important questions related to this committee's charge that could be answered through data analysis? If so, what are those questions?

Answered: 6 Skipped: 5

#	RESPONSES	DATE
1	Defining affordable energy is a tough one. There are so many factors that are part of this.	11/1/2022 12:21 PM
2	Not at this time.	10/24/2022 10:50 AM
3	Collect data on whether and to what extent households receiving energy assistance are (a)being referred to, and (b) actually receiving EWR and weatherization services.	10/13/2022 10:06 PM
4	Which customers are getting on affordable payment plans and keeping up with those programs. Are those customers getting EWR services? Are the ones that are receiving EWR having an easier time keeping up with the payment plans?	10/13/2022 3:49 PM
5	If the programs in place are not working for low income-maybe offer them to middle class. These individuals are more likely to need just a little help to get back on their feet. The data appears to suggest low income need a different type of support. Let's make energy affordable- and keep that rate.	10/10/2022 1:50 PM
6	I think there is already a lot of data and sometimes it is overwhelming to try to process all at once.	10/10/2022 1:43 PM

Survey Results: Question 6

Q6 Share any thoughts, questions, or comments on the data that has been collected and shared so far:

Answered: 3 Skipped: 8

#	RESPONSES	DATE
1	Presentations have been very thorough. The survey result presentations are vey helpful.	10/13/2022 3:49 PM
2	it seems to focus mostly on low income and EWR. I don't believe these topics are granular and feel bigger data would show a different picture. Data showing energy users compared to energy users would show who our audience more dynamically. Then programs could be developed for each layer based on energy use.	10/10/2022 1:50 PM
3	I agree seeing it in a graph would be helpful.	10/10/2022 1:43 PM

Survey Results: Question 7

Q7 Other Provide any feedback any comments or feedback on the subcommittee's work so far:

Answered: 4 Skipped: 7

#	RESPONSES	DATE
1	I think this is a big undertaking. It seems like the attendance has dwindled at the meetings more recently. Maybe send out an invite to improve participation and attendance. This may bring some fresh ideas to the table.	11/1/2022 12:22 PM
2	I appreciate that this effort is being made.	10/13/2022 10:06 PM
3	Great job thus far!	10/13/2022 3:49 PM
4	Thank you for your expertise and willingness to ask for feedback.	10/10/2022 1:50 PM

AAA Commission Charge

- ❑ Look at all aspects of energy affordability including:
 - **streamlining** and making more **accessible** existing energy assistance programs
 - ❑ 2021-2022
 - researching next generation **affordable payment plans**
 - ❑ Tentatively 2023
 - analyzing **collections** processes
 - ❑ Potentially 2023
 - integration with **EWR** and weatherization, and rate design
 - ❑ EWR 2022

Moving Forward

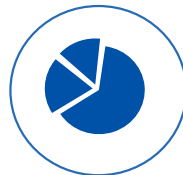
- ❑ Staff has requested an extension for the 20757 2022 report
 - To incorporate results from the summit & follow-up
- ❑ Recommendations to the Commission will be based on discussions at the LIEPB September meeting and Summit
- ❑ Awaiting Commission direction to see which ideas/goals will affect the AAA work going forward

Next Steps



Next Meeting:

Determined based on today's meeting feedback



Data:

Crisis cycling data is complete and will be uploaded on the [website](#) in the data and goals tracker. Feel free to choose different graphs to best view it



Goals:

Goalsetting for 2023



Leadership:

Working on education around why rates increase

Affordability, Alignment and Assistance Subcommittee

Tanya Paslawski (5 Lakes Energy) tanya@5lakesenergy.com

Amy Bandyk (CUB Michigan) amy.bandyk@cubofmichigan.org

Jamie Curtis (MPSC—MEAP administrator) CurtisJ14@michigan.gov

Elaina Braunschweig (MPSC—Rates and Tariff) Braunschweig@michigan.gov



Michigan Public Service Commission

Meeting Overview

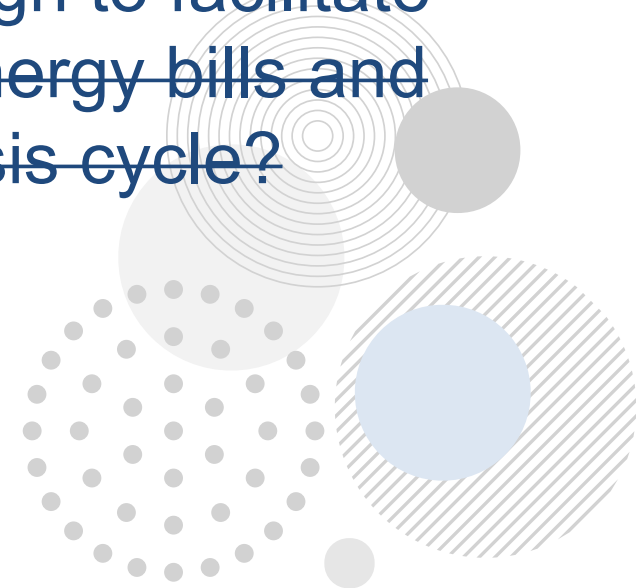
- Guiding question and subcommittee charge
- Meeting structure/roadmap
- Survey results
- Addressing concerns
- Finalize goals
- Assign tasks/research topics

*Slides and materials will be shared by email after the meeting



Guiding Question

~~What is the best system/program design to facilitate customers' sustainably paying their energy bills and avoiding the crisis-assistance-crisis cycle?~~



Guiding Statement

End the crisis-assistance-crisis cycle by centering energy *affordability* and facilitating customers sustainably affording their energy bills by providing all households with uninterrupted *access to affordable, sufficient* energy in an *efficient, healthy, and sustainable* manner.

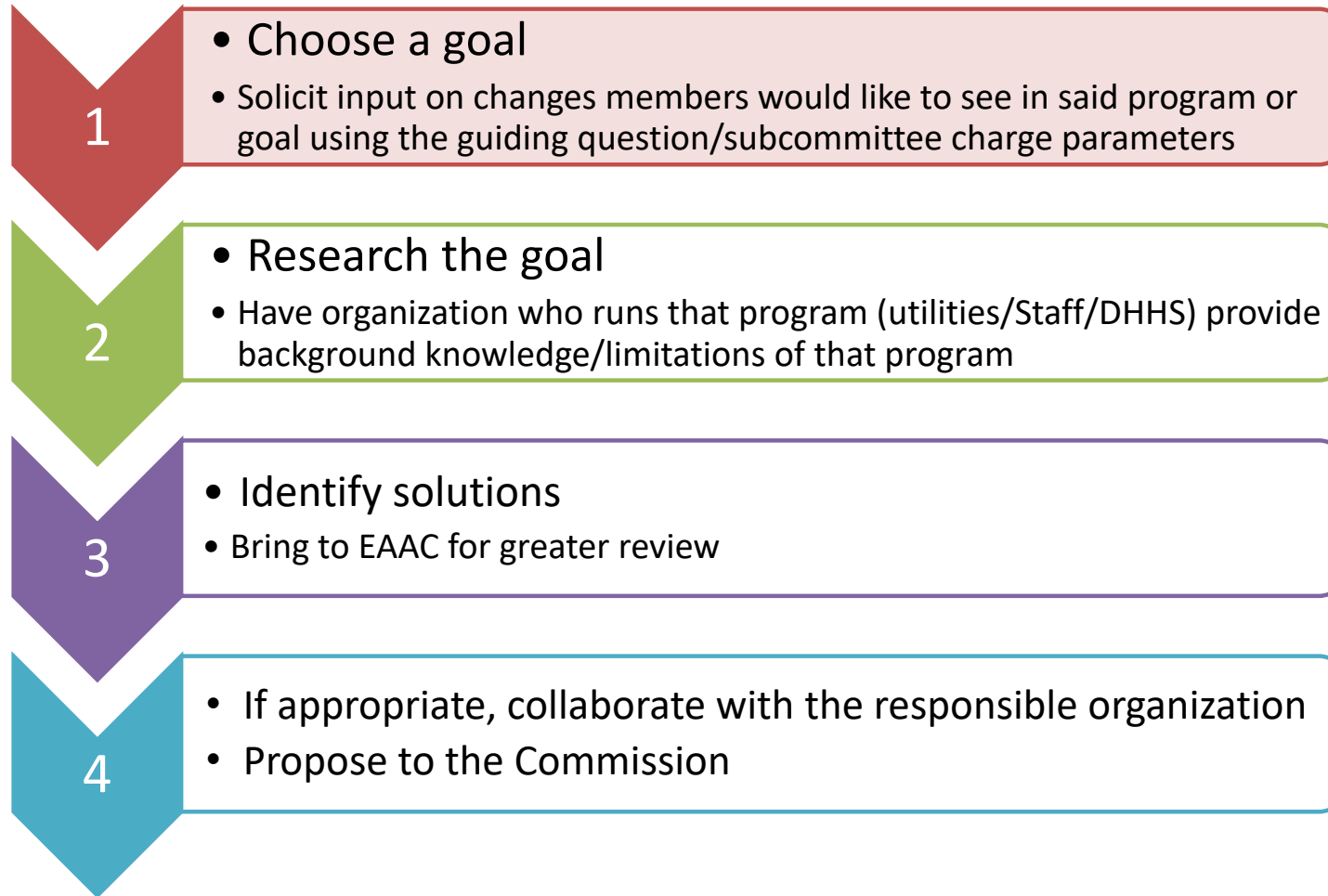


New Guiding Principles

- *This ideal system/program design should achieve this while also:*
 - **Ensuring equitable distribution** in the access to, use of, and outcomes from energy affordability and assistance policies/programs
 - **Centering impacted community priorities** and participation in policy/program development, accountability, and assessment
 - **Treating customers with dignity**, enabling them to live comfortably, and not penalizing customers for an inability to pay their bills
 - **Coordinating and communicating clearly** with relevant state agencies to integrate state policy goals, including those related to healthy homes and climate change



Logistics: Meeting Structure

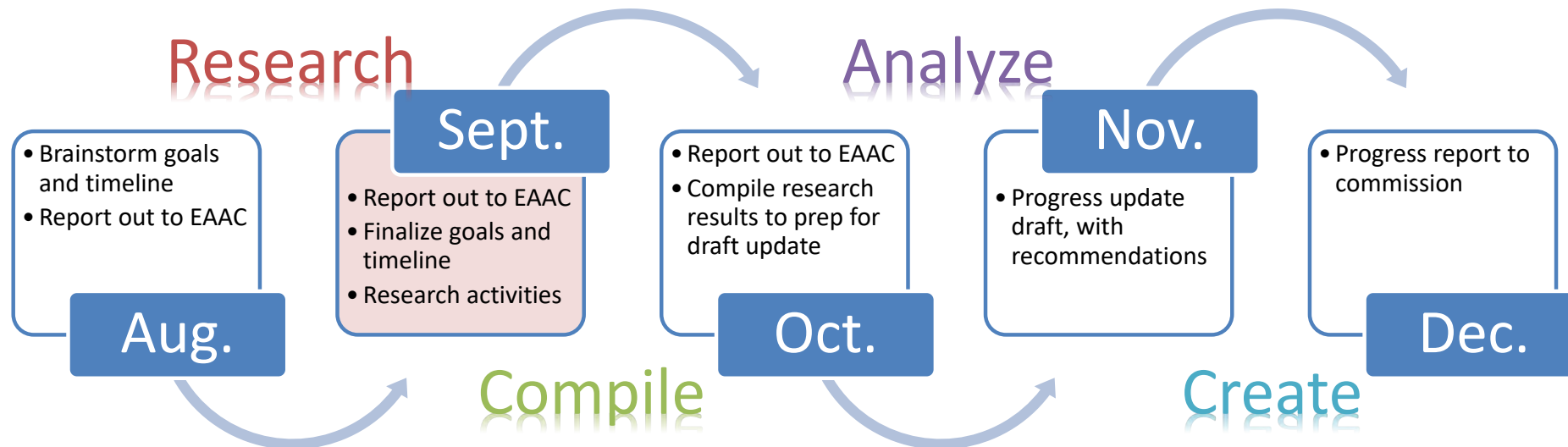


Logistics

- File-sharing medium
 - Website https://www.michigan.gov/mpsc/0,9535,7-395-93307_93312_93320-566302--,00.html
- Delegating/Communication
 - Research/project groups organized by leadership
- Frequency and date/time of meetings
 - After each meeting we will send out a follow-up email with current projects



Projected 2021 Timeline



Beyond 2021

December 2022: Submit updated report with recommendations

2023: Continue collaborative as necessary and finalize work

Survey Results: Priority List

Rank the following areas of focus for prioritization in the December report:

Answered: 28 Skipped: 0



Survey Results: Priority List

What specifically do you want to see changed?

- Eligibility process for low-income programs
 - Delve into ideas from last meeting. E.g.:
 - Automation of the process
 - Look at Cohere pilot
 - Automatic enrollment by the utility company (utility collect data and enroll those who are eligible)
 - Proactively identify customers who are falling behind before it gets to the point of emergency
 - Standardize eligibility so that programs interact with each other
 - Standardize a screening tool and application process
 - Align state and federal program requirements
 - More flexible and understandable
 - Shared databases for identification of LI households
 - Create a secure portal for customers to upload documentation
 - Look at ongoing assistance that doesn't require yearly eligibility verification
 - Increased coordination when a customer qualifies for one program, including energy waste reduction upgrades
 - Review customer journey maps
 - Provide flexibility in eligibility
 - Take into account certain expenses (other bills, debt), medical issues/equipment



Goals from last meeting → Project List

Accessibility

(Mostly addressed through outreach group and guiding principles i.e. equity)

- Customer journey

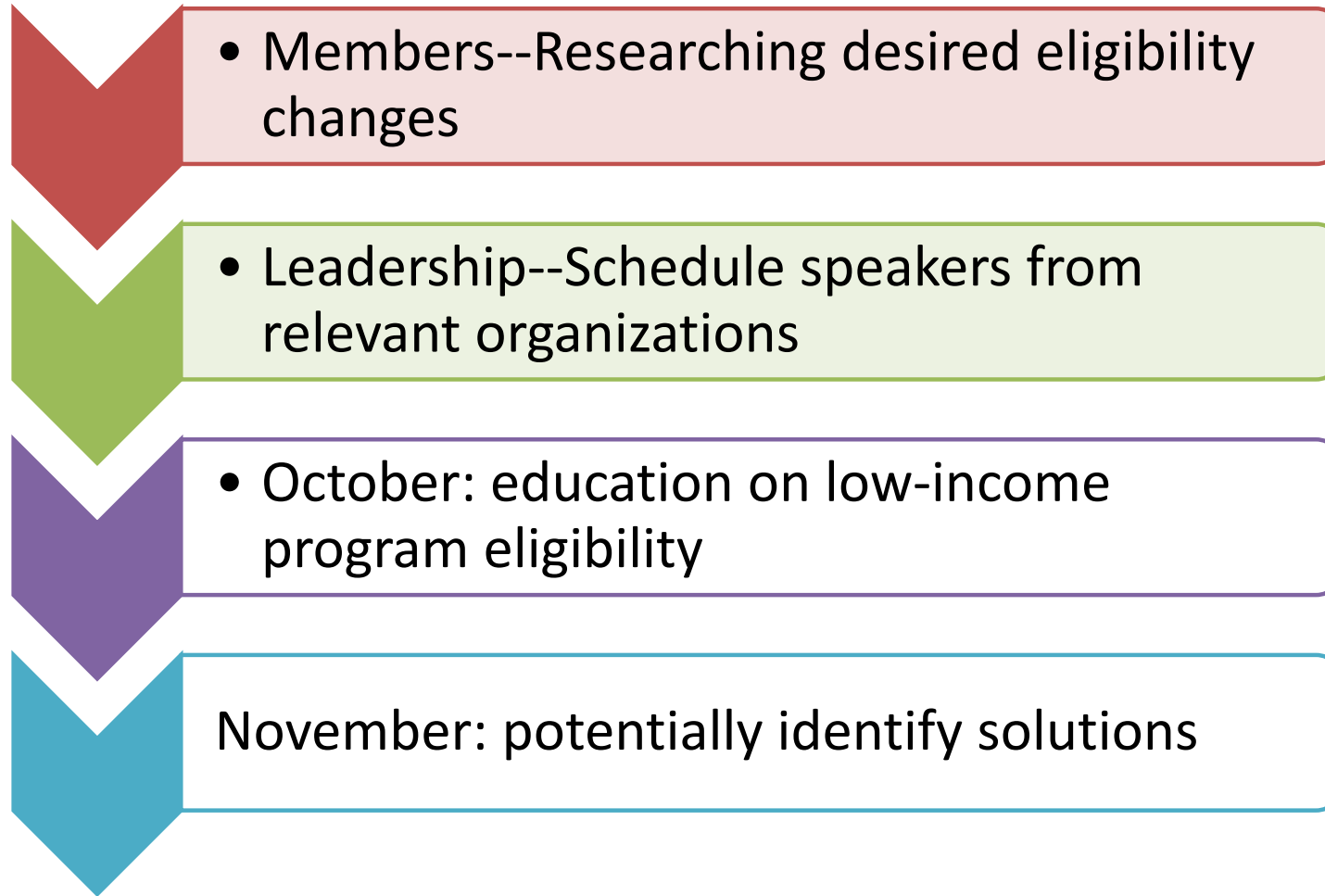
Eligibility

- How verification and collection (works with accessibility)
- Not having to be in crisis to get assistance
 - Avoid policies and program designs that include punitive measures that penalize customers for their inability to pay
- Simplify/expedite process
- Streamline design
- Make more flexible and understandable
- Should be as AUTOMATIC as possible
- Implications of expanding eligibility to 200% FPL
- Critical care---**came out in survey. Please contact leadership or extrapolate in the Google doc about your concerns**

Affordability

- Arrearage management (payment plans, late fees, debt forgiveness)
- Work with MEAP workgroup
 - Update APP pilots
- Financing options for PIPPs and credits
- Can EWR programs be tied to property values?
- Renewable generation and efficient resource opportunities

Next Steps



Assign Research

Task	Name	Timeframe
Research other states' programs (NEUAC)	Tom Page, Anne Armstrong	
Customer journey mapping (utility)	Maria Christian	
Customer journey mapping (human services org)	Wende Randall, Niki Fanjoy, Heather Kapustka	
Customer journey mapping (2-1-1)		

Monthly Totals Summary

Public Utility Name	Service Type	Year of Reporting Period	Month of Reporting Period	Customer Type	(1) Customer Count	(2) Customers Receiving Disconnect Notice	(3) Customers Disconnected for Non-Payment	(4) Customers Reconnected (Fully Paid or w/ DPA)	(5) New DPA Count
Ameren IL	Electric	2024	March	Non-Residential	186,687	3,316	665	563	76
				Residential	1,063,041	24,637	0	281	27,624
				Total:	1,249,728	27,953	665	844	27,700
	Gas	2024	March	Non-Residential	68,426	2,166	361	287	55
				Residential	744,812	17,336	0	170	19,526
				Total:	813,238	19,502	361	457	19,581
Aqua IL	Sewer	2024	March	Non-Residential	2,477	87	4	2	23
				Residential	31,028	1,275	223	120	601
				Total:	33,505	1,362	227	122	624
	Water	2024	March	Non-Residential	5,339	210	8	1	23
				Residential	59,386	2,907	361	289	1,052
				Total:	64,725	3,117	369	290	1,075
ComEd	Electric	2024	March	Non-Residential	369,132	0	0	0	1
				Residential	3,706,345	0	0	0	6,577
				Total:	4,075,477	0	0	0	6,578
Consumers Gas	Gas	2024	March	Non-Residential	627	0	1	0	0
				Residential	4,605	457	9	5	2
				Total:	5,232	457	10	5	2
IL American Water	Sewer	2024	March	Non-Residential	4,894	160	9	6	3
				Residential	78,747	3,079	279	215	515
				Total:	83,641	3,239	288	221	518
	Water	2024	March	Non-Residential	21,096	473	31	20	8
				Residential	273,460	7,055	1,005	744	1,593
				Total:	294,556	7,528	1,036	764	1,601
IL Gas	Gas	2024	March	Non-Residential	6,397	32	0	0	0
				Residential	8,122	400	33	19	0
				Total:	14,519	432	33	19	0
Liberty Utilities	Gas	2024	March	Non-Residential	2,002	0	0	1	1
				Residential	19,250	0	0	32	87
				Total:	21,252	0	0	33	88
MidAmerican Energy	Electric	2024	March	Non-Residential	10,869	192	8	9	14
				Residential	73,240	3,168	121	68	1,061
				Total:	84,109	3,360	129	77	1,075
	Gas	2024	March	Non-Residential	5,306	172	1	0	13
				Residential	60,338	2,826	8	4	947
				Total:	65,644	2,998	9	4	960
Mt. Carmel Public Utility	Electric	2024	March	Non-Residential	904	95	0	1	0
				Residential	4,372	594	18	8	45
				Total:	5,276	689	18	9	45
	Gas	2024	March	Non-Residential	367	36	0	0	0
				Residential	3,039	450	7	4	32
				Total:	3,406	486	7	4	32
Nicor Gas	Gas	2024	March	Non-Residential	195,420	3,574	570	356	441
				Residential	2,085,091	25,401	0	155	17,727
				Total:	2,280,511	28,975	570	511	18,168
North Shore Gas	Gas	2024	March	Non-Residential	13,538	324	19	13	31
				Residential	151,731	161	0	3	973
				Total:	165,269	485	19	16	1,004
Peoples Gas	Gas	2024	March	Non-Residential	73,620	3,116	54	44	296
				Residential	822,490	11,421	0	61	13,373
				Total:	896,110	14,537	54	105	13,669

Monthly Totals Summary

Public Utility Name	Service Type	Year of Reporting Period	Month of Reporting Period	Customer Type	(6) Customers Under Existing DPA (1st of month)	(7) Customers Completing DPA	(8) Failed Pay Agreements Count	(9) Customers Renegotiating DPA	(10) Customers w/ Late Payment Fee/Charges
Ameren IL	Electric	2024	March	Non-Residential	81	3	49	0	20,064
				Residential	49,662	1,270	17,108	229	121,524
				Total:	49,743	1,273	17,157	229	141,588
	Gas	2024	March	Non-Residential	57	2	29	0	8,574
				Residential	34,457	890	11,777	162	84,346
				Total:	34,514	892	11,806	162	92,920
Aqua IL	Sewer	2024	March	Non-Residential	17	6	10	0	651
				Residential	1,318	78	528	0	13,942
				Total:	1,335	84	538	0	14,593
	Water	2024	March	Non-Residential	29	13	23	0	1,092
				Residential	2,101	140	908	0	20,651
				Total:	2,130	153	931	0	21,743
ComEd	Electric	2024	March	Non-Residential	2	0	0	0	0
				Residential	93,519	80	3	518	1
				Total:	93,521	80	3	518	1
Consumers Gas	Gas	2024	March	Non-Residential	0	0	0	0	53
				Residential	15	1	1	0	713
				Total:	15	1	1	0	766
IL American Water	Sewer	2024	March	Non-Residential	13	2	1	1	577
				Residential	2,548	283	51	202	11,749
				Total:	2,561	285	52	203	12,326
	Water	2024	March	Non-Residential	25	3	1	2	2,424
				Residential	8,100	868	193	598	46,830
				Total:	8,125	871	194	600	49,254
IL Gas	Gas	2024	March	Non-Residential	0	0	0	0	0
				Residential	0	0	0	0	0
				Total:	0	0	0	0	0
Liberty Utilities	Gas	2024	March	Non-Residential	4	0	1	0	0
				Residential	618	5	5	5	0
				Total:	622	5	6	5	0
MidAmerican Energy	Electric	2024	March	Non-Residential	25	4	14	0	469
				Residential	2,054	120	843	6	4,156
				Total:	2,079	124	857	6	4,625
	Gas	2024	March	Non-Residential	20	4	11	0	257
				Residential	1,852	108	753	6	3,226
				Total:	1,872	112	764	6	3,483
Mt. Carmel Public Utility	Electric	2024	March	Non-Residential	0	0	0	0	95
				Residential	59	14	30	0	585
				Total:	59	14	30	0	680
	Gas	2024	March	Non-Residential	0	0	0	0	36
				Residential	40	11	23	0	451
				Total:	40	11	23	0	487
Nicor Gas	Gas	2024	March	Non-Residential	568	17	332	0	30,462
				Residential	27,094	62	10,133	0	394,981
				Total:	27,662	79	10,465	0	425,443
North Shore Gas	Gas	2024	March	Non-Residential	29	1	20	1	2,122
				Residential	2,331	62	483	7	21,819
				Total:	2,360	63	503	8	23,941
Peoples Gas	Gas	2024	March	Non-Residential	594	27	203	3	16,504
				Residential	30,798	732	7,321	122	216,097
				Total:	31,392	759	7,524	125	232,601

Monthly Totals Summary

Public Utility Name	Service Type	Year of Reporting Period	Month of Reporting Period	Customer Type	(11) Customers Under Existing MPA (1st of month)	(12) Customers Completing MPA	(13) Customers Enrolling in New MPA	(14) Customers Renegotiating MPA	(15) Customers w/ Required Deposit
Ameren IL	Electric	2024	March	Non-Residential	0	0	0	0	12,249
				Residential	386	10	100	0	88,965
				Total:	386	10	100	0	101,214
	Gas	2024	March	Non-Residential	0	0	0	0	6,280
				Residential	245	5	72	0	60,724
				Total:	245	5	72	0	67,004
Aqua IL	Sewer	2024	March	Non-Residential	0	0	0	0	0
				Residential	0	0	0	0	0
				Total:	0	0	0	0	0
	Water	2024	March	Non-Residential	0	0	0	0	0
				Residential	9	0	11	0	0
				Total:	9	0	11	0	0
ComEd	Electric	2024	March	Non-Residential	0	0	0	0	47,159
				Residential	690	0	20	0	432,098
				Total:	690	0	20	0	479,257
Consumers Gas	Gas	2024	March	Non-Residential	0	0	0	0	0
				Residential	0	0	0	0	0
				Total:	0	0	0	0	0
IL American Water	Sewer	2024	March	Non-Residential	0	0	0	0	0
				Residential	27	1	0	0	0
				Total:	27	1	0	0	0
	Water	2024	March	Non-Residential	0	0	0	0	0
				Residential	84	3	0	0	0
				Total:	84	3	0	0	0
IL Gas	Gas	2024	March	Non-Residential	0	0	0	0	0
				Residential	0	0	0	0	0
				Total:	0	0	0	0	0
Liberty Utilities	Gas	2024	March	Non-Residential	0	0	0	0	73
				Residential	0	0	0	0	831
				Total:	0	0	0	0	904
MidAmerican Energy	Electric	2024	March	Non-Residential	0	0	0	0	71
				Residential	7	0	1	0	646
				Total:	7	0	1	0	717
	Gas	2024	March	Non-Residential	0	0	0	0	55
				Residential	5	0	1	0	564
				Total:	5	0	1	0	619
Mt. Carmel Public Utility	Electric	2024	March	Non-Residential	0	0	0	0	16
				Residential	0	0	0	0	216
				Total:	0	0	0	0	232
	Gas	2024	March	Non-Residential	0	0	0	0	4
				Residential	0	0	0	0	116
				Total:	0	0	0	0	120
Nicor Gas	Gas	2024	March	Non-Residential	0	0	0	0	2,096
				Residential	94	0	46	0	45,096
				Total:	94	0	46	0	47,192
North Shore Gas	Gas	2024	March	Non-Residential	0	0	0	0	163
				Residential	6	0	0	0	3,000
				Total:	6	0	0	0	3,163
Peoples Gas	Gas	2024	March	Non-Residential	0	0	0	0	2,009
				Residential	179	2	17	2	20,186
				Total:	179	2	17	2	22,195

Monthly Totals Summary

Public Utility Name	Service Type	Year of Reporting Period	Month of Reporting Period	Customer Type	(16) Customers w/ New or Increased Deposit	(17) Customers w/ Reduced or Forgone Deposit	(18) Customers w/ Returned Deposit	(19) Customers Past Due >30 days w/ DPA (1st of month)	(20) Amount Past Due >30 days w/ DPA (1st of month)
Ameren IL	Electric	2024	March	Non-Residential	682	5	577	110	\$334,136.58
				Residential	5,381	456	3,510	58,727	\$26,286,725.83
				Total:	6,063	461	4,087	58,837	\$26,620,862.41
	Gas	2024	March	Non-Residential	345	2	349	88	\$91,229.79
				Residential	3,373	301	2,310	41,111	\$13,772,801.80
				Total:	3,718	303	2,659	41,199	\$13,864,031.59
Aqua IL	Sewer	2024	March	Non-Residential	0	0	0	8	\$63,627.74
				Residential	0	0	0	661	\$347,196.29
				Total:	0	0	0	669	\$410,824.03
	Water	2024	March	Non-Residential	0	0	0	31	\$108,223.53
				Residential	0	0	0	1,937	\$756,288.47
				Total:	0	0	0	1,968	\$864,512.00
ComEd	Electric	2024	March	Non-Residential	1,788	1,791	1,532	0	\$0.00
				Residential	23,686	12,094	6,655	93,551	\$30,015,954.97
				Total:	25,474	13,885	8,187	93,551	\$30,015,954.97
Consumers Gas	Gas	2024	March	Non-Residential	0	0	0	0	\$0.00
				Residential	0	0	0	0	\$0.00
				Total:	0	0	0	0	\$0.00
IL American Water	Sewer	2024	March	Non-Residential	0	0	0	13	\$7,955.87
				Residential	0	0	0	2,548	\$760,271.83
				Total:	0	0	0	2,561	\$768,227.70
	Water	2024	March	Non-Residential	0	0	0	25	\$39,927.66
				Residential	0	0	0	8,100	\$2,063,885.82
				Total:	0	0	0	8,125	\$2,103,813.48
IL Gas	Gas	2024	March	Non-Residential	0	0	0	0	\$0.00
				Residential	0	0	0	0	\$0.00
				Total:	0	0	0	0	\$0.00
Liberty Utilities	Gas	2024	March	Non-Residential	4	0	2	3	\$1,343.71
				Residential	37	0	3	287	\$32,818.73
				Total:	41	0	5	290	\$34,162.44
MidAmerican Energy	Electric	2024	March	Non-Residential	8	0	2	25	\$7,629.00
				Residential	42	3	48	2,054	\$399,916.00
				Total:	50	3	50	2,079	\$407,545.00
	Gas	2024	March	Non-Residential	7	0	2	20	\$5,299.00
				Residential	39	3	46	1,852	\$311,108.00
				Total:	46	3	48	1,872	\$316,407.00
Mt. Carmel Public Utility	Electric	2024	March	Non-Residential	0	0	2	0	\$0.00
				Residential	2	0	2	56	\$13,825.55
				Total:	2	0	4	56	\$13,825.55
	Gas	2024	March	Non-Residential	0	0	4	0	\$0.00
				Residential	3	0	2	32	\$5,201.68
				Total:	3	0	6	32	\$5,201.68
Nicor Gas	Gas	2024	March	Non-Residential	2	0	40	568	\$827,916.98
				Residential	0	0	442	27,094	\$10,229,981.14
				Total:	2	0	482	27,662	\$11,057,898.12
North Shore Gas	Gas	2024	March	Non-Residential	0	0	2	19	\$7,898.00
				Residential	0	0	48	1,977	\$622,292.00
				Total:	0	0	50	1,996	\$630,190.00
Peoples Gas	Gas	2024	March	Non-Residential	0	0	18	418	\$838,227.00
				Residential	0	0	284	26,299	\$11,271,440.00
				Total:	0	0	302	26,717	\$12,109,667.00

Monthly Totals Summary

Public Utility Name	Service Type	Year of Reporting Period	Month of Reporting Period	Customer Type	(21) Customers Past Due >30 days w/o DPA (1st of month)	(22) Amount Past Due >30 days w/o DPA (1st of month)
Ameren IL	Electric	2024	March	Non-Residential	2,870	\$1,174,926.32
				Residential	82,018	\$38,554,180.20
				Total:	84,888	\$39,729,106.52
	Gas	2024	March	Non-Residential	1,105	\$604,799.05
				Residential	54,728	\$16,284,582.28
				Total:	55,833	\$16,889,381.33
Aqua IL	Sewer	2024	March	Non-Residential	191	\$131,542.95
				Residential	4,460	\$762,792.61
				Total:	4,651	\$894,335.56
	Water	2024	March	Non-Residential	655	\$708,462.37
				Residential	12,879	\$1,632,167.70
				Total:	13,534	\$2,340,630.07
ComEd	Electric	2024	March	Non-Residential	23,076	\$47,729,206.58
				Residential	333,937	\$101,062,642.65
				Total:	357,013	\$148,791,849.23
Consumers Gas	Gas	2024	March	Non-Residential	6	\$2,900.89
				Residential	124	\$6,846.87
				Total:	130	\$9,747.76
IL American Water	Sewer	2024	March	Non-Residential	0	\$0.00
				Residential	21	\$13,001.48
				Total:	21	\$13,001.48
	Water	2024	March	Non-Residential	0	\$0.00
				Residential	86	\$43,518.74
				Total:	86	\$43,518.74
IL Gas	Gas	2024	March	Non-Residential	0	\$0.00
				Residential	0	\$0.00
				Total:	0	\$0.00
Liberty Utilities	Gas	2024	March	Non-Residential	412	\$-157,872.64
				Residential	4,877	\$-180,991.15
				Total:	5,289	\$-338,863.79
MidAmerican Energy	Electric	2024	March	Non-Residential	606	\$114,986.00
				Residential	8,058	\$1,077,020.00
				Total:	8,664	\$1,192,006.00
	Gas	2024	March	Non-Residential	256	\$142,665.00
				Residential	6,486	\$832,189.00
				Total:	6,742	\$974,854.00
Mt. Carmel Public Utility	Electric	2024	March	Non-Residential	36	\$3,705.09
				Residential	170	\$33,399.74
				Total:	206	\$37,104.83
	Gas	2024	March	Non-Residential	12	\$1,150.85
				Residential	144	\$16,772.10
				Total:	156	\$17,922.95
Nicor Gas	Gas	2024	March	Non-Residential	8,912	\$7,291,589.86
				Residential	173,352	\$66,007,553.54
				Total:	182,264	\$73,299,143.40
North Shore Gas	Gas	2024	March	Non-Residential	690	\$367,111.00
				Residential	11,110	\$3,340,789.00
				Total:	11,800	\$3,707,900.00
Peoples Gas	Gas	2024	March	Non-Residential	7,355	\$16,099,507.00
				Residential	138,870	\$99,629,705.00
				Total:	146,225	\$115,729,212.00

COM/MGA/avs

PROPOSED DECISION

Agenda ID #16988 (REV. 1)

Quasi- Legislative

12/13/18 Item 25

Decision **PROPOSED DECISION OF COMMISSIONER GUZMAN ACEVES**
(Mailed 10/30/2018)

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to
Consider New Approaches to
Disconnections and Reconnections
to Improve Energy Access and
Contain Costs.

Rulemaking 18-07-005

**DECISION ADOPTING INTERIM RULES TO REDUCE RESIDENTIAL
CUSTOMER DISCONNECTIONS FOR CALIFORNIA-JURISDICTIONAL
ENERGY UTILITIES**

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**DECISION ADOPTING INTERIM RULES TO REDUCE RESIDENTIAL
CUSTOMER DISCONNECTIONS FOR CALIFORNIA-JURISDICTIONAL
ENERGY UTILITIES**

Summary

This decision adopts interim rules applicable to California-jurisdictional gas and electric utilities and are designed to reduce the number of residential customer disconnections and to improve the reconnection processes for disconnected customers. Customers' access to electric and gas service is critical to their economic and social stability and well-being. The Commission has implemented policies and procedures to reduce gas and electric utility service disconnections; however, the rate of customer disconnections continues to rise. Accordingly, the instant rulemaking has been instituted with the goal of developing policies and rules to reduce the statewide level of gas and electric service disconnections for nonpayment by residential customers.

This decision adopts interim rules to take effect immediately on an emergency basis to provide rapid relief while we consider longer term solutions. We apply these interim rules to large investor owned gas and electric utilities in California. We impose a goal for limiting disconnections to 2017 recorded levels per utility. We also modify the existing rule prohibiting disconnections during extreme weather conditions. The utilities currently must not disconnect residential customers during extreme weather conditions based on a 24-hour look-ahead. Today's decision extends this look-ahead period from 24 to 72 hours to provide greater customer protection from being disconnected when weather impacts are the most severe. In identifying vulnerable customers to be protected against disconnection, we shall include any household on medical baseline or life support and for customers age 65+ as defined in Decision 16-09-016 for senior citizens.

We leave this proceeding open to consider additional policies, rules, and regulations to address issues to reduce the rate of customer disconnections.

1. Factual Background

On September 28, 2017, Governor Brown signed Senate Bill (SB) 598 (Hueso 2017) into law. SB 598 acknowledges that disconnections of gas and electric utility customers have been rising and notes the public health impacts in terms of hardship and stress resulting from disconnections, especially among vulnerable populations.¹

California's electric and natural gas investor-owned utilities (IOUs) each have differing procedures and protocols pertaining to disconnection for failure to timely pay for service and as well as differing procedures for reconnection. Some aspects of disconnection and reconnection processes occur pursuant to Commission-adopted rules and policies. Other aspects are voluntary and are not enforced by Commission rules at all. Although the impetus for disconnection, repayment options, and reconnection times, differ across the IOUs, the ramifications of disconnection for customers can be far-reaching. The compounding effects of disconnection include disruption of the customer's normal daily activities (*e.g.* potentially, the ability to maintain employment,) as well as broad public health and social impacts associated with lack of electric and gas service.

Among other things, SB 598 requires the Commission to develop rules, policies or regulations with a goal of reducing the statewide disconnection rate of

¹ The Commission's Policy and Planning Division (PPD) also issued a paper in December 2017 finding that, aside from a brief slowdown in 2010, disconnections have been rising. Since 2011, the number of disconnections has steadily increased from the paused state in 2010.

gas and electric utility customers by January 1, 2024. The Commission is also required to analyze the impacts on disconnection rates of any utility rate increases in each utility's general rate case. SB 598 also sets forth circumstances under which a customer shall not be disconnected for nonpayment, including a customer receiving a medical baseline allowance, a customer (or member of their household) receiving hospice care, customer dependence on life-support equipment, or the presence of medical conditions requiring electric and natural gas service to sustain life or prevent deterioration of the medical condition.

Through the instant rulemaking, we intend to implement specific requirements in SB 598. We also intend to analyze the current disconnection paradigm more broadly to determine if more effective structures or policies can be adopted to reduce disconnections, reduce costs and improve the disconnection process across utilities. Through the instant rulemaking, we intend to undertake a comprehensive assessment of the root causes of (or events that correlate with) residential customer disconnections while also evaluating the rules, processes and procedures regarding disconnections and reconnections at both a statewide and utility specific level.

The scope of this rulemaking will build upon previous measures adopted in Rulemaking (R.) 10-02-005 to reduce disconnection rates during the Great Recession through improved customer notification and education. Decision (D.) 10-07-048 adopted interim actions to reduce disconnections before the 2010-2011 winter season. D.10-12-051 approved a settlement agreement to address disconnection practices of the major IOUs.

1.1. Procedural Background

On July 20, 2018, the Commission instituted the instant rulemaking to consider new approaches to disconnections and reconnections to improve energy

access across California's electric and gas investor-owned utilities. A prehearing conference (PHC) was held on August 15, 2018. The *Assigned Commissioner's Phase 1 Scoping Memo and Ruling and Request for Comments on a Proposed Pilot Program* (Scoping Memo) issued on September 13, 2018.

This rulemaking names as respondents the four largest electric and natural gas investor-owned utilities (IOUs). However, disconnections also occur within the service territories of small and multi-jurisdictional utilities under our jurisdiction. As such, the small and multi-jurisdictional gas and electric corporations are also respondents.² California community choice aggregators (CCA) are not identified as respondents because CCA disconnections are managed by the interconnecting utility. However, CCA participation in this proceeding has been encouraged.

The Scoping Memo identified two phases for this rulemaking. Phase 1 is to adopt policies, rules or regulations with a goal of reducing, by January 1, 2024 or before, the statewide level of residential gas and electric service disconnections for nonpayment. Phase II will take a broader approach to the evaluation of residential natural gas and electric disconnections with the goal of determining if the disconnection rate can be reduced through broader reforms and new preventive approaches.

² The smaller IOUs named as respondents are: Southwest Gas Company, Liberty Utilities (CalPeco Utilities) LLC, Bear Valley Electric Service, a division of Golden State Water Company, PacifiCorp, Alpine Natural Gas Operating Company, West Coast Gas Company, Inc. We realize that the smaller IOUs may have unique issues that the larger utilities do not have. Therefore, we will address what policies should be implemented by the smaller IOUs in a separate phase of Phase I of this proceeding. However, we encourage the smaller IOUs to be proactive in their efforts to reduce service disconnections in their service territories while the Commission further develops this proceeding.

The Scoping Memo provided notice and opportunity to comment on the planned adoption of interim rules to reduce the rate of disconnections. As set forth in Section 4.1 through 4.3 of the Scoping Memo, the parties were provided the opportunity to comment on these proposed interim measures. Reply comments were also served. The utilities were directed to be prepared to implement adopted interim measures as quickly as possible.

Opening Comments were filed on September 18, 2018, by Pacific Gas and Electric Company (PG&E), the Public Advocates Office at the CPUC (The Public Advocates Office, Formerly the Office of Ratepayer Advocates or ORA),³ Center for Accessible Technology and the National Consumer Law Center (CforAT and NCLC), Southern California Edison Company (SCE), The Utility Reform Network (TURN), collectively, by Bear Valley Electric Service, a division of Golden State Water Company, Liberty Utilities (CalPeco Electric) LLC (Liberty CalPeco), and PacifiCorp dba Pacific Power (collectively, the California Association of Small and Multi-Jurisdictional Utilities (CASMU), the Coalition of California Utility Employees (CUE), GRID Alternatives (GRID), San Diego Gas & Electric Company (SDG&E) and Southern California Gas Company (SoCalGas), Utility Consumers' Action Network (UCAN), and Southwest Gas Corporation (SWG) also filed opening comments. Reply comments were filed on September 24, 2018.

No evidentiary hearings were held. The basis for this decision is the record developed through the above-referenced filed comments.

³ At the time of filing its comments, the Public Advocates Office was identified by its previous name, the Office of Ratepayer Advocates.

2. Preliminary Issues to be Resolved

2.1. Interim Rules versus Pilot Program Characterizations

In the Scoping Memo, the interim measures being considered were defined as a “Pilot Program.” The Center for Accessible Technology and National Consumer Law Center (CforAT and NCLC) argue, however, that the interim measures proposed in the Scoping Memo are not pilot programs as typically defined by the Commission. CforAT and NCLC describe the proposals as interim mechanisms, interim protections, and interim rules. The Public Advocates Office supports the use of CforAT and NCLC proposed terminology, arguing that the temporary measures, as described in the Scoping Memo, are inconsistent with the Commission’s previous definition of pilots.

2.1.1. Discussion

We agree with the terminology proposed by the parties for purposes of characterizing our interim rules as adopted herein. We conclude that using the terminology “Pilot Program” is not the most descriptive of the actions we adopt herein. We shall hereafter refer the measures being adopted herein as interim rules, rather than as the “Pilot Program.”

2.2. Applicability of Interim Rules to Smaller Utilities

CASMU asks that the smaller California-jurisdictional utilities not be made subject to the interim rules being adopted here. CASMU notes that each of its member utilities has less than 50,000 customers in California and serves in rural and/or mountainous regions of the state. CASMU argues that given the small customer base of its members, their utility planning effort and participation in Commission proceedings is more limited compared to large IOUs.

Given the small size of the customer base, CASMU argues that it is relatively more difficult and/or disproportionately more burdensome, for customers of these small utilities to absorb new program costs, with cost sharing or cost subsidization among or across customers. CASMU argues that implementing these interim rules would create a disproportionate cost burden for the smaller customer base. CASMU also argues that SB 598 exempted CASMU members from the requirements of that enacted statute. For these reasons, CASMU argues that its members should be excluded from the requirements of the interim rules being enacted in this decision.

The Public Advocates Office, however, interprets the scope of the Commission's interim rules to be statewide, although the Scoping Memo does not specify the population to be covered.

2.2.1. Discussion

Although SB 598 only requires the Commission to adopt rules for the four major electric and gas utilities, we recognize that customer disconnection concerns affect utility customers statewide. However, we also recognize that the smaller IOUs may have unique circumstances that the other larger IOUs do not face. Therefore, we will not apply these interim rules to the smaller IOUs at this time. However, we will evaluate what procedures shall be applied to the smaller IOUs in a separate and distinct phase of this proceeding. However, since disconnections are a statewide concern, we encourage the smaller IOUs to actively work on appropriate solutions while we further develop the record concerning the unique issues that may impact the smaller IOUs.

2.3. Memorandum Account Treatment of Costs

PacifiCorp initially proposed a memorandum account be established for recovery of incremental additional costs incurred by utilities in connection with the implementing these interim rules. PacifiCorp argues that in addition to enabling utilities to recover incremental costs related to this program, a memorandum account would serve as means of tracking and recording cost data that can be used to develop the final requirements that emerge from this proceeding. However, as discussed in section 2.2.1, the smaller IOUs are being exempted from the interim rules for the time being and any rules pertaining to the smaller IOUS will be conducted in a separate phase of this proceeding. Therefore, PacifiCorp's argument is currently moot.

PG&E and SCE both requested that the Commission allow them to establish a memorandum account in their opening comments, which were filed on November 19, 2018. We will discuss this request in Section 2.3.1, below.

2.3.1. Discussion

PG&E and SCE failed to show in opening comments that the interim rules will result in any incremental costs to them. We decline to authorize memorandum account recovery of incremental costs relating to incremental costs that may be incurred in connection with implementing the interim rules adopted herein. We are not persuaded that incremental costs associated with implementing these rules are of such significance as to warrant authorization of memorandum account treatment. We note that SB 598 requires the Commission to analyze the impacts on disconnection rates of any utility rate increases in each utility's general rate case. For the limited purposes of the interim rules adopted herein, however, we find insufficient basis to institute memorandum account treatment of costs at this time. Also, we are not persuaded that the proposal is

sufficiently defined as to how to segregate the specific costs that would be eligible for memorandum account treatment, and how such costs would be distinguished from other costs typically incurred in the course of business. Given our goal of implementing these rules quickly, we have insufficient basis to approve all of the terms and conditions that would apply to a memorandum account and decline to grant such a request at this time.

2.4. Reporting Requirements on Arrearages

CforAT and NCLC note that utilities currently collect monthly data on arrearages and disconnections for quarterly reports and recommends that utilities provide reports on arrearages each month that an interim disconnections cap is in place. CforAT and NCLC note that in R.10-02-005, struggling households experienced increased arrearage amounts following a limitation of residential disconnections for non-payment.

The Public Advocates Office agrees that monthly reporting of arrearages would help parties assess the impact of each of the interim measures. For the duration of the interim measures, the Public Advocates Office believes that all IOUs should be required to file in this proceeding the arrearage data on a monthly basis.

2.4.1. Discussion

We conclude that it is acceptable for the large investor-owned utilities⁴ to report on arrearages and disconnections on a monthly basis as suggested by CforAT, NCLC and the Public Advocates Office. We require all respondent utilities to report on arrearages and disconnections on a monthly basis for the

⁴ PG&E, SCE, SDG&E, SoCalGas.

duration of the interim measures.⁵ An updated version of the data reporting template as provided in the September 12th ruling in this proceeding is attached to this decision (Appendix B). The large IOUs are required to submit the information requested in the updated template on a monthly basis. This requirement supersedes the quarterly reporting requirement from the September 12th ruling. Monthly reports should be filed and served on the 20th of each month (or the next business day thereafter).

3. Adopted Interim Rules

We adopt the interim rules set forth below to reduce the rate of customer disconnections. These rules shall remain in effect pending a subsequent Phase I decision or until the Commission directs otherwise. These rules are adopted based on the proposal that appeared in preliminary form in the Assigned Commissioner's Scoping Memo. These rules: (a) prohibit disconnection of designated vulnerable customers and (b) prevent disconnections during prescribed extreme weather events. This decision also adopts a goal of limiting the rate of disconnections to 2017 levels. We have considered parties' comments in response to the Scoping Memo, and have made adjustments, as appropriate, in adopting these interim rules.

3.1. Limiting Disconnection Rates to 2017 Recorded Levels

To ensure no further increases in disconnections occur, and that a path towards reductions is ensured, the Scoping Memo proposed to establish a disconnection rate cap for each IOU at the IOU's 2017 disconnection rate.

⁵ This requirement does not apply to small, multi-jurisdictional utilities such as Southwest Gas or any other entity not included in the Commission's reporting requirements under Pub. Util. Code 910.5.

Parties generally support the proposal to establish a disconnection rate cap set at each of the IOUs' respective 2017 disconnection rates. Several IOUs and other parties, however, express concern regarding risks and unintended consequences of establishing a disconnection rate cap across all customers. SCE argues that disconnection rate cap could provide arbitrary and unnecessary relief to customers not at high risk of being disconnected and potentially ignore customer behavior leading to disconnection of service. PG&E expressed concerns regarding potential of unintentional consequences of a disconnection cap, including: (1) higher balances for customers subject to disconnection; (2) shifting of costs to other customers due to nonpayment; and (3) potential gaming as the cap is reached.

SDG&E and SoCalGas request that any disconnect cap be analyzed before implementation, or, if the Commission decides to move forward with a cap, it be set at 3.95% for SDG&E and 2.4% for SoCalGas. This represents an *increase* from 2017 levels. SoCalGas and SDG&E argue that the caps set at 2017 levels would penalize them for positive performance, depriving them of flexibility in managing disconnections.

SDG&E and SoCalGas also question why 2017 data should be used for capping disconnections, other than that it represents the most recent year. They argue that disconnection rates can be affected by weather, economic, and other conditions, all of which should be considered when adopting a cap.

TURN advocates quick implementation of the interim protections for residential customers to prevent further increases.

SCE and PG&E both propose to limit the disconnection rate cap to only Phase 1 of this proceeding. TURN argues that the pilot shall last for the duration

of this proceeding, or until annual targets for reduced disconnections are adopted.

SCE proposes to apply the disconnection rate cap only to vulnerable customer populations instead of to all residential customers. TURN responds, however, that SB 598 mandated reductions in disconnections for *all* residential customers by 2024, not just vulnerable customers.

TURN expressed concerns that because disconnections have been increasing, and this proceeding could take a prolonged period to resolve, interim protections are necessary to prevent further increases in disconnections. Otherwise, the Commission could potentially be mandating a reduction from a higher level of disconnections and end up with the same or higher disconnection levels compared to when SB 598 was passed.

The Public Advocates Office supports immediate adoption of the interim measures but agrees with the IOUs that the proposed measures raise questions about implementation that could result in inconsistent application across IOU service territories, and unintended consequences.

CforAT and NCLC note the risks of increased arrearages, and state that imposing a hard cap without additional guidance would eliminate the ability of both the Commission and utilities to directly target relief to those customers most in need. SWG supports aspects of the disconnection rate cap pilot, but questions how the disconnection rate cap would be calculated or implemented.

The parties made various comments about the disconnection cap in their comments on the proposed decision. For the most part, the parties accept using the 2017 rates to set the interim disconnection cap, with the only exception being SDG&E and SoCalGas.

SCE warns in its comments that there may be unintended consequences as a result of the disconnection cap and advises that the Commission should gather more data before implementing the cap. PG&E requests that there be a delay in implementing the cap until the first full month following adoption and that the monthly cap should be based on PG&E's monthly customer account population, which may fluctuate from month to month. SDG&E and SoCalGas strongly oppose the cap and allege it is unfair because they have the lowest number of disconnections for 2017. SDG&E contends that preventing any disconnections for a month could likely lead to higher arrearages for some customers and this will be difficult to pay off and thus make reconnections more difficult for them.

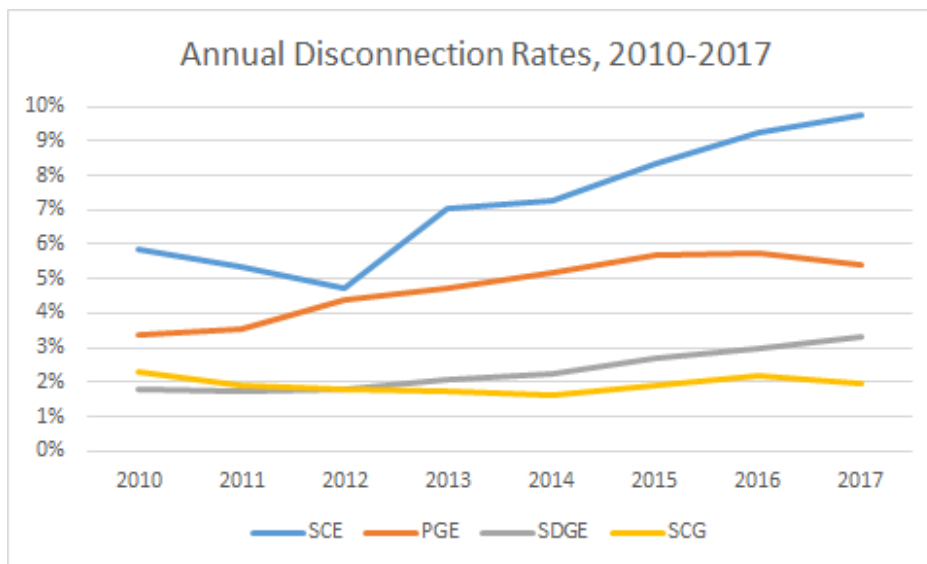
CforAT and NCLC support the use of an absolute cap, but recommends that it not become effective until January 2019 since the utilities do not disconnect customers during the holidays. UCAN suggests that the cap should be set at 95 percent of the 2017 levels. TURN opposes any modification of the cap, but proposes allowing SDG&E a three-month grace period to implement the cap. GRID supports the use of a cap and recommends that the Commission require utilities to minimize disconnections of certain categories of vulnerable customers as they manage disconnections under the cap.

3.1.1. Discussion

We shall require each of the large IOUs to set a goal of limiting residential customer disconnections to the rate of disconnections recorded in 2017. While the ruling proposed a hard cap on disconnections at 2017 levels, this decision adopts a soft cap or goal to limit disconnections to 2017 levels. A separate phase of the proceeding will address the appropriate goal for the smaller IOUs.

We deny requests to postpone implementation of this goal until further vetting and workshops occur. To stem the rising incidence of disconnections,

immediate implementation of the goal is needed to offer customers some form of immediate relief. Disconnection rates have been rising in the large IOUs since the Commission began tracking disconnection rates in 2010. As the below chart shows, the disconnection rates of SCE and SDG&E have increased over the years, while SoCalGas's annual disconnection rates remain relatively steady around 2%. PG&E also shows an overall growing trend in disconnections despite the disconnection rate declining slightly last year.



Source: Data were compiled by the Energy Division, based on the Quarterly Disconnect Data Reports submitted by IOUs as a requirement of R.10-02-005.

We recognize that other metrics besides 2017 data arguably might be used to establish the goal, as certain parties propose. On balance, however, we conclude that 2017 recorded levels provides a more straightforward, metric that can be implemented quickly. Since 2017 is the most recent year for which we have complete data, encouraging the large IOUs to limit disconnections to 2017 rates will help curb the rising disconnection rate. This decision aims to implement immediate interim relief, which includes limiting the number of

customers experiencing disconnection. We therefore adopt 2017 data as the basis for utilities to establish their goals.

We adopt a goal, rather than a hard cap, for the large IOUs due to concerns expressed in comments about the unintended consequences of a hard cap. These consequences include higher arrearages for those who avoid disconnection as a result of a cap and the possibility of ratepayers who are current on their energy bills subsidizing those who are behind on their energy bills. Under existing rules and policies that differ across IOUs, some customers incur large amounts of arrearages before disconnection, while other customers are disconnected when their debt to the utility is relatively low. As this decision offers the large IOUs more flexibility by establishing a goal rather than a hard cap, we direct the large IOUs to use that flexibility to manage disconnections in a way that limits the number of customers experiencing disconnection while also minimizing the growth of arrearages. Hard caps and reductions will be deliberated in Phase I of this proceeding.

To establish the goal, Appendix A of this decision sets forth 2017 disconnection data per utility. Specifically, each utility shall calculate an absolute number (as opposed to a percentage) that will be its goal for the maximum number of disconnections in its service territory. To calculate the absolute number, the utilities shall apply the 2017 disconnection percentages to their residential populations when this decision goes into effect. The calculation of the absolute number should be included in the IOUs' first monthly report of 2019. Until or unless ordered otherwise by this Commission, large IOUs should endeavor to keep the number of disconnections implemented for each subsequent year below the annual disconnection goal.

If any of the large IOUs exceed the annual disconnections goal, within 60 days that IOU must file a report with the Commission explaining:

- 1) why the utility is exceeding the goal,
- 2) what steps were taken by the utility to manage disconnections to remain below the goal, and
- 3) why those steps were insufficient in limiting disconnections to the established goal.

The report must also be served to the service list of this proceeding. Establishing reporting requirements for the large IOUs if they exceed the goal, in addition to the reporting requirements in Section 2.4.1, will hold the large IOUs accountable as they manage their disconnection rates. The reporting requirement will remain in effect for as long as the disconnection goal remains in effect.

We deny SCE's request to limit the disconnection cap only to vulnerable customer populations. As noted by TURN, the Commission is required by SB 598 to develop policies, rules, or regulations to reduce residential disconnections by January 1, 2024 for *all* residential customers, not just vulnerable customers. SB 598 created a separate section of the Pub. Util. Code Section 779.3, to address additional protections specifically for vulnerable customers. We thus shall impose the disconnections goal such that it applies to all residential energy customer disconnections.

We also deny the request of SDG&E and SoCalGas to set their disconnection caps at 3.95% and 2.4% respectively. We find no justification to deviate from 2017 recorded levels in setting the goal. Although SDG&E claims it has the lowest disconnection rate among the major electric utilities, it has increased its monthly residential disconnections from 1,795 per month in 2010 to 4,248 per month in 2018, a 137% *increase*. SDG&E is now seeking to increase its

disconnection levels even further. However, we recognize that implementing this goal immediately for SDG&E may severely limit their ability to disconnect customers for nonpayment. Therefore, we agree with the recommendation of TURN and will grant SDG&E a three-month grace period to manage its disconnections. The goal for the remaining covered utilities shall be effective January 1, 2019.

SDG&E's 2018 residential disconnections are already projected to be 0.37% higher than 2017 levels. SDG&E seeks authority to *further increase* its disconnection rate by another 0.27%. SoCalGas requests to increase its disconnection rate to 2.4%, even though it is only currently trending at 2.1% for 2018. We deny this request. SDG&E's disconnection goal is set at 2017 recorded levels.

The goal for limiting residential customer disconnections for large IOUs will remain in effect until the end of Phase 1 of this proceeding and no later than 18 months from this decision. Setting a definitive timeframe for the disconnection goal provides certainty that reforms will take place in a timely manner to address some of the causes of high rates of disconnections. This proceeding will consider and adopt policies to ensure that customers having difficulty paying their energy bills receive interventions to help manage their bills and prevent disconnection. The policies developed at the close of Phase 1 will go beyond the interim rules created in this decision, as the Commission complies with its statutory requirement to reduce the disconnection rate by 2024.

3.2. Limiting Disconnections of Vulnerable Customers

In addition to explicitly requiring an overall reduction in disconnection rates, SB 598 created protections for vulnerable customers for whom disconnection would be life-threatening. Specifically, SB 598 prohibits gas or

electrical corporations from disconnecting customers who utilize a medical baseline allowance, are financially unable to pay, agree to a payment plan, and either are under hospice care, on life-support equipment, diagnosed with a life-threatening condition that makes electricity service medically necessary.

In line with SB 598 protections, the Scoping Memo similarly proposed to ban disconnections of vulnerable customers, defined as customers who qualify for medical baseline and/or are above 65 years old, as long as the customer agrees to a payment plan. As noted in SB 598, customer disconnections are a public health issue, and impact the elderly, and people with physical disabilities, and with life-threatening medical conditions.

In filed comments, certain parties suggested changes to the definition of “vulnerable customers” for purposes of protections from disconnection. Suggested changes were offered mostly by UCAN and GRID. UCAN recommends that in addition to customers who qualify for medical baseline and/or are above 65 years old, the category of “vulnerable customers” also include members of a household under the age of 10, or those who do not qualify for medical baseline but can show proof of serious illness. GRID also requests to expand the definition of “vulnerable customers: to include: low income households, households with children, households of color, households where English is not the primary language spoken, physically disabled customers, and tribes.

SCE does not currently collect or track all of the data described by UCAN and GRID, and claims that gathering the information would require extensive effort, and be overly intrusive. SCE recommends that before early interventions or rapid relief is adopted, a consensus definition of “vulnerable customers” be determined in the Phase 1 workshop. SCE argues that some suggested

definitions such as “households with children” and “households of color,” are vague and could cause confusion and implementation problems.

PG&E supports the proposal to suspend disconnection of vulnerable customers if the customer agrees to a payment plan. PG&E’s customers with life-support equipment and receiving medical baseline allotments are currently afforded this benefit. PG&E would support extending this protection to those over age 65 who self-identify as vulnerable. PG&E already offers payment plans to all qualifying customers and has a process for customers to self-identify as being vulnerable. PG&E, however, requests more time to modify its current process to allow for self-identification by customers age 65 or older. On a going forward basis, PG&E suggests coordinating consistent policies among the IOUs through workshops and provision for time to implement adopted changes.

SDG&E and SoCalGas are generally amenable to the disconnection protections proposed for “vulnerable customers” in the Scoping Memo, but oppose expansions as to who should qualify. They argue that such changes are not appropriate because: (1) they do not maintain information to redefine the group, (2) acquiring the information would be intrusive and difficult, and (3) the category would encompass a substantial portion of customers, and potentially even a majority. They argue that if the proposed changes are to begin imminently, it would be impossible for them to be sufficiently tested, analyzed, or implemented.

Because SDG&E and SoCalGas do not generally request or maintain age data for all customers, they express concern over being directed to actively seek out age information from all customers. They argue that such efforts may prove difficult, seem overly intrusive, and invite certain customers to abuse the system.

They therefore request that the Commission clarify that there will be no affirmative duty on the utilities to ask customers their age.

Because some of the demographic data described by GRID and UCAN would be self-reported by customers, SCE agrees with SoCalGas/SDG&E that it may invite abuse. If additional data collection is necessary, SCE argues that more time and funding may be needed for system modifications. SCE requests that before the definition of “vulnerable customers” is expanded, it should be vetted in Workshop 1 so that unintended consequences can be avoided.

In comments on the proposed decision, CUE, GRID, PG&E, SCE, and CforAT and NCLC expressed support for the protections for vulnerable customers. PG&E expresses concern about its ability to disconnect vulnerable customers who fail to comply with the offered payment plan. SCE requests that the protections go into effect on January 7, 2019 to allow for time to train customer service representatives to request age information during final calls before disconnection. SDG&E and SoCalGas argue that their existing protections are as stringent as those in the proposed decision.

CforAT and NCLC recommends specific guidelines on the type of payment plan utilities must offer to those customers. CforAT and NCLC are concerned that customers will accept whatever payment plan is offered to them, even if they cannot afford the payment plan provided, in order to avoid disconnection in the near term. CforAT and NCLC propose that utilities be required to offer vulnerable customers payment plans spread over at least four months.

3.2.1. Discussion

For purposes of interim rules prohibiting disconnections of vulnerable customers, we shall adopt the following. The utilities shall not disconnect

customers for nonpayment who qualify for medical baseline and/or are above 65 years old, as long as the customer agrees to a payment plan offered by the utility. The utility is required to offer the vulnerable customer a payment plan with a duration of at least four months. Customers may select a payment plan of a shorter duration if they choose, but the utility must offer a payment plan of at least four months' duration to any vulnerable customer at risk of disconnection. For the purpose of applying this requirement, we define senior citizens as any permanent member of a household, age 65 or older, in any income bracket, consistent with the criteria in D.16-09-016.⁶ The utilities shall not disconnect a customer if anyone in the household meets that definition.

We shall not require the utility to make affirmative inquiry of every residential household as to whether eligible vulnerable customers reside there. If the utility has discussions with the customer over the telephone or in person with an employee of the utility prior to disconnection, the utility shall have a duty to inquire if there is anyone in the household who meets the age 65+ parameters for senior citizens as adopted herein.

In the event that an individual 65 or over fails to successfully complete a payment plan of at least four months' duration, the utility may proceed with disconnection assuming that none of the other interim prohibitions apply. However, we encourage the IOUs to try and work with the customer to ensure that adequate opportunities are provided for a customer 65 or over to resolve any payment delinquencies. For example, IOUs are encouraged to offer vulnerable customers payment plans that exceed the four-month minimum established in this decision.

⁶ See D. 16-09-016, Section 2.1.2, Finding of Fact 3, and Ordering Paragraph 1.

We decline to expand the alternative definitions of vulnerable customers such as that proposed by UCAN and GRID. Before considering adoption of such expanded definitions, further examination is warranted regarding the implications and the practicalities of implementation. In further stages of this proceeding, we may consider these proposals to redefine the definition of vulnerable customers in further detail.

The IOUs also indicated in their comments on the proposed decision that they would need additional time to implement changes to their systems to gather information concerning the age of a customer. We will allow the IOUs until close of business on December 21, 2018 to implement the changes regarding whether an individual 65 or older resides in the household.

3.3. Temperature-Related Limitations on Disconnections

The Scoping Memo proposed that energy IOUs not be allowed to disconnect customers when the 72-hour National Weather Service forecast predicts temperatures above 100 degrees or below 32 degrees. This proposed protection recognizes that disconnections are a public health issue, particularly when temperatures are extreme. Lost access to energy services on extremely hot or cold days can be life threatening for some populations, including infants, children, and the elderly. To protect customers from disconnection due to nonpayment during periods of extreme temperatures this winter, we establish thus immediate, interim temperature limitations on disconnections.

In filed comments, certain parties seek clarification and/or modifications to the Scoping Memo proposal regarding temperature limits on disconnections. Other parties, while generally supportive of the temperature limitations, suggested alternative approaches that differ from certain existing IOU disconnection policies. UCAN recommends that temperature protections ban

disconnections during weather conditions that are ten or more degrees above or below average for a period of in excess of three days. SDG&E and SoCalGas are open to exploring these limitations, but believe UCAN's proposal does not appear sufficiently developed at this time.

The IOUs generally support the temperature limitation concept, but note that their temperature-based limitations on disconnections differ somewhat from the approach described in the Scoping Memo. PG&E uses an internal comprehensive meteorological forecast for its service territory. Forecasts are updated daily and disconnects are suspended for all communities when the daily forecast predicts temperatures at or above 100 degrees, and at or below 32 degrees. PG&E proposes continued use of its current process rather than adoption of the National Weather Service forecast approach.

PG&E also claims that time would be required to make technological enhancements and new controls to apply its current daily forecast approach to a 72-hour window. PG&E argues that such changes would be best evaluated and addressed through workshops. PG&E thus requests permission to continue implementing its current severe temperature disconnection policy without change at this time.

SCE believes that the proposal to suspend disconnections during extreme weather should be delayed until after Phase 1 workshops. SCE requests the Commission include examination and analysis of this and other pilot proposals in the Workshop 1, where thorough discussion and vetting on the design and impacts of implementation can be conducted.

TURN argues that protections from disconnection for residential customers during extreme temperatures should be implemented as soon as possible. PG&E, SDG&E, and SoCalGas have already implemented protections

during extreme weather and support continuation of such protection. SCE is the only major IOU that has not yet implemented these protections for residential customers. The CforAT, NCLC, and the Public Advocates Office state that as many as half of the states in the United States already have policies on residential disconnections during periods of extreme temperatures.

The Public Advocates Office states that elimination of customer disconnections during weather events could result in higher arrearages for customers than those seen in a typical month. The Public Advocates Office believes there could be unintended consequences if the IOUs move away from current policies for temperature-based disconnections to the process described in the Scoping Memo. The Public Advocates Office recommends that the IOUs be allowed to use their current processes for the interim measures, and that subsequent workshops as necessary, can address ways to refine interim measures, as appropriate.

In comments on the proposed decision, CUE and CforAT and NCLC support the temperature protections. SCE states that it will change its existing policy to comply with the interim temperature protection, and PG&E and SDG&E and SoCalGas reiterated their request for a grace period for implementing the temperature protections.

3.3.1. Discussion

For purposes of the interim rules, we shall require that the energy IOUs cannot disconnect residential electricity customers when temperatures above 100 degrees⁷ or below 32 degrees are expected based on a 72-hour look-ahead period. This limitation draws on existing PG&E practice, which prevents

⁷ The limitation on disconnections above 100 degrees does not apply to gas providers

disconnection of utility customers when temperatures on a given day exceed 100 degrees or are below 32 degrees.

In their comments, the major IOUs argued that they would need more time to implement technological enhancements to comply with the proposed 72-hour weather forecast disconnection measure. We recognize that requiring the utilities to rely upon the National Weather Service model referenced in the Assigned Commissioner's Scoping Memo could require some additional implementation time to the extent that it differs from their existing temperature disconnection policy. Accordingly, to address this concern, we shall permit each utility to continue to use its own internal weather monitoring systems rather than the National Weather Service model. Additionally, we will allow the utilities until close of business on December 21, 2018, to implement the 72-hour look-ahead. By doing this, we address some of the IOUs' concerns regarding implementation lead time, while still providing protections before the weather becomes too extreme. We therefore will require the adopted interim rules calling for a 72-hour look-ahead period to take effect no later than close of business on December 21, 2018. This rule must be applied in assessing extreme weather conditions before disconnection occurs. The first workshop of 2019, and subsequent workshops as necessary, shall address ways to refine the interim measures, as appropriate, consistent with best practices.

4. Comments on Proposed Decision

The proposed decision in this matter was mailed to the parties in accordance with Section 311 of the Public Utilities Code and comments were allowed under Rule 14.3 of the Commission's Rules of Practice and Procedure. Comments were filed on November 16, 2018, by Department of Community Services and Development. Comments were also filed on

November 19, 2018 by Grid Alternatives, CforAt and NCLC, CUE, PG&E, PacifiCorp, SDG&E and SoCal Gas, SCE, BVES-Liberty CalPeco and Southwest Gas. Reply comments were filed by PG&E, TURN, SDG&E and SoCalGas, SCE, BVES-Liberty Calpeco, UCAN, CforAt and NCLC, and Grid Alternatives. As appropriate, we have addressed the relevant comments in this decision.

5. Assignment of Proceeding

Pursuant to Public Utilities Code Section 1701.4 and Rule 13.2

Commissioner Martha Guzman Aceves is the assigned Commissioner and the Presiding Officer. Gerald F. Kelly is the assigned Administrative Law Judge in this proceeding.

Findings of Fact

1. The Commission opened R.18-07-005 pursuant to SB 598, in order to address disconnection rates across California's electric and gas investor-owned utilities.
2. The Commission seeks to adopt policies and rules that reduce disconnections and improve reconnection processes and outcomes for disconnected customers.
3. As noted in SB 598, residential electric and gas disconnections are on the rise and create public health impacts, especially on vulnerable populations, causing tremendous hardship and undue stress, including increased health risks to vulnerable populations, as well as overreliance on emergency services and underutilization of preventive programs.
4. Rulemaking 18-07-005 calls for a comprehensive assessment of the root causes of (or events that correlate with) residential customer disconnections while also evaluating the rules, processes and procedures regarding disconnections and reconnections at both a statewide and utility specific level.

5. The assigned Commissioner's Ruling in R.18-07-005 laid out a plan to establish interim rules to provide quick relief to address the continuing increase in disconnection. The Assigned Commissioner's Scoping Memo and Ruling proposed to: (a) limit the rate of disconnections to the 2017 levels, (b) prohibit the disconnection of specifically defined categories of vulnerable customers and (c) prevent disconnections during certain seasonal events.

6. SB 598 mandated protections for vulnerable customers for whom disconnection would be life-threatening.

7. Lost access to energy services on extremely hot or cold days can be life threatening for some populations, including infants, children, and the elderly.

8. There shall be no memorandum account treatment of costs that may be incurred in connection with complying with this decision.

Conclusions of Law

1. The parties in this proceeding have had a reasonable opportunity to comment on the Assigned Commissioner's Scoping Memo, including the interim rules proposed therein, which form the basis for this decision.

2. Given the continuing rise in the rate of residential customer disconnections throughout the service territories of California-jurisdictional utilities, it is reasonable to take quick action to adopt the interim rules set forth below while the Commission considers longer-term solutions as outlined in the Assigned Commissioner's Scoping Memo.

3. Due to the unique circumstances confronting smaller utilities, It is reasonable to conduct a separate phase concerning interim rules for the smaller IOUs.

4. Recorded levels of disconnections by each of the California-jurisdictional energy utilities during 2017, as set forth in Appendix A, form an appropriate

basis to establish a goal of reducing disconnection levels pending further Commission action in this proceeding.

5. The interim rules adopted in this decision recognize the intent and directives set forth in SB 598, as described in Rulemaking 18-05-007.

6. In line with the provisions of SB 598, it is reasonable to impose restrictions prohibiting disconnections of vulnerable customers defined as customers who qualify for medical baseline, life support and/or are above 65 years old, as long as the customer agrees to a payment plan.

7. It is reasonable to require that utilities offer vulnerable customers a payment plan of at least four months' duration.

8. It is reasonable to prohibit the energy utilities covered by the interim rules adopted in this decision from disconnecting residential electricity customers when temperatures above 100 degrees or below 32 degrees are expected based on a 72-hour look-ahead period. For this purpose, it is reasonable to allow each utility to use its own existing in-house weather forecasting processes.

9. It is reasonable to prohibit gas utilities covered by the interim rules adopted in this decision from disconnecting gas service when the temperature falls below 32-degrees on a 72-hour look-ahead period.

10. The interim rules set forth below should be adopted and made effective no later than close of business on December 21, 2018.

11. The goal of limiting disconnections to 2017 levels shall be effective January 1, 2019 for all covered IOUs, with the exception of SDG&E, who will be granted a three-month grace period prior to implementing the goal.

O R D E R

1. The interim rules set forth below are hereby adopted in order to reduce residential customer disconnections and to improve reconnection processes. These interim measures shall become effective as set forth below.. The rules shall apply to the four large Investor Owned Utilities as follows: Pacific Gas and Electric Company, Southern California Edison Company, San Diego Gas and Electric Company, and Southern California Gas Company. Pursuant to these interim rules, each of these utilities shall comply as follows:

- (a) Effective January 1, 2019, each respective utility shall set a goal of limiting residential customer disconnections using the recorded 2017 percentage of each respective utility. Disconnections implemented for each subsequent year must remain below the interim annual disconnection goal. The utilities shall use an absolute number for the interim annual disconnection goal. To calculate the absolute number, the utilities shall apply the 2017 disconnection percentages to their residential populations when this decision goes into effect. The recorded 2017 disconnection percentages to be used are set forth in Appendix A of this decision. No later than 5 business days from the mailing of this order, the utilities shall file their goal as calculated with their current residential customer population. The adopted disconnection rate goal shall remain in effect for the duration of Phase 1 of this proceeding or until annual targets for reduced residential disconnections have been adopted to ensure no further increases. The calculated goals shall be filed by a Tier 1 Advice Letter. SDG&E shall be granted a three month grace period for the goal.
- (b) Effective no later than close of business December 21, 2018, residential customers shall not be disconnected for nonpayment if they qualify for medical baseline and/or are above 65 years old, as long as the customer agrees to a payment plan. The Respondent Utility must offer a payment plan of at least four months' duration to the customer; the

customer is free to select a shorter payment plan period, but must be offered a payment plan of at least four months' duration by the Respondent Utility. For the purpose this requirement, senior citizens are defined as any permanent member of a household, age 65 or older, in any income bracket, consistent with Decision 16-09-016 criteria for purposes of applying Public Utilities Code Section 745. If anyone in a household meets that definition, the household's service may not be disconnected. The Respondent Utility is not required to make affirmative inquiry of every residential household as to whether eligible vulnerable customers reside there. If the Respondent Utility has discussions with a residential customer prior to disconnection, however, that Utility shall have a duty to inquire if anyone in that household meets the age 65+ parameters for senior citizens adopted herein.

- (c) Residential customers shall not be disconnected when temperatures above 100 degrees or below 32 degrees are forecasted based on a 72-hour look-ahead period. Each utility may continue to use its own internal weather monitoring systems for meeting this requirement.

2. Liberty Utilities, Southwest Gas Company, Bear Valley Electric Service, a division of Golden State Water Company, PacifiCorp, Alpine Natural Gas Operating Company, and West Coast Gas Company, Inc. will be included into a separate phase of this proceeding designed to establish similar interim rules at a later time in this proceeding.

- 3. If any of the large IOUs exceed the annual disconnections goal, within 60 days of exceeding the goal that IOU must file and serve a report with the Commission explaining:
 - a. why the utility is exceeding the goal,
 - b. what steps were taken by the utility to manage disconnections to remain below the goal, and

c. why those steps were insufficient in limiting disconnections to the established goal.

4. The request for a memorandum account to recover the incremental costs associated with complying with these adopted interim rules is denied.

5. If any of the rules adopted herein require changes to a utility's tariff, that utility shall promptly file an advice letter to implement such changes within 30 days of this decision. Provided that the changes are of a ministerial nature, a Tier 1 advice letter filing is acceptable for this purpose.

6. All respondents are directed to file monthly reports of specific disconnection data as specified in Appendix B, or in a form otherwise approved by the Energy Division. The first monthly report shall be filed on the 20th of the month following the mailing of this order and further reports filed the 20th of each month (or the next business day) thereafter until the interim protections have ended or further direction is provided.

7. Rulemaking 18-05-007 shall remain open for subsequent proceedings pursuant to the Assigned Commissioner's Scoping Memo.

This order is effective today.

Dated _____, at San Francisco, California.

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APPENDIX A – Disconnection Data

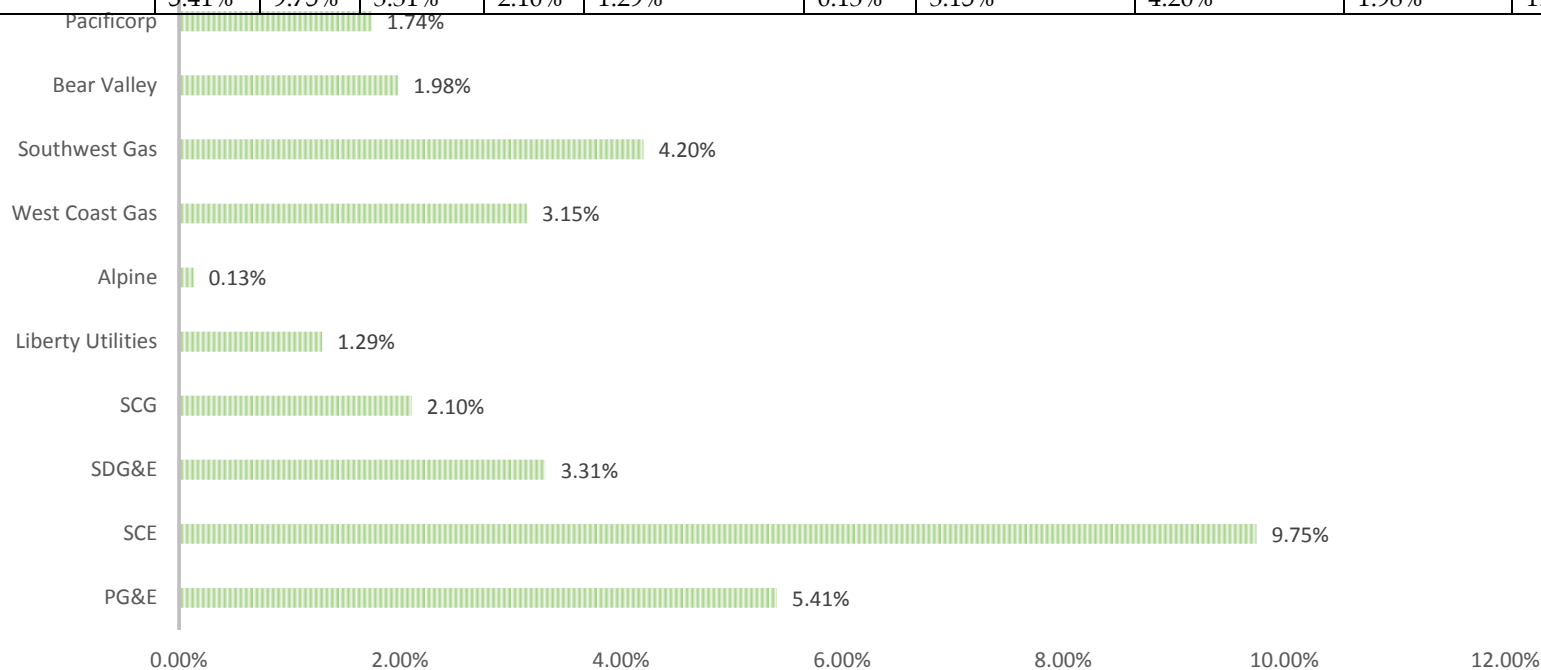
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APPENDIX B – Reporting

R.18-07-005 COM/MGA/avs

ATTACHMENT A

Disconnection rate			2017 DISCONNECTION RATE							
2017	PG&E	SCE	SDG&E	SCG	Liberty Utilities	Alpine	West Coast Gas	Southwest Gas	Bear Valley	Pacificorp
Total	5.41%	9.75%	3.31%	2.10%	1.29%	0.13%	3.15%	4.20%	1.98%	1.74%



ATTACHMENT B
Reporting

Quarterly reporting on disconnections and arrearages

Each monthly report after the first should include prior months data until the end of the calendar year.

Section 1 - Payment arrangements and bill assistance

Number of customers requesting bill assistance					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of customers with ongoing payment plans					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of customers receiving payment extension of <30 days					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of customers with 3 month payment arrangements					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of customers with 3 month+ payment arrangements					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

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Month	Number of customers who were connected with outside bill payment assistance from organizations (IOU/Local Service Provider)	Number of customers who received outside bill payment assistance from organizations (IOU/Local Service Provider)

*Please break this amount down by customer group if the information is available.

Section 2 - Broken payment arrangements

Number of customers with late or broken 3 month payment arrangements					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of customers with late or broken 3 month+ payment arrangements					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Section 3 – Arrearages

Number of customers in arrears					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of customers 31-60 days in arrears					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of customers 61-90 days in arrears					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

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Number of customers 91-120 days in arrears					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of customers 121+ days in arrears					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of accounts paid 100% within 30 days from statement date					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of accounts paid 50-99% within 30 days from statement date					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of accounts paid <50% within 30 days from statement date					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Total Dollar amount of Residential Accounts in Arrears – Month

Number of Days	All Balances	% of total outstanding
31-60 days		
61-90 days		
91-120 days		
121-150 days		
151-179 days		
180+ days		
Total outstanding receivables		

Total Dollar amount of non-CARE/FERA accounts in Arrears – Month

Number of Days	All Balances	% of total outstanding

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31-60 days		
61-90 days		
91-120 days		
121-150 days		
151-179 days		
180+ days		
Total outstanding receivables		

Total Dollar amount of CARE accounts in Arrears – Month

Number of Days	All Balances	% of total outstanding
31-60 days		
61-90 days		
91-120 days		
121-150 days		
151-179 days		
180+ days		
Total outstanding receivables		

Total Dollar amount of FERA accounts in Arrears – Month

Number of Days	All Balances	% of total outstanding
31-60 days		
61-90 days		
91-120 days		
121-150 days		
151-179 days		
180+ days		
Total outstanding receivables		

Total Dollar amount of Medical Baseline accounts in Arrears – Month

Number of Days	All Balances	% of total outstanding
31-60 days		
61-90 days		
91-120 days		
121-150 days		
151-179 days		
180+ days		
Total outstanding receivables		

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(REV. 1)

Total Dollar amount of Residential accounts in Arrears by amount owed – Month

Amount owed	All Balances	% of total outstanding
<\$500		
\$1000 - \$500		
\$2000-1000		
>\$2000		
Total outstanding receivables		

Total Dollar amount of non-CARE/FERA accounts in arrears by amount owed – Month

Amount owed	All Balances	% of total outstanding
<\$500		
\$1000 - \$500		
\$2000-1000		
>\$2000		
Total outstanding receivables		

Total Dollar amount of CARE accounts in arrears by amount owed – Month

Amount owed	All Balances	% of total outstanding
<\$500		
\$1000 - \$500		
\$2000-1000		
>\$2000		
Total outstanding receivables		

Total Dollar amount of FERA accounts in arrears by amount owed – Month

Amount owed	All Balances	% of total outstanding
<\$500		
\$1000 - \$500		
\$2000-1000		
>\$2000		
Total outstanding receivables		

Total Dollar amount of Medical Baseline accounts in arrears by amount owed – Month

Amount owed	All Balances	% of total outstanding
<\$500		
\$1000 - \$500		

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\$2000-1000		
>\$2000		
Total outstanding receivables		

Total number of accounts in arrears by amount owed – Month

Amount owed	Non CARE/FERA	CARE	FERA	Medical Baseline	Total
<\$200					
\$500-\$200					
\$1000-\$500					
\$2000-1000					
>\$2000					

Section 4 – Disconnection/termination

Number of customers experiencing disconnection for non-payment					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Out of those disconnected in the month please show those for whom it is their 2 nd or more disconnection that year					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of customers reconnected within 24 hours					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of customers reconnected within 24-48 hours					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of customers reconnected within 48-72 hours					

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Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of customers reconnected within 72+ hours					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Section 5 – Security Deposits

Number of customers with security desposits					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Section 6 – Notices

Number of customers who received an initial disconnection notice (15 day or similar)					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Number of customers who received a secondary disconnection notice (48 hour or similar)					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

Section 7 – Basic information

Number of active customer accounts in IOU territory					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

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(REV. 1)

Number of customers involuntarily returned to utility service from CCA					
Month	Non CARE/FERA	CARE	FERA	Medical Baseline	Total

*Please list this information by CCA if possible.

- A list of zip codes within the IOU territory by disconnection rate for that month, descending, Excel format
- A list of zip codes within the IOU territory by total number of disconnections for that month, descending, Excel format (if providing this information would violate customer confidentiality, please blank the affected zip codes for submission to the service list and provide the confidential version to Energy Division)

Section 8 – Interim measures information

- **Please include the calculation for the annual disconnection goal.**
- **Please list any instances in the last quarter in which your utility has invoked temperature related limits on disconnections.**
- **Please list the average amount owed of customers who were disconnected in the previous month.**

(End of Attachment B)

Conclusions of Law

1. The parties in this proceeding have had a reasonable opportunity to comment on the Assigned Commissioner's Scoping Memo, the Workshop Reports, Staff Proposals and assigned ALJ rulings, which form the basis for this decision.

2. Previously, there was a rise in the rate of residential customer disconnections throughout the service territories of California-jurisdictional utilities. In D.18-12-013, the Commission adopted various interim rules which helped to reduce the number of disconnections. Therefore, it is reasonable to adopt and make permanent some of the interim rules as set forth in D.18-12-013 and as modified by this decision.

3. Because the smaller IOUs may have unique circumstances and other challenges, it is appropriate to apply these rules only to the larger IOUs.

4. Phase 1A of this proceeding should be conducted later to determine which rules shall apply to the smaller IOUs.

5. The rules adopted in this decision recognize the intent and directives set forth in Senate Bill 598, as described in the Order Instituting Rulemaking for this proceeding.

6. In line with the provisions of SB 598, it is reasonable to impose restrictions prohibiting disconnections of customers who qualify for medical baseline , if the customer agrees to a payment plan.

7. It is reasonable to prohibit the energy utilities from disconnecting residential electricity customers when temperatures above 100 degrees or below 32 degrees are expected based on a 72-hour look-ahead period. For this purpose,

neada.org

Winter and COVID-19 Utility Shut-off Moratoriums - NEADA.ORG

Scott Dukart

8–10 minutes

If this was a normal year, 40 states would have implemented some form of utility shutoff moratoriums during the winter months to protect customers from losing their home heating when the temperature drops. Under normal circumstances, these policies can be difficult to track since they vary between states. This year, the addition of temporary shutoff moratoriums put in place to protect customers affected by the pandemic has muddied the waters even further. As spring approaches and many winter moratoriums end, millions of utility customers are finding themselves unprotected by moratoriums for the first time in over a year. This is a list of all utility actions and state-mandated moratoriums that NEADA is aware of at the time of release. Please contact Mark Wolfe (mwolfe@neada.org) or Cass Lovejoy (clovejoy@neada.org) with questions and Elizabeth Eagles (eeagles@neada.org) with additions or updates with source documentation.

1. **How many people were covered by COVID moratoriums on utility shutoffs?**

Over the summer and into the fall of 2020, a patchwork of states implemented temporary moratoriums to prevent shutoffs for customers affected by the pandemic. Some moratoriums were

extended beyond their initial end dates to coincide with annual winter shutoff moratoriums that many states implement every year to protect customers during cold winter months. Others were allowed to expire.

Table 1. Population covered by COVID-19 moratoriums, Jul. – Oct. 2020

	31-Jul	31-Aug	30-Sep	31-Oct
Population covered	184,944,156	155,527,034	138,112,481	131,102,944
% of U.S. covered	56%	48%	42%	40%

2. Projected population covered by utility moratoriums January 31 – April 30, 2021

The number of people protected from utility shutoffs is projected to decrease as annual winter moratoriums begin to expire in March and April of 2021. There are three types of state moratoriums currently at play: 1) emergency COVID-19 moratoriums that were first implemented in the spring and summer, 2) annual date-based winter moratoriums that cover all customers for a set period of time, and 3) temperature-based winter moratoriums, which only prevent utility shut-offs when the temperature drops below a certain threshold. Table 2 shows the actual and projected number of people covered by COVID-19/date-based winter moratoriums. We have combined these because they provide guaranteed coverage for a set time period. Table 3 shows the actual and projected number of people covered by temperature-based winter moratoriums, which only provide temporary protection during cold snaps.

Table 2. Projected population covered by COVID-19/date-based

utility moratoriums, January – April 2021

	31-Jan (actual)	28-Feb (actual)	31-Mar (projected)	30-Apr (projected)
Population covered	185,786,993	185,786,993	174,061,751	107,094,655
% of U.S. covered	57%	57%	53%	33%

Table 3. Projected population covered by temperature-based utility moratoriums, January – April 2021

	31-Jan (actual)	28-Feb (actual)	31-Mar (projected)	30-Apr (projected)
Population covered	104,354,835	104,354,835	93,737,412	51,665,872
% of U.S. covered	32%	32%	29%	16%

3. Active Moratoriums

The intersection of COVID and annual winter moratoriums complicates matters significantly. Some states that had COVID moratoriums in place extended them until winter date-based moratoriums went into effect. Others let theirs lapse for a month or more before winter set in. Some states that would normally have temperature-based moratoriums are still operating under COVID shutoff bans that protect customers regardless of the weather. And then there are states that do not normally have an annual winter shutoff moratorium, some of which have ongoing COVID moratoriums, while others either never had any or let them expire. A full list of COVID and winter shutoff moratoriums, including start and end dates, can be found at the bottom of the page.

Type of moratorium	Count	States
No active COVID-19 or winter moratorium	11	Alaska, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, North Dakota, Oregon, Utah, West Virginia
Active annual winter moratorium (no additional COVID protection)	10	Alabama ⁺ , Arizona ⁺ , Michigan, Minnesota, Missouri ⁺ , Nebraska, Nevada ⁺ , Oklahoma ⁺ , South Dakota, Wyoming ⁺
Moratoriums that will expire between March and July of 2021	27	Arkansas, California, Colorado, Connecticut, Delaware ⁺ , Hawaii, Illinois ⁺⁺ , Iowa ⁺⁺ , Kansas ⁺⁺ , Maine, Maryland ⁺ , Massachusetts, Mississippi*, Montana ⁺⁺ , New Hampshire*, New Jersey*, New Mexico, North Carolina*, Ohio*, Pennsylvania*, Rhode Island*, South Carolina ⁺ , Tennessee ⁺ , Texas ⁺ , Vermont, Washington, Wisconsin
Indefinite COVID moratoriums	3	DC, New York, Virginia
⁺ States that only have temperature-based winter moratoriums.		
*States with an unprotected gap between COVID-19 moratoriums and winter moratoriums.		

When do COVID-19 and winter utility moratoriums start and end in each state?

	COVID-19 Start Date	COVID-19 End Date	Winter Start Date	Winter End Date	Temperature based?
Alabama					≤32° F
Alaska	4/9/20	11/15/20			
Arizona					≤32° F
Arkansas	4/10/20	5/3/21	11/1/20	3/31/21	≤32° F
California	3/16/20	6/30/21			
Colorado	3/20/20	6/12/21			
Connecticut	3/12/20	10/31/20	11/1/20	5/1/21	
Delaware	3/24/20	11/1/20	11/15/20	4/15/21	≤20° F
DC	3/17/20	15 days after emergency			≤32° F
Florida					
Georgia			11/15/20	3/15/21	≤32° F
Hawaii	3/27/20	3/31/21			
Idaho			12/1/20	2/28/21	
Illinois	3/18/20	8/1/20	12/1/20	3/31/21	≤32° F
Indiana	3/19/20	8/14/20 (protections till 10/14/20)	12/1/20	3/15/21	

Iowa	3/13/20	7/1/20	11/1/20	4/1/21	≤20° F
Kansas	3/16/20	5/31/20	11/1/20	3/31/21	≤35° F
Kentucky	3/16/20	11/6/20			
Louisiana	3/13/20	7/16/20			
Maine	3/16/20	11/1/20	11/15/20	4/15/21	
Maryland	3/16/20	11/15/20	11/1/20	3/31/21	If 72 hr. forecast is ≤32° F
Massachusetts	3/13/20	7/1/21	11/15/20	3/15/21	
Michigan			11/1/20	3/31/21	
Minnesota			10/15/20	4/15/21	
Mississippi	3/15/20	6/14/20	12/1/20	3/31/21	
Missouri			11/1/20	3/31/21	≤32° F
Montana	3/30/20	6/30/20	11/1/20	4/1/21	≤32° F at 8an or in forecast
Nebraska			11/1/20	3/31/21	
Nevada					≤20° F
New Hampshire	3/17/20	7/15/20	11/15/20	3/31/21	
New Jersey	10/15/20	6/30/21	11/15/20	3/15/21	
New Mexico	3/19/20	Large IOUs (>100,00 meters) under moratorium	11/15/20	3/15/21	

		until 5/14/21 followed by 90-day transition period. Water utilities and smaller gas and electric under moratorium until 3/20/21 with 45-day transition period.			
New York	3/13/20	180 days after emergency or 3/31/21	11/1/20	4/15/21	<32° F
North Carolina	3/31/20	8/31/20	11/1/20	3/31/21	
North Dakota					
Ohio	3/13/20	4/1/20	10/20/20	4/15/21	
Oklahoma			11/15/20	4/15/21	≤32° F day, ≤20° F night
Oregon					
Pennsylvania	3/13/20	11/9/20 if above	12/1/20	3/31/21	

		300% FPL			
Rhode Island	3/17/20	7/17/20 (11/1/20*)	11/1/20	4/30/21	
South Carolina	3/16/20	5/15/20	12/1/20	3/31/21	Forecast $\leq 32^{\circ}$ F for 45 hrs.
South Dakota			11/1/20	3/31/21	
Tennessee	3/31/30	8/29/20			$< 32^{\circ}$ F
Texas	3/26/20	8/31/20, (9/30/20*)			$\leq 32^{\circ}$ F
Utah			11/15/20	3/15/21	
Vermont	3/18/20	Ended 10/15/20, then on 12/22/20, was extended through 3/31/21	11/1/20	3/31/21	$\leq 10^{\circ}$ F, $\leq 32^{\circ}$ F for elderly
Virginia	3/16/20	Ended 10/5/20, then on 11/18/20, was extended until 60 days after emergency			
Washington	3/19/20	7/31/21	11/1/20	3/31/21	

West Virginia					
Wisconsin	3/13/20	11/1/20	11/1/20	4/15/21	
Wyoming			11/1/20	4/30/21	≤32° F

*Extended moratorium for qualified low-income customers

Note: the above table is only meant to provide a generalized summary of temperature-based moratoriums, which in some states, have a number of caveats and further age/income restrictions. For a comprehensive list of temperature-based moratoriums, visit <https://liheapch.acf.hhs.gov/Disconnect/SeasonalDisconnect.htm>

BACKGROUND

Since 2012, California law has declared that every person in the state has a right to clean, safe, and affordable drinking water. And, it is incontrovertible that the lack of electrical power puts residents at an extreme disadvantage and potential risk of harm.

Low-Income communities and communities of color such as South LA, East Los Angeles, portions of the San Fernando Valley, and the Harbor are disproportionately impacted by high utility burdens, arrearages, and water or power shut-offs.

Our own data shows that majority Black and LatinX communities were nearly 2.5 and 2 times, respectively, more likely to experience shutoffs than majority white communities. Black and Latino-majority communities also generally experience the longest shut-off durations.

These impacts are exacerbated by the ongoing economic and climate crisis, as seen with the recent heat storms that spread across the City. Utility burden and shut-offs are symptoms of broader structural and systemic disparities, such as redlining and lack of economic and community development, that have created and reinforced inequality.

Against this backdrop, LADWP has made a commitment to equity and seeks to ensure baseline protections for its customers as we work to achieve utility debt relief, affordable rates, a just clean energy transition, and better customer service. Notably, as part of its commitment, LADWP participated in the US Water Alliance's Preventing Shutoffs for Low-Income Households pilot project in partnership with SCOPE and South LA community members, which included extensive analysis of utility shut-off data, community impacts, and recommended strategies to discontinue utility shutoff as a debt collection practice with respect to low-income customers.

A review of customer bill paying patterns before, during and after the COVID shutoff moratorium revealed that low income customers continued to pay their utility bills at a rate equal to or higher than the overall customer base. And, based on its review of publicly available data, researchers from the UCLA Luskin Center for Innovation and UCLA Institute of the Environment currently supporting the Department's LA 100 Equity Strategies effort concluded that service shut off of low-income customers is not plausibly justified as a revenue recovery imperative.

At our September 27, 2022, Board Meeting, LADWP staff shared plans to restart shut-offs for residential non-discount customers in May 2023 and residential discount customers in September 2023 in addition to efforts to develop and deploy a range of programs intended to offer more robust support for economically vulnerable customers.

**MOTION TO DISCONTINUE SHUT-OFFS AS AN ACCOUNT
MANAGEMENT/COLLECTION TOOL FOR CUSTOMERS ENROLLED IN LADWP
EZ-SAVE AND LIFELINE DISCOUNT PROGRAMS**

**I move that the Board of Water and Power Commissioners instruct the
Department to:**

1. Discontinue collection-related water and power shutoffs aimed at low-income residential customers enrolled in LADWP EZ-SAVE, Lifeline and related assistance programs; and continue to ramp up efforts to secure utility debt relief, improve affordability, pursue equitable decarbonization efforts, provide comprehensive customer service, and increase pathways to family-sustaining union jobs at LADWP.
2. Prioritize customers who would have been at risk of disconnection prior to the adoption of this motion for a “Customer Consultation” as part of the Department’s recently adopted program.
3. Discontinue water and power shutoffs for all customers during extreme weather events. [Implementation of this provision should be set to localized climate conditions in the City of Los Angeles and approved by this Board at a future meeting].
4. Increase marketing and communication efforts, with a combination of both paid and earned media, directed at targeted customers/communities to meaningfully increase awareness and enrollment in EZ-SAVE, Lifeline and related programs, including but not limited to “level pay” and report to the Board semi-annually on results.
5. Through the Office of Diversity, Equity, and Inclusion, develop and implement sustainable partnerships with community-based organizations to meaningfully leverage and enhance communication and outreach efforts to targeted customers/communities regarding LADWP programs related to both debt relief and sustainability and report to the Board annually on results. CBO’s serving on the Equity Strategies Steering Committee should be prioritized for partnership consideration.
6. Explore the feasibility of adopting a policy to extend additional shutoff protections to small commercial customers and customers in the top 20% highest scoring census tracts under CalEnviroScreen 4.0.

When using these data, please cite: Sanya Carley and David Konisky, 2023, "Utility Disconnections
For questions about these data, please email: enjab@indiana.edu

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State	Cold-based protections	Date-based protections	Temperature-based protections
Alabama	Yes	No	Yes
Alaska	No	No	No
Arizona	No	No	No
Arkansas	Yes	No	Yes
California	Yes	No	Yes
Colorado	Yes	No	Yes
Connecticut	Yes	Yes	No
Delaware	Yes	Yes	Yes
District of Columbia	Yes	No	Yes
Florida	No	No	No
Georgia	Yes	Yes	Yes
Hawaii	No	No	No
Idaho	Yes	Yes	No
Illinois	Yes	Yes	Yes
Indiana	Yes	Yes	No
Iowa	Yes	Yes	Yes
Kansas	Yes	Yes	Yes
Kentucky	Yes	Yes	No
Louisiana	Yes	No	Yes
Maine	Yes	Yes	Yes
Maryland	Yes	Yes	Yes
Massachusetts	Yes	Yes	No
Michigan	Yes	Yes	No
Minnesota	Yes	Yes	No
Mississippi	Yes	Yes	No
Missouri	Yes	No	Yes
Montana	Yes	Yes	Yes
Nebraska	No	No	No
Nevada	Yes	No	Yes
New Hampshire	Yes	Yes	No
New Jersey	Yes	Yes	Yes
New Mexico	Yes	Yes	No
New York	Yes	Yes	No
North Carolina	Yes	Yes	No
North Dakota	No	No	No
Ohio	Yes	Yes	No
Oklahoma	Yes	No	Yes
Oregon	Yes	No	Yes
Pennsylvania	Yes	Yes	No
Rhode Island	Yes	Yes	No
South Carolina	Yes	Yes	No
South Dakota	Yes	Yes	No
Tennessee	No	No	No
Texas	Yes	No	Yes
Utah	No	No	No
Vermont	Yes	Yes	Yes
Virginia	No	No	No
Washington	Yes	Yes	No
West Virginia	Yes	No	Yes
Wisconsin	Yes	Yes	No
Wyoming	Yes	Yes	Yes

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State	Heat-based protections	Date-based protections	Temperature-based protections
Alabama	No	No	No
Alaska	No	No	No
Arizona	Yes	No	No
Arkansas	Yes	No	Yes
California	Yes	No	Yes
Colorado	Yes	No	Yes
Connecticut	No	No	No
Delaware	Yes	Yes	Yes
District of Columbia	Yes	No	Yes
Florida	No	No	No
Georgia	Yes	No	No
Hawaii	No	No	No
Idaho	No	No	No
Illinois	Yes	No	Yes
Indiana	No	No	No
Iowa	No	No	No
Kansas	No	No	No
Kentucky	No	No	No
Louisiana	Yes	No	No
Maine	No	No	No
Maryland	Yes	No	Yes
Massachusetts	No	No	No
Michigan	No	No	No
Minnesota	Yes	No	No
Mississippi	Yes	No	No
Missouri	Yes	Yes	Yes
Montana	No	No	No
Nebraska	No	No	No
Nevada	Yes	No	Yes
New Hampshire	No	No	No
New Jersey	Yes	No	Yes
New Mexico	No	No	No
New York	No	No	No
North Carolina	No	No	No
North Dakota	No	No	No
Ohio	No	No	No
Oklahoma	Yes	No	Yes
Oregon	Yes	No	No
Pennsylvania	No	No	No
Rhode Island	Yes	No	No
South Carolina	No	No	No
South Dakota	No	No	No
Tennessee	No	No	No
Texas	Yes	No	No
Utah	No	No	No
Vermont	No	No	No
Virginia	No	No	No
Washington	Yes	No	Yes
West Virginia	No	No	No
Wisconsin	Yes	No	No
Wyoming	No	No	No

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For questions about these data, please email: enjab@indiana.edu

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State	Young Individuals	Medical Condition Individuals	Elderly People	Individuals with Disabilities	Military Veterans
Alabama	No	No	No	No	No
Alaska	No	Yes	Yes	Yes	No
Arizona	No	Yes	No	No	No
Arkansas	No	Yes	Yes	Yes	No
California	No	Yes	No	No	Yes
Colorado	No	Yes	No	No	No
Connecticut	No	Yes	No	No	No
Delaware	No	Yes	No	No	Yes
District of Columbia	No	Yes	No	No	No
Florida	No	No	No	No	No
Georgia	No	Yes	No	No	No
Hawaii	No	No	No	No	No
Idaho	Yes	Yes	Yes	No	No
Illinois	No	Yes	No	No	Yes
Indiana	No	Yes	No	No	No
Iowa	No	Yes	No	No	Yes
Kansas	No	No	No	No	No
Kentucky	No	Yes	No	No	No
Louisiana	No	Yes	No	No	Yes
Maine	No	Yes	No	No	No
Maryland	No	Yes	No	No	No
Massachusetts	Yes	Yes	Yes	No	No
Michigan	No	Yes	Yes	No	Yes
Minnesota	No	Yes	No	No	No
Mississippi	No	Yes	No	No	No
Missouri	No	Yes	No	No	No
Montana	No	Yes	Yes	Yes	No
Nebraska	No	Yes	No	Yes	No
Nevada	No	Yes	Yes	Yes	No
New Hampshire	No	Yes	No	No	No
New Jersey	No	Yes	No	No	No
New Mexico	No	Yes	No	No	No
New York	No	Yes	Yes	Yes	No
North Carolina	No	No	Yes	Yes	No
North Dakota	No	Yes	Yes	Yes	No
Ohio	No	Yes	No	No	Yes
Oklahoma	No	Yes	Yes	Yes	No
Oregon	No	Yes	No	No	No
Pennsylvania	No	Yes	No	No	No
Rhode Island	Yes	Yes	Yes	Yes	No
South Carolina	No	Yes	No	No	No
South Dakota	No	Yes	No	No	No
Tennessee	No	Yes	No	No	No
Texas	No	Yes	No	No	No
Utah	No	Yes	No	No	No
Vermont	No	Yes	Yes	No	No
Virginia	No	Yes	No	No	No
Washington	No	Yes	No	No	No
West Virginia	No	No	No	No	No
Wisconsin	Yes	Yes	Yes	Yes	No
Wyoming	No	Yes	No	No	No

When using these data, please cite: Sanya Carley and David Konisky, 2023, "Utility Disconnections Dashboard," Energy Justice Lab
For questions about these data, please email: enjlal@indiana.edu

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State	Must a utility provide written notice?	Must a utility attempt in-person notification?	Must a utility attempt notice by phone?	Minimum number of days' notice prior to shutoff
Alabama	Yes	No	No	5 days
Alaska	Yes	Yes	Yes	15 days
Arizona	Yes	No	Yes	10 days
Arkansas	Yes	No	No	5 days
California	Yes	No	No	10 days
Colorado	Yes	Yes	Yes	12 days
Connecticut	Yes	No	No	13 days
Delaware	Yes	No	Yes	3 days
District of Columbia	Yes	No	No	15 days
Florida	Yes	Yes	No	5 working days
Georgia	Yes	No	No	5 days
Hawaii	Yes	No	No	5 days
Idaho	Yes	Yes	Yes	7 days
Illinois	Yes	No	Yes	10 days
Indiana	Yes	No	No	14 days
Iowa	Yes	Yes	Yes	12 days
Kansas	Yes	No	Yes	10 days
Kentucky	Yes	No	No	10 days
Louisiana	Yes	No	No	5 days
Maine	Yes	Yes	Yes	14 days
Maryland	Yes	Yes	Yes	14 days
Massachusetts	Yes	Yes	Yes	3 days
Michigan	Yes	No	Yes	10 days
Minnesota	Yes	Yes	No	5 days
Mississippi	Yes	No	No	5 days
Missouri	Yes	No	Yes	10 days
Montana	Yes	Yes	Yes	20 days
Nebraska	Yes	No	No	7 working days
Nevada	Yes	Yes	No	10 days
New Hampshire	Yes	Yes	Yes	14 days
New Jersey	Yes	Yes	No	10 days
New Mexico	Yes	No	No	15 days
New York	Yes	Yes	Yes	15 days
North Carolina	Yes	Yes	Yes	10 days
North Dakota	Yes	Yes	No	10 days
Ohio	Yes	Yes	No	14 days
Oklahoma	Yes	No	No	10 days
Oregon	Yes	Yes	Yes	15 days
Pennsylvania	Yes	No	No	10 days
Rhode Island	Yes	No	Yes	10 days
South Carolina	Yes	No	No	10 days
South Dakota	Yes	No	No	10 days
Tennessee	Yes	No	No	7 days
Texas	Yes	No	No	10 days
Utah	Yes	No	No	10 days
Vermont	Yes	Yes	Yes	14 days
Virginia	Yes	No	No	10 days
Washington	Yes	No	Yes	8 days
West Virginia	Yes	No	No	10 days
Wisconsin	Yes	Yes	No	10 days
Wyoming	No	Yes	Yes	7 days

STATE OF MICHIGAN
BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

In the matter of the application of **DTE GAS COMPANY** for authority to increase its rates, amend its rate schedules and rules governing the distribution and supply of natural gas, and for miscellaneous accounting authority.

Case No. U-21291

ALJ Jonathan F. Thoits

PROOF OF SERVICE

I, Mark Templeton, certify that an electronic copy of the Official Exhibits FLO-135 to FLO-167 (Part 7 of 13) on Behalf of Frontline Organizations was served on the following on June 24, 2024.

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The statements above are true to the best of my knowledge, information, and belief.

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