DTE Electric Company
One Energy Plaza, 1635 WCB
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September 12, 2024

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

RE: In the matter of the Application of **DTE ELECTRIC COMPANY** for authority to increase its rates, amend its rate schedules and rules governing the distribution and supply of electric energy, and for miscellaneous accounting authority
MPSC Case No. U-21534

Dear Ms. Felice:

The following is attached for paperless electronic filing:

Official Exhibits of the DTE Electric Company admitted into the record on September 4-6, 2024 and September 9-10, 2024:

Exhibits A-25 thru A-40

If you have any questions or concerns with this filing, please contact me at the above referenced number.

Respectfully submitted,

Estella R. Branson

Digitally signed by Estella R. Branson
Date: 2024.09.12 12:44:57 -04'00'

Estella R. Branson
Senior Paralegal

Enclosure

Michigan Public Service Commission
DTE Electric Company
Community Lighting Outage Duration
2017 through 2023

Case No.: U-21534
Exhibit: A-25
Schedule: O1
Witness: R. A. Bellini
Page: 1 of 1

Line No.	Description	(a) 2017	(b) 2018	(c) 2019	(d) 2020	(e) 2021	(f) 2022	(g) 2023
					Year			
1	**Average Days Duration ***	3.60	3.53	3.89	3.27	5.22	4.7	4.16**
2	**Standard Events Completed**	18,999	19,241	21,738	19,136	17,512	17,799	14,842
3	**OK on Arrival**	2,522	2,587	3,647	2,258	3,011	2,527	2,223
4	**SL Knockdowns**	285	209	313	265	161	428	355
5	**Standard Events Adjusted**	16,192	16,445	17,778	16,613	14,340	14,844	12,264
6	**Long Duration Defects - Standard (> than 10 Days)**	801	415	1,050	578	2,488	1,541	909***
7	**# of Follow Up Events Completed**	1,671	2,067	1,750	1,624	1,131	1,931	1,702***
8	**Follow Up Outage Events Duration**	35.81	56.32	65.49	29.99	30.07	33.2	18.3**
9	**Total Duration Days (Incl. Follow Up Events + Standard Events)**	6.08	8.38	9.52	5.36	7.99	7.24	5.34**
					Night Patrol Results			
10	**Night Patrols (Total Lights Canvassed**	N/A	N/A	62,002	178,498	223,364	173,998	91,782
11	**Total Lights Identified as Non-Operational**	N/A	N/A	1,614	7,578	9,082	6,215	4,012
12	**% of Lights Confirmed as Non-Operational**	N/A	N/A	2.60%	4.25%	4.07%	3.57%	4.37%

* Average Outage Duration Cycle times are expressed in Days. Performance metrics do not include any patrol and fix activities. Outdoor Lighting Events include all underground fault repair times and 3rd party damage repairs. The total cycle time is measured from when the outage was first reported to when repaired and operating again. Metrics are specific to all Company owned, operated and maintained lights.

**DTE - Community Lighting retired its Outage Management System (OMS) in January 2023 and migrated to a new OMS effective October 2023. Our interim OMS system was not able to calculate duration metrics and therefore duration metrics are reflective of only the new events created within the current OMS.

***DTE - Community Lighting retired its Outage Management System (OMS) in January 2023 and migrated to a new OMS effective October 2023. Our interim OMS system was not able to uniquely identify long duration and follow-up events; DTE estimated both by using the counts from the new events created within the current OMS and extrapolating to the first nine months.

Michigan Public Service Commission
DTE Electric Company
Community Lighting Outage Cost
2017 through 2023

Case No.: U-21534
Exhibit: A-25
Schedule: O2
Witness: R. A. Bellini
Page: 1 of 1

Line No.	Description	(a) 2017	(b) 2018	(c) 2019	(d) 2020	(e) 2021	(f) 2022	(g) 2023
					Year			
1	**Total Outgage Cost ($000)**	$ 4,566	$ 5,238	$ 7,792	$ 6,080	$ 6,594	$ 8,050	$ 9,400
2	**Total Outage Events**	20,670	21,308	23,488	20,760	18,643	19,730	16,544
3	**Outage Cost Per Event**	$ 221	$ 246	$ 332	$ 293	$ 354	$ 408	$ 568
4	**Total DTE-owned Assets**	191,795	193,334	194,698	196,936	197,560	199,085	199,490

November 29, 2023

Dear Community Lighting Customer,

We want to update you on a change to the streetlights and outdoor protective lights that DTE Energy currently offers and your municipality currently utilizes.

As consumer demand shifts from HID style luminaires, which includes High Pressure Sodium (HPS), to more energy efficient LED style options, DTE has been notified by our manufacturers that they will no longer produce HPS fixtures. The HPS lighting option will be phased out of their product lines throughout 2024.

Since your municipality still has HPS lighting, DTE will continue to replace any light fixture that fails with the equivalent HPS fixture until our inventory is depleted. After our HPS fixture inventory has been depleted, DTE will replace any failed HPS fixtures with the equivalent wattage LED fixture and the change in rates will be updated on your next monthly bill.

While this is a change, LEDs offer several benefits. If you are interested, DTE is able to proactively convert your HPS fixtures to LED. If this conversion is completed during the 2024 construction season, your municipality will be able to take advantage of a labor credit to offset the project cost. You may also be able to benefit from Energy Efficiency rebates.

We value your partnership and serving our communities. If you're interested in getting your municipality added to the 2024 conversion project list, please contact your assigned Account Manager.

Schedule a time to speak with your account manager by scanning the QR code.

As always, we appreciate being your streetlight provider.

Sincerely,

DTE Energy Community Lighting

Michigan Public Service Commission
DTE Electric Company
WP Calculation of $5.8M Disallowance
by MI-MAUI in U-21297

Note: This exhibit is an excerpt from a workpaper prepared by Witness Bunch (MI-MAUI) as part of his direct testimony in Case No. U-21297; it is a calculation of DTE's overspend (columns P through U) resulting in a $5.8M LED plant disallowance. The total overspend is summarized on the first line of this exhibit.

Case No.: U-21534
Exhibit: A-25
Schedule: O4
Witness: R. A. Bellini

DTE LED Conversions vs Leotek Recommended

Line No.	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
1									Total overspend (Leotek recommended vs DTE choice)	$	5,838,950
2									Impact on required revenue at 5.6986%	$	332,738
3	LookUp	Description	UG / OH	Lamp Type	LAMP WATTAGE	Original HID Fixture	Leotek Recommended Watts Medium	DTE Cost of Leotek Recommended LED	Cost of Actual DTE Choice	Unit Cost difference	Total Cost Difference (Overspend)
4	E1 SL - Option I-UG	De-Energized	UG	HPS	250						
5	E1 SL - Option I-UG	NULL	UG	HPS	70						
6	E1 SL - Option I-UG	NULL	UG	HPS	100						
7	E1 SL - Option I-UG	NULL	UG	HPS	150				25,355.0	24,415.00	
8	E1 SL - Option I-UG	NULL	UG	HPS	250					940.00	
9	E1 SL - Option I-UG	NULL	UG	HPS	400					0.04	
10	E1 SL - Option I-UG	NULL	UG	HPS	1,000				3,745.0	0.15	
11	E1 SL - Option I-UG	De-Energized	UG	LED	65						
12	E1 SL - Option I-UG	Dusk-Midnight	UG	LED	135				23,488.0	19,730.00	$ 3,758
13	E1 SL - Option I-UG	NULL	UG	LED	35	70	27	120.0	120.0	-	$ -
14	E1 SL - Option I-UG	NULL	UG	LED	45					-	$ -
15	E1 SL - Option I-UG	NULL	UG	LED	55	100	30	120.0	152.7	32.73	$ 168,265
16	E1 SL - Option I-UG	NULL	UG	LED	65	100	30	120.0	169.1	49.09	$ 443,037
17	E1 SL - Option I-UG	NULL	UG	LED	75	150	64	169.1	185.5	16.37	$ 24,080
18	E1 SL - Option I-UG	NULL	UG	LED	85	150	64	169.1	210.8	41.73	$ 55,042
19	E1 SL - Option I-UG	NULL	UG	LED	95					-	$ -
20	E1 SL - Option I-UG	NULL	UG	LED	105					-	$ -
21	E1 SL - Option I-UG	NULL	UG	LED	115					-	$ -
22	E1 SL - Option I-UG	NULL	UG	LED	125					-	$ -
23	E1 SL - Option I-UG	NULL	UG	LED	135	250	89	201.8	283.6	81.82	$ 1,211,018
24	E1 SL - Option I-UG	NULL	UG	LED	145	250	89	201.8	294.8	92.98	$ 18,968
25	E1 SL - Option I-UG	NULL	UG	LED	155	250	89	201.8	306.0	104.13	$ 97,257
26	E1 SL - Option I-UG	NULL	UG	LED	165					-	$ -
27	E1 SL - Option I-UG	NULL	UG	LED	175	310	123	267.3	328.3	60.98	$ 43,357
28	E1 SL - Option I-UG	NULL	UG	LED	185					-	$ -
29	E1 SL - Option I-UG	NULL	UG	LED	205	400	171	328.3	361.7	33.47	$ 19,814
30	E1 SL - Option I-UG	NULL	UG	LED	215					-	$ -
31	E1 SL - Option I-UG	NULL	UG	LED	235	400	171	328.3	395.2	66.94	$ 37,486
32	E1 SL - Option I-UG	NULL	UG	LED	245					-	$ -
33	E1 SL - Option I-UG	NULL	UG	LED	255					-	$ -
34	E1 SL - Option I-UG	NULL	UG	LED	265					-	$ -
35	E1 SL - Option I-UG	NULL	UG	LED	285	400	171	328.3	451.0	122.72	$ 138,060
36	E1 SL - Option I-UG	NULL	UG	LED	295						
37	E1 SL - Option I-UG	NULL	UG	MH	70						
38	E1 SL - Option I-UG	NULL	UG	MH	100						
39	E1 SL - Option I-UG	NULL	UG	MH	150						

Michigan Public Service Commission
DTE Electric Company
WP Calculation of $5.8M Disallowance
by MI-MAUI in U-21297

Case No.: U-21534
Exhibit: A-25
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Page: 2 of 2

Line No.	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
						DTE LED Conversions vs Leotek Recommended					
1	LookUp	Description	UG / OH	Lamp Type	LAMP WATTAGE	Original HID Fixture	Leotek Recommended Watts Medium	DTE Cost of Leotek Recommended LED	Cost of Actual DTE Choice	Unit Cost difference	Total Cost Difference (Overspend)
2	E1 SL - Option I-UG	NULL	UG	MH	175						
3	E1 SL - Option I-UG	NULL	UG	MH	250						
4	E1 SL - Option I-UG	NULL	UG	MH	400						
5	E1 SL - Option I-UG	NULL	UG	MV	100						
6	E1 SL - Option I-UG	NULL	UG	MV	175						
7	E1 SL - Option I-UG	NULL	UG	MV	250						
8	E1 SL - Option I-UG	NULL	UG	MV	400						
9	E1 SL - Option I-OH	De-Energized	OH	HPS	100						
10	E1 SL - Option I-OH	De-Energized	OH	HPS	250						
11	E1 SL - Option I-OH	Dusk-Midnight	OH	HPS	250						
12	E1 SL - Option I-OH	Dusk-Midnight	OH	HPS	400						
13	E1 SL - Option I-OH	NULL	OH	HPS	70						
14	E1 SL - Option I-OH	NULL	OH	HPS	100						
15	E1 SL - Option I-OH	NULL	OH	HPS	150						
16	E1 SL - Option I-OH	NULL	OH	HPS	250						
17	E1 SL - Option I-OH	NULL	OH	HPS	400						
18	E1 SL - Option I-OH	NULL	OH	HPS	1,000						
19	E1 SL - Option I-OH	Dusk-Midnight	OH	LED	135						
20	E1 SL - Option I-OH	Dusk-Midnight	OH	LED	285						
21	E1 SL - Option I-OH	NULL	OH	LED	45						
22	E1 SL - Option I-OH	NULL	OH	LED	55	100	30	120.0	152.7	32.73	$ 374,333
23	E1 SL - Option I-OH	NULL	OH	LED	65	100	30	120.0	169.1	49.09	$ 1,761,300
24	E1 SL - Option I-OH	NULL	OH	LED	75					-	$ -
25	E1 SL - Option I-OH	NULL	OH	LED	85	150	64	169.1	201.8	32.73	$ 33,810
26	E1 SL - Option I-OH	NULL	OH	LED	95	150	64	169.1	218.2	49.10	$ 74,190
27	E1 SL - Option I-OH	NULL	OH	LED	105					-	$ -
28	E1 SL - Option I-OH	NULL	OH	LED	115					-	$ -
29	E1 SL - Option I-OH	NULL	OH	LED	125					-	$ -
30	E1 SL - Option I-OH	NULL	OH	LED	135	250	89	201.8	283.6	81.82	$ 1,258,964
31	E1 SL - Option I-OH	NULL	OH	LED	145					-	$ -
32	E1 SL - Option I-OH	NULL	OH	LED	155					-	$ -
33	E1 SL - Option I-OH	NULL	OH	LED	165					-	$ -
34	E1 SL - Option I-OH	NULL	OH	LED	175					-	$ -
35	E1 SL - Option I-OH	NULL	OH	LED	185					-	$ -
36	E1 SL - Option I-OH	NULL	OH	LED	205					-	$ -
37	E1 SL - Option I-OH	NULL	OH	LED	215					-	$ -
38	E1 SL - Option I-OH	NULL	OH	LED	235					-	$ -
39	E1 SL - Option I-OH	NULL	OH	LED	245					-	$ -
40	E1 SL - Option I-OH	NULL	OH	LED	255					-	$ -
41	E1 SL - Option I-OH	NULL	OH	LED	285	400	171	328.3	451.0	122.72	$ 76,209
42	E1 SL - Option I-OH	NULL	OH	LED	295					-	$ -
43	E1 SL - Option I-OH	NULL	OH	LED	305					-	$ -
44	E1 SL - Option I-OH	NULL	OH	LED	325					-	$ -

DTE LED STEET LIGHT LUMINARE SELECTION PROCESS REVIEW

DMD CONSULTING ENGINEERING LTD

Table of Contents

1 INTRODUCTION

The purpose of this report is to provide a review of DTE's replacement LED roadway luminaire selection process and to provide an opinion as to whether the approach used by DTE is accurate and well-reasoned. This report applies to luminaire selection on the basis of selecting a new LED luminaire to replace an existing 100W and 250W high pressure sodium (HPS) luminaires while still maintaining existing lighting levels.

The scope of this assignment is therefore to review DTE selection methodology exclusive to HPS-LED conversions on existing roadways.

DMD were selected by DTE based on our extensive expertise with respect to street lighting design and HPS to LED conversions.

2 TERMINOLOGY/DEFINITIONS

Terminologies defined and contained in this report are as follows:

- Average illuminance (Eav) – Over a surface, illuminance averaged over the specified surface, the amount of light falling incident to a surface.
- Footcandle (fc) The unit of illumination when the foot is taken as the unit of length. It is the illumination on a surface one square foot in area on which there is a uniformly distributed flux of one lumen, or the illumination produced on a surface, all points of which are at a distance of one foot from a directionally uniform point source of one candela.
- High pressure sodium (HPS) lamp – A high-intensity discharge (HID) screw-in lamp in which light is produced by radiation from sodium vapor source.
- Light-emitting diode (LED) – A solid-state diode whose radiated output is a function of its physical construction, material used, and exciting current.
- Lumen (lm) – The unit of luminous flux. It is equal to the flux through a unit solid angle (steradian) from a uniform point source of one candela (candle), or to the flux on a unit surface all points of which are at unit distance from a uniform point source of one candela.
- Luminance (L) - Luminance in a direction, at a point on the surface view at 83m from the point.
- Luminaire – Apparatus that distributes, filters or transforms the light.
- Photometry – Measurement of quantities referring to radiation as evaluated according to a given luminous efficiency function, e.g. V(λ) or V'(λ).
- Watt – The unit of power produced by a current of one ampere across a potential difference of one volt.
- Uniformity Ratio– On a given plane. A measure of the variation of illuminance over the plane expressed as either – 1. The ratio of the minimum to the maximum illuminance. – 2. The ratio of the minimum to the average illuminance.

3 REVIEW

Prior to starting the review, DMD had a meeting with DTE to review processes and discuss the scope. A number of additional meetings were held to respond to questions and clarify where required.

The following documentation materials were provided by DTE:

- Work Paper A - AGI32 simulation files for 7 road type templates traditionally lit with 100 Watt HPS Luminaires previously analyzed by DTE Energy (7 files)
- Work Paper B - AGI Simulation files for 4 potential solid state replacements for the 7 “100” Watt templates” (28 files)
- Work Paper C - AGI32 simulation files for 4 road type templates traditionally lit with 250 Watt HPS Luminaires previously analyzed by DTE Energy (4 files)
- Work Paper D - AGI Simulation files for 4 potential solid-state replacements for the 4 “250” Watt templates” (16 files)
- Work Paper E - Format Intensity Distribution files for Leotek potential replacement luminaires 100Watt HPS
- Work Paper F - Format Intensity Distribution files for Leotek potential replacement luminaires 250 Watt HPS
- Work Paper G – DTE Roadway Typicals Master Table 02 01 18
- Work Paper H – Application Performance Results 100 HPS ALL LED to HPS 11 11 22
- Work Paper I – Application Performance Results 100 HPS DTE LED to Leotek LED’s 11 11 22
- Work Paper J – Application Performance Results 250 HPS ALL LED to HPS 11 11 22
- Work Paper K – Application Performance Results 250 HPS DTE LED to Leotek LED’s 11 11 22
- Work Paper L - 100 Watt HPS to LED Equivalent – Rendered Performance Comparison
- Work Paper M - 250 Watt HPS to LED Equivalent – Rendered Performance Comparison
- Work Paper N – Local Local Intersections
- Work Paper O – Collector Collector Intersections

- Work Paper P – HPS IES Files (2 files)
- Work Paper Q – Leotek LED IES Files (8 files)

Documentation was generally reviewed which was applicable to the analysis. Note our review was based solely on the luminaires and wattages provided by DTE.

We reviewed the LED replacement luminaires defined by DTE for the 100W and 250W HPS.

For the purpose of this LED conversion, DTE compared luminaires in their opening day condition where they would have maximum light output. This seems to be reasonable approach to an HPS to LED luminaire comparison.

DMD's review consisted of performing spot checks of the lighting asset data defined in Work Paper G – DTE Roadway Typicals Master Table 02 01 18 against the lighting calculations performed by DTE. The spot check also included a review of the lighting calculation target levels summaries. DMD then reviewed the various calculation summaries for each LED option against the HPS baseline, see below for our review.

We understand DTE requires all IES photometric files furnished from lighting manufacturers for assessment must be goniophotometer tested by an NVLAP-accredited testing and calibration laboratory. The National Institute of Standards and Technology (NIST) administers the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP provides accreditation in testing and calibration laboratory used for Caliper LM-79 testing in solid-state lighting (SSL) products. This is in line with industry practice.

DMD noted two minor errors in DTE's calculation files. The first being in roadway 100 D (as defined in Work Paper G – DTE Roadway Typicals Master Table 02 01 18, which listed an arm length of 7.5' when a 6' arm was used in the calculations. The second error was found in roadway 250 F (as defined in Work Paper G), which listed a pavement classification value of R2 when R3 was used in the calculations. Additionally, for roadway 250 F, a setback of 3' and 10' was listed in Work Paper G, when the calculations showed 3' pole setbacks for both sides of the street. DMD ran our own calculations in these scenarios to accurately reflect the data in Work Paper G, and updated the averaged luminaire performance for both 100W and 250W HPS luminaire replacements which we reference in this section of the report.

Our revised calculation summary is found in our "Revised Performance Summary.xlsx" spreadsheet we provided to DTE. Our corrections did not produce significant differences in results to DTE's original analysis. DMD also conducted local-local and collector-collector intersection lighting analysis for the same fixtures DTE selected for comparison in the 100W and 250W HPS roadway replacements.

DMD documentation included in this report and provided to DTE:

- "Revised Rdwy Performance Summary.xlsx" This document corrects the errors found in roadways 100 D and 250 F, and acts as an updated Work Paper I and Work Paper K for Illuminance, Luminance and spill lighting.
- "Intersection Performance Summary.xlsx"

DMD has summarized the data provided by DTE (incorporating our updated calculations) for the 100W and 250W HPS fixtures to be replaced. The comparison data includes a baseline calculation for the existing HPS luminaire and the 4 LED luminaires DTE used in the conversion analysis.

100W HPS replacement

"Revised Rdwy Performance Summary.xlsx" contains Target Roadway lighting calculation summaries for Roadways 100A through 100G as they are described in Work Paper G - Roadway Typicals Master Table 02 01 18. These 7 roadways pertain to 100W HPS replacements only. The calculation summaries contain roadway Luminance and Illuminance metrics for the existing 100W HPS and the 4 LED luminaires DTE used in the conversion analysis.

"Revised Rdwy Performance Summary.xlsx" then takes the calculation summaries for each of the 4 LED models considered in the analysis and compares the average values for Luminance and Illuminance to the average values for the HPS luminaire as HPS is taken as the baseline. See below for a summary of the performance comparisons between HPS (baseline) and the LED luminaires:

27W LED

The 27W LED luminaire provides an average Illuminance level that is 36.9% below the average level achieved by the HPS baseline and the 27W LED provides an average Luminance level that is 31.3% below the average level achieved by the HPS baseline.

The 27W LED does not adequately perform to the same level as the existing HPS luminaire.

30W LED

The 30W LED luminaire provides an average Illuminance level that is 29.5% below the average level achieved by the HPS baseline and the 30W LED provides an average Luminance level that is 20.5% below the average level achieved by the HPS Baseline.

The 30W LED does not adequately perform to the same level as the existing HPS luminaire.

37W LED

The 37W LED luminaire provides an average Illuminance level that is 13.4% below the average level achieved by the HPS baseline and the 37W LED provides an average Luminance level that is 3.0% below the average level achieved by the HPS Baseline.

The 37W LED does not adequately perform to the same level as the existing HPS luminaire.

58W LED

The 58W LED luminaire provides an average Illuminance level that is 6.5% higher than the HPS baseline and the 58W LED provides an average Luminance level that is 27.7% higher than the HPS baseline.

The 58W LED maintains the minimum Luminance and Illuminance target levels defined by the HPS baseline.

Summary

We have reviewed DTE's LED luminaire assessment process based on files provided (AGi32 files, analysis spreadsheet, etc.) for the HPS to LED comparison. We confirm that the data matches calculations DTE provided for the seven sample straight continuously lighted roadway configs for the 100W HPS evaluation. Where DMD found errors in DTE's initial analysis, we corrected the calculations and based our luminaire evaluation on an updated comparison summary. Our findings arrived at the same luminaire selection as DTE's original evaluation.

Typically recommended lighting levels are treated as a minimum maintained requirement, there are no strict guidelines regarding over lighting or ranges associated with over lighting.

Of the 4 LED luminaires compared in this analysis, the 58W LED luminaire is the only fixture that is capable of meeting Average Luminance and Illuminance of the 100W HPS baseline opening day light levels calculated over the 7 roadway types.

The 58W luminaire meets off target max spill lighting values along the property frontages when compared to the 100W HPS baseline. The 37W and 30W fixtures fail spill lighting target levels.

Based on many recent LED conversions, we have found that the actual energy reduction to be around 50% to 60% based on HPS input watts. In this case the input watts, including ballast loss (130W) divided by the LED input wattage (58W) resulting in a 55% decrease in wattage.

250W HPS replacement

"Revised Rdwy Performance Summary.xlsx" contains Roadway lighting calculation summaries for Roadways 250A, 250B, 250C AND 250F as they are described in Work Paper G - Roadway

Typicals Master Table 02 01 18. These roadways pertain to 250W HPS replacements only. The calculation summaries contain roadway Luminance and Illuminance metrics for the existing 250W HPS and the 4 LED luminaires used in the analysis.

"Revised Rdwy Performance Summary.xlsx" then takes the calculation summaries for each of the 4 LED models considered in the analysis and compares the average values for Luminance and Illuminance to the Average values for the HPS luminaire as HPS is taken as the baseline. See below for a summary of the performance comparisons between HPS (baseline) and the LED luminaires:

72W LED

The 72W LED luminaire provides an average Illuminance level that is 30.2% below the average level achieved by the HPS base line and the 72W LED provides an average Luminance level that is 35.2% below the average level achieved by the HPS Baseline.

The 72W LED does not adequately perform to the same level as the existing HPS luminaire.

89W LED

The 89W LED luminaire provides an average Illuminance level that is 19.3% below the average level achieved by the HPS base line and the 89W LED provides an average Luminance level that is 19.9% below the average level achieved by the HPS Baseline.

The 89W LED does not adequately perform to the same level as the existing HPS luminaire.

111W LED

The 111W LED luminaire provides an average Illuminance level that is 13.8% below the average level achieved by the HPS base line and the 111W LED provides an average Luminance level that is 3.0% below the average level achieved by the HPS baseline.

The 111W LED does not adequately perform to the same level as the existing HPS luminaire.

136W LED

The 136W LED luminaire provides an average Illuminance level that is 1% below the HPS baseline and is within a reasonable level of tolerance to be considered acceptable. The 136W LED provides an average Luminance level that is 10.8% more than the HPS Baseline.

The 136W LED performs to nearly the same level as the existing HPS luminaire.

Summary

We have reviewed DTE's LED luminaire assessment process based on files provided (AGi32 files, analysis spreadsheet, etc.) for the HPS to LED comparison. We confirm that the data matches calculations DTE provided for the four sample straight continuously lighted roadway configs for the 250W HPS evaluation. Where DMD found errors in DTE's initial analysis, we corrected the calculations and based our luminaire evaluation on an updated comparison summary. Our findings arrived at the same luminaire selection as DTE's original evaluation.

Out of the 4 LEDs the 136W luminaire had the highest Average Illuminance value, only 1% short of the target value set out by the 250W HPS baseline which we deem a reasonable level of tolerance for a replacement. The 136W LED exceeded Average Luminance by 10.3% more than the 250W HPS.

The off target light levels produced by the 136W LED Luminaire showed a significant 49% reduction in the calculated maximum spill light values along the property frontages compared to the 250W HPS baseline.

Based on many recent LED conversions have found that the actual energy reduction to be around 50% to 60% based on HPS input watts. In this case the input watts, including ballast loss (300W) divided by the LED input wattage (136W) resulting in a 55% decrease in wattage.

Intersection Analysis (100W) – Existing Condition

DTE provided 3 typical local-local intersections which DMD defined in "*Intersection Performance Summary.*xlsx". DMD conducted independent lighting calculations for each, including the same 4 LED luminaires used in the 100W roadway analysis and compared the results to the lighting levels of the existing HPS luminaire. The average calculated values of the 3 intersections were used to compare each of the 4 LED luminaires to the baseline 100W HPS fixture.

27W LED

The 27W LED luminaire provides an average Illuminance level that is 39.0% below the average level achieved by the HPS baseline and the 27W LED provides a 26.2% reduction in spill lighting at surrounding property lines.

The 27W LED does not maintain all HPS baseline lighting metrics.

30W LED

The 30W LED luminaire provides an average Illuminance level that is 31.1% below the average level achieved by the HPS baseline and the 30W LED provides an 17.8% reduction in spill lighting at surrounding property lines.

The 30W LED does not maintain all HPS baseline lighting metrics.

37W LED

The 37W LED luminaire provides an average Illuminance level that is 17.4% below the average level achieved by the HPS baseline and the 37W LED provides a 1.0% increase in spill lighting at surrounding property lines.

The 37W LED does not maintain all HPS baseline lighting metrics.

58W LED

The 58W LED luminaire provides an average Illuminance level that is 5.5% above the average level achieved by the HPS baseline and the 58W LED provides a 51.2% increase in spill lighting at surrounding property lines.

The 58W LED does not maintain all HPS baseline lighting metrics.

Summary

The light levels produced by the 58W LED Luminaire showed an increase in Average Illuminance. The 58W fixture failed to meet spill light targets at surrounding property lines with a 51.2% increase compared to the 100W HPS baseline. While the 37W, 30W and 27W fixtures meet spill lighting targets within a reasonable tolerance, the 58W luminaire is the only fixture that was able to maintain the minimum Average Illuminance of the HPS baseline.

Intersection Analysis (250W) – Existing Condition

DTE provided 3 typical collector-collector intersections which DMD defined in "*Intersection Performance Summary.*xlsx". DMD conducted independent lighting calculations for each, including the same 4 LED luminaires used in the 250W roadway analysis and compared the results to the lighting levels of the existing HPS luminaire. The average calculated values of the 3 intersections were used to compare each of the 4 LED luminaires to the baseline 250W HPS fixture.

72W LED

The 72W LED luminaire provides an average Illuminance level that is 39.8% below the average level achieved by the HPS baseline and the 72W LED provides a 6.6% increase in spill lighting at surrounding property lines.

The 72W LED does not maintain all HPS baseline lighting metrics.

89W LED

The 89W LED luminaire provides an average Illuminance level that is 25.4% below the average level achieved by the HPS baseline and the 89W LED provides a 31.3% increase in spill lighting at surrounding property lines.

The 89W LED does not maintain all HPS baseline lighting metrics.

111W LED

The 111W LED luminaire provides an average Illuminance level that is 9.8% below the average level achieved by the HPS baseline and the 111W LED provides a substantial 134.7% increase in spill lighting at surrounding property lines.

The 111W LED does not maintain all HPS baseline lighting metrics.

136W LED

The 136W LED luminaire provides an average Illuminance level that is 3.5% below the average level achieved by the HPS baseline and the 136W LED provides a 27.3% reduction in spill lighting at surrounding property lines.

The 136W LED meets HPS baseline lighting metrics to a reasonable level of tolerance.

Summary

The 136W luminaire had the highest Average Illuminance out of the 4 LEDs at only 3.5% below the target HPS baseline levels, which we would deem to be within a reasonable level of tolerance. The 136W LED luminaire was the only luminaire to maintain baseline spill light levels, with a 27.3% reduction in max spill light levels at property frontages compared to the 250W HPS baseline.

Intersection Analysis (100W) – Retrofitted Pole Arm

DTE provided 3 typical local-local intersections, defined in "*Intersection Master Table.*xlsx" each of which DMD conducted independent lighting calculations for. Our analysis included the same

4 LED luminaires used in the 100W roadway analysis and compared the results to the lighting levels of the existing HPS luminaire. The average calculated values of the 3 intersections were used to compare each of the 4 LED luminaires to the baseline 100W HPS fixture.

DTE has stated they often replace pole arms at intersections lit by a single luminaire, with a pole arm at 45° to the intersection. Their replacement procedure involves replacing the existing pole arm with a 6' pole arm, and mounting it at the same mounting height and orienting it 90° to the intersection to cast more light parallel to the roadway, and mitigate off target light spill. DMD ran calculations at each of the 3 provided local-local intersections with these lighting configurations.

27W LED (90° Pole Arm)

The 27W LED luminaire provides an average Illuminance level that is 39.2% below the average level achieved by the HPS baseline and the 27W LED provides a 22.4% increase in spill lighting at surrounding property lines.

The 27W LED does not maintain all HPS baseline lighting metrics.

30W LED (90° Pole Arm)

The 30W LED luminaire provides an average Illuminance level that is 32.0% below the average level achieved by the HPS baseline and the 30W LED provides an 40.6% increase in spill lighting at surrounding property lines.

The 30W LED does not maintain all HPS baseline lighting metrics.

37W LED (90° Pole Arm)

The 37W LED luminaire provides an average Illuminance level that is 16.9% below the average level achieved by the HPS baseline and the 37W LED provides a 68.4% increase in spill lighting at surrounding property lines.

The 37W LED does not maintain all HPS baseline lighting metrics.

58W LED (90° Pole Arm)

The 58W LED luminaire provides an average Illuminance level that is 13.1% above the average level achieved by the HPS baseline and the 58W LED provides a 19.5% reduction in spill lighting at surrounding property lines.

The 58W LED meets all HPS baseline lighting metrics.

Summary

After reorienting the luminaire arm, the light levels produced by the 58W LED Luminaire showed both increase in Average Illuminance and a reduction in spill lighting at surrounding property lines. All other LED fixtures fail both criteria.

Intersection Analysis (250W) – Retrofitted Pole Arm

The same procedure detailed in the 100W retrofitted pole arm analysis was repeated for the 3 collector-collector intersections.

72W LED (90° Pole Arm)

The 72W LED luminaire provides an average Illuminance level that is 40.6% below the average level achieved by the HPS baseline and the 72W LED provides a 14.5% increase in spill lighting at surrounding property lines.

The 72W LED does not maintain all HPS baseline lighting metrics.

89W LED (90° Pole Arm)

The 89W LED luminaire provides an average Illuminance level that is 26.5% below the average level achieved by the HPS baseline and the 89W LED provides a 41.3% increase in spill lighting at surrounding property lines.

The 89W LED does not maintain all HPS baseline lighting metrics.

111W LED (90° Pole Arm)

The 111W LED luminaire provides an average Illuminance level that is 11.2% below the average level achieved by the HPS baseline and the 111W LED provides a substantial 146.6% increase in spill lighting at surrounding property lines.

136W LED (90° Pole Arm)

The 136W LED luminaire provides an average Illuminance level that is 1% below the average level achieved by the HPS baseline and the 136W LED provides a 62.1% reduction in spill lighting at surrounding property lines.

The 136W LED meets HPS baseline lighting metrics to a reasonable level of tolerance.

Summary

After reorienting the luminaire arm the 136W luminaire had the highest Average Illuminance value, only 1% short of the target value set out by the 250W HPS baseline, which we deem to be within a reasonable level of tolerance.

The off target light levels produced by the 136W LED Luminaire showed the most significant reduction in the calculated maximum spill light values along the property frontages and showed a 62.1% improvement compared to the 250W HPS baseline. None of the other LED luminaires met off target spill levels set out by the 250W HPS baseline.

The light levels produced by the 136W LED luminaire was only 1% short Average Illuminance HPS baseline levels, which we deem to be within a reasonable level of tolerance. The 136W fixture resulted in a significant improvement in max spill lighting. All other LED fixtures fail both criteria.

4 CONCLUSION

From a comparison standpoint, matching published lumens from luminaire to luminaire is not always the best method. It is more important to assess lighting levels on the roadway, which was undertaken by DTE. DTE reviewed both roadway lighting levels on and off the roadway defining lighting Luminance and Illuminance metrics in the analysis, including spill lighting. In our opinion, what DTE have provided is reasonable for an HPS to LED conversion given they have focused on calculated lighting levels on the roadway vs simply using lumen values.

DTE's use of multiple roadway types and averaging the results of these roadways is a reasonable methodology to use in comparing luminaires and as a luminaire selection guide in large scale retrofit HPS-LED conversions.

Based on the criteria and approach defined by DTE, DMD is in agreement with the conversion methods and LED luminaires chosen to replace the incumbent 100W and 250W HPS luminaires.

Report Prepared by:

Donato Speidel, PEng

Review by:

Don McLean, PLEng

Michigan Public Service Commission
DTE Electric Company
DMD - Intersection Performance Summary

Note: This exhibit represents Don McLeans intersection summary of his intersection analysis of various LED comparisons for replacements of both the 100W and 250W HPS luminaires.

Case No.: U-21534
Exhibit: A-25
Schedule: O6
Witness: R. A. Bellini

Line No.	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)

1 **README**
2 The following tables show percent increases in calculation values of the LED fixtures as compared to the incumbent HPS baseline
3 (See "Intersection Summary" tab)
4 **Cell highlight legend**
5 Green — LED out performs HPS baseline levels
6 Yellow — LED is within 5% of meeting levels of HPS baseline (DMD deems this to be an acceptable level of tolerance)
7 Red — LED fails to meet HPS baseline lighting levels

		Existing Intersection Condition					90° Orientation On 6' Arm				
8											
9	**100W HPS REPLACEMENT**	HPS	58W	37W	30W	27W	HPS	58W	37W	30W	27W
10	Avg Illuminance	-	5.5%	-17.4%	-31.1%	-39.0%	-	13.1%	-16.9%	-32.0%	-39.2%
11	Max spill	-	51.2%	1.0%	-17.8%	-26.2%	-	-19.5%	68.4%	40.6%	22.4%

12 *Intersection summaries averaged for the 3 local-local intersections

		%250W HPS					%250W HPS				
13											
14	**250W HPS REPLACEMENT**	HPS	136W	111W	89W	72W	HPS	136W	111W	89W	72W
15	Avg Illuminance	-	-3.5%	-9.8%	-25.4%	-39.8%	-	-1.0%	-11.2%	-26.5%	-40.6%
16	Max spill	-	-27.3%	134.7%	31.3%	6.6%	-	-62.1%	146.6%	41.3%	14.5%

17 *Intersection summaries averaged for the 3 collector-collector intersections

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1					**100W HPS**		**58W LED** (GCM2-30H-MV-NW-2R-XX-610)					**37W LED** (GCJ2-30J-MV-40K-2R-XX-060 S)					**30W LED** (GCJ1-30J-MV-40K-2R-XX-050 S)					**27W LED** (GCJ1-30J-MV-40K-2R-XX-045 S)			
2	**Location**	**Mounting Height (ft)**	**Arm length**	**Arm Orientation**	**Avg (Fc)**	**Max Spill**	**Avg**	**%HPS**	**Max Spill**	**%HPS**		**Avg**	**%HPS**	**Max Spill**	**%HPS**		**Avg**	**%HPS**	**Max Spill**	**%HPS**		**Avg**	**%HPS**	**Max Spill**	**%HPS**
3	S Linville Ave St & Hazelwood St, Westland, Michigan 48186	28'	18'	45	1.14	1.4	1.21	6%	2.1	50%		0.94	-18%	1.5	7%		0.78	-32%	1.2	-14%		0.69	-39%	1.1	-21%
4	Griffith Ave & Wiltshire Rd, Berkley, Michigan 48072	28'	18'	45	1.23	1.7	1.25	2%	2.69	56%		1.03	-16%	1.69	-2%		0.86	-30%	1.39	-19%		0.76	-38%	1.2	-28%
5	Pine St & 9th St, Port Huron, Michigan 48060	28'	18'	45	1.04	1.3	1.13	9%	1.84	47%		0.85	-18%	1.22	-2%		0.71	-32%	1	-20%		0.63	-39%	0.9	-29%
6								5.5%		51.2%			-17.4%		1.0%			-31.1%		-17.8%			-39.0%		-26.2%
7					**100W HPS**		**58W LED** (GCM2-30H-MV-NW-2R-XX-610)					**37W LED** (GCJ2-30J-MV-40K-2R-XX-060 S)					**30W LED** (GCJ1-30J-MV-40K-2R-XX-050 S)					**27W LED** (GCJ1-30J-MV-40K-2R-XX-045 S)			
8	**Location**	**Mounting Height (ft)**	**Arm length**	**Arm Orientation**	**Avg (Fc)**	**Max Spill**	**Avg**	**%HPS**	**Max Spill**	**%HPS**		**Avg**	**%HPS**	**Max Spill**	**%HPS**		**Avg**	**%HPS**	**Max Spill**	**%HPS**		**Avg**	**%HPS**	**Max Spill**	**%HPS**
9			6'	90 - arm over Linville Ave	0.92	0.4	1.03	12%	0.3	-25%		0.76	-17%	0.7	75%		0.61	-34%	0.6	50%		0.55	-40%	0.5	25%
10	Same roadway geometries used in 100W calcs, re-orient pole arms to 90 deg		6'	90 - arm over Wiltshire	0.97	0.6	1.07	10%	0.7	21%		0.8	-18%	0.91	57%		0.66	-32%	0.75	29%		0.59	-39%	0.7	16%
11			6'	90 - arm over 9th st	0.76	0.9	0.89	17%	0.43	-54%		0.64	-16%	1.63	73%		0.53	-30%	1.34	43%		0.47	-38%	1.2	27%
12								13.1%		-19.5%			-16.9%		68.4%			-32.0%		40.6%			-39.2%		22.4%

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DMD - Intersection Performance Summary

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1					**250W HPS**		**136 W LED** (Leotek GCL1-80G-MV-NW-2R-XX-5)					**111W LED** (GCM3-60J-MV-40K-2R-XX-170 S)					**89W LED** (GCM2-60J-MV-40K-2R-XX-140 S)					**72W LED**			
2	**Location**	**Mounting Height (ft)**	**Arm length**	**Deg**	**Avg**	**Max Spill**	**Avg**	**%HPS**	**Max Spill**	**%HPS**		**Avg**	**%HPS**	**Max Spill**	**%HPS**		**Avg**	**%HPS**	**Max Spill**	**%HPS**		**Avg**	**%HPS**	**Max Spill**	**%HPS**
3	Sheldon Rd & Saltz Rd, Canton, Michigan 48187	30'	6'	90	0.86	1.9	0.84	-2%	0.41	-79%		0.73	-15%	3.41	77%		0.6	-30%	2.81	46%		0.49	-43%	2.3	18%
4	Avondale Rd & Wildwood Ave, Westland, Michigan 48186	28.75'	6'	90	0.86	0.8	0.9	5%	0.29	-65%		0.84	-2%	3.5	317%		0.7	-19%	1.32	57%		0.56	-35%	1.1	27%
5	13th St & Court St, Port Huron, Michigan 48060	28'	18'	45	2.44	1.6	2.13	-13%	2.58	62%		2.15	-12%	1.76	11%		1.77	-27%	1.45	-9%		1.43	-41%	1.2	-26%
6								-3.5%		-27.3%			-9.8%		134.7%			-25.4%		31.3%			-39.8%		6.6%
7					**250W HPS**		**136 W LED** (Leotek GCL1-80G-MV-NW-2R-XX-5)					**111W LED** (GCM3-60J-MV-40K-2R-XX-170 S)					**89W LED** (GCM2-60J-MV-40K-2R-XX-140 S)					**72W LED**			
8	**Location**	**Mounting Height (ft)**	**Arm length**	**Deg**	**Avg**	**Max Spill**	**Avg**	**%HPS**	**Max Spill**	**%HPS**		**Avg**	**%HPS**	**Max Spill**	**%HPS**		**Avg**	**%HPS**	**Max Spill**	**%HPS**		**Avg**	**%HPS**	**Max Spill**	**%HPS**
9	Unchanged (these intersections already had a 90 deg arm)			90	0.86	1.93	0.84	-2%	0.41	-79%		0.73	-15%	3.41	77%		0.6	-30%	2.81	46%		0.49	-43%	2.28	18%
10				90	0.86	0.84	0.9	5%	0.29	-65%		0.84	-2%	3.5	317%		0.7	-19%	1.32	57%		0.56	-35%	1.07	27%
11	Same roadway geometries used in 250W calcs, re-orient pole arms to 90 deg		6'	90 - arm over 13th st	2.21	0.95	2.09	-5%	0.55	-42%		1.85	-16%	1.39	46%		1.53	-31%	1.15	21%		1.24	-44%	0.93	-2%
12								-1.0%		-62.1%			-11.2%		146.6%			-26.5%		41.3%			-40.6%		14.5%

Michigan Public Service Commission
DTE Electric Company
DMD - Revised Rdwy Performance Summary

Note: This exhibit represents Don McLeans roadway performance summary of his intersection analysis of various LED comparisons for replacements of both the 100W and 250W HPS luminaires.

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1	**README**												
2	The following tables show percent increases in calculation values of the LED fixtures as compared to the incumbent HPS baseline												
3													
4	**Cell highlight legend**												
5	Green	LED out performs HPS baseline levels											
6	Yellow	LED is within 5% of meeting levels of HPS baseline (DMD deems this to be an acceptable level of tolerance)											
7	Red	LED fails to meet HPS baseline lighting levels											

	100W HPS	Exhibit C Performance Summary					Revised Performance Summary*				
8											
9	**REPLACEMENT**	HPS	58W	37W	30W	27W	HPS	58W	37W	30W	27W
10	Luminance	-	23.0%	-5.1%	-20.0%	-31.1%	-	27.7%	-3.0%	-20.5%	-31.3%
11	Illuminance	-	6.1%	-13.7%	-29.4%	-36.8%	-	6.5%	-13.4%	-29.5%	-36.9%
12	North Spill	-	-54.8%	18.7%	-2.4%	-14.3%	-	-54.3%	22.1%	0.5%	-11.3%
13	South Spill**	-	-10.4%	-24.7%	-36.9%	-45.4%	-	-10.4%	-24.7%	-36.9%	-45.4%

14 * For roadway **100 D**, an arm length discrepency was found in Exhibit G to what was used in the calcs.
15 ** South side spill lighting does not apply to **100 D**, and therefore there is no observed change in the revised summary (see "*100W*" sheet tab).

	250W HPS	Exhibit E Performance Summary					Revised Performance Summary*				
16											
17	**REPLACEMENT**	HPS	136W	111W	89W	72W	HPS	136W	111W	89W	72W
18	Luminance	-	12.6%	-0.6%	-13.4%	-33.6%	-	10.3%	-3.0%	-19.9%	-35.2%
19	Illuminance	-	-0.8%	-12.6%	-24.2%	-38.8%	-	-1.0%	-13.8%	-19.3%	-30.2%
20	North Spill	-	-66.3%	14.5%	-6.0%	-23.8%	-	-65.8%	35.5%	11.5%	-9.5%
21	South Spill	-	-49.4%	-37.0%	-43.8%	-54.6%	-	-49.0%	-34.9%	-41.8%	-53.4%

22 * For roadway **250 F**, a setback and pavement classification discrepency was found to what was listed in Exhibit G and to what was observed on Google Maps. DMD ran revised calcs for this roadway and updated the overall performance summary.

Michigan Public Service Commission
DTE Electric Company
DMD - Revised Rdwy Performance Summary

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Line No.	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
1			**HPS**	**58W**	**% HPS**	**37W**	**% HPS**	**30W**	**% HPS**	**27W**	**% HPS**
2	**Luminance** (Cd/SqM)	100 A	0.72	0.94	30.6%	0.7	-2.8%	0.51	-29.2%	0.51	-29.2%
3	Average	100 B	0.43	0.52	20.9%	0.43	0.0%	0.35	-18.6%	0.26	-39.5%
4		100 C	0.51	0.59	15.7%	0.46	-9.8%	0.44	-13.7%	0.33	-35.3%
5		100 D	0.34	0.32	-5.9%	0.26	-23.5%	0.26	-23.5%	0.23	-32.4%
6		100 E	0.66	0.87	31.8%	0.64	-3.0%	0.53	-19.7%	0.47	-28.8%
7		100 F	0.33	0.45	36.4%	0.36	9.1%	0.29	-12.1%	0.26	-21.2%
8		100 G	0.35	0.46	31.4%	0.33	-5.7%	0.27	-22.9%	0.24	-31.4%
9					**23.0%**		**-5.1%**		**-20.0%**		**-31.1%**
10	**Illuminance** (Fc)	100 A	0.87	0.93	6.9%	0.75	-13.8%	0.62	-28.7%	0.55	-36.8%
11	Average	100 B	0.42	0.44	4.8%	0.39	-7.1%	0.32	-23.8%	0.28	-33.3%
12		100 C	0.49	0.52	6.1%	0.42	-14.3%	0.34	-30.6%	0.31	-36.7%
13		100 D	0.45	0.48	6.7%	0.36	-20.0%	0.3	-33.3%	0.27	-40.0%
14		100 E	0.84	0.9	7.1%	0.71	-15.5%	0.58	-31.0%	0.52	-38.1%
15		100 F	0.39	0.4	2.6%	0.36	-7.7%	0.29	-25.6%	0.26	-33.3%
16		100 G	0.46	0.5	8.7%	0.38	-17.4%	0.31	-32.6%	0.28	-39.1%
17					**6.1%**		**-13.7%**		**-29.4%**		**-36.8%**
18	**North Spill** (Fc)	100 A	0.11	0.06	-45.5%	0.14	27.3%	0.12	9.1%	0.1	-9.1%
19	Max	100 B	0.15	0.09	-40.0%	0.06	-60.0%	0.05	-66.7%	0.04	-73.3%
20		100 C	0.1	0.05	-50.0%	0.04	-60.0%	0.03	-70.0%	0.03	-70.0%
21		100 D	0.17	0.07	-58.8%	0.28	64.7%	0.23	35.3%	0.2	17.6%
22		100 E	0.15	0.06	-60.0%	0.21	40.0%	0.17	13.3%	0.15	0.0%
23		100 F	0.21	0.08	-61.9%	0.35	66.7%	0.29	38.1%	0.26	23.8%
24		100 G	0.46	0.15	-67.4%	0.7	52.2%	0.57	23.9%	0.51	10.9%
25					**-54.8%**		**18.7%**		**-2.4%**		**-14.3%**
26	**South Spill** (Fc)	100 A	0.16	0.06	-62.5%	0.05	-68.8%	0.04	-75.0%	0.04	-75.0%
27	Max	100 B	0.08	0.04	-50.0%	0.07	-12.5%	0.06	-25.0%	0.05	-37.5%
28		100 C	0.13	0.05	-61.5%	0.2	53.8%	0.16	23.1%	0.14	7.7%
29		100 D									
30		100 E									
31		100 F	0.27	0.63	133.3%	0.16	-40.7%	0.13	-51.9%	0.12	-55.6%
32		100 G	0.09	0.08	-11.1%	0.04	-55.6%	0.04	-55.6%	0.03	-66.7%
33					**-10.4%**		**-24.7%**		**-36.9%**		**-45.4%**

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DTE Electric Company
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Line No.	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)
1			**HPS**	**58W**	**% HPS**	**37W**	**% HPS**	**30W**	**% HPS**	**27W**	**% HPS**			
2	**Luminance** (Cd/SqM)	100 A	0.72	0.94	30.6%	0.7	-2.8%	0.51	-29.2%	0.51	-29.2%			
3	Average	100 B	0.43	0.52	20.9%	0.43	0.0%	0.35	-18.6%	0.26	-39.5%			
4		100 C	0.51	0.59	15.7%	0.46	-9.8%	0.44	-13.7%	0.33	-35.3%			
5		100 D	0.33	0.42	27.3%	0.3	-9.1%	0.24	-27.3%	0.22	-33.3%			
6		100 E	0.66	0.87	31.8%	0.64	-3.0%	0.53	-19.7%	0.47	-28.8%			
7		100 F	0.33	0.45	36.4%	0.36	9.1%	0.29	-12.1%	0.26	-21.2%			
8		100 G	0.35	0.46	31.4%	0.33	-5.7%	0.27	-22.9%	0.24	-31.4%			
9					**27.7%**		**-3.0%**		**-20.5%**		**-31.3%**			
10	**Illuminance** (Fc)	100 A	0.87	0.93	6.9%	0.75	-13.8%	0.62	-28.7%	0.55	-36.8%			
11	Average	100 B	0.42	0.44	4.8%	0.39	-7.1%	0.32	-23.8%	0.28	-33.3%			
12		100 C	0.49	0.52	6.1%	0.42	-14.3%	0.34	-30.6%	0.31	-36.7%			
13		100 D	0.44	0.48	9.1%	0.36	-18.2%	0.29	-34.1%	0.26	-40.9%			
14		100 E	0.84	0.9	7.1%	0.71	-15.5%	0.58	-31.0%	0.52	-38.1%			
15		100 F	0.39	0.4	2.6%	0.36	-7.7%	0.29	-25.6%	0.26	-33.3%			
16		100 G	0.46	0.5	8.7%	0.38	-17.4%	0.31	-32.6%	0.28	-39.1%			
17					**6.5%**		**-13.4%**		**-29.5%**		**-36.9%**			
18	**North Spill** (Fc)	100 A	0.11	0.06	-45.5%	0.14	27.3%	0.12	9.1%	0.1	-9.1%			
19	Max	100 B	0.15	0.09	-40.0%	0.06	-60.0%	0.05	-66.7%	0.04	-73.3%			
20		100 C	0.1	0.05	-50.0%	0.04	-60.0%	0.03	-70.0%	0.03	-70.0%			
21		100 D	0.18	0.08	-55.6%	0.34	88.9%	0.28	55.6%	0.25	38.9%			
22		100 E	0.15	0.06	-60.0%	0.21	40.0%	0.17	13.3%	0.15	0.0%			
23		100 F	0.21	0.08	-61.9%	0.35	66.7%	0.29	38.1%	0.26	23.8%			
24		100 G	0.46	0.15	-67.4%	0.7	52.2%	0.57	23.9%	0.51	10.9%			
25					**-54.3%**		**22.1%**		**0.5%**		**-11.3%**			
26	**South Spill** (Fc)	100 A	0.16	0.06	-62.5%	0.05	-68.8%	0.04	-75.0%	0.04	-75.0%			
27	Max	100 B	0.08	0.04	-50.0%	0.07	-12.5%	0.06	-25.0%	0.05	-37.5%			
28		100 C	0.13	0.05	-61.5%	0.2	53.8%	0.16	23.1%	0.14	7.7%			
29		100 D												
30		100 E												
31		100 F	0.27	0.63	133.3%	0.16	-40.7%	0.13	-51.9%	0.12	-55.6%			
32		100 G	0.09	0.08	-11.1%	0.04	-55.6%	0.04	-55.6%	0.03	-66.7%			
33					**-10.4%**		**-24.7%**		**-36.9%**		**-45.4%**			

Error found in DTE calculation for 100 D. DMD corrected the calculations and showed corrected values here

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Line No.	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
1			**HPS**	**136W**	**% HPS**	**111W**	**% HPS**	**89W**	**% HPS**	**72W**	**% HPS**
2	**Luminance** (Cd/SqM)	250 A	2.22	2.62	18.0%	2.19	-1.4%	1.81	-18.5%	1.46	-34.2%
3	Average	250 B	1.36	1.43	5.1%	1.39	2.2%	1.15	-15.4%	0.93	-31.6%
4		250 C	1.57	1.66	5.7%	1.52	-3.2%	1.26	-19.7%	1.02	-35.0%
5		250 F	2.13	2.59	21.6%	2.13	0.0%	2.13	0.0%	1.42	-33.3%
6					**12.6%**		**-0.6%**		**-13.4%**		**-33.6%**
7	**Illuminance** (Fc)	250 A	2.98	3.03	1.7%	2.64	-11.4%	2.18	-26.8%	1.76	-40.9%
8	Average	250 B	1.29	1.21	-6.2%	1.04	-19.4%	1.04	-19.4%	0.84	-34.9%
9		250 C	1.51	1.44	-4.6%	1.39	-7.9%	1.15	-23.8%	0.93	-38.4%
10		250 F	2.94	3.12	6.1%	2.6	-11.6%	2.15	-26.9%	1.74	-40.8%
11					**-0.8%**		**-12.6%**		**-24.2%**		**-38.8%**
12	**North Spill** (Fc)	250 A	0.54	0.21	-61.1%	0.79	46.3%	0.65	20.4%	0.53	-1.9%
13	Max	250 B	0.32	0.11	-65.6%	0.27	-15.6%	0.22	-31.3%	0.18	-43.8%
14		250 C	0.55	0.18	-67.3%	0.86	56.4%	0.71	29.1%	0.57	3.6%
15		250 F	0.45	0.13	-71.1%	0.32	-28.9%	0.26	-42.2%	0.21	-53.3%
16					**-66.3%**		**14.5%**		**-6.0%**		**-23.8%**
17	**South Spill** (Fc)	250 A	0.64	0.22	-65.6%	0.67	4.7%	0.67	4.7%	0.54	-15.6%
18	Max	250 B	0.72	0.72	0.0%	0.33	-54.2%	0.27	-62.5%	0.22	-69.4%
19		250 C	0.31	0.12	-61.3%	0.11	-64.5%	0.09	-71.0%	0.07	-77.4%
20		250 F	0.41	0.12	-70.7%	0.27	-34.1%	0.22	-46.3%	0.18	-56.1%
21					**-49.4%**		**-37.0%**		**-43.8%**		**-54.6%**

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Line No.	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)
1			**HPS**	**136W**	**% HPS**	**111W**	**% HPS**	**89W**	**% HPS**	**72W**	**% HPS**			
2	**Luminance** (Cd/SqM)	250 A	2.22	2.62	18.0%	2.19	-1.4%	1.81	-18.5%	1.46	-34.2%			
3	Average	250 B	1.36	1.43	5.1%	1.39	2.2%	1.15	-15.4%	0.93	-31.6%			
4		250 C	1.57	1.66	5.7%	1.52	-3.2%	1.26	-19.7%	1.02	-35.0%			
5		250 F	1.63	1.83	12.3%	1.47	-9.8%	1.21	-25.8%	0.98	-39.9%			
6					**10.3%**		**-3.0%**		**-19.9%**		**-35.2%**			
7	**Illuminance** (Fc)	250 A	2.98	3.03	1.7%	2.64	-11.4%	2.18	-26.8%	1.76	-40.9%			
8	Average	250 B	1.29	1.21	-6.2%	1.04	-19.4%	1.04	-19.4%	0.84	-34.9%			
9		250 C	1.51	1.44	-4.6%	1.39	-7.9%	1.15	-23.8%	0.93	-38.4%			
10		250 F	2.27	2.39	5.3%	1.9	-16.3%	2.11	-7.0%	2.12	-6.6%			
11					**-1.0%**		**-13.8%**		**-19.3%**		**-30.2%**			
12	**North Spill** (Fc)	250 A	0.54	0.21	-61.1%	0.79	46.3%	0.65	20.4%	0.53	-1.9%			
13	Max	250 B	0.32	0.11	-65.6%	0.27	-15.6%	0.22	-31.3%	0.18	-43.8%			
14		250 C	0.55	0.18	-67.3%	0.86	56.4%	0.71	29.1%	0.57	3.6%			
15		250 F	1.04	0.32	-69.2%	1.61	54.8%	1.33	27.9%	1.08	3.8%			
16					**-65.8%**		**35.5%**		**11.5%**		**-9.5%**			
17	**South Spill** (Fc)	250 A	0.64	0.22	-65.6%	0.67	4.7%	0.67	4.7%	0.54	-15.6%			
18	Max	250 B	0.72	0.72	0.0%	0.33	-54.2%	0.27	-62.5%	0.22	-69.4%			
19		250 C	0.31	0.12	-61.3%	0.11	-64.5%	0.09	-71.0%	0.07	-77.4%			
20		250 F	0.39	0.12	-69.2%	0.29	-25.6%	0.24	-38.5%	0.19	-51.3%			
21					**-49.0%**		**-34.9%**		**-41.8%**		**-53.4%**			

Error found in DTE calculation for 250 F. DMD corrected the calculations and showed corrected

Don McLean, PL Eng, FIES

Don is a founder and senior partner in DMD and Associates. He has over 42 years of experience in the design of electrical engineering projects, including roadway lighting, control systems, power distribution, traffic signals and related traffic engineering. Don has managed electrical and lighting for thousands of electrical projects ranging in values over $35M. Don has participated in major road transportation projects valued at well over $2.4B. His experience includes turnkey, bid-build, design-build, design-build-finance-operate and P3 methods of project delivery. Don's experience, knowledge and attention to detail have led to ongoing successful projects.

Don typically undertakes a senior management role, and his varying tasks may include work planning & scheduling, product review, standards development, design, and reviews. His role as a project manager includes managing larger and more complex projects.

Don is very active design engineer who specializes in roadway lighting. Over his career it is estimated Don has been involved in over 3,000 projects involving:

- Electrical and control systems.
- Roadway and related outdoor lighting.
- Bridges and tunnels.
- Traffic signals.
- Hydro, Tel and Communications systems.
- Intelligent Transportation Systems (ITS).

As an industry expert, Don has also undertaken numerous presentations and seminars across North America on various topics related to the roadway lighting industry. He has mentored and trained over 30 designers and engineers over his career. In addition, Don has authored numerous standards and publications and is active in numerous safety based research projects. Don has written electrical standards and lighting policies which define where and how to light for over 30 cities and numerous transportation organizations.

Don has authored/co-authored/contributed to a number of nationally used publications including:

- FHWA Lighting Handbook
- AASHTO Solid State Lighting Guide
- Transportation Association of Canada Roadway Lighting Design Guide
- International Signal Association Level 2 Roadway Lighting Certification.
- Illuminating Engineering Society (IES) RP-8

Don is a Fellow with the IES. Don is active on over eight IES outdoor lighting committees and is the lead for the IES Application Advisory Panel who advises the IES on lighting applications and a member of the IES Standards Committee who oversees all standard lighting publications.

Don is well experienced with street lighting design, cost estimates, calculations, and standards for LED street light conversion designs that maximize night-time visibility while at the same time conserving power. Don has a thorough understanding of costs (operation and capital), financial assessments, feasibility studies, current and ongoing research, best practices, principals, concepts, standards, photometry and design software, electrical code(s) and standards, lighting

controls, products and construction related to roadway lighting. As such, he is able to provide a truly unique value proposition and add value while reducing risk to our clients.

Don has also undertaken numerous projects involving various types of lighting including parking lot lighting, park and plaza lighting, sports and area lighting, decorative and streetscape lighting, freeway and interchange lighting (including high mast), sign lighting, feature lighting such as walls and sculpture and water features, bikeways, bridges and tunnels, transit platforms and bus loops. Don expertise includes adaptive lighting controls and smart city lighting technologies. Don stays on top of the technology curve by working closely with manufacturers and industry committees.

Don is actively involved with the environmental elements and impacts of roadway lighting and is active with the International Dark Sky Association.

Don has worked with VTTI for over 10 years. He is currently involved with NCHRP 05-22A providing input to VTTI research. Don has worked with VTTI on numerous past projects in NCHRP 05-22, and FHWA Lighting workshops and the FHWA Lighting Handbook and are teamed with VTTI on NCHRP 05-26.

Don McLean CET

Senior Manager / Principal - DMD

EDUCATION / REGISTRATIONS

British Columbia Institute of Technology: Certified Engineering Technologist, 1979

Engineers and Geoscientists of BC (EGBC)

Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Transportation Association of Canada Road Safety Committee

PROFESSIONAL EXPERIENCE

President DMD Consulting Engineers Ltd (2001 – Current)

President DMD and Associates Electrical Consultants Ltd (2000-Current)

Engineer, Shaflik Engineering Ltd, (1980-2000)

SELECTED PUBLICATIONS

Co-author – FHWA Lighting Handbook (2023)

Contributor – AASHTO Solid State Lighting Guide

Co-author NCHRP 5-22 - GUIDELINES FOR SOLID STATE ROADWAY LIGHTING

Lead Author - Transportation Association of Canada Guide for the Design of Roadway Lighting – 500+ page National Publication (2006) – Converted to IESNA RP-8-18

Lead Author - Transportation Association of Canada Light Reduce and Energy Efficiency Guide – National Publication (2012) https://www.tac-atc.ca/en/publications/ptm-rlepr-e

Lead Author - BC Ministry of Transportation Electrical and Traffic Engineering Manual (1995-2013)
http://www.th.gov.bc.ca/publications/eng_publications/electrical/electrical_and_traffic_eng/Electrical_Signing_Design_Manual/tableofcontents.htm

Lead Author – BC Ministry Electrical and Signing Material Standards (1995-2003)
http://www.th.gov.bc.ca/publications/eng_publications/electrical/electrical_and_traffic_eng/2003_material_standards/2003_material_standards.htm

Co-author - International Signal Association Level II Lighting Certification Program (2008)

Co-author US Federal Lighting Handbook (2012)
https://safety.fhwa.dot.gov/roadway_dept/night_visib/lighting_handbook/

Contributor – IESNA RP-8, RP-22, RP-6, RP-33, etc

City of Edmonton Street and Walkway Lighting Design and Construction Standards (2016)

SELECTED RESEACH / PROJECTS

NCHRP 05-22 Guidelines for Solid-State Roadway Lighting

Sponsor: NCHRP

Value: $400,000

Co-author

The lighting industry has changed dramatically over the past decade. The optics of legacy HID, full-cutoff luminaires were restricted to the lamp and reflector design; these lamps emit light in almost every direction, which must then be reflected to the roadway. Roadway luminaires have moved beyond this design through the vast possibilities presented by solid-state lighting (SSL)—at present, in the form of light emitting diodes (LED)--which also boasts lower energy usage, reduced maintenance, and improved color. AASHTO target light levels are calculated over a grid limited to the traveled roadway. Any light that lands outside of the calculation grid is not quantified in the average and uniformity results but is still present with roadway luminaires and may provide a safety benefit. With the greater ability to control the distribution and the sharp cutoff at the edges with SSL luminaires, light levels beyond the calculation grid may be dramatically reduced, but a design may still meet the AASHTO criteria. The goal of this research is to investigate the application of AASHTO criteria to SSL roadway lighting and provide guidance for light level criteria for areas immediately adjacent to the traveled roadway when using SSL luminaires. This research will also explore the benefits and challenges of adaptive lighting and provide further guidelines for its use, as well as the environmental and health effects of roadway lighting. One significant outcome was new design criteria referred to as surround ratio which showed significant object detection benefit.

FHWA Lighting Handbook

Sponsor: FHWA

Value: $300,000

Co-author

The work under this contract was to provide and major update to the 2012 FHWA Roadway Lighting Handbook. The first handbook was published in 1978 and it was decided that an update was needed to inform practitioners of the fundamentals such as theory, technology, standards, and Federal-Aid guidance pertaining to roadway lighting.

The updated handbook provides:

- A basic understanding of the roadway lighting process from a federal and state perspective.
- Discussion of the limits of scope between this handbook and criteria documents developed by AASHTO and the IES
- Discussion of the safety aspects of roadway lighting citing research on the topic and summarizing results
- Discussion of vision and fundamental concepts including spectrum/wavelength and other properties, structure of the eye including photoreceptors and their properties, and function of the pupil, adaptation, accommodation, and visual acuity
- Various lighting metrics including illuminance, luminance, veiling luminance, uniformity and contrast models.
- Various warranting systems for lighting
-

- Environment considerations for lighting systems including skyglow, light trespass, glare, wildlife impacts, and related health studies.
- Lighting system selection elements
- Lighting applications and examples for various roadway types

Transportation Association of Canada Roadway Lighting Design Guide

Transportation Association of Canada

Value: $200K

Lead Author

The Transportation Association of Canada Roadway Lighting Design Guide was originally published in 1983 and was deemed in early 2000 to be outdated and in need of replacement. Through a Canada wide competitive selection process, DMD was selected to prepare the new Roadway Lighting Design Guide. The nearly 500-page design guide covers all aspects of roadway lighting design including vision fundamentals and concepts, obtrusive lighting, planning and design process, system components and common elements, standards and codes, computer applications, maintenance, roadways and interchanges, intersections, roundabouts, crosswalks, tunnels, toll plazas, off roadway facilities (parking lots, pathways, etc.), signs, streetscapes, and work zone/temporary lighting. In preparing the document, design standards and design practices from North America, Australia, New Zealand and Europe were researched. The majority of the Guide is, therefore, based on existing recommended practices of the Illuminating Engineering Society of North America (IESNA) and the Commission Internationale De l'Eclairage (CIE). The document featured a warranting system for various road types which has been applied to the 2012 FHWA Handbook. One of the features was an innovative warranting system for intersections using point score system based on various factors to define full, partial or delineation lighting. The document was groundbreaking as it defined many new and evolving design methods which were applied throughout North America and today the majority of this document was used to form IES RP-8-18.

FHWA Lighting Workshop

FHWA

Value: $155K

Co-Author/Presenter

Developed and presented a comprehensive 3-day lighting workshop for FHWA Safety Engineers. The workshop featured extensive educational materials focused on lighting fundamentals, components, visibility concepts, environmental impacts, warranting systems, research, and cost benefit. Current warranting systems were explained and discussed in detail. The workshop featured night-time demonstrations and Virginia Tech Smart Road. The session was very collaborative and informative for both the presenters and attendees.

502 FLOYD ST.
BLACKSBURG, VA 24060

February 24, 2024

Mr. Robert Bellini
Manager, Community Lighting
DTE Energy

RE: Review of the DTE Energy Luminaire Selection Process

Dear Mr. Bellini,

Please find my discussion and opinions on my review of the DTE Luminaire Selection Process below.

PRELIMINARY OPINION

Based upon my review of the material provided and my own work in the selection of an appropriate solid state replacement luminaire for existing High Pressure Sodium (HPS) luminaires, I find that the methodology chosen is both aligned with the current methods in the industry and that the selected luminaires are appropriate for the application.

MY BACKGROUND:

The opinions expressed in this document reflect my personal training and experience as an illumination engineer specializing in the area of transportation lighting and visibility. As shown in the attached curriculum vitae, I have a B.A.Sc., an M.A.Sc., and a Ph.D. from the University of Waterloo in System Design Engineering specializing in lighting. My dissertation considered the reflection properties of pavement surfaces and their influence on roadway object visibility. In addition, I have approximately 30 years of professional experience, specifically in the field of illumination engineering as it relates to roadway lighting and visibility. I have been the author or co-author of over 80 papers and scientific publications discussing object visibility, pedestrian visibility, roadway lighting, visibility in adverse weather conditions, and headlamp performance.

Given my experience and my education, I feel that I am well qualified to provide the opinions expressed herein as they pertain to the selection of luminaires for an application. These opinions,

which are based upon a reasonable degree of engineering probability, are provided in the sections that appear below.

Activity Performed

During the course of this project, I was asked to:

1) Review the status in the industry on the current practices used in the selection of solid-state replacement luminaires.
2) Evaluation of DTE Energy's LED selection methodology for HPS to LED conversions on existing streetlighting systems
3) Independently verify the previous replacement selections made by DTE Energy
4) Provide additional analysis on individual intersections to provide a recommendation for luminaires in these applications.

Provided Materials

The following materials were provided:

- AGI32 simulation files for 7 road type templates traditionally lit with 100 Watt HPS Luminaires previously analyzed by DTE Energy
- AGI Simulation files for 4 potential solid state replacements for the 7 “100” Watt templates”
- AGI32 simulation files for 4 road type templates traditionally lit with 250 Watt HPS Luminaires previously analyzed by DTE Energy
- AGI Simulation files for 4 potential solid-state replacements for the 4 “250” Watt templates”
- IES Format Intensity Distribution files for Leotek potential replacement luminaires and 100Watt and 250 Watt HPS
- Master Table of DTE Energy Selected Templates for Roadway Analysis
- Calculation spreadsheets for the DTE Energy 2021 Luminaire Selection
- Calculation spreadsheets and exhibits (A through I) developed as background information for the 2021 DTE Rate Submission

Review of Industry Practice

The selection of a solid-state (LED) luminaire to replace an existing technology is a complicated process. LED luminaires are unlike traditional light source luminaires in that the lighting distribution can vary significantly from one luminaire manufacturer to another. As a result, the typical process for the selection of luminaires is based on performance in a given test street area.

The process using the test street method would be to select a given street and develop the required specification defining the roadway characteristics. Potential luminaires are then selected

and either modelled in lighting design software or in a physical test installation. This design simulation process can either be performed by the purchasing agency or through submission made by luminaire manufacturers. The selection of the luminaire from potential options is generally made through an evaluation of design criteria and national standards or in comparison to the incumbent technologies.

This methodology has been used in a variety of applications and documented. Example projects and case studies which use this methodology are documented in Pacific Northwest National Labs documents featuring work from the Detroit lighting system revitalization, the relighting of the streets in Kansas City, and the relighting of Princeton University. In my role at the Virginia Tech Transportation Institution, I have been involved in this process for the District of Columbia and the Virginia Department of Transportation.

The two selection methods, comparison to design standards and comparison to incumbent technology, differ in the application of corrections to the design simulations.

Comparison to the design standards requires the application of light loss factors to calculate the maintained lighting levels. There is the potential for variability in the factors applied as luminaires of different designs and different light delivery methods have different light level maintenance distributions.

The comparison to the incumbent technology method does not use light loss factors but rather compares the potential replacement luminaire to the existing luminaires as if they were new and out of the box. This method reduces the potential variability that can exist in the selection and application of the luminaires. It is noteworthy that this method of comparing to incumbent technology assumes that the existing technology does not over- or under-light the roadway.

Review of the DTE Methodology

In 2021, the process used by DTE Energy was to compare to the incumbent technology. This is valid. In this instance, as the manufacturer was already selected, it would be expected that the maintenance factor would be similar across the potential replacement luminaires. Thus, the selection of the luminaire is based on the various available luminaire options within the manufacturers catalog. Thus, the comparison for the 2021 submittal was to compare new LED luminaires to new HPS luminaires.

In the review of the DTE methodology, I opened the AGI32 Simulation packages for the 100 Watt HPS replacement comparisons and the 250 Watt HPS comparisons. In all there were 8 comparison templates for 100 Watt selection process and 4 templates for the 250 Watt comparisons. In each of the simulations, I verified the parameters placed in the simulation

including luminaire type, location, and tilt angle. I then calculated the lighting levels within each model. Using this data, I compared the calculated results to the incumbent HPS technology where the roadway illuminance, luminance, glare, sidewalk illuminance and light trespass values were reviewed. In the analysis, the result criteria were established that the luminaire had to increase the luminance and the illuminance on the roadway with the desire to increase the sidewalk illuminance while reducing glare and the light trespass.

A weighting function was developed to assist in the selection of a replacement luminaire where if the illuminance and luminance was not increased, the option was not considered viable. Then the viable replacement luminaires were weighted in terms of the other factors of glare, light trespass, sidewalk illuminance and maximum illuminance. The weights used in the weighting function are shown in Table 1. In the table, the measures represent the calculated values and the criteria for each of the measures is the average, maximum and uniformity (Avg/Min). During the weighting process, the criteria was assigned 2 if it was in the desired direction of change, assigned a 1 if it was within 5% of the incumbent and assigned a 0 if the criteria did not change in the desired direction. The values were then weighted by the values in Table 1 and summed. The north and south criteria on the light trespass and the sidewalk illuminance criteria represent each side of the roadway. The desired direction for the measured is also shown for each calculation.

Table 1 System Analysis Weighting Functions

Measure	Criteria	Weighting Function	Desired Direction
Roadway Illuminance	Average	1	Increase
	Maximum	0.25	Decrease
	Avg/Min	0.25	Decrease
Roadway Luminance	Average	1	Increase
	Maximum	0.25	Decrease
	Avg/Min	0.25	Decrease
Veling Luminance	Average	0.25	Decrease
	Maximum	0.5	Decrease
Visibility Level	Average	0.25	Increase
House Side	North	0.25	Decrease
	South	0.25	Decrease
Sidewalk	North	0.25	Increase
	South	0.25	Increase

The analysis results are shown in Table 2 for the 100 Watt Incumbent technology and Table 3 for the 250 Watt incumbent technology. In these tables, a green square represents a light source that

provides the desired direction of change in the measure and a red square represents an option that fails the criteria. The number represented in the square is the weighted percentage according to the weighting function. The table lists the template for each of the alternative design considered.

Table 2 100 Watt HPS Replacement Summary

Template A	**Pass/Fail**
58 W	79
37 W	Fail
30W	Fail
27 W	Fail
Template B	
58 W	71
37 W	Fail
30W	Fail
27 W	Fail
Template C	
58 W	84
37 W	Fail
30 W	Fail
27 W	Fail
Template D	
58 W	72
37 W	Fail
30W	Fail
27 W	Fail
Template E	
58 W	78
37 W	Fail
30 W	Fail
27W	Fail
Template F	
58 W	60
37 W	Fail
30 W	Fail
27 W	Fail
Template G	
58 W	65
37 W	62.5
30 W	50
27W	Fail

Table 3 250 Watt HPS Replacement Summary

Template A	**Pass/Fail**
136 W	68
111 W	Fail
89 W	Fail
72 W	Fail
Template B	
136 W	Fail
111 W	63
89 W	Fail
72 W	Fail
Template C	
136 W	74
111 W	Fail
89 W	Fail
72 W	Fail
Template F	
136 W	75
111 W	Fail
89 W	Fail
72 W	Fail

From this analysis, the results indicate that 58 Watt LED solution for the 100 Watt HPS is the only solution that meets the criteria for Template A through F and is the highest ranking luminaire for Template G. Similarly, for the 250 Watt Comparisons the 136 Watt LED replacement solution is suitable for Templates A, B and F. The 111 Watt solution is most appropriate for Template B.

Based on this analysis, I would recommend the Leotek 58W to replace the 100W HPS and the Leotek 136W to replace the 250W HPS.

Additional Analysis

In addition to the review of the current methods, 6 additional intersections were considered for analysis. Based on the AASHTO roadway categorization, three of the intersections were Collector/Collector intersections and three were Local/Local type intersections. In general, the intersection were standalone with one or possibly two luminaires lighting the intersections.

The test locations requested for Analysis are shown in Table 4 and Table 5. Each intersection was modelled in the AGI32 lighting analysis software. In the simulation, for each location,

calculations were located at the intersection box (the area within the crosswalks), illuminance calculation grids were also placed on each of the roadways to the north, east, west and south of the roadway, crosswalk calculations (vertical grids at 5ft high) at each crosswalk and finally sidewalk and light trespass grids at each corner of the intersections. The layout for the calculations is shown in Figure 1. Note that Roadway Luminance is not considered in these evaluations as the criteria for this category of roadway is typically illuminance only and roadway luminance is not appropriate.

Table 4 Collector/Collector Analysis Locations

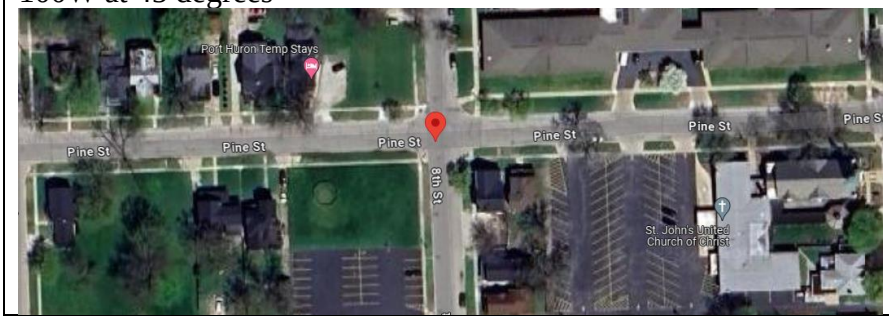
Sheldon Rd & Saltz Rd, Canton, Michigan 48187 UG Street Light Post_30' mount height_6' support arm 1 Luminaire on the corner parallel to cross street aiming North 
Avondale Rd & Wildwood Ave, Westland, Michigan 48186 UG Street Light Post_28.75' mount height_6' support arm\ One Luminaire on both roads perpendicular to the roadway at corner 
13th St & Court St, Port Huron, Michigan 48060 OH Street Light Pole_28' mount height_18' support arm One Beacon Luminaire at 45 degrees to roadway 

Table 5 Local/Local Analysis Locations

S Linville Ave St & Hazelwood St, Westland, Michigan 48186
OH Street Light Post, 28’ mount height, 18’ support arm
One Beacon Luminaire at 45 degrees

Griffith Ave & Wiltshire Rd, Berkley, Michigan 48072
OH Street Light Pole, 28’ mount height, 18’ support arm
One Beacon Luminaire at 45 Degrees

Pine St & 8th St, Port Huron, Michigan 48060
OH Street Light Pole, 28’ mount height, 18’ support arm
100W at 45 degrees



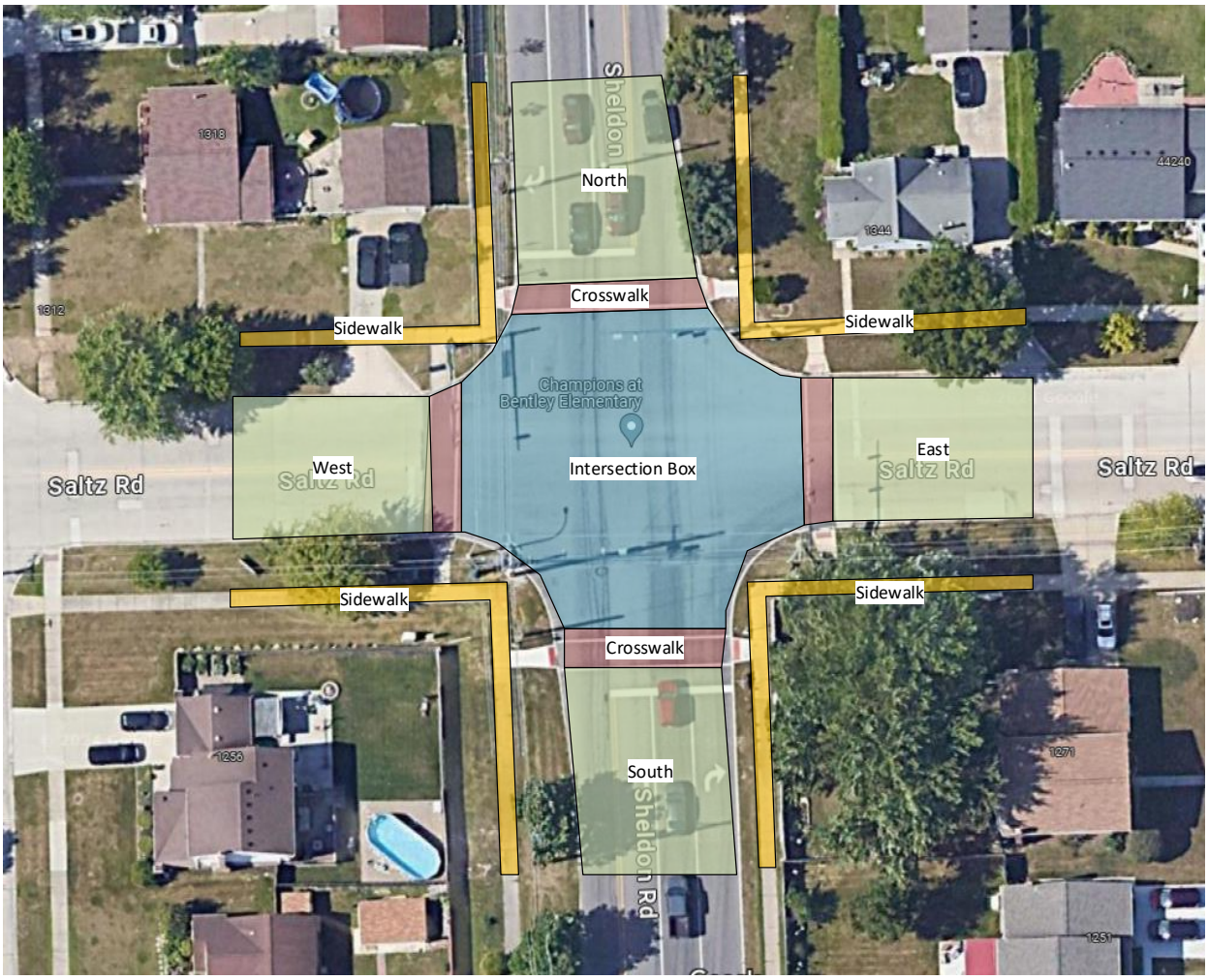


Figure 1 Calculation Area Layout for Sample Intersection

Using the same approach to the analysis as in the review of the DTE Energy effort, the illuminance grids were evaluated in terms of their performance. For the analysis, the desired change in the illuminance criteria as compared to incumbent is an increase in the average illuminance while the maximum illuminance and the uniformity (Avg/Min) are either reduced or maintained. in each of the illuminance grids was assess In general, it was desired that the average illuminance requirements were increased while the maximum values were maintained or decreased.

The results of the analysis is shown in Table 6. The data is interpreted in the same manner as the previous analysis with the requirement being that the illuminance in the test be equal to or higher than with the current technology.

Table 6 Intersection Analysis Results

Collector / Collector	
Sheldon Saltz	
136 W	47.5
111 W	Fail
89 W	Fail
72 W	Fail
Avondale and Wildwood	
136 W	63.5
111 W	47
89 W	Fail
72 W	Fail
13th and Court	
136 W	Fail
111 W	Fail
89 W	Fail
72 W	Fail
Local/Local	
S. Linville and Hazelwood	
58 W	43.5
37 W	Fail
30 W	Fail
27 W	Fail
Griffith and Wiltshire	
58 W	48
37 W	Fail
30 W	Fail
27 W	Fail
8th and Pine	
58 W	55
37 W	Fail
30 W	Fail
27 W	Fail

From this analysis, the results indicate that 58 Watt LED solution for the 100 Watt HPS is the only solution that meets the criteria for Local / Local intersections. Similarly, for the 250 Watt Comparisons the 136 Watt LED replacement solution is suitable for Sheldon and Shantz Intersection and the leading luminaire for the Avondale and Whitlock intersection utilizes 2 luminaires instead of a single luminaire. It is noteworthy that the Avondale and Whitlock

intersection is the only one with 2 luminaires and also note that no luminaire meets all of the criteria for the 13th and Court intersection.

Based on the intersection analyses, I would recommend the Leotek 58W to replace the 100W HPS and the Leotek 136W to replace the 250W HPS.

Summary of Conclusions

A summary of my conclusions from the analysis is:

- The approach DTE Energy used for the selection of luminaires is valid and aligns with the state of the art in the industry
- The luminaires selected by DTE energy were appropriate for the template roadways considered in their analysis.
- The appropriate luminaires for intersection evaluations selected through analysis are Leotek 136W and the Leotek 58W for the 250Watt HPS and for the 100 Watt HPS respectively.

It is important to note that this report is preliminary, and my opinions are subject to change should additional materials be supplied or facts become known. Please contact me at the above address, rgibbons@vtti.vt.edu, 540-231-1581 (W) or 540-818-3370 (C), if you have any questions.

Sincerely,

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KEY QUALIFICATIONS

Ron Gibbons is the Director of the Center for Infrastructure Based Safety Systems (CIBSS) at the Virginia Tech Transportation Institute (VTTI). He is also the Institute's lead lighting research scientist. He is currently the PI on projects investigating the Spectral Effects of new light sources on roadways, the visibility of police vehicles and on an investigation into the adaptive lighting of roadways. Gibbons is the author of over 80 published papers on roadway lighting, photometry, and target visibility. He is a past Director of Division 4 of the International Commission on Illumination (CIE) and a past president of the Illuminating Engineering Society of North America. Dr. Gibbons joined the Philips Lighting Company in 1995 as the manager of the Corporate Calibration and Standards Laboratory where he was responsible for the measurement and calibration of light sources for the entire North American region. He has also worked as a luminaire designer, operations manager, and project engineer. Dr. Gibbons earned his Ph.D. from the University of Waterloo, Canada, in 1997. His field of research involved the reflection properties of pavement surfaces and the impact on target visibility. He also worked on several projects studying visual performance, visual acuity, and peripheral vision.

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Gibbons, R. B., and Adrian, W. K. (1999). Influence of pavement reflection on target visibility. Journal of the Illuminating Engineering Society, 28(2), 102-112. (Also Presented at the 1998 IESNA Annual Conference.)

Gibbons, R. B., & Lighting, P. (1998). High illuminance calibration facility and procedures - Discussion. Journal of the Illuminating Engineering Society, 27(2), 139-139.

Gibbons, R. B. (1997a). A sphere photometry system for the nineties - Discussion. Journal of the Illuminating Engineering Society, 26(1), 54-55.

Gibbons, R. B. (1997b). Analysis of integrating sphere errors for lamps having different angular intensity distributions - Discussion. Journal of the Illuminating Engineering Society, 26(2), 113-113.

Gibbons, R. B. (1997c). The photometric effect of lamp/ballast configurations in multiple-lamp fluorescent luminaires - Discussion. Journal of the Illuminating Engineering Society, 26(2), 48-48.

Gibbons, R. B., & Lighting, P. (1998). High illuminance calibration facility and procedures - Discussion. Journal of the Illuminating Engineering Society, 27(2), 139-139.

Georgalas, A. M. and Gibbons, R. B. (1997). Sphere photometry correction factors. Proceedings of the 1997 IESNA Annual Conference.

Gibbons R. B. and Adrian, W. K. (1997). Influence of observation angles on road surface reflection characteristics. Journal of the Illuminating Engineering Society, 26(2), 139-149. (Also Presented at the 1996 IESNA Annual Conference.)

Adrian, W. K. and Gibbons, R. B. (1997). Fields of visibility for the night time driver. Proceedings of PAL 97, Progress in Automotive Lighting, 8-23.

Adrian, W. K. and Gibbons, R. B. (1994). Visual performance and its metric. Lighting and Engineering, 2(3), 1-34, 1994. (Also published in Russian in Svetotekhnika, 10, 2-17, 1994.)

Gibbons, R. B. and Adrian, W. K. (1994). Reflection properties of pavement surfaces for observation angles greater than 1° (DTFH 61-93-P-01429). Washington, DC: Federal Highway Administration.

Gibbons, R. B., Adrian, W. K., and Thomas, L. (1993, October). Amendments in calculating STV: Influence of light reflected from the road surface. Proceedings of the 2nd International Symposium on Visibility and Luminance in Roadway Lighting, Lighting Research Institute.

Adrian, W. K. and Gibbons, R. B. (1993). Visibility level und die sichtbarkeit in der strassenbeleuchtung. [Visibility level and visibility for street lighting.] Licht, 45(10), 734-739.

PRESENTATIONS AND RECOGNITION

AASHTO Summer Meeting. LED Lighting and the AMA, July 2017

2017 Street and Area Lighting Conference - Lighting Needs for the Future of Transportation, September 13, 2017,

Lighting and Safety, AARP, Blacksburg, January 2018

2018 Better Buildings by Design, Lighting in the Connected Transportation Environment, Burlington Vermont, February 2018

2018 Light and Human Health Conference, The Precious Balance of Roadway Lighting, April 12, Atlanta, GA

CIE Workshop on Roadway Lighting, Taiwan, April 2018

CIE Workshop on Visibility, Impact of Lighting on Safety, May 24 2018, Berlin, Germany

CIE Workshop on Visibility, Distribution Analysis of Detection Distances: A New Approach to Analyze Nighttime Roadway Visibility, May 24 2018, Berlin, Germany

Nighttime Lighting Research – Holophane Lighting, Newark, OH, October 2015

Dirt Depreciation on LED Luminaires – Street and Area Lighting Conference, Savannah, GA September 2015

Adaptive lighting Workshop Moderator – CIE Quadrennial Meeting – Manchester June 2015

Lessons Learned from the Next Generation Luminaire Competition: LightFair 2015

Nighttime Lighting Research – Holophane Lighting, Newark, OH, April 2015

The safety effects of road lighting – what international research tells us, Auckland, New Zealand, March 2015

FHWA Advanced Roadway Lighting, Chicago, Saratoga Springs, Olympia, Pheonix, Atlanta, October 2014 – January 2015

Nighttime Lighting Research – Holophane Lighting, Newark, OH, October 2014

Adaptive Roadway Lighting, Street and Area Lighting Conference, Nashville, 2014

Nighttime Lighting Research – Holophane Lighting, Newark, OH, April 2014

Quantifying the impact of road lighting on safety: Guidance for implementation, Sydney Austrailia, March 2014

Quantifying the impact of road lighting on safety: Guidance for implementation, Auckland, New Zealand, March 2014

Nighttime Lighting Research – Holophane Lighting, Newark, OH, October 2013

Guidelines for Crosswalk Lighting, Commision Internationale D'Eclairage Symposium, October 2010

Adaptive Roadway Lighting, IES Maritime Conference, June 2013

Roadway Lighting Design Approaches: Intermediate and Advanced Courses, Lightfair May 2013

Nighttime Lighting Research – Holophane Lighting, Newark, OH, April 2013

Nighttime Lighting Research – Holophane Lighting, Newark, OH, October 2012

21 Days in a Bucket Truck – IES Maritime Conference, June 2012

Nighttime Lighting Research – Holophane Lighting, Newark, OH, April 2012

Nighttime Lighting Research – Cooper Lighting, Peachtree City, GA, November 2011

A tale of Three Cities, Applying Led in the Real World, Illuminating Engineering Society of North America, November 2011

Roadway Lighting Applications Panel, Illuminating Engineering Society of North America, November 2011

Nighttime Lighting Research – Holophane Lighting, Newark, OH, October 2011

Spectral Impacts of Solid State Lighting – IES Street and Area Lighting Conference, New Orleans, LA, September 2011

A tale of Three Cities, Applying Led in the Real World, Commission Internationale d'Eclairage, 26th Quadrennial Session, Sun City, South Africa, June 2011

Applications of LED Lighting – Canadian Regional IES Conference, Moncton, New Brunswick, June 2011

LED Applications – LightFair International, Philadelphia, PA, May 2011

Nighttime Lighting Research – Holophane Lighting, Newark, OH, April 2011

LED Applications – Municipal Solid State Lighting Consortium, Kansas City, KS, March 2011

Spectral Impacts of Solid State Lighting – CIE United States National Committee Symposium, Toronto, Ontario, March 2011

Spectral Impacts of Solid State Lighting – CIE United States National Committee Symposium, Philadelphia, PA, May 2011

Nighttime Lighting Research – Holophane Lighting, Newark, OH, November 2010

Spectral Impacts of Solid State Lighting – CIE United States National Committee Symposium, Toronto, ON, November 2010

Spectral Impacts of Solid State Lighting – IES Street and Area Lighting Conference, Huntingdon Beach, CA, September 2010

LED Applications – Department of Energy Symposium, Philadelphia, PA, August 2010

Alternative Lighting Systems in Roadway, Commision Internationale D'Eclairage Symposium, March 2010, Vienna, Austria

Lighting on the Minneapolis I-35 West Bridge, Commision Internationale D'Eclairage Symposium, March 2010, Vienna, Austria

Alternative Light Sources in Roadway lighting, IES Maritime Regional Conference, Badek, Nova Scotia, June 2010

Nighttime Lighting Research – Holophane Lighting, Newark, OH, April 2010

Alternative Light Sources in Roadway lighting, IES Washington DC Section, January 2010

Alternative Light Sources in Roadway lighting, IES Grand Rapids Section, January 2010

Impact of Glare on Driver Performance, Illuminating Engineering Society of North America (IES), Annual Conference, Seattle, November 2009

Nighttime Lighting Research – Holophane Lighting, Newark, OH, November 2009

Nighttime Lighting Research – Holophane Lighting, Newark, OH, April 2009

Daily Planet - Discovery Channel Canada, February 2009

Nighttime Lighting Research – Holophane Lighting, Newark, OH, November 2008

Keynote Speaker – East Regional IES Conference, May 1, 2008

Crosswalk Lighting – East Regional IES Conference, May 1, 2008

Crosswalk Lighting – Canadian Regional IES Conference, Hamilton, Bermuda, April 2008

Warning Lights on Maintenance Vehicles, South Eastern Equipment Managers Conference, Asheville, NC, June, 2007

Impact of Weather on Infrared Vision Systems - Intelligent Lighting Systems for the Automotive Industry, Detroit MI, May 2007

Nighttime Lighting Research – Holophane Lighting, Newark, OH, April 2007

International Dark Sky Association Meeting – "Roadway lighting and Driver Safety", Washington, DC, February 2007

Nighttime Lighting Research – Illuminating Engineering Society of Blue Ridge Section, Roanoke, VA January 2007

"Human Factors Workshop 145 – Driving at Dusk", - Transportation Research Board Annual Meeting January 2007

Nighttime Lighting Research – Illuminating Engineering Society of North America Golden Gate Section, San Francisco, CA, November 2006

Dateline NBC – Getting out alive, Driving in Fog, original air date December 10, 2004

SELECTED RESEARCH

CHS: SMALL: Methods to Assess Automotive Augmented Reality Head-up Display Effects on Driver Performance (Co-PI) Sponsored By the National Science Foundation (2018-08-10 - 2021-07-31) Total: $499,996

Considering the Health Effects of Outdoor Lighting (PI) Sponsored By the US Department of Energy (2017-09-01 - 2019-10-31) Total: $1,214,625

Solid-State Roadway Lighting (PI) Sponsored By the WSP USA Inc (2017-06-01 - 2019-03-31) Total: $160,013

Sensor Activated Pavement Markings (PI) Sponsored By the Virginia Transportation Research Council (2016-09-28 - 2017-05-31) Total: $69,883

CMS Message Phrasing (PI) Sponsored By the Virginia Transportation Research Council (2016-09-01 - 2016-11-30) Total: $24,849

Weather Camera Positional Sensitivity Study (Co-PI) Sponsored By the Virginia Transportation Research Council (2016-09-01 - 2017-03-31) Total: $7,575

Evaluation of Lighting for Hawai' DOT (PI) Sponsored By the Johnson Controls, Inc. (2016-01-01 - 2016-06-30) Total: $34,079

NGL 2015 Outdoor Judging Event (PI) Sponsored By the Battelle Memorial Institute (2015-03-02 - 2015-04-30) Total: 5$2,500

Evaluation of Lighting in the Fort Pitt Tunnels (PI) Sponsored By the Sargent Electric Company (2014-12-20 - 2016-07-31) Total: $12,695

Evaluating the Efficacy of Lighting, Markings, and Paint Schemes in Reducing in the Incidence of Law Enforcement Vehicle Crashes (PI) Sponsored By the US Department of Justice (2013-10-01 - 2019-12-31) Total: $1,159,508

NGL Outdoor Judging Event (PI) Sponsored By the Battelle Memorial Institute (2013-08-15 - 2014-02-28) Total: $60,000

Mobile System Development (PI) Sponsored By the Minnesota Department Of Transportation (2013-06-12 - 2014-01-15) Total: $65,000

Develop Alternative Intersections Informational Guides (Co-PI) Sponsored By the Federal Highway Administration (2013-06-07 - 2014-04-30) Total: $495,066

Trinidad Nights (PI) Sponsored By the Colorado Department Of Transportation (2013-02-01 - 2013-09-01) Total: $60,000

Project Management (PI) Sponsored By the Federal Highway Administration (2013-02-01 - 2014-01-31) Total: $23,041

NGL Judging (PI) Sponsored By the Battelle Memorial Institute (2012-10-09 - 2013-01-31) Total: 50000

Visibility Support (PI) Sponsored By the Federal Highway Administration (2012-09-30 - 2015-08-31) Total: $245,792

Airport Garage Lighting (PI) Sponsored By the National Academy of Sciences (2012-06-04 - 2014-10-31) Total: $300,000

Accelerating Roundabout Implementation (PI) Sponsored By the Federal Highway Administration (2011-08-18 - 2015-09-30) Total: $1,179,302

Adaptive Lighting (PI) Sponsored By the Federal Highway Administration (2011-08-08 - 2014-03-31) Total: $886,542

VCTIR Vehicle Detection (Co-PI) Sponsored By the Virginia Transportation Research Council (2011-04-16 - 2011-08-31) Total: $36,655

Shiny Sign (PI) Sponsored By the Texas A&M Research Foundation (2011-04-01 - 2015-04-30) Total: $223,838

Roadway lighting Safety (09/01/2008 - Present), (PI) sponsored by the Surface Transportation Safety Center of Excellence

Rural Intersection Lighting (03/01/2009 - Present), (PI) sponsored by the Surface Transportation Safety Center of Excellence

Spectral Effects (PI) Sponsored By the Federal Highway Administration (2010-09-24 - 2015-01-31) Total: $1,612,871

Strategic Initiative For Evaluation Of Reduced Lighting On Roadways sponsored by FHWA (September 2011-January 2015)

FHWA Safety IDIQ (PI) Sponsored By the Federal Highway Administration (2010-07-21 - 2013-01-31) Total: $133,333

NCHRP Project 15-41, "Implications of Headlamps Visibility on Design of SAG vertical curves" (PI) Sponsored by the National Cooperative Highway Research Program. (07/01/10-12/31/2011)

Disability and Discomfort Glare Modeling, (PI) Sponsored by the National Surface Transportation Safety Center of Excellence

Development of a Luminance Camera for In-Vehicle Lighting Assessment, (PI) Sponsored by the National Surface Transportation Safety Center of Excellence

Development of a Luminance Metrics for Roadway Lighting, (PI) Sponsored by the National Surface Transportation Safety Center of Excellence

Development of a Roadway Lighting Mobile Measurement System, (PI) Sponsored by the National Surface Transportation Safety Center of Excellence

Application of Alternative Light Sources to Roadway Lighting in Anchorage AK Sponsored by the City of Anchorage (11/2008 – 6/2009)

Application of Alternative Light Sources to Roadway Lighting in San Diego, CA Sponsored by the City of San Diego (3/2009 – 11/2009)

Application of Alternative Light Sources to Roadway Lighting in San Jose, CA (PI) Sponsored By the Clanton & Associates Inc (2010-01-01 - 2010-05-31) Total: $34,000

*Bright Billboard (*PI) Sponsored By the Science Applications International Corporation (2009-10-15 - 2011-03-30) Total: $19,212

Wet Vis IV (PI) Sponsored By the Virginia Transportation Research Council (2009-03-01 - 2011-12-31) Total: $,301719

Wet Vis III (PI) Sponsored By the Virginia Transportation Research Council (2009-03-01 - 2011-04-30) Total: $210,000

Aloha Nights (PI) Sponsored By the Magnaray International (2008-11-01 - 2009-09-01) Total: $25,000

*Visibility Model (*PI) Sponsored By the Federal Highway Administration (2008-10-01 - 2011-03-31) Total: $700,000

Splash & Spray (Co-PI) Sponsored By the Federal Highway Administration (2008-10-01 - 2013-09-30) Total: $794,749

Guidebook for approach light system hazard assessment and mitigation (PI) Sponsored By The National Academies (2007-10-03 - 2009-04-30) Total: $300,000

Support to Florida dot wet pavement marking visibility research (PI) Sponsored By the Texas Transportation Institute (2007-08-16 - 2008-11-30) Total: $65,000

Street lighting design (PI) Sponsored By the Fairfax County (2007-02-22 - 2007-06-30) Total: $25,000

Glare (PI) Sponsored By the University of Michigan - Ann Arbor (2006-08-02 - 2010-06-30) Total: $263,230

Rulemaking support-rewrite of FMVSS 108 (PI) Sponsored By the National Highway Traffic Safety Administration (2006-01-04 - 2008-01-03) Total: $259,950

NTP (Co-PI) Sponsored By the GM NAO Technical Center (2005-11-10 - 2006-11-15) Total: $190,549

Foare cleveland study (Co-PI) Sponsored By the Rubin, Winston, Diercks, Harris & Cooke LLP (2005-10-01 - 2006-11-15) Total: $113,620

Lighting testing (PI) Sponsored By the University of Iowa (2004-09-01 - 2004-09-30) Total: $4,125

Rulemaking support-rewrite of fmvss 108-task order 22 (PI) Sponsored By the National Highway Traffic Safety Administration (2004-08-16 - 2005-09-30) Total: $89,819

Guidelines for selection and application of warning lights on roadway-operations equipment (PI) Sponsored By The National Academies (2004-07-29 - 2007-12-31) Total: $300,000

Visibility needs of motorists during wet night conditions-phase iii (PI) Sponsored By the Virginia Transportation Research Council (2004-07-01 - 2006-08-31) Total: $505,088

All weather lights (PI) Sponsored By the FIAMM SpA (2004-06-25 - 2004-07-24) Total: $7,508

Develop design guidelines for "crosswalk lighting" (PI) Sponsored By the University of Michigan - Ann Arbor (2002-07-03 - 2006-07-31) Total: $295,096

Symposium (PI) Sponsored By the Federal Highway Administration (2002-02-25 - 2002-05-31) Total: $8,058

Wet Visibility (Co-PI) Sponsored By the Virginia Transportation Research Council (2001-11-01 - 2004-08-31) Total: $300,000

Adaptive Lighting (project researcher), sponsored by a major automobile company, 01/25/02 – 01/24/03 and (PI) (09/01/03 – 09/01/04)

Enhanced Night Visibility (project researcher), sponsored by the Federal Highway Administration, (03/01/98 – 02/28/06)

SERVICE TO INDUSTRY

Illuminating Engineering Society, Board of Directors (2001 – 2010), President (2008-2009),
Member Roadway Lighting Standard Practice Committee,
Chair Roadway Sign Lighting Committee

Commission Internationale de l'Eclairage,
Associate Director Division 4
Chairperson TC 4-33 – Roadway Safety and Glare

Transportation research Board
Visibility Committee
Sign and Marking Materials Committee

Michigan Public Service Commission
DTE Electric Company
Projected 2025 PURPA Capacity-Related Generation Cost

Case No.: U-21534
Exhibit: A-26
Schedule: P1
Witness: S. D. Burgdorf
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Line No.	(a) Description	(b) Gen Forecast (MWh)	(c) Contract Fixed Price Component ($/MWh)	(d) Contract O&M Price Component ($/MWh)	(e) Total Capacity Related Generation Cost ($1,000)	(f) Total Fuel-Related Generation Cost[1] ($1,000)
1	**PURPA/PA2 Contracts**					
2	Ann Arbor - Barton Dam	3,408	$ 35.00	$ -	$ 119	
3	Ann Arbor - Superior	1,879	$ 35.00	$ -	$ 66	
4	STS French Landing	7,161	$ 35.00	$ -	$ 251	
5	Charter Township of Ypsilanti - Ford Lake (JYRO)	11,000	$ 29.80	$ 4.06	$ 372	
6	BFI - Arbor Hills				$ 1,597	
7	Ann Arbor Landfill, Michigan Cogen. Sys.	3,559	$ 15.20	$ 6.96	$ 79	
8	Riverview Energy #1				$ 491	
9	Sumpter Energy Assoc. - City Sand and Carleton Farms	73,016	$ 33.90	$ 6.96	$ 2,983	
10	Sumpter Energy Assoc. - Pine Tree Acres Landfill	69,258	$ 35.40	$ 6.96	$ 2,934	
11						
12	**Total PURPA/PA2**	169,282			**$ 8,892.095**	**$ 2,925**

Note 1: Fuel-Related Generation Cost based on difference of total projected PURPA PSCR Cost and the Capacity Related Generation Cost.
Note 2: BFI - Arbor Hills annual capacity cost in column (e) based on a fixed contract capacity and capacity rate, rather than actual generation.

Michigan Public Service Commission
DTE Electric Company
Projected 2025 PA295/PA342 Capacity-Related Generation Cost

Case No.: U-21534
Exhibit: A-26
Schedule: P2
Witness: S. D. Burgdorf
Page: 1 of 1

Line No.	(a) Description	(b) Source of Transfer Price	(c) Gen Forecast (MWh)	(d) LCOE/ Contract Price ($/MWh)	(e) Transfer Price ($/MWh)	(f) Transfer Price Fixed Price Component ($/MWh)	(g) Transfer Price Variable Price Component ($/MWh)	(h) Price Recovered in PSCR ($/MWh)	(i) Total Capacity-Related Generation Cost ($1,000)	(j) Total Fuel-Related Generation Cost[1] ($1,000)
1	**Renewable - Company Owned**									
2	Gratiot 2	U-15806	247,084	$ 93.93	$ 118.28	$ 10.60	$ 107.68	$ 118.28	$ 2,619	$ 26,606
3	Minden	U-15806	112,210	$ 66.50	$ 118.28	$ 10.60	$ 107.68	$ 118.28	$ 1,189	$ 12,083
4	Sigel	U-15806	251,887	$ 66.50	$ 118.28	$ 10.60	$ 107.68	$ 118.28	$ 2,670	$ 27,123
5	McKinley	U-15806	51,410	$ 66.50	$ 118.28	$ 10.60	$ 107.68	$ 118.28	$ 545	$ 5,536
6	Echo	U-16656	390,309	$ 58.50	$ 82.31	$ 31.35	$ 50.96	$ 82.31	$ 12,237	$ 19,891
7	Brookfield	U-16656	251,734	$ 51.75	$ 82.31	$ 31.35	$ 50.96	$ 82.31	$ 7,893	$ 12,829
8	Pinnebog	U-17632	174,179	$ 54.75	$ 82.80	$ 35.80	$ 47.00	$ 82.80	$ 6,235	$ 8,187
9	Pine River	U-17804	408,495	$ 52.00	$ 86.71	$ 39.01	$ 47.70	$ 86.71	$ 15,934	$ 19,486
10	Polaris	U-18082	502,158	$ 46.00	$ 93.48	$ 40.07	$ 53.41	$ 93.48	$ 20,124	$ 26,819
11	Meridian	U-20484	564,125	$ 49.13	$ 73.52	$ 34.73	$ 38.78	$ 73.52	$ 19,594	$ 21,879
12	DTE Solar Currents	U-15806	14,580	N/A	$ 309.88	$ 202.20	$ 107.68	$ 309.88	$ 2,948	$ 1,570
13	Romulus/Brownstown Solar	U-16656	1,340	N/A	$ 82.31	$ 31.35	$ 50.96	$ 82.31	$ 42	$ 68
14	Demille/Turrill/O'Shea Solar	U-17632	66,155	N/A	$ 82.80	$ 35.80	$ 47.00	$ 82.80	$ 2,368	$ 3,110
15	Ford	U-20484	979	N/A	$ 73.52	$ 34.73	$ 38.78	$ 73.52	$ 34	$ 38
16	Selfridge	U-21353	19,786	N/A	$ 62.50	$ 35.07	$ 27.43	$ 62.50	$ 694	$ 543
17										
18	**Total Renewable - Co-Owned**		3,056,431						**$ 95,126**	**$ 185,767**
19										
20	**Renewable - PPA Wind & Solar**									
21	DTE Renewable Generation, LLC - Stoney Corners / Garden	U-15806	76,089	$ 116.00	$ 118.28	$ 10.60	$ 107.68	$ 116.00	$ 806	$ 8,020
22	Invenergy - Gratiot 1	U-15806	271,880	$ 91.43	$ 118.28	$ 10.60	$ 107.68	$ 91.43	$ 2,882	$ 21,976
23	NextEra - Tuscola Bay	U-15806	364,755	$ 60.90	$ 118.28	$ 10.60	$ 107.68	$ 60.90	$ 3,866	$ 18,347
24	NextEra - Tuscola Wind II	U-16656	299,365	$ 49.25	$ 82.31	$ 31.35	$ 50.96	$ 49.25	$ 9,386	$ 5,358
25	NextEra - Pheasant Run	U-16656	254,536	$ 49.25	$ 82.31	$ 31.35	$ 50.96	$ 49.25	$ 7,980	$ 4,556
26	Heritage - Big Turtle	U-16656	66,970	$ 53.00	$ 82.31	$ 31.35	$ 50.96	$ 53.00	$ 2,100	$ 1,450
27	River Fork - Ranger Power	U-20484	100,282	$ 42.90	$ 73.52	$ 34.73	$ 38.78	$ 42.90	$ 3,483	$ 819
28										
29	**Total PPA Wind & Solar**		1,433,876						**$ 30,503**	**$ 60,525**
30										
31										
32	**Renewable - PPA LFG/Biomass**									
33	L'Anse Warden	U-15806	115,385	$ 102.00	$ 136.89	$ 29.21	$ 107.68	$ 102.00	$ 3,370	$ 8,399
34	Blue Water Renewables	U-15806	25,943	$ 99.00	$ 136.89	$ 29.21	$ 107.68	$ 99.00	$ 758	$ 1,811
35	Waste Management	U-15806	24,378	$ 85.00	$ 136.89	$ 29.21	$ 107.68	$ 85.00	$ 712	$ 1,360
36										
37	**Total PPA LFG/Biomass**		165,706						**$ 4,840**	**$ 11,570**
38										
39	**Total PA295/PA342 Capacity-Related Generation Cost**								**$ 130,469.507**	
40	**Total PA295/PA342 Fuel-Related Generation Cost**									**$ 257,862**

Note: 1. Fuel-Related Generation Cost based on difference of total projected PA295 PSCR Cost and the Capacity Related Generation Cost.

Michigan Public Service Commission
DTE Electric Company
Projected 2025 Capacity-Related Generation Cost & Energy Sales Revenue Net of Fuel Cost
(in $000's)

Case No.: U-21534
Exhibit: A-26
Schedule: P3
Witness: S. D. Burgdorf
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Line No.	(a) Description		(b)
1	**Capacity-Related Generation Cost**		
2	PURPA/PA2 Contracts	$	8,892
3	PA295/342 Renewable - Company Owned	$	95,126
4	PA295/342 Renewable - PPA Wind	$	30,503
5	PA295/342 Renewable - PPA LFG/Biomass	$	4,840
6	Capacity Purchases	$	(1,308)
7	**Total 2025 Projected Capacity-Related Generation Costs in PSCR**	**$**	**138,054**
8			
9			
10	**Energy Sales Revenue**		
11	Projected 2025 Energy Market Sales	$	2,180,036
12	Projected 2025 Off-System Energy Sales	$	-
13	Projected 2025 Unit Specific Bilateral Energy Sales	$	-
14	Projected 2025 Regulation, Spinning, and Supplemental Ancillary Services Sales	$	4,343
15	Projected 2025 Schedule 2 Reactive Ancillary Services Revenue	$	-
16	Total Projected 2025 Energy Sales Revenue	$	2,184,379
17			
18			
19	**Fuel Cost**		
20	Fuel	$	1,201,032
21	Total Projected 2025 Fuel Generation Expense	$	1,201,032
22			
23	**Projected 2025 Energy Sales Revenue Net of Fuel Costs**	**$**	**983,347.023**

(a)	(b)	(c)	(d)	(e)
LINE NO.	ORGANIZATION	DESCRIPTION	BENEFITS	BUSINESS UNIT(S)	MEMBERSHIP COSTS
	NONDISCRETIONARY			
1	Institute of Nuclear Power Operators (INPO)	INPO's mission is to promote the highest levels of safety and reliability in the operation of nuclear electric generating plants. All U.S. organizations that operate commercial nuclear power plants are INPO members. For U.S. Commercial Nuclear Assets, which includes Fermi 2, being a member of INPO is not a discretionary option. INPO is nondiscretionary for Nuclear operations.	Nondiscretionary for Nuclear Operations	Nuclear	$1,513,128
2	US Nuclear Regulatory Commission (NRC)	The United States Nuclear Regulatory Commission (NRC) is the independent federal agency responsible for ensuring the safe use of radioactive materials for beneficial civilian purposes while protecting people and the environment. The NRC regulates commercial nuclear plants, including the Fermi 2 Power Plant, through licensing, inspection, and enforcement of its requirements. NRC licensing and assessment fees are regulated at 10 CFR 170 and 10 CFR 171 and payment of these fees in not a discretionary option.	Nondiscretionary for Nuclear Operations	Nuclear	$7,958,545

(a)	(b)	(c)	(d)	(e)
LINE NO.	ORGANIZATION	DESCRIPTION	BENEFITS	BUSINESS UNIT(S)	MEMBERSHIP COSTS
	NONDISCRETIONARY continued			
3	North American Electric Reliability (NERC)	• Proposes, supports the development of, monitors compliance with, and enforces mandatory Reliability Standards for the North American Bulk Electric System (BES), subject to regulatory oversight and approvals from FERC in the U.S. and applicable authorities in Canada. • Conducts near-term and long-term reliability assessments of the North American Bulk Power System (BPS). • Certifies BPS operators as having and maintaining the necessary knowledge and skills to perform their reliability responsibilities. • Maintains situational awareness of events and conditions that may threaten BPS reliability. • Coordinates efforts to improve physical and cyber security for the BPS of North America. • Conducts detailed analyses and investigations of system disturbances and unusual events as well as measuring ongoing system trends to determine root causes, uncovering lessons learned, and issuing relevant findings as advisories, recommendations, guidelines, and essential actions to the industry to mitigate and control risks to reliability. • Identifies and prioritizes risks to reliability and uses a broad toolkit to mitigate and control risks to reliability, including the potential need for new or modified Reliability Standards, improved compliance monitoring and enforcement methods, or other initiatives.	Nondiscretionary for Generator and Distribution Owners	Distribution Operations	$2,978,713

	(a)	(b)	(c)	(d)	(e)	(f)
LINE NO.	ORGANIZATION	DESCRIPTION	BENEFITS	CUSTOMER BENEFITS	BUSINESS UNIT(S)	MEMBERSHIP COSTS
		DISCRETIONARY				
1	American Society of Employers (ASE)	The American Society of Employers (ASE) is a not-for-profit employer association serving Michigan's business community. Member organizations rely on ASE as a source for information and support on all matters affecting the employment relationship. ASE provides compensation and benefits data.	• Benchmarking • Research	DTE's membership with ASE is a cost-effective way to gain information and support regarding benefit and compensation practices.	Human Resources	$19,011
2	Center for Energy Workforce (CEWD)	The Center for Energy Workforce or (CEWD) is a non-profit consortium of more than 120 energy companies, associations, unions, educational institutions, and government entities working in partnership to ensure a skilled, diverse workforce pipeline for the energy industry.	• Benchmarking • Research • Best practices • Networking	See link for more information: https://cewd.org/membership/membership-benefits/	Human Resources	$14,840
3	Conference Board Inc.	The Conference Board is a non-advocacy, not-for-profit entity holding 501 (c)(3) tax-exempt status in the United States. The Conference Board conducts economic and business research and convenes business leaders in various forums. Membership with The Conference Board gives us research and insights on key topics and upcoming challenges in the areas of employee compensation, economics, and finance.	• Networking • Research	See link for more information: https://www.conference-board.org/membership##	Corporate	$37,464
4	Edison Electric Institute (EEI)	EEI provides strategic business intelligence, and essential conferences and forums. The EEI facilitates collaboration regarding emerging issues facing the industry. The EEI also provides a forum to ask industry related questions to other utilities and provides invaluable resource information about the utility industry and other issues that are important to DTE Electric.	• Benchmarking • Best Practices • Networking • Research	Please refer to the testimony of Witness Crozier.	Various	$1,435,103

(a)	(b)	(c)	(d)	(e)	(f)
LINE NO.	ORGANIZATION	DESCRIPTION	BENEFITS	CUSTOMER BENEFITS	BUSINESS UNIT(S)	MEMBERSHIP COSTS
		DISCRETIONARY continued				
5	Electric Power Research Institute (EPRI)	The Electric Power Research Institute, Inc. conducts research, development and demonstration relating to the generation, delivery and use of electricity for the benefit of the public. An independent, nonprofit organization, they bring together scientists and engineers as well as experts from academia and the industry to help address challenges in electricity. Their work spans nearly every area of electricity generation, delivery and use, management, and environmental responsibility. They provide both short- and long-term solutions in these research areas for the electricity industry, its customers and society.	• Benchmarking • Best practices • Networking • Research	Please refer to the testimony of Witness Davis. Please refer to the testimony of Witness Guillaumin.	Nuclear Energy Supply	$1,976,555
6	Gartner	Works with companies to share, analyze, and apply proven practices. Every year they equip over 20,000 senior leaders from more than 10,000 organizations across 110 countries with the intelligence they need to respond quickly to evolving business conditions. Gartner helps businesses effectively manage their talent, customers, and operations to exceed business objectives.	• Benchmarking • Best practices • Networking	Gartner provides research at a lower cost than DTE could do on its own. Gartner also provides industry wide expertise that DTE may not otherwise have access to.	Internal Audit	$43,939

(a)	(b)	(c)	(d)	(e)	(f)
LINE NO.	ORGANIZATION	DESCRIPTION	BENEFITS	CUSTOMER BENEFITS	BUSINESS UNIT(S)	MEMBERSHIP COSTS
		DISCRETIONARY continued				
7	HR Policy Association	The association represents the largest employers doing business in the United States and globally. The Association brings these executives together not simply to discuss how human resource practices and policies should be improved, but also to create a vision for successful HR strategies and pursue initiatives that promote job growth, employment security and competitiveness.	• Benchmarking • Best practices	DTE uses the information to help improve HR operations and policies, manage costs, and sustain a skilled workforce.	Human Resources	$10,194
8	Human Capital Institute (HCI)	HCI's extensive library spans the full spectrum of talent management from candidate experience to acquisition, engagement, and more to foster growing HR skills, build business acumen, and acting more strategically.	• Best Practices • Research	HCI provides DTE with access to strategic talent management content including research reports and articles, webcasts, etc.	Human Resources	$19,680
9	Institute for Corporate Productivity	Purpose is to discover and advance next practices in human capital. Produces research on human capital and HR best practices and emerging workforce trends.	• Practices • Research	The Institute for Corporate Productivity is a human capital focus research organization that provides the Company insights on topics related to organizational culture change, employee collaboration, the attraction and retention of talent and diversity, equity and inclusion issues. The importance of these topics was amplified during the COVID-19 pandemic and its after affects.	Human Resources	$57,856

(a)	(b)	(c)	(d)	(e)	(f)
LINE NO.	ORGANIZATION	DESCRIPTION	BENEFITS	CUSTOMER BENEFITS	BUSINESS UNIT(S)	MEMBERSHIP COSTS
		DISCRETIONARY continued				
10	National Safety Council (NSC)	The NSC is a nonprofit organization whose mission is to save lives by preventing injuries and deaths at work, in homes and communities and on the road through leadership, research, education and advocacy. This membership provides access to online learning, practical tips, training tools, publications, libraries, original research, networking, and educational events to further support workforce safety, especially the high-risk jobs DTE Electric employees perform.	• Best Practices • Benchmarking • Research	See link for more information: https://www.nsc.org/company	Corporate Safety	$43,709
11	Neuroleadership Institute (NLI)	NLI provides research-based consultancy that uses science to make a company's culture more societal and transforms the way their organizations think, grow and perform.	• Research	NLI provides research-based consultancy that uses science to make a company's culture more societal and transforms the way their organizations think, grow and perform.	Human Resources	$7,478
12	Nuclear Energy Institute (NEI)	Membership with NEI includes access to NEI's Personnel Access Data System (PADS) which allows NEI members to share security background check information with each other resulting in significant security efficiencies. NEI also provides members, including DTE Electric, with support required to demonstrate compliance with NRC security regulations. NEI is also responsible for industry initiatives to improve safety and operational efficiencies.	• Benchmarking • Best Practices	Please refer to the testimony of Witness Davis.	Nuclear	$759,515

(a)	(b)	(c)	(d)	(e)	(f)
LINE NO.	ORGANIZATION	DESCRIPTION	BENEFITS	CUSTOMER BENEFITS	BUSINESS UNIT(S)	MEMBERSHIP COSTS
		DISCRETIONARY continued				
13	Nuclear Procurement Issues Corporation (NUPIC)	Nuclear Procurement Issues Corporation (NUPIC) NUPIC was formed in 1989 by a partnership involving all domestic and several international nuclear utilities. The NUPIC program evaluates suppliers furnishing safety-related components and services and commercial-grade items to nuclear utilities.	• Research	Suppliers furnishing safety-related components and services and certain commercial-grade items must be evaluated by qualified nuclear evaluators. NUPIC participation allows DTE Electric to accept the valuations of other members to maintain the Fermi 2 Approved Suppliers List; Otherwise, DTE Electric would have to separately and independently inspect and evaluate each supplier which would not be reasonable nor prudent. Please refer to the testimony of Witness Davis.	Nuclear	$12,894

Mayor's Office

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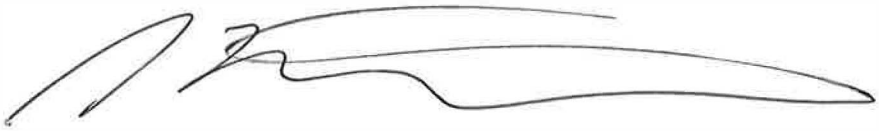
Satvir Deol
Director, DO Engineering and Planning
DTE Energy
1 Energy Plaza
Detroit MI 48226

Dear Mr. Deol,

The City of Detroit welcomes DTE's underground pilot to the Buffalo Charles/Davison neighborhoods. The City supports any projects that will improve the quality of life for its residents, including improved safety and reliability that is expected to be delivered through this pilot. DTE reached out and worked with City Departments prior to starting the project for input on location and scope, and we continue to coordinate as the project progresses. We also acknowledge that DTE engaged with local leaders and residents before the project launched and they continue to communicate status updates and respond to inquiries.

The City of Detroit is looking forward to improved safety and reliability for our residents in this project area.



Sam Krassenstein
Chief of Infrastructure, Mayor's Office
krassensteins@detroitmi.gov

EV Status Report
2023

DTE

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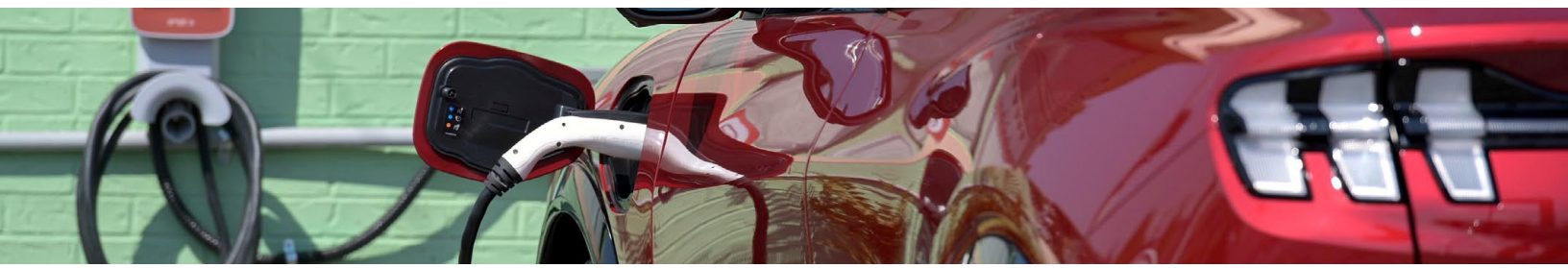
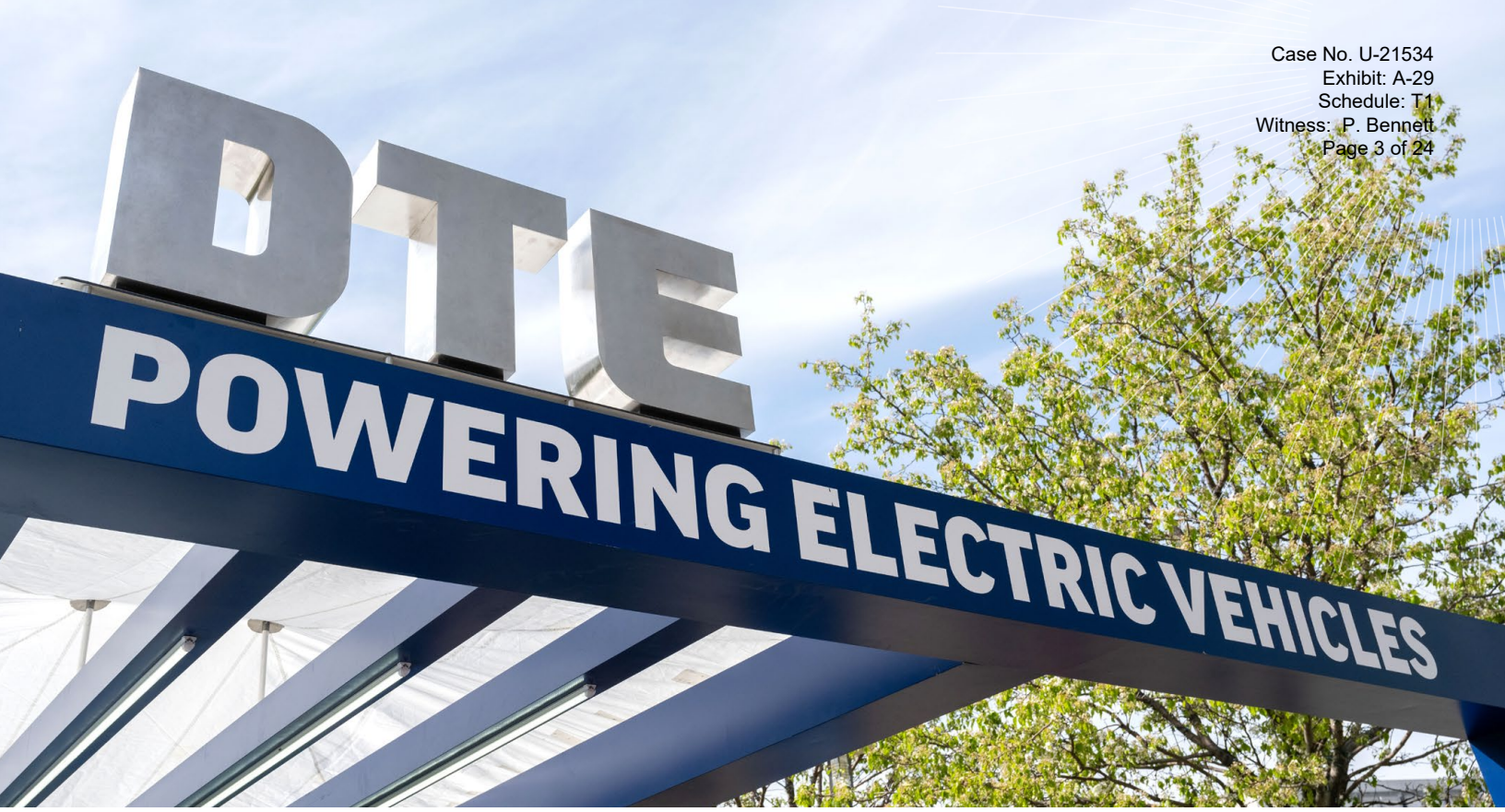




Executive Summary

In 2022, low vehicle inventory coupled with rising vehicle prices resulted in the lowest number of new vehicle sales nationwide in over a decade. However, electric vehicle (EV) sales continued to show record growth, accounting for almost 7% of the light-duty market share - an increase of over 60% from 2021. In Michigan, EV sales increased over 50% to approximately 15,500 in 2022, with nearly 75%, or 11,500, of those EVs sold in DTE Electric service territory. There will be almost 120 EV models available by the end of this year, and, in combination with federal funding opportunities, the EV market is poised to accelerate.

DTE Electric (DTEE or the Company) received approval for its first EV pilot, Charging Forward, in May 2019. The Charging Forward program has since grown with two additional approved filings, Charging Forward eFleets and the Charging Forward Expansion in 2021 and 2022, respectively. The total approved budget for all Charging Forward programs is now $46.1 million, with a total spend of $13.2 million as of April 30, 2023.

The Company's five guiding principles for Charging Forward are to reduce barriers to EV adoption, efficiently integrate EV load with its distribution system, help enable equitable access to EVs, test new technologies to prepare for widespread adoption in the future, and support the State of Michigan's transportation electrification goals. Charging Forward is making progress toward achieving all goals.

Charging Forward is reducing barriers to EV adoption by addressing lack of awareness of EVs through its Education and Outreach and eFleet Advisory Services components and lack of confidence in the refueling infrastructure by facilitating charger deployment with rebates. DTEE is efficiently integrating the EV load with its distribution system by requiring Time of Day rates and prioritizing business applications with available capacity. Through new offerings such as its EV Rebate and Business Charger Installation programs, Charging Forward is also helping enable equitable access to EVs. Additionally, the Company continues to test new technologies through innovative new programs such as the Emerging Technology Fund and EV Data Sharing. Lastly, Charging Forward is supporting the State of Michigan's transportation electrification goals by aligning its program requirements with those of state and federal EV programs as applicable and supporting business customers who want to combine funding from DTE with funding from other stakeholders (government or otherwise).

As of April 30, 2023, Charging Forward as a whole has achieved almost 140 million customer impressions to date through its various Education & Outreach campaigns. Additionally, the eFleets team has reached out to over 5,300 leads, conducted 600 consultations, and completed about 170 Total Cost of Ownership analyses, resulting in fleet owner commitments to electrify over 2,100 vehicles through 2026. DTEE has approved 3,145 Home Charger Rebates to date and recently launched three new residential customer offerings: Home Charger Installation, EV Rebates, and EV Data Sharing. Charging Forward has approved Business Charger Rebates for 1,297 Level 2 ports and 135 fast chargers, and has approved eFleet Charger Rebates for 178 Level 2 ports and 46 fast chargers. The Company is also launching three new business customer offerings: Business Charger Installation, Charging Hubs, and eFleet Battery Support. Based on the installation of 3,145 residential Level 2 chargers, 872 business Level 2 ports, and 51 DCFCs in Charging Forward, 9.2 Gigawatt-hours have been consumed to date. This is the equivalent of approximately 30.1 million electric miles powered by DTE, translating to 7,300 metric tons of carbon emissions eliminated and almost 860 thousand gallons of gasoline avoided. Across both residential and business chargers, 90% of consumption fell outside the coincident peak hours of 3pm-7pm.

Additionally, DTEE is developing a comprehensive Transportation Electrification Plan that will detail the company's market assessment, investment plans, and benefit-cost analysis and tie closely to its Distribution Grid Plan. The Company is in the process of evaluating its five-year investment strategy by charging segment while maintaining an overall focus on customer affordability at the portfolio level. DTEE will engage stakeholders before filing the Transportation Electrification Plan by year end.

Playing an active role in these early adoption years to ensure DTEE is learning about EV charging behavior, piloting new technologies, and efficiently integrating charging infrastructure with the distribution system is important now to ensure the benefits of added EV load accrue to all DTEE customers in the future.

30.1 million electric miles powered by DTE = 7,300 metric tons of carbon emissions eliminated and almost 860 thousand gallons of gasoline avoided.

Background

Company Overview

DTE Energy (NYSE: DTE) is a Detroit-based diversified energy company involved in the development and management of energy-related businesses and services nationwide. Its operating units include an electric company serving 2.3 million customers in Southeast Michigan and a natural gas company serving 1.3 million customers in Michigan. The DTE portfolio also includes non-utility businesses focused on industrial energy services, renewable natural gas, and energy marketing and trading. As an environmental leader, DTE utility operations will reduce carbon dioxide and methane emissions by 90% by 2040 to produce cleaner energy while keeping it safe, reliable and affordable. DTE Electric and Gas aspire to achieve net zero carbon and greenhouse gas emissions by 2050. DTE is committed to serving with its energy through volunteerism, education and employment initiatives, philanthropy and economic progress. Information about DTE is available at dteenergy.com, empoweringmichigan.com, twitter.com/dte_energy and facebook.com/dteenergy.

Report Purpose

The purpose of the Charging Forward Annual Status Report is to provide a detailed update on DTEE's EV programs, including residential, business, and fleet offerings. As agreed in previous regulatory proceedings, the Company will provide key learnings regarding charging behavior and benefit-cost analysis with each of its annual reports. Where applicable, DTEE will also describe any design modifications with supportive reasoning. The Company has filed four status reports to date: a Pre-Implementation Status Report filed May 2019 and three subsequent Annual Status Reports filed May 2020, June 2021, and June 2022. Unless otherwise specified, all numbers throughout the remainder of this report reflect Charging Forward's status as of April 30, 2023.

Industry Updates

In 2022, the automotive industry overall began to overcome pandemic-related supply shortages, but low vehicle inventory coupled with rising vehicle prices resulted in the lowest number of new vehicle sales in over a decade. About 13.7 million new vehicles were sold in the United States (US) in 2022, a decline of about 9% from the 15.0 million sold in 2021.[1] However, EV sales continued to show record growth and once again outperformed the overall automotive industry market. In 2022, EVs accounted for almost 7% of the light-duty market share, an increase of over 60% from 2021, with all-electric EVs also known as Battery Electric Vehicles, or BEVs making up 80% of that share.[2] In December 2022, EVs accounted for 10% of the light-duty market share – the highest percentage to date and the first time EV market share moved into double digits.[3] This growth has continued into the first quarter of 2023, with BEV sales up over 60% and plug-in hybrid EV (PHEV) sales up almost 30% as compared to the first quarter of 2022.[4]

Increased EV model availability continues to be a key driver of sales. The combined number of BEV and PHEV models available has doubled from 44 in 2019 to 88 in 2022, and that's expected to grow to almost 120 by the end of 2023. The majority of new model launches are BEVs, with an average electric range of over 270 miles, compared to 204 miles in 2019.[5] However, dealership inventory remains a critical bottleneck to EV adoption. A recent Sierra Club study found that only one-third of dealers nationwide had an EV available for sale. This availability barrier is attributed to both the industry-wide supply chain issues discussed earlier and automaker allocation of EVs to dealerships.[6]

Two legislative bills are also making a big impact on the EV market: the Bipartisan Infrastructure Law (BIL, signed into law November 2021) and the Inflation Reduction Act (IRA, signed into law August 2022). Through the National Electric Vehicle Infrastructure (NEVI) portion of the BIL, a minimum of $7.5 billion will be deployed over the next five years to fund a direct current fast charging (DCFC) network. The BIL includes an additional $32.5 billion eligible to support EVs, plus $10.5 billion for grid upgrades and battery development. The IRA includes $47 billion eligible to support EVs, not including funding to support the $7,500 consumer tax credit for light-duty EVs. These BIL and IRA investments in EVs and EV infrastructure over the next five years dwarf the $3.3 billion awarded by the US government for EVs and EV infrastructure across 16 prior programs.[7]

Michigan Trends

In Michigan, EV sales increased over 50% to approximately 15,500 in 2022, compared to about 10,100 in 2021. Nearly 75%, or 11,500, of those EVs were sold in DTEE service territory. The portion of EV sales that were PHEVs rose from 18% in 2020 to 38% in 2021 with the popularity of the Jeep Wrangler 4xe, and that continued in 2022 with 37% of EV sales being PHEVs. However, that trend seems to be beginning to reverse again: the first two months of sales in 2023 show BEVs averaging about 75% of sales. As of February 2023, Michigan now has approximately 48,000 EVs in the state, with about 33,000 (69%) of them in DTEE service territory.[8]

Although the rate of adoption varies significantly across forecasts, both near- and long-term forecasts for EV sales in Michigan show increasing levels of adoption. DTEE is projecting that EVs will be approximately 30% of new sales and 13% of vehicles on the road in Michigan by 2030 (up from 22% and 10%, respectively, in the 2022 Annual Status Report). This new adoption curve estimates nearly 900,000 EVs in Michigan by the end of 2030.

Michigan continues to enact policy and execute programs to support the EV market. As part of the BIL, the Michigan Department of Transportation (MDOT) will receive and distribute $110 million in NEVI funds over the next five years. MDOT is making nearly $38 million available in the first round to build out high-powered DCFC infrastructure along designated alternative fuel corridors in the state. Michigan also outperformed expectations in the 2022 Clean School Bus (CSB) Rebate program (funded by BIL), by receiving the fifth-highest number of awards in the country, with 24 districts winning a total of 133 electric buses. Regarding state funding, Governor Whitmer recommended $170 million in the fiscal year 2024 state budget to support the Michigan Future Mobility Plan, including $65 million to expand EV charging infrastructure, $48 million to temporarily exempt EVs from the state's sales and use taxes, $45 million to support the transition to climate-friendly vehicles for local governments and agencies, and $10 million to electrify the state's fleet.

[1] https://www.cnbc.com/2023/01/06/2022-us-auto-sales-are-worst-in-more-than-a-decade-.html
[2] Automotive Communities Partnership
[3] Atlas Public Policy EV Hub
[4] Automotive Communities Partnership
[5] Electric Power Research Institute
[6] https://www.sierraclub.org/sites/www.sierraclub.org/files/2023-05/SierraClubRevUpReport2023.pdf
[7] Atlas Public Policy
[8] S&P Global

Charging Forward Overview

Approvals and Objectives

Since its initial approval from the Michigan Public Service Commission (MPSC) with Order U-20162 in May 2019, the Charging Forward program has continued to grow and evolve. The original pilot, proposed in Case Number U-20162, was approved for $13.1 million with modifications, guidance, and recommendations. Including other EV-related pilots folded into Charging Forward as supported by stakeholders, the Charging Forward spend estimate increased to $14.1 million. Building on the momentum of the fleet element in the initial filing, the Company proposed Charging Forward eFleets (eFleets) in 2020. The $13.4 million pilot was approved in March 2021 in Case Number U-20935. Most recently, in November 2022, the MPSC approved $18.6 million for the Charging Forward Expansion (Expansion) in Case Number U-20836.

As part of Order U-20162, the MPSC established three objectives for utilities in the transportation electrification space as follows:

1. Maximize pilot program participation at minimum cost,
2. Aggressively test new and novel practices and technologies to ensure that new load associated with EV charging maximizes net benefits to all ratepayers, and
3. Ensure that investments in make-ready infrastructure serve double duty by directly addressing core barriers (such as range anxiety), and by enabling the Company to learn reasonable and practicable ways to actively manage charging times and locations, to minimize required investment in new distribution infrastructure, and to obviate adverse grid impacts related to uncontrolled charging.

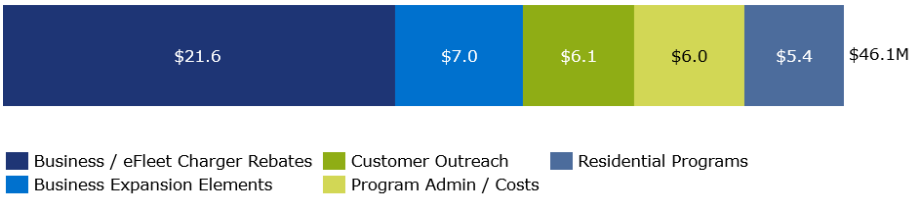
DTEE adopted these overarching objectives and has evolved them over the last four years into five guiding principles for its Charging Forward programs:

1. Reduce barriers to EV adoption,
2. Efficiently integrate EV load with its distribution system,
3. Help enable equitable access to EVs,
4. Test new technologies to prepare for widespread adoption in the future, and
5. Support the State of Michigan's transportation electrification goals.

Budget and Spend

The total approved budget for Charging Forward, including the initial filing, eFleets, and the Expansion, is $46.1 million as shown in Figure 1 below.

Figure 1: Total Approved Budget by Category (in millions)



Business Expansion Elements include the following business customer offerings that were recently approved in the Expansion: Business Charger Installation, Charging Hubs, eFleet Battery Support, and the Emerging Technology Fund. Customer Outreach includes the Education and Outreach approved with each program plus eFleet Advisory Services. Residential Programs include Home Charger Rebates, Home Charger Installation, and EV Rebates. The total spend to date is $13.2 million as shown in Table 1 below.

Table 1: Charging Forward Spend to Date (in millions)

	Initial Filing	eFleets	Expansion	Total
Business / eFleet Charger Rebates	$4.9	$0.5	-	$5.4
Business Expansion Elements	-	-	$0.1	$0.1
Customer Outreach	$1.9	$0.6	$0.1	$2.6
Program Admin / Costs	$2.6	$0.7	$0.3	$3.6
Residential Programs	$1.1	-	$0.4	$1.5
Total	**$10.5**	**$1.8**	**$.9**	**$13.2**

Stakeholder Engagement

DTEE engages a variety of stakeholders to evolve with market dynamics and integrate lessons learned as applicable, starting with its own customers. The EV team engages with DTEE residential customers (regardless of Charging Forward program participation or not) through an annual survey to track their attitudes on EVs. The EV Team also conducts post-rebate surveys with residential and business customers who participate in Charging Forward programs, to improve its processes.

On a national level, DTEE is an active member of several organizations including American Council for an Energy Efficient Economy, Automotive Communities Partnership, Alliance for Transportation Electrification, CALSTART, the DOE US DRIVE[9] program, the Edison Electric Institute, and the Electric Power Research Institute (EPRI). Additionally, the EV team engages with Atlas Public Policy, the Environmental Protection Agency (EPA), EVNoire, Forth Mobility, the Natural Resources Defense Council, Sierra Club, and Smart Electric Power Alliance. DTEE is also a member of the National Electric Highway Coalition (NEHC), which is committed to ensuring fast charging stations will allow the public to drive EVs with confidence along major travel corridors by the end of 2023. NEHC consists of more than 60 utilities across the country.

On a regional level, DTEE works closely with regulators and policymakers, including the MPSC, Michigan Department of Environment, Great Lakes, and Energy (EGLE), MDOT, and the Office of Future Mobility and Electrification (OFME) to ensure that its EV programs align with state goals and policies. Other regional organizations with which DTE engages include 5 Lakes Energy, Clean Fuels Michigan, Ecology Center, Electrification Coalition, Michigan Economic Development Corporation, Michigan Energy Innovation Business Council, and Midwest Transportation Electrification Collaborative.

From an industry perspective, DTEE maintains frequent contact with OEMs and charging companies through its Charging Forward programs. Those that are invited to its stakeholder discussions include Blink, Chargepoint, Daimler, Delta Products, eCamion, Electrify America, Enel X, EV Connect, EVGo, FLO, Ford, General Motors (GM), Rivian, Tesla, Red E Charging, and Volta.

To discuss progress and solicit feedback, DTEE hosted its sixth key stakeholder discussion on March 29, 2023. The team also distributes high-level quarterly reports to the same stakeholders mentioned above to provide updates on EV sales in DTEE territory, Charging Forward application statuses, and other key achievements.

Long-Term Strategy

DTEE is developing a comprehensive Transportation Electrification Plan (TEP) that will detail the company's market assessment, investment plans, and benefit-cost analysis and tie closely to its Distribution Grid Plan. The Company is in the process of evaluating its five-year investment strategy by charging segment while maintaining an overall focus on customer affordability at the portfolio level. DTEE will engage stakeholders before filing the TEP by year end.

A guiding principle of Charging Forward described above is testing new technologies to prepare for widespread adoption in the future. To that end, DTEE recently launched the Emerging Technology Fund (ETF), which was approved as part of the Expansion. The ETF is a $900,000 grant program established to enable timely funding of prudent pilots in a rapidly evolving market. Types of projects considered include EV-grid integration solutions, novel engagement of underserved communities, and second-life applications for used EV batteries. Organizations seeking funding are vetted via three stages of review: initial screening by the EV team, cross-functional review by other business units within DTE, and the final review by the ETF Advisory Committee (AC). The AC was assembled in March 2023 and includes members from the Ecology Center, EPRI, Ford, GM, the MPSC, and Next Energy. The AC has already met for a kick-off and first round of funding reviews (agreed but not yet finalized / announced) and will meet up to two more times this year until funding is exhausted.

DTE will file a comprehensive Transportation Electrification Plan by the end of 2023.

[9] US DRIVE stands for Driving Research and Innovation for Vehicle efficiency and Energy sustainability

Customer Outreach

Education and Outreach

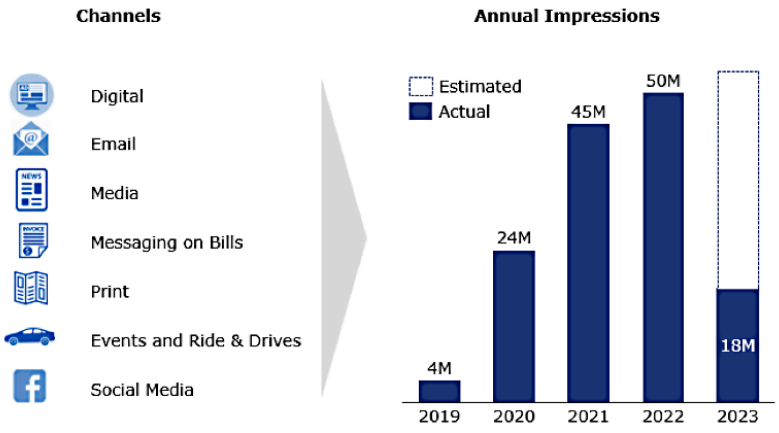
Charging Forward's EV Education and Outreach (E&O) has defined goals for three key customer segments, including residential customers, charging station owner-operators (site hosts), and fleet owners as outlined in Table 2 below.

Table 2: Key Customer Education and Outreach Goals by Segment

	Residential Customers	Site Hosts	Fleet Owners
Inform on available incentives	x	x	x
Make benefits of EVs clear	x	x	x
Educate on available EV models	x		x
Advise on best times to charge	x		
Recruit potential site hosts		x	x
Increase in-person EV experiences	x		
Help enable equitable access to EVs	x		

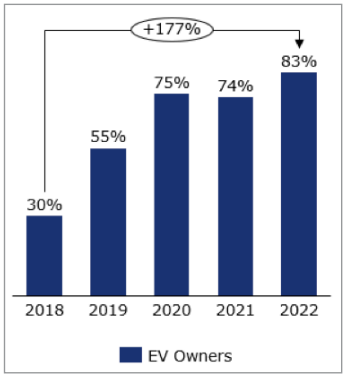
To achieve these goals, the EV team continues to utilize effective marketing channels to reach all three customer segments described above, resulting in over 140 million customer impressions to date as shown in Figure 2 below.

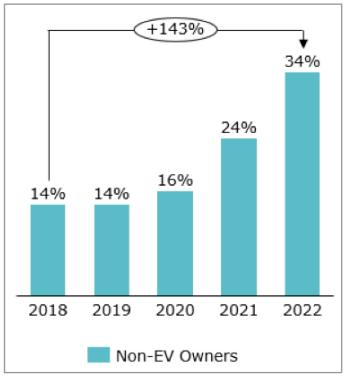
Figure 2: Customer Education & Outreach Impressions Overview



Charging Forward conducts an annual tracking survey to measure customer awareness of EVs by sending the same question set to randomly selected residential customers who manage their utility bill and receives approximately 500 responses. Results from 2022 marked the fifth wave of the study. One question that is a strong indicator of E&O success is awareness of DTEE's EV E&O efforts, or DTE EV advertising recall, which continues to trend upwards. EV owners have 83% ad recall and non-EV owners have 34% ad recall, increases of 177% and 143%, respectively, since 2018 as shown in Figure 3 below.

Figure 3: DTE EV Advertising Recall

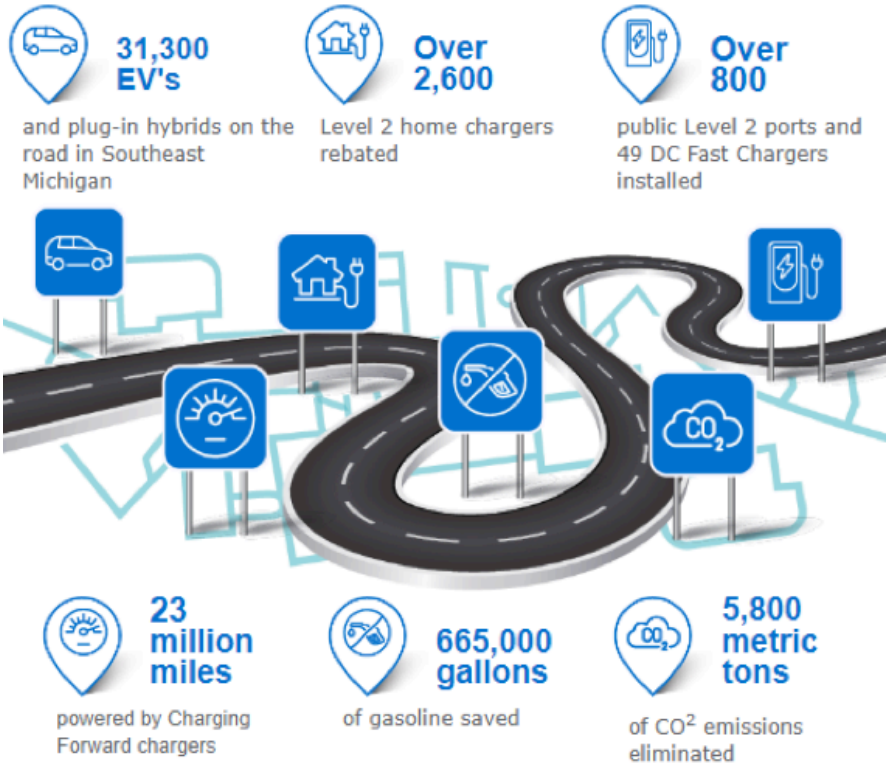




The majority of E&O efforts aim to drive customers to DTEE's robust EV webpages. Since program launch, over 345,000 customers have visited the residential EV website. Before the Expansion approval, this website included information on the Home Charger Rebate, as well as other resources for residential customers, such as education on Time of Day electric pricing, EV benefits, and a virtual EV Showroom. DTEE has since added webpages for the new residential programs approved with the Expansion, including Home Charger Installation, EV Data Sharing, and the EV Rebate. Similarly, the business EV website includes information on available incentives (e.g., the Business Charger Rebate and eFleet Charger Rebate) in addition to valuable resources, such as eFleet Advisory Services, an overview of the charger installation process, and a directory of electricians. Since launch, the business website has been visited by more than 66,000 site hosts and fleet owners.

Charging Forward launched EV Connections in April 2020 to build a sense of community centered around EVs. All customers are welcome to join, and interest continues to grow, with more than 1,700 customers now enrolled – an increase of 55% since the 2022 Annual Status Report. The EV team engages this group primarily through its biannual eNewsletter, which highlights Charging Forward progress, introduces readers to an EV driver, and spotlights a new site host to increase awareness of public charging locations. The most recent eNewsletter Road Map is shown in Figure 4 below.

Figure 4: Recent EV Connections eNewsletter Road Map



"I want to thank DTE for providing the opportunity to test drive [an] EV. I wouldn't have been able to experience driving them without going to a dealership and hoping one was available. The ability to drive different price range EVs was great... Thank you DTE!"

DTE Ride and Drive Participant

Since the 2022 Annual Status Report, Charging Forward used the DTE EV Garage at the following eight in-person events: Detroit Grand Prix, Detroit Jazz Festival, a University of Michigan football game, GM Factory Zero Employee Appreciation Day, the North American International Auto Show at Beacon Park, and three Ride and Drives, with two in Detroit and one in Ann Arbor. In addition to an EV and charger, the EV Garage showcases educational messaging and an interactive game to test the knowledge visitors gain, with over 80% of those surveyed stating they learned "something" or "a lot" about the benefits of EVs. Customers overwhelmingly enjoy the Ride and Drives, with one surveyed participant responding, *"I want to thank DTE for providing the opportunity to test drive [an] EV. I wouldn't have been able to experience driving them without going to a dealership and hoping one was available. The ability to drive different price range EVs was great... Thank you DTE!"* Ride and Drives facilitate in-person exposure and hands-on learning, a critical enabler of EV adoption. A sampling of images from these events is shown in Figure 5 below.

Figure 5: Sample Images from 2022 EV Ride and Drives

One modification the Charging Forward team made to 2023 in-person EV events is the addition of the EV Underpass as shown in Figure 6 below. The EV Garage proved popular last year, but the team was unable to fulfill all requests for its use due to budget constraints. As a result, the Company created the EV Underpass, which encompasses the same educational messages the EV Garage houses but is approximately 30% cheaper to transport and setup, allowing Charging Forward to increase outreach by attending more events.

Figure 6: EV Underpass

In 2022, Charging Forward piloted two ride-hailing pilots that were funded by its E&O budget as discussed in its annual stakeholder meetings. The first was a pilot with Lyft to provide their drivers up to $5,000 in incentives for purchasing or leasing a BEV. Six applicants were ultimately approved, as the availability of low-cost, high-range EVs and public chargers proved to be a significant barrier. Because of low enrollment in the Lyft pilot, the Company pivoted to partnering with ride-hailing fleet owner Hertz instead of individual drivers. The pilot increased the Hertz EV rental fleet in Metro Detroit that is available exclusively to Uber drivers through their national partnership. To date, Hertz has added 325 EVs to their fleet, resulting in over 850,000 EV experiences from July 2022 through April 2023 (assuming 1.7 passengers per ride as reported by Lyft and approximately 500,000 rides during this time period as reported by Uber). Additionally, 66% of these rides either picked up or dropped off passengers in a disadvantaged community in DTEE service territory. The MPSC did not approve DTEE's proposal to continue ride-hailing pilots as part of the Expansion, so the Company is not expanding its pilot with Hertz beyond what was already agreed to in 2022, and expects the pilot to end at the end of 2023 (though the EVs will remain in the Hertz rental fleet).

eFleet Advisory Services

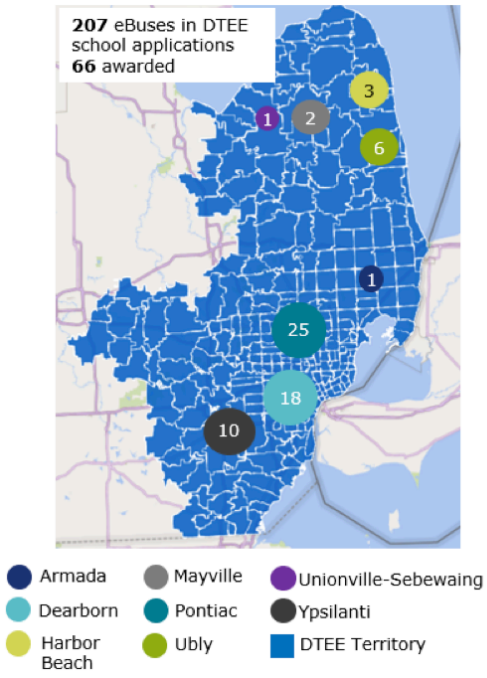
DTEE developed eFleet Advisory Services (eFAS) to empower fleet owners to make informed decisions about how to best electrify their fleets. Additional objectives include supporting customers seeking BIL or IRA funding and applying lessons learned from initial deployments to future distribution operation planning efforts. The eFleets team utilizes a seven-step eFAS process to support fleet owners' electrification journeys as follows:

1. Gather fleet data to analyze operational needs,
2. Provide customized list of available EVs using the eFleets virtual showroom,
3. Model electric fueling requirements that can vary based on eFleet adoption rates,
4. Recommend necessary charging options for fleet owner consideration,
5. Guide fleet owners through the service connection process,
6. Analyze potential fuel savings and carbon reduction, and
7. Facilitate eFleet Charger Rebate application and implementation.

Since its launch in October 2021, DTEE has reached out to over 5,300 leads, conducted 600 consultations, and completed about 170 total cost of ownership (TCO) analyses for its business customers. After fleet owners receive a TCO analysis, they are asked to complete a survey on their electrification plans as a result of the eFAS received. Analysis of 39 returned surveys yields an electrification plan of over 2,100 vehicles through 2026, demonstrating the effectiveness of eFAS facilitating fleet electrification for DTEE business customers.

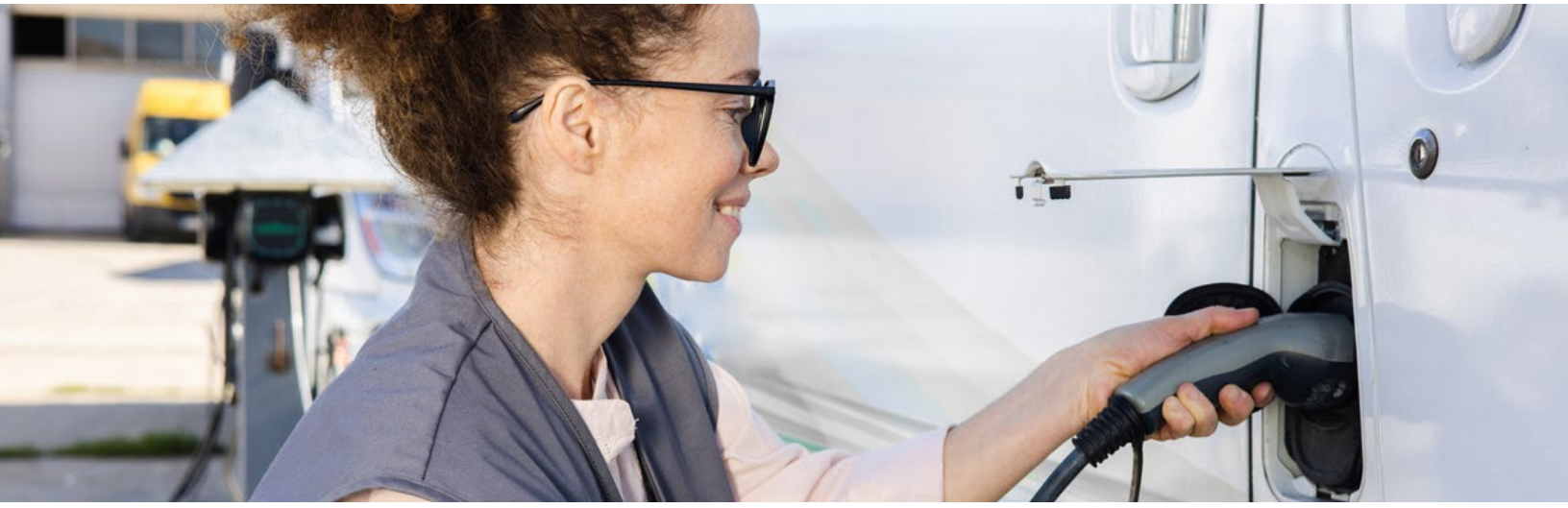
With regard to supporting customers seeking available BIL funding, the eFAS team successfully promoted the 2022 CSB program by reaching out to all of the school districts in DTEE service territory – over 160 – and following up with multiple touch points with the 53 districts that were identified as prioritized by the EPA. As a result, school districts in DTEE applied for over 200 electric school buses, with 66 ultimately awarded to eight school districts as shown in Figure 7 below. All awarded buses are on track to be deployed this year and receive eFleet Charger Rebates for the necessary charging infrastructure.

Figure 7: EPA's 2022 CSB Rebate Awards in DTEE Service Territory



Through its consultations and TCO analyses, the team has been actively gathering valuable feedback and lessons learned to further improve eFAS. Key updated lessons learned and associated modifications as applicable include:

- Over 80% of eFleet Charger Rebates have gone to customers in just three fleet segments as discussed in more detail in that section below,
- Organizations with sustainability programs are now considering the incorporation of EVs as part of their carbon reduction plans, and they find the carbon reduction analysis provided as part of eFAS particularly compelling,
- Vehicle use cases vary, ranging from 5,000 to 30,000 miles per year, but the team is able to prioritize use cases that have sufficient utilization levels to justify rebate awards from a ratepayer perspective. For example, for DCFC rebates to be rate neutral over time, the assigned fleet vehicle should have a minimum of 20,000 miles driven per year,
- Some companies utilize eFAS and proceed to electrify their fleet accordingly but opt not to leverage eFleet Charger Rebates. This decision is often driven by internal security policies regarding data sharing or preferred charging equipment not on Charging Forward's qualified charger list,
- Conversations with OEMs continue to provide valuable guidance, enabling the team to prioritize the electrification of use cases with EVs available in the market,
- The team is developing and/or maintaining strong relationships with installers, OEMs, energy service companies, and dealers as they can provide additional resources and support to amplify eFAS efforts, and
- Proof of purchase orders was initially the only eFleet Charger Rebate requirement, but supply chain disruptions made them difficult to acquire before charger deployment. As a result, and as an alternative to the purchase order, Charging Forward started to accept good faith commitment letters, which has proven successful: organizations are willing to proceed with charger installation in anticipation of electrifying their fleets when model availability allows.



Residential Customer Programs

Home Charger Rebates

Like Customer E&O, Home Charger Rebates were part of the initial Charging Forward pilot launched in June 2019. Through this program, DTEE provides a rebate of $500 to its residential customers that purchase or lease an EV, install a qualified Level 2 charger, and enroll in a qualified Time of Day rate. The full eligibility requirements and terms and conditions to receive the rebate are detailed in the terms and conditions agreement. All Home Charger Rebate applications and documentation are managed through the PowerClerk® website.

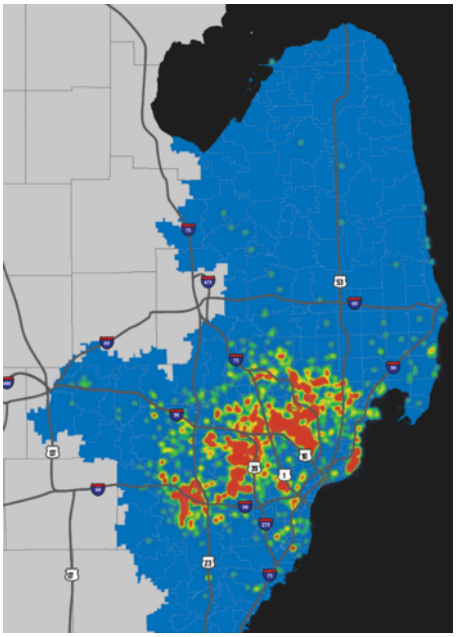
Approved Home Charger Rebates have increased by 1,938 since the 2022 Annual Status Report (from 1,207 to 3,145), representing over 60% of approved applications in just the last year of a four-year program. Since the beginning of 2023, there has been a significant increase in interest for Home Charger Rebates with over 200 applications submitted each month, nearly doubling the 2022 average of about 120 submissions per month. This is a result of removing the stricter qualified charger requirement in March 2022 as reported in the last status report. Since that modification, the most popular charging provider among participants is Tesla, which did not previously qualify, as shown in Table 3 below. The most popular participating EV models in descending order are the Chevrolet Bolt, Ford Mustang Mach-e, Tesla Model 3, Tesla Model Y, and the Jeep Wrangler 4xe.

Table 3: Top Three Home Charger Rebate Network Providers

Overall Rank	Network Provider	12 Months Ending April 30, 2023	Program to Date
1	Enel-X	359	965
2	Chargepoint	297	894
3	Tesla	570	580

The distribution of approved Home Charger Rebates in DTEE service territory remains primarily in Ann Arbor and Detroit suburbs, with the top five suburbs in descending order being Canton, Northville, Novi, Troy, and Bloomfield Hills. However, the team notices interest growing in other areas, with sixteen new cities and towns in DTEE service territory receiving approved applications since the last status report. The heat map of approved Home Charger Rebates, which can be used to infer highest areas of EV adoption in DTEE service territory, is shown in Figure 8 to the right.

Figure 8: Heat Map of Approved Home Charger Rebates



Starting March 1, 2023, DTEE converted its residential customers on rate schedule D1 (residential service rate) to rate schedule D1.11 (standard Time of Day), which has weekday on-peak hours of 3pm – 7pm. However, to help ensure the benefits of transportation electrification accrue to all customers, DTEE still requires enrollment in one of the company's more variable Time of Day rate schedules: D1.2 (Enhanced Time of Day), D1.8 (Dynamic Peak Pricing), or D1.9 (EV Rate). All of these have stricter requirements than D1.11 and can provide additional fuel savings to enrolled EV drivers.

DTEE monitors Time of Day rate selection for the program to better understand EV driver preferences. D1.2 continues to be the most popular choice with 44% of approved customers, followed by D1.9 at 31% and D1.8 at 25%. Application submission results showed that 84% of applicants said the Charging Forward rebate "Somewhat" or "Very Much" influenced their decision to sign up for one of the required Time of Day rates, demonstrating that Home Charger Rebates is successfully shifting EV load – and, for whole-homes rates, some non-EV load - off-peak.

The team continues to process Home Charger Rebate applications quickly; the average runtime for DTEE to review and approve applications is only 16 days, including time for application corrections. Overall, customers have been very satisfied with the Home Charger Rebate program, with 91% of surveyed customers considering themselves "promoters" of the program.[10] This satisfaction can be further observed in the following customer verbatims gathered from the post-rebate survey:

- *"It was easy to manage, you had great people available to answer questions both by phone and online"*
- *"Ease of process, fast rebate time, fair in the amount given back"*
- *"Off peak charging together with the cash rebate represents considerable savings & acts as a further incentive to adopt an electric car"*
- *"It's a good program that is well-explained and helps new EV owners get started"*

Home Charger Installation

Recently approved with the Expansion, Home Charger Installation is a turnkey installation and financing solution for DTEE residential customers designed to reduce the complexity and upfront cost barriers for home chargers. In Q4 2022, the Company issued a Request for Proposal (RFP) to electricians to select an installation partner. After issuing the RFP to approximately 15 companies, the Company selected Vehya based on price, anticipated customer experience, and the ability to manage the expected installation volume. Vehya is a Detroit-based software platform delivering EV charging solutions to businesses and homeowners. They offer a certified network of electricians and an easy-to-use online portal for interested customers to complete a short questionnaire, receive an instant quote, and select appointment times that work best for their schedule. Home Charger Installation jobs are dispatched to Vehya's network of local electricians based on location, availability, and customer ratings. Participating customers choose a financing term of one, three, five, or 10 years, which will automatically be added to their next DTEE monthly bill following installation. The full eligibility requirements and terms and conditions to participate in the program are detailed in the Home EV Charger Installation Agreement.

Since launch on February 27th, 2023, DTEE has seen high interest in the offering, indicating there was a market need for a turnkey installation and financing solution. Over 700 customers have registered as users through the portal, and 160 of them have paid a $100 deposit for an electrical contractor assessment of their property to confirm the final quote. In only two months since launch, 55 installations have been completed, ranging from $650 to $5,250 in total costs with an average installation cost of $2,155. Customers have selected all of the term options, with the most popular being three years, followed by 10, five, and one year, respectively. To date, the program is seeing an average of 20 days from account creation to installation day. However, because some customers prefer to schedule installations closer to vehicle delivery dates (as far out as November 2023), the runtime is likely not a good metric to indicate performance. The team will instead evaluate customer satisfaction through post participation surveys and scheduling adherence with Vehya.

EV Rebates

Another recently approved offering is the EV Rebate, a $1,500 incentive for low- and moderate-income (LMI) residential DTEE customers who purchase or lease a new or used BEV designed to help offset the upfront price premium of EVs and enable equitable access to EVs for qualifying customers. The full eligibility requirements and terms and conditions to receive the rebate are detailed in the EV Rebate Agreement. All EV Rebate applications and documentation are managed through the PowerClerk® website.

[10] Customers who have completed the rebate process were sent a customer satisfaction survey with one question asking how likely it is that they would recommend the rebate program to a friend or colleague on a scale 1-10. They were categorized as "Promoter", "Passive", or "Detractor

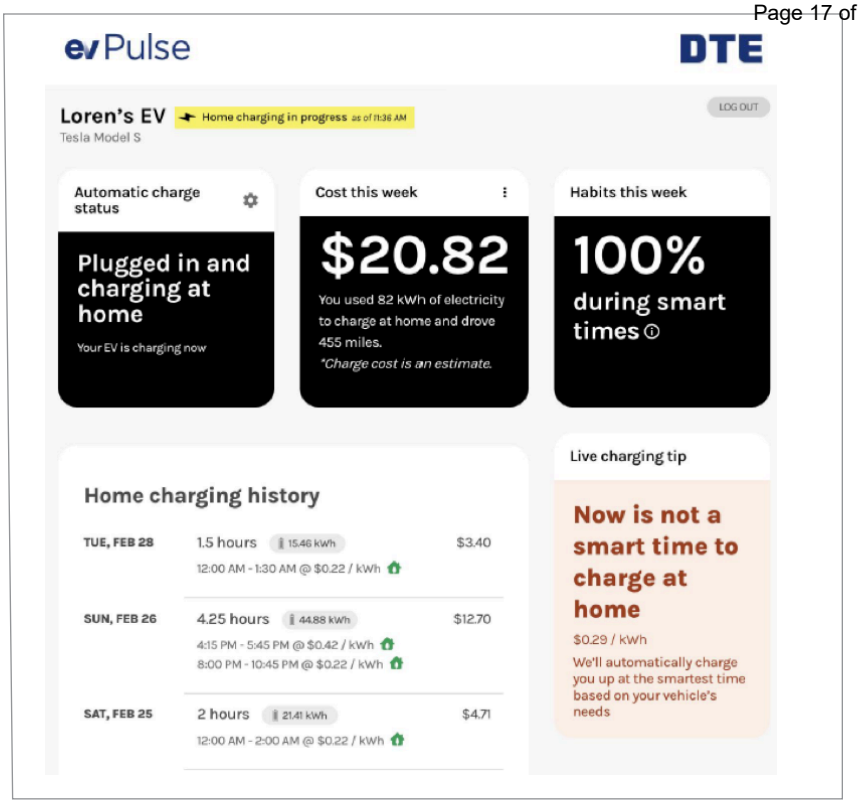
A core eligibility requirement is that an applicant's total household income must be under 400% of the 2023 Health and Human Services Poverty Guidelines (often referred to as the federal poverty level, or FPL). This guideline changes depending on the size of the household but is equivalent to $58,320 for an individual and $120,000 for a four-person household. DTEE estimates that half of its residential electric customer households would meet this criterion.

Since launch on March 17, 2023, DTEE has received 30 applications, of which eight have been approved. The primary reason for rejection was EVs surpassing the $50,000 total taxable price restriction (19 applications). The remaining three rejected applications were for PHEVs, which also do not qualify. For the eight approved so far, the team has found that the average household income is about 220% of the FPL.

EV Data Sharing and Demand Response

DTEE decided to end its Bring Your Own Charger (BYOC) pilot with Sagewell at the end of 2022, primarily due to the fact that Tesla chargers – the primary target for BYOC - are now eligible for the Home Charger Rebate program. The Company prefers to require one of its stricter Time of Day rates in exchange for any off-peak incentives. Additionally, DTEE sought to better understand data collection and charging behavior through vehicle telematics for different rate schedules. As a result, Charging Forward is now collaborating with WeaveGrid on two new offerings: EV Data Sharing and an expansion of the existing DTE Smart Charge program. Both make use of WeaveGrid's evPulse tool, which pairs vehicle telematic data with DTEE rate information to help drivers save money and access valuable charging insights. Participants of EV Data Sharing will give DTEE access to their vehicle telematics data in exchange for free access to weekly insight emails and a charging dashboard such as the example shown in Figure 9 above.

Figure 9: EV Data Sharing Example of Customer Dashboard



Interested drivers of Tesla, Kia, Hyundai, and Toyota EVs can enroll and find the full terms of service online. Since launch on March 23, 2023, 136 drivers have enrolled, primarily via targeted marketing to those known by DTEE to drive a qualified EV.

As mentioned above, DTE Smart Charge, a demand response program for BMW, Ford, and GM EVs, is being expanded through WeaveGrid to include Tesla vehicles beginning in June 2023. With this expansion, DTEE can schedule enrolled EVs to charge during their respective rates' off-peak times and pause charging during critical peak periods of high electric demand.[11] Participating customers will receive a $50 incentive upon enrollment and an additional $50 incentive at the end of the summer season if they are still enrolled.

[11] Participants will have the ability to opt-out if needed

Business Customer Programs

Network Provider Qualification

DTEE seeks to promote a competitive marketplace environment for EV supply equipment (EVSE) network providers in Southeast Michigan. To date, the Charging Forward team has completed five Requests for Information (RFIs), sending them to a total of 54 different network and manufacturing vendors during the most recent round in August 2022. The team evaluates submissions based on network capabilities, data sharing processes, hardware attributes, and the respondent's value proposition to both site hosts and DTEE. Based on that, 35 business Level 2 chargers ranging from 7.2 to 19.2 kilowatts (kW) and 55 DCFCs ranging from 50-350kW currently qualify for Business Charger Rebates from eight different network providers (including Blink, ChargePoint, eCamion, Enel X, EV Connect, FLO, Red E Charging, and Volta) and 13 different manufacturers (including ABB, ADS Tec, Autel, BTC Power, ChargePoint, eCamion, FLO, Freewire, Mid-Cour, Phihong/Zerova, Rhombus, Tellus, and Tritium). For eFleet Charger Rebates, 30 Level 2 chargers of the same power output range and 61 DCFCs ranging from 24-360kW qualify from six of those same network providers plus Ford Pro. To continue adding value for Charging Forward participants, DTE is preparing to launch a sixth RFI this summer to evaluate EVSE network providers in its portfolio.

With the approval of the Expansion, the MPSC also added an uptime requirement for Charging Forward. Order U-20836 states, *"the Commission adopts a 97% charger uptime for participants in this pilot as is currently proposed by the Federal Highway Administration's (FHA's) NEVI program guidelines. Should the FHA ultimately revise or update its guidance on uptime requirements upon issuance of the final NEVI rule, the Commission would then be open to revisiting these guidelines and reserves the right to modify this charger uptime requirement to maintain consistency with federal guidelines."* Based on the FHA proposed rules at the time of the Order, DTE notified qualified network providers and participating site hosts to maintain an uptime of 97% for each charging port, as calculated by the following formula:

$$\mu = \frac{8760 - (T_{outage} - T_{excluded})}{8760} \times 100$$

where:

- μ = port uptime percentage,
- T_{outage} = total hours of outage in the previous year, and
- $T_{excluded}$ = total hours of outage in the previous year caused by allowable exceptions such as electric utility service interruptions, internet or cellular service provider interruptions, and outages caused by EVs, provided that the site host can demonstrate that the charging port would otherwise be operational.

DTEE is requiring qualified network providers to submit biannual reports beginning June 2023 stating the uptime percentage for all participating Charging Forward ports commissioned after December 2022. Failure to provide biannual reports or maintain 97% uptime in any calendar year will disqualify network providers and site hosts from future Business Charger Rebates.

Business Charger Rebates

Along with Customer E&O and Home Charger Rebates, Business Charger Rebates were part of the initial Charging Forward pilot and launched in June 2019. Through this program, qualified site hosts receive rebates of $2,000 per Level 2 port and up to $55,000 per DCFC with the goal of incentivizing EVSE deployment to reduce "range anxiety", a lack of confidence in refueling infrastructure and a key barrier to EV adoption. Full eligibility requirements and terms and conditions to receive the rebate are detailed in the Business Charger Rebate Agreement. All applications and documentation are managed through the Business Charger Rebate PowerClerk® website.

Business Charger Rebates have continued to increase in both approvals and installations over the last year, with only about 110 Level 2 and 18 DCFC rebates remaining available. As a result, the team expects to fully subscribe both incentives by the end of Q3 2023. The complete status of applications is outlined in Table 4 below.

Table 4: Business Charger Rebate Application Statuses

Type	Approved	Installed	Under Review	Rejected/Withdrawn
Level 2 sites (ports)	460 (1,297)	199 (872)	17 (79)	129 (666)
DCFC sites (chargers)	55 (135)	22 (51)	6 (9)	102 (259)

The pace of Business Charger Rebates has continued to increase over the last year. Since the 2022 Annual Status Report, Charging Forward has seen a 93% increase in the number of Level 2 ports installed and a 29% increase in the number of Level 2 ports approved. For DCFCs, there is a 70% and 73% increase in the number of installed and approved chargers, respectively. The primary factor driving more projects to installation is members of the Charging Forward team proactively facilitating communication among site hosts, electrical contractors, network providers, and DTEE's Distribution Operations teams. Doing so enabled the team to better understand project bottlenecks and challenges and step in earlier to identify timely solutions as needed. Additionally, the team has implemented deadlines for sites hosts, as described in the last status report, which prevents stalled applications from remaining in the queue too long.

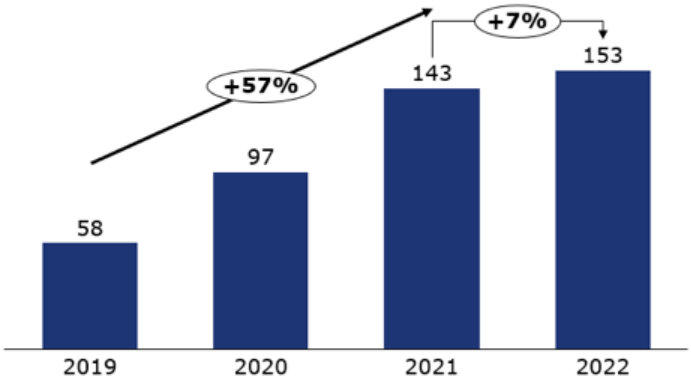
Overall, customers have been satisfied with Business Charger Rebates, as evidenced by the following verbatims gathered during the post-rebate survey:

- *"The process was simple and easy to follow, and the support and follow-up with the DTE team was outstanding along the way"*
- *"It is a great program that helps bring the new EV technology to Michigan"*
- *"Installing this infrastructure in historic properties is an exercise in creativity and is expensive. Subsidies like this one are needed to deliver the infrastructure needed, and particularly for affordable housing like this nonprofit provides. It's great that this program is available"*

As part of the Expansion approval, DTEE published site requirements and preferred site conditions for DCFC sites. The goal of publishing this on the Business Charger Rebate website was to make transparent the types of sites DTEE is seeking for its limited remaining rebates available. The refined and published criteria have led to a more objective process for approving and vetting Business Charger Rebate applications and have slightly increased the number of applications that were rejected. Those rejections are mainly due to lack of surrounding amenities or distance from highway exits.

As previously reported and according to the tiered design of Business Charger Rebates, DTEE saw a year over year (YOY) increase of almost 60% in the average power output of approved DCFCs from 2019 to 2021. However, that trend is beginning to level off to less than 10% in the last year as shown in Figure 10 below. The team expects the average power output of 153kW in 2022 to remain relatively flat over the next few years since the minimum power requirement for NEVI is 150kW.

Figure 10: Average Power Output of Approved DCFCs by Year (kW)



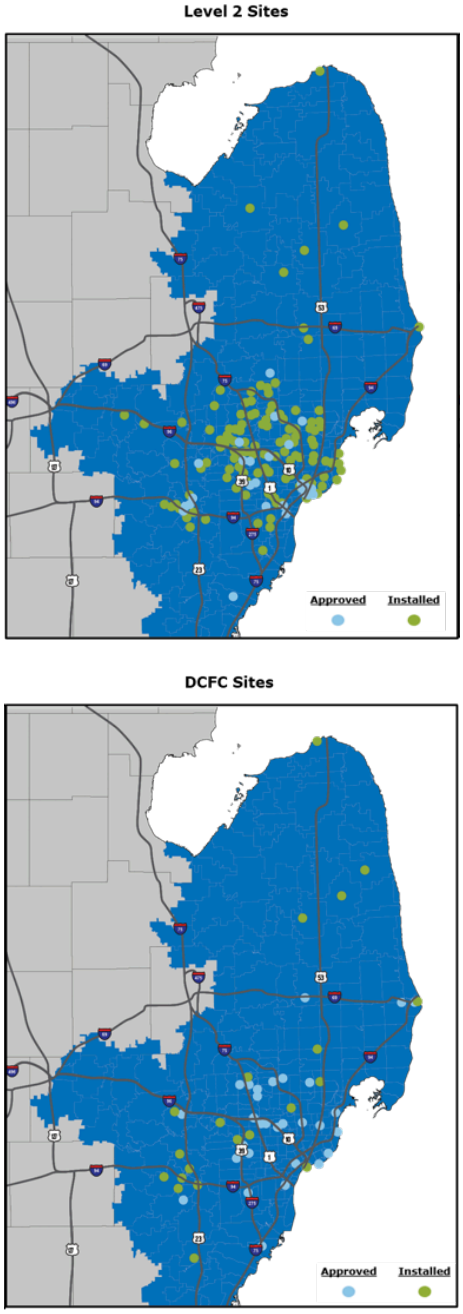
The number of installed Business Charger Rebate sites has increased significantly over the last year as discussed above. The impact of the larger sample size is shown in Table 5 below. EV Supply Infrastructure, or the cost of electrical infrastructure between the meter and the charger, increased for Level 2 sites but decreased slightly for DCFC sites. These costs can vary significantly between sites depending on scope of work (e.g., asphalt, electrical upgrades required, transformer pads, etc.), so the team will continue to track this in the future with a larger sample size. Level 2 applications range from two to twenty ports with an average of four ports per site for approved applications, a decrease of one port compared to last year's report. The team is observing a trend of Level 2 applications ranging from only two to four ports with larger applications becoming rarer. There are no changes for DCFC application sizes; they range from two to four chargers with an average of two chargers per site. The team expects that could increase in the future, since NEVI awards must have a minimum of four DCFCs per site.

Table 5: Average Business Charger Rebate Installation Costs

Type	Sites Installed	Average (Avg) Ports per Site	YOY Change (Ports)	Avg EV Supply Infrastructure Cost per Site	YOY Change (%)
Level 2	199	4	(1)	$13,000	+30%
DCFC	22	2	0	$91,000	(3%)

The EV team is also tracking the geographic spread of approved applications as shown in Figure 11 to the right. All eleven counties in DTEE service territory have at least one approved site, but only four of the counties have 90% of approved sites: Oakland (37%), Wayne (34%), Washtenaw (12%), and Macomb (7%). Drilling down to the city level, Detroit (16%), Ann Arbor (11%), Troy (5%), and Waterford Township (5%) have the most approved applications. The remaining 63% are in various cities with one to five projects.

Figure 11: Map of Business Charger Rebate Sites by Charger Type



eFleet Charger Rebates

The eFleet Charger Rebate program was approved as part of eFleets in March 2021 and is designed to complement eFAS by facilitating the deployment of necessary fleet charging infrastructure. Full eligibility requirements and terms and conditions to receive the rebate are detailed in the eFleet Charger Rebate Agreement. All eFleets applications and documentation are managed through the eFleet Charger Rebate PowerClerk® website.

eFleet Charger Rebates are building momentum: since the 2022 Annual Status Report, the team has increased approved Level 2 ports from 24 to 178 and approved DCFCs from six to 46. DTEE has found that eFleet Charger Rebate applicants have been deploying EVSE at a faster pace compared to Business Charger Rebate applicants. This trend is likely due to three key reasons. First, fleet owners often have larger budgets with longer-term financial planning, allowing them to invest in charging infrastructure more readily. Second, fleet owner applications typically have more chargers per site than other site host applications. Lastly, expected delivery dates of ordered EVs is a catalyst for fleets to coordinate their charging infrastructure deployment accordingly. A complete overview of the status of eFleet Charger Rebates is shown in Table 6 below.

Table 6: eFleet Charger Rebate Application Statuses

Type	Approved	Installed	Under Review	Rejected/Withdrawn
Level 2 sites (ports)	32 (178)	16 (102)	0 (0)	5 (12)
DCFC sites (chargers)	14 (46)	3 (8)	1 (1)	5 (7)

More than 80% of eFleet Charger Rebates have been awarded to business customers in only three segments: government (43%), school (37%), and delivery (6%). In the government segment, only two cities make up 88% of approved ports in this segment, signifying more advanced transportation electrification plans to achieve their decarbonization goals. The high demand in the school segment is mostly driven by school districts that were awarded EPA CSB funds, although there are also participating universities and colleges that generally cite their sustainability plans as the primary reason behind electrifying their fleets. Over 80% of the delivery segment is in partnership with one restaurant and its delivery service as part of their nationwide electrification plans. The remaining 14% of eFleet Charger Rebates are spread across smaller fleet customers ranging in their electrification journeys from one to six chargers with their applications.

As described above, eFleet Charger Rebate projects generally have more ports per site than Business Charger Rebate projects: on average they have seven Level 2s (compared to four) and three DCFCs (compared to two) per site as shown in Table 7 below. The higher average EV Supply Infrastructure costs compared to Business Charger Rebates, even after considering the additional ports per site, is driven by higher-powered, specialized charging to serve the specific use cases of the fleets.

DTEE seeks to promote a competitive marketplace environment for EV supply equipment (EVSE) network providers in Southeast Michigan

Table 7: Average eFleet Charger Rebate Installation Costs

Type	Sites Installed	Avg Ports per Site	Avg EV Supply Infrastructure Cost per Site
Level 2	16	7	$26,600
DCFC	3	3	$159,000

Similar to other Charging Forward programs, eFleet Charger Rebate participants receive a post-rebate survey. The verbatims received demonstrate the value of the eFleets program overall:

- *"DTE team members were very helpful during and after the rebate submission process"*
- *"The eFleet Charger Rebate program helps facilitate the installation of EV chargers"*

New Expansion Elements

DTEE received approval in November 2022 for three new programs focused on business customers as part of the Expansion: Business Charger Installation, Charging Hubs, and eFleet Battery Support. All three are in different stages of maturity with details on the programs and status to date provided below.

First, Business Charger Installation is designed to increase access to charging in four specific customer segments that were not seeing significant traction in the Business Charger Rebate program: municipalities, disadvantaged communities, LMI multi-unit dwellings, and rural areas. For this program, DTEE will fund and own the EV Supply Infrastructure, reducing upfront complexity and cost of installation in these targeted segments. Due to the limited pilot size and specific eligibility requirements, DTEE is establishing strategic partnerships with stakeholders as needed to fully subscribe the program by year end. Since its launch in March 2023, multiple sites have been approved to move forward (pending acceptance of terms and conditions by participants). Sites have been approved in the targeted segments of municipalities, disadvantaged communities, and rural areas, with the first installations expected by Q3 2023.

Second, Charging Hubs is designed to support fleet electrification by providing multiple fast chargers at one location and pull-through spaces for larger vehicles. DTEE received approval to build, own, and operate up to two Charging Hubs. After exploring several sites, the team has supported two grant applications for hubs in Southeast Michigan. In February, DTEE partnered with Detroit Diesel (Daimler Truck North America) and the State of Michigan to submit a grant for a Charging Hub located in Redford with a decision expected by July. As part of the application, the team submitted over ten Letters of Support from surrounding businesses and other stakeholders.

In April, the DTEE Distribution Operations team submitted an application for a large resilience project in Southwest Detroit and included a Charging Hub as part of that larger submission with a decision expected in Q3 2023. While the exact location is still to be determined (pending grant award), the intersection of I-75, I-96, and the Ambassador Bridge makes it an ideal location with ample truck traffic to potentially utilize the site.

Lastly, eFleet Battery Support is designed to facilitate transit bus electrification by alleviating the upfront price premium of electric buses. With this program, DTEE will purchase bus batteries on behalf of transit agencies, and those participating agencies will pay a monthly service charge that will both keep rates neutral over time for other DTEE customers and allow them to still capture fuel savings benefits. The terms and conditions for eFleet Battery Support are nearing completion, and the pilot is expected to officially launch in Q3 2023.

Additional Key Learnings

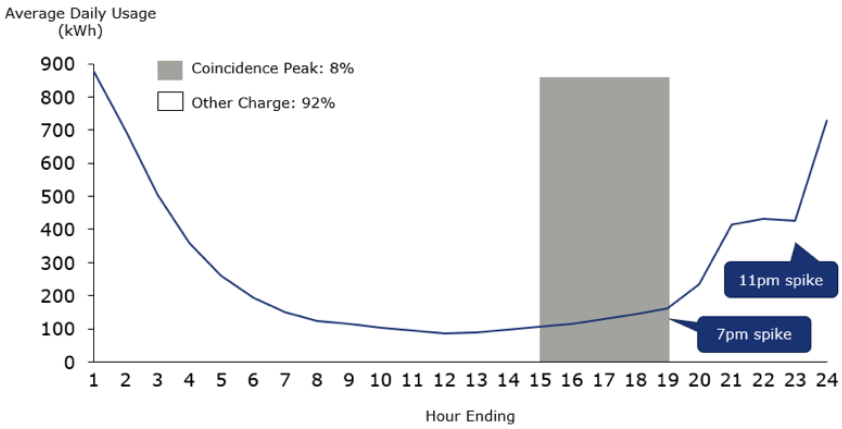
Charging Profiles & Utilization

As a condition of qualifying as an approved vendor for Charging Forward, Network Providers must share the charging data with the team on an anonymized basis. DTEE has set up an internal dashboard using Power BI to analyze the data, with ChargePoint, Enel X, EV Connect, and Shell Recharge Solutions as the only Network Providers with installed chargers integrated in the dashboard tool so far. The remaining vendors will continue to be integrated as chargers are installed.

Based on the installation of 3,145 residential Level 2 chargers, 872 business Level 2 ports, and 51 DCFCs in Charging Forward, 9.2 Gigawatt-hours (GWh) have been consumed to date. This is the equivalent of 30 million electric miles powered by DTEE, translating to 7,300 metric tons of carbon emissions eliminated and almost 860 thousand gallons of gasoline avoided. Across both residential and business chargers, 90% of consumption fell outside the coincident peak hours of 3pm-7pm. Overall, usage has been primarily overnight, driven by residential charging.

Residential charging makes up 73% (or 6.7 GWh) of total participating charger consumption. As expected with the Time of Day requirement, Home Charger Rebate participants primarily charge off-peak as shown in Figure 12 below. For all the residential chargers, 92% of consumption fell outside the coincident peak hours of 3pm-7pm. The graph shows spikes at 7 pm (when off-peak pricing starts for Enhanced Time of Day rate) and 11 pm (when off-peak pricing starts for both the EV and Dynamic Peak Pricing rates).

Figure 12: Average Daily Home Charger Usage (Jun 2019 – Apr 2023)



As can be expected, total energy consumption measured from participating Charging Forward chargers has continued to grow as more chargers are deployed. The increase in annual consumption from business Level 2 and DCFCs has increased at a compound annual growth rate of 292%, from approximately 20 MWh in the first year to nearly 1.5 GWh in the fourth year. Over 80% of DCFC charging session durations are under one hour, while Level 2 session times vary greatly (50% are four hours or more). However, since EVs are parked at Level 2 chargers longer, the idle time when they are parked and not charging is much greater at 47% of the session on average, compared to only 8% of the session for higher-priced DCFCs. High level charging station characteristics for business Level 2 and DCFCs are outlined in Table 8 below.

Table 8: Business Charging Session Characteristics (Jun 2019 – Apr 2023)

Type	Average Charging Time (minutes)	Average Usage per Session (kWh)	Average Fee to Driver ($)	Average Fee to Driver ($/kWh)
Level 2	146	13.87	$3.09	$0.22
DCFC	41	27.28	$9.64	$0.35

For Level 2 chargers that require a fee for usage, the average cost is $3.09/session (with an average usage per session of 13.87 kWh). As expected, drivers are paying a premium to charge their vehicles faster. On the DCFC side, the average energy dispensed is greater at approximately 27 kWh/session at a cost of $9.64. That equates to an eGallon price of approximately $3.47.[12] The average price of gasoline in Michigan is $3.64 at the time of this report but has been as high as $5.21 in the last year, so even with premium DCFC pricing, EV drivers can still save on "fuel" compared to paying at the pump.[13]

Benefit-Cost Analysis

In its initial proposal, the Charging Forward team estimated net present value (NPV) of $2,100-$2,800 in gross margin that each EV sale provides toward DTE system fixed costs over its lifetime as described by Company Witness Serna in filing U-20162 (pages 43-44). DTEE has continued to provide updates on its NPV gross margin analyses in subsequent status reports. Based on the latest market dynamics and charging behavior lessons learned, the team refined the average NPV of lifetime gross margin to approximately $1,800-$2,100 as described by Company Witness Peterson in filing U-21297 (pages 62-63) and as outlined in Table 9 below.

Table 9: Overview of NPV Gross Margin Calculation

Assumption Description	2018 Value	2023 Value	Key Assumptions for Updated Analysis
Annual EV electricity usage (kWh)	3,900	3,670	• 0.27 kWh/mile for cars • 0.49 kWh/mile for pickups • 11,463 miles/year
Life of each incremental EV (years)	10	10	
Weighted average revenue rate ($/kWh)	$0.14	$0.12-$0.13	• 73% from residential • 27% from business
Base Fuel and Purchased Power ($/kWh)	$0.033	$0.034	
Coincident Peak charging (%)	30%	15%	• 12% from residential • 25% from business[14]
NPV Gross Margin Incremental EV Sales ($)	$2,100-$2,800	$1,800-$2,100	• Discount rate of 6.79%

Four adjustments to the 2023 NPV analysis from the last status report are the annual EV usage, the split between residential versus business charging, the average revenue rate that DTEE will receive, and the base fuel and purchased power cost. The latter two are results of tariff updates following Order U-20836. For annual EV usage, the team reduced all of the input assumptions slightly based on updated guidance from the Alternative Fuels Data Center and internal analysis regarding increased vehicle efficiencies. Lastly, the residential versus business split was modified to reduce residential charging from 80% to 73% based on actual data and to tie to DTEE's load forecasting assumptions.

With the actual sales from the past three years (~21,000) and strong sales so far in 2023, the team is confident gross margin benefits from EV sales will more than cover the total anticipated costs of Charging Forward. Playing an active role in these early adoption years to ensure DTE is learning about EV charging behavior, piloting new technologies, and efficiently integrating charging infrastructure with the distribution system now is important to optimize investments to serve EV load in the future.

[12] Based on DOE methodology and assuming 33 mpg internal combustion engine equivalent and 0.3 kWh/mile
[13] AAA
[14] Note the measured value program to date is 13% on-peak, but the team is using a more conservative estimate of 25% on-peak for the purposes of benefits estimation

Case No. U-21534
Exhibit: A-30

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March 1, 2024 Tree Trim Annual Report

In Case U-20162, on May 2, 2019, the Commission directed DTE Electric (DTEE) to file an annual report to detail the progress of the Surge program and Enhanced Tree Trim Program (ETTP) performance. From the U-20162 Order:

> Thus, the annual report shall also break out all activity, costs, and miles trimmed under any and all tree trimming programs (including hardening) in the city of Detroit, to provide information on the progress made in the city of Detroit with each program. The reporting shall include measurable data for the efforts, including miles completed by service center, performance of ETTP circuits compared to non-ETTP circuits, the costs of the efforts, number of employees directly involved in the efforts, tree-related outage reductions, SAIDI reductions, and whether the funding for the efforts is a capital expense or O&M cost. Further, the report shall track ETTP circuit performance, comparing average outages for the three years prior to the enhanced trimming with outages in the years after the trimming has been performed. The first report is due in this docket March 1, 2020, and an annual report is due on March 1 of each year thereafter.

Per Case U-20162 order and Case U-20561 order, this report covers the requested information. The report is split into six sections:

1) Miles Completed to ETTP Standard – Annual ETTP maintenance miles are reported by Service Center over the 2015-2023 time period. City of Detroit miles are broken out separately.
2) O&M and Capital Spend on Tree Trimming Activities – Annual tree trim spend are reported by Service Center over the 2016-2023 time period. City of Detroit spend is broken out separately. Costs from 2015 are not included because the ETTP specification makes up a relatively small portion of the overall tree trim spend in that year.
3) ETTP Circuit Performance – ETTP circuit performance comparing average outage events, customer interruptions, outage minutes, and wire downs before and after ETTP work. The performance will cover ETTP circuits trimmed in 2015 through 2022 with reliability data that ranges from 2012 to 2023. Performance of ETTP circuits trimmed in 2023 will be measured starting in 2024.
4) Spot Tree Trimming – Description of spot-trimming work done on the 10 worst performing circuits.
5) Tree Trim Workforce – A 2023 summary of the tree trim workforce is broken down by DTEE employees and contractors.

6) Incremental Funding for Tree Trim Program – Description of the additional work completed in 2023 from the increased funding from Case No. U-21128, in which the Company committed an incremental $90M to the tree trim program.

Section 1 – Miles Completed to ETTP Standard

Since the inception of the ETTP standard, the Company has trimmed 38,550 miles. 5,299 ETTP miles were trimmed in 2023 as part of the Surge program. Below, **Table 1** breaks out ETTP miles trimmed by distribution and subtransmission, **Table 2** details miles trimmed by service center and year. **Table 3** shows total miles trimmed to ETTP, which may include second and third cycle ETTP trimming. It has a breakdown of only unique miles trimmed to ETTP, which does not count the second or third cycle of ETTP trimming. It also shows miles in backlog (off-cycle), average density and work location by service center. Previous filings from the Company also included manual/climbing trimming data by service center, which was from a onetime study performed by a third-party consultant. The Company does not collect climbing data for each circuit trimmed, however, backlot work is strongly correlated with manual/climbing trimming. **Table 4** shows ETTP miles trimmed in the City of Detroit, and **Table 5** covers miles trimmed as part of the 4.8kV Hardening Program.

Table 1 – ETTP Miles Trimmed by Circuit Type

Circuit Type	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total	% of System
Distribution[1]	257	2,270	2,733	3,128	3,181	4,583	5,021	5,991	4,566	31,730	81%
Subtransmission[2]	188	1,030	868	540	1,006	1,006	726	723	733	6,820	100%
Total Miles	**445**	**3,300**	**3,601**	**3,668**	**4,187**	**5,589**	**5,747**	**6,714**	**5,299**	**38,550**	**83%[3]**

[1] Some of these distribution miles are on their second cycle of ETTP trimming and show up in the numbers more than once.
[2] Some of these subtransmission miles are on their second or third cycle of ETTP trimming and show up in the numbers more than once.
[3] Numerator only includes unique miles – it only counts the miles once even if the miles are on their second or third cycle of ETTP trimming.

Table 2 – ETTP Miles Trimmed by Service Center

Service Center	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
ANN	5	143	566	309	246	537	285	585	423	3,099
CAN	40	60	62	271	307	335	360	375	244	2,054
HWL	192	272	445	262	264	603	659	719	320	3,736
LAP	13	341	390	423	378	653	584	555	616	3,953
MAR	70	351	419	432	303	334	395	776	781	3,861
MTC	23	250	259	115	321	430	274	335	79	2,086
NAE	42	693	470	533	557	463	826	793	605	4,982
NPT	5	159	263	342	254	536	561	196	437	2,753
PON	6	426	230	237	424	567	618	551	443	3,502
RFD	24	219	112	381	670	444	300	922	466	3,538
SBY	8	111	102	207	129	114	181	377	453	1,682
WWS	17	275	283	156	334	573	704	531	433	3,306
Total Miles	**445**	**3,300**	**3,601**	**3,668**	**4,187**	**5,589**	**5,747**	**6,714**	**5,299**	**38,550**

Table 3 – ETTP Miles Trimmed, Miles of Backlog, Average Tree Density and Mix of Work by Service Center

Service Center	Cumulative Miles Trimmed ETTP[4]	Total System Miles		For the 2023 Plan Only			
		Unique Miles Trimmed to ETTP[5]	Remaining Miles of Backlog to ETTP[6]	2023 Unique Miles Trimmed to ETTP[5]	Total 2023 Miles Trimmed	Avg. Tree Density[7] (trees/mile)	Work Location[7] (% Backlot)
ANN	3,099	2,090	146	184	423	575	73%
CAN	2,054	1,387	40	1	244	408	93%
HWL	3,736	2,404	25	38	320	301	74%
LAP	3,953	2,645	24	115	616	276	65%
MAR	3,861	2,449	534	370	781	201	61%
MTC	2,086	1,365	1,206	0	79	108	80%
NAE	4,982	2,887	895	140	605	157	84%
NPT	2,753	1,943	10	46	437	125	75%
PON	3,502	2,614	238	294	443	476	68%
RFD	3,538	2,994	423	226	466	315	84%
SBY	1,682	1,239	71	260	453	286	60%
WWS	3,306	2,343	1,006	95	433	290	82%
Total Miles	**38,551**	**26,359**	**4,615**	**1,768**	**5,299**	**290**	**73%**

[4] Includes second or third cycle ETTP trim.
[5] Does not include second or third cycle ETTP trim.
[6] Remaining miles in backlog after 2023 trimming.
[7] Density and work location are calculated based on task points identified by the planners during planning – includes brush.

Table 4 – ETTP Miles Trimmed in the City of Detroit by Service Center

Service Center	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total	% of City
CAN	40	42	60	234	293	291	326	246	240	**1,772**	**-**
MTC	-	-	6	-	-	6	-	**-**	5	**17**	**-**
RFD	5	87	27	251	464	90	129	259	192	**1,504**	**-**
Total Detroit Miles[8]	**45**	**129**	**93**	**485**	**757**	**387**	**455**	**505**	**438**	**3,293**	**97%[9]**

Table 5 – ETTP Miles Trimmed as Part of the 4.8kV Hardening Program[10]

Service Center	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
CAN	-	-	-	20	0	106	198	199	143	**666**
RFD	-	-	-	127	158	161	129	325	100	**1,000**
Total 4.8kV Miles	**-**	**-**	**-**	**147**	**158**	**267**	**327**	**524**	**243**	**1,666**

Section 2 – O&M and Capital Spend on Tree Trimming Activities

The Company spent $169,669,666 in O&M for its tree trim program in 2023 as detailed in **Table 6**; years 2016 through 2022 are also included for reference. **Table 6** groups costs into five categories:

1) Line Clearance Maintenance – Comprises costs needed for maintenance activities such as contractor labor and equipment, general foreman cost, per diems, and overtime premiums.
2) Trouble – Spend on non-storm unplanned reactive tree trim work related to outage or non-outage problems on the electric system.
3) Tree Trim Program/Other – Includes customer request work, auditing, software maintenance, the herbicide program, training, safety, and other cost miscellaneous costs associated with Tree Trim.
4) DTE Staff Cost – DTE staff costs related to the tree trim program.
5) COVID Expenses – Includes costs associated with the additional safety measures that were taken due to the COVID-19 Pandemic.

[8] Some of these miles are on their second cycle of ETTP trimming and show up in the number more than once.
[9] Numerator only includes unique miles trimmed to ETTP, therefore does not double count miles on second- cycle or beyond.
[10] Program began in 2018 and miles in Table 5 are a subset of miles in Tables 1-3.

Table 6 – Annual O&M Tree Trim Spend by Category[11]

O&M Spend	2016	2017	2018	2019	2020	2021	2022	2023
Line Clearance Maintenance	$59,155,543	$69,344,451	$71,757,936	$116,748,952	$151,021,453	$140,202,546	$209,270,442	$149,227,403
Trouble	$10,738,172	$11,395,011	$12,966,909	$16,556,969	$12,237,821	$10,667,520	$12,682,979	$9,535,799
Tree Trim Program/Other	$2,771,660	$1,812,622	$2,500,756	$10,229,182	$6,839,979	$15,670,339	$13,013,567	$6,483,393
DTE Staff Cost	$1,496,789	$1,704,325	$1,883,630	$2,667,190	$3,722,732	$4,372,897	$4,603,174	$4,423,070
COVID-19[12]					$1,340,624	$746,118		
O&M Total	**$74,162,165**	**$84,256,409**	**$89,109,232**	**$146,202,293**	**$175,162,609**	**$171,659,420**	**$239,570,162**	**$169,669,666**

Table 7 further breaks down the "Line Clearance Maintenance" costs in **Table 6** by service center.

Table 7 – Annual Maintenance Tree Trim Spend by Service Center (O&M Only)

Service Center	2016	2017	2018	2019	2020	2021	2022	2023
ANN	$4,081,462	$12,103,989	$9,489,387	$6,699,698	$18,811,275	$11,077,345	$19,663,782	$17,458,180
CAN	$3,312,191	$1,200,014	$8,851,085	$18,827,931	$11,253,759	$6,701,520	$14,189,914	$4,913,541
HWL	$4,838,162	$12,561,698	$6,269,100	$6,523,040	$19,744,784	$23,573,175	$20,366,427	$10,942,721
LAP	$5,145,835	$5,820,146	$4,385,310	$5,306,986	$12,866,142	$8,215,356	$6,297,393	$9,272,157
MAR	$3,679,637	$4,450,068	$5,021,951	$2,757,355	$5,087,650	$3,444,947	$8,968,144	$11,316,545
MTC	$3,868,638	$4,093,991	$1,961,451	$3,770,923	$9,913,687	$3,727,800	$4,874,212	$2,258,725
NAE	$3,100,279	$2,242,086	$2,615,529	$3,137,335	$5,336,176	$3,858,290	$5,567,071	$4,196,993
NPT	$1,990,418	$4,844,204	$5,288,021	$3,400,257	$9,634,726	$12,826,082	$6,520,390	$11,730,643
PON	$12,293,540	$8,619,875	$8,167,988	$24,883,843	$27,768,967	$29,346,468	$31,445,874	$19,290,761
RFD	$5,929,162	$3,762,082	$11,025,927	$28,999,125	$12,309,855	$6,816,756	$42,187,521	$27,138,327
SBY	$3,351,803	$3,078,400	$4,338,480	$2,656,440	$3,982,452	$2,863,698	$15,143,984	$13,380,970
WWS	$7,564,417	$6,567,898	$4,343,707	$9,786,018	$14,311,980	$27,751,110	$34,045,729	$17,327,840
Total	**$59,155,544**	**$69,344,451**	**$71,757,936**	**$116,748,951**	**$151,021,453**	**$140,202,546**	**$209,270,442**	**$149,227,403**

[11] Table does not include any spot trimming expenses from other programs because they are not part of the tree trim maintenance costs. This table does not include tree trimming cost related to storm, those costs are charged outside the tree trim budget.
[12] These expenses were mainly for the one-person per vehicle policy, and PPE for DTEE employees and contractors.

Table 8 details the 4.8kV Hardening capital spend in 2018-2023.

Table 8 – Annual 4.8kV Hardening Tree Trim Capital Spend by Service Center

Service Center	2018	2019	2020	2021	2022	2023
CAN	$ 2,136,156	-	$5,878,864	$11,757,474	$10,675,606	$7,819,132
RFD	$ 7,858,107	$ 10,081,771	$12,025,855	$10,274,963	$25,313,553	$10,955,464
Total	**$ 9,994,263**	**$ 10,081,771**	**$17,904,719**	**$22,032,437**	**$35,989,159**	**$18,774,596**

Table 9 highlights the $25,903,156 tree trim spend in the City of Detroit for the year 2023, which includes $16,148,871 of Capital spend. City spend in 2016 through 2023 is included for reference.

Table 9 – Annual Detroit O&M and 4.8kV Hardening Capital Tree Trim Spend

	2018	2019	2020	2021	2022	2023
Detroit - O&M	$14,071,122	$40,513,330	$7,333,594	$3,875,167	$8,468,206	$9,754,285
Detroit – 4.8kV Hardening Capital	$9,326,363	$10,081,771	$11,888,408	$21,408,206	$28,865,840	$16,148,871
Detroit Total	**$23,397,485**	**$50,595,101**	**$19,222,002**	**$25,283,373**	**$37,334,046**	**$25,903,156**

Section 3 – ETTP Circuit Performance

Methodology Used to Calculate ETTP Performance

The methodology used to calculate ETTP Performance for all distribution circuits uses the average of three years of pre-trim ETTP tree-related outage events and compares it to each year post-trimming. All post-trim year results of the same year were then summed to increase the sample size (as an example, all post-trim year 1 results are included collectively as a sum). The difference between the before trimming performance and the post trimming performance was used to create the "% Change in Outage Event Reduction for ETTP circuits". To create a control group for comparison, the same methodology was used for the remainder of circuits not trimmed ETTP[13] (Non-ETTP circuits), which are identified as "% Change in Outage Event Reduction for Non-ETTP circuits". To account for natural weather variation, the performance of the control group is subtracted from the ETTP circuit performance to provide an accurate representation of the true impact of the ETTP. This is the same methodology outlined in Case U-20561, U-20836, and U-21297.

[13] This group consists of circuits that have not been trimmed to the ETTP specification and are considered off-cycle.

Table 10 – Methodology for ETTP Performance Analysis

2012	2103	2014	2015	2016	2017	2018	2019	# of ETTP Circuits
			Three Year Average Pre-ETTP Performace			Year of Trim	Post Trim Year 1	321
			Three Year Average Pre-ETTP Performace			Year of Trim	Post Trim Year 1	Post Trim Year 2	128
		Three Year Average Pre-ETTP Performace			Year of Trim	Post Trim Year 1	Post Trim Year 2	Post Trim Year 3	171
	Three Year Average Pre-ETTP Performace			Year of Trim	Post Trim Year 1	Post Trim Year 2	Post Trim Year 3	Post Trim Year 4	20

Table 11 – Methodology for Control Group Non-ETTP Performance Analysis

2012	2103	2014	2015	2016	2017	2018	2019	# of ETTP Circuits
			Three Year Average Pre-Non-ETTP Performace			Year of Trim	Post Trim Year 1	N/A
			Three Year Average Pre-Non-ETTP Performace			Year of Trim	Post Trim Year 1	Post Trim Year 2	N/A
		Three Year Average Pre-Non-ETTP Performace			Year of Trim	Post Trim Year 1	Post Trim Year 2	Post Trim Year 3	N/A
	Three Year Average Pre-Non-ETTP Performace			Year of Trim	Post Trim Year 1	Post Trim Year 2	Post Trim Year 3	Post Trim Year 4	N/A

The control group of non-ETTP circuits and the ETTP circuits are compared against each other to account for non-tree trim related variations. This methodology normalizes reliability performance from variations that occur year-to-year, such as weather and storms. This approach provides a more accurate measure of the ETTP effectiveness since we are comparing circuits over the course of years.

ETTP Outage Event Performance

The actual difference of outage events on ETTP circuits compared to the balance of the system not trimmed ETTP is 54.0% in post-trim year 1, 36.8% in the second year, 43.8% in the third year,

and 11.1% in the fourth year. The actual reduction for Years 1-4 post ETTP trim is depicted in **Table 12**.

Table 12 – ETTP Tree-Related Outage Event Difference Compared to Non ETTP Circuits

	Number of Dist. Circuits ETTP Trimmed	% Change in Outage Event Reduction for ETTP circuits	% Change in Outage Event Reduction for Non-ETTP circuits	**Difference in % Change in Event Reduction ETTP vs Non-ETTP circuits**	U-20162 Surge Model Projected Reduction
1 Year Post Trim	2,063	-22.0%	32.0%	**-54.0%**	-57.0%
2 Years Post Trim	1,442	-12.8%	49.6%	**-36.8%**	-57.0%
3 Years Post Trim	974	9.94%	53.7%	**-43.8%**	-50.0%
4 Years Post Trim	491	58.1%	69.2%	**-11.1%**	-37.0%

ETTP Customer Interruptions Performance

Using the same methodology discussed above, the Company has determined that actual customer interruptions on ETTP circuits vs. Non-ETTP circuits show a 57.9% difference in Year 1, 59.3% difference in Year 2, 48.6% difference in Year 3, and 40.7% difference in Year 4. These results are shown in Table 13.

Table 13 – ETTP Tree-Related Customer Interruption Difference Compared to Non ETTP Circuits

	Number of Dist. Circuits ETTP Trimmed	% Change in Outage Interruption Reduction for ETTP circuits	% Change in Outage Interruption Reduction for Non-ETTP circuits	**Difference in % Change in Event Reduction ETTP vs Non-ETTP circuits**	U-20162 Surge Model Projected Reduction
1 Year Post Trim	2,063	-38.8%	19.1%	**-57.9%**	-57.0%
2 Years Post Trim	1,442	-28.0%	31.2%	**-59.3%**	-57.0%
3 Years Post Trim	974	-24.1%	24.6%	**-48.6%**	-50.0%
4 Years Post Trim	491	-14.3%	26.4%	**-40.7%**	-37.0%

ETTP Customer Outage Minute Performance

Customer minutes of interruption, shown in **Table 14**, also shows significant improvements from the ETTP program. Actual minutes of customer interruption on ETTP circuits vs. Non-ETTP circuits show a 32.4% difference in Year 1, 8.1% difference in Year 2, -22.4% difference in Year 3, and -6.4% difference in Year

Table 14 – ETTP Tree-Related Customer Outage Minutes of Interruption Difference Compared to Non ETTP Circuits

	Number of Dist. Circuits ETTP Trimmed	% Change in Outage Minutes Reduction for ETTP circuits	% Change in Outage Minutes Reduction for Non-ETTP circuits	**Difference in % Change in Event Reduction ETTP vs Non-ETTP circuits**	U-20162 Surge Model Projected Reduction
1 Year Post Trim	2,063	-27.0%	5.3%	**-32.4%**	-57.0%
2 Years Post Trim	1,442	16.4%	24.5%	**-8.1%**	-57.0%
3 Years Post Trim	974	10.5%	-11.9%	**22.4%**	-50.0%
4 Years Post Trim	491	1.3%	-5.2%	**6.4%**	-37.0%

Table 15 shows the 2023 outage minutes avoided due to ETTP trimming and the impact to overall system SAIDI, which reflects a net reduction of 226 SAIDI minutes. If only ETTP circuits are considered, the SAIDI reduction is 313 minutes.

Table 15 – 2023 ETTP Outage Minute Reduction and SAIDI Impact

	ETTP Outage Minutes
3 Years Before Trim Avg. Outage Minutes	603,540,803
2023 Outage Minutes	900,537,209
Minutes Saved	-296,996,406
Minutes Avoided – Non ETTP System Deterioration	947,747,698
Total Minute Reduction	650,751,293
ETTP Overall System SAIDI Minute Reduction	**300**

SAIDI Minute Reduction for ETTP Circuits ONLY	**390**

ETTP Wire-Down Performance

Using the same methodology discussed above, the Company has determined that actual wire-down events for ETTP circuits vs. Non-ETTP circuits show a 55.4% difference in Year 1, 56.8% difference in Year 2, 39.8% difference in Year 3, and 15.3% difference in Year 4. These results are shown in **Table 16**.

Table 16 – Post-ETTP Wire-Down Difference Compared to Non-ETTP Circuits

	Number of Dist. Circuits ETTP Trimmed	% Change Wire-Down Events for ETTP circuits	% Change for Wire-Down Events for Non-ETTP circuits	**Difference in % Change in Wire-Down Events ETTP vs. Non-ETTP circuits**
1 Year Post Trim	2,063	-65.5%	-10.1%	**-55.4%**
2 Years Post Trim	1,442	-64.8%	-8.0%	**-56.8%**
3 Years Post Trim	974	-58.3%	-18.5%	**-39.8%**
4 Years Post Trim	491	-52.7%	-37.4%	**-15.3%**

Section 4 – Spot Trimming on Worst Performing Circuits

DTE Electric provides an annual power quality investigation report which contains data on all primary customer power quality investigations conducted in the past year for end-use customers, derived from their power quality meters, and the outcome of each investigation. This report contains the DTE Electric January 1, 2023 through December 31, 2023 results and identifies a list of 10 worst performing circuits based on SAIFI outages compared to the rest of the system (based on all cause codes, not just tree related events). Table 17 lists these circuits and the spot trimming that took place in 2023, or planned maintenance trimming.

Table 17 – Tree Trimming on 2023 Ten Worst Performing Circuits

Circuit	sysSAIFI[14]	sysSAIFI ex MED[15]	Spot Trimming		Last Maintenance Trimming Year
			Performed in 2023?	Number of Poles Trimmed	
MOTT9789	0.01031	0.00451	No		2020
NIXON8932	0.00905	0.00339	No		2023
CROWN9832	0.00853	0.00581	Yes	4	2022
GODSN8134	0.00792	0.00390	Yes	110	2018
PERU9432	0.00765	0.00508	No		2022
KENSL9858	0.00719	0.00436	No		2022
STATE8137	0.00657	0.00308	No		2014
DUBLN8195	0.00617	0.00093	Yes	12	2020
CODY9537	0.00606	0.00187	Yes	125	2015
DUBLN8205	0.00595	0.00126	Yes	21	2020

Section 5 – Tree Trim Workforce

The internal employees directly involved in Tree Trimming are detailed in **Table 18**. In 2023, the average number for contractors on property were 1,282. Contractor headcount fluctuation over the course of 2023 is seen in **Chart 1**.

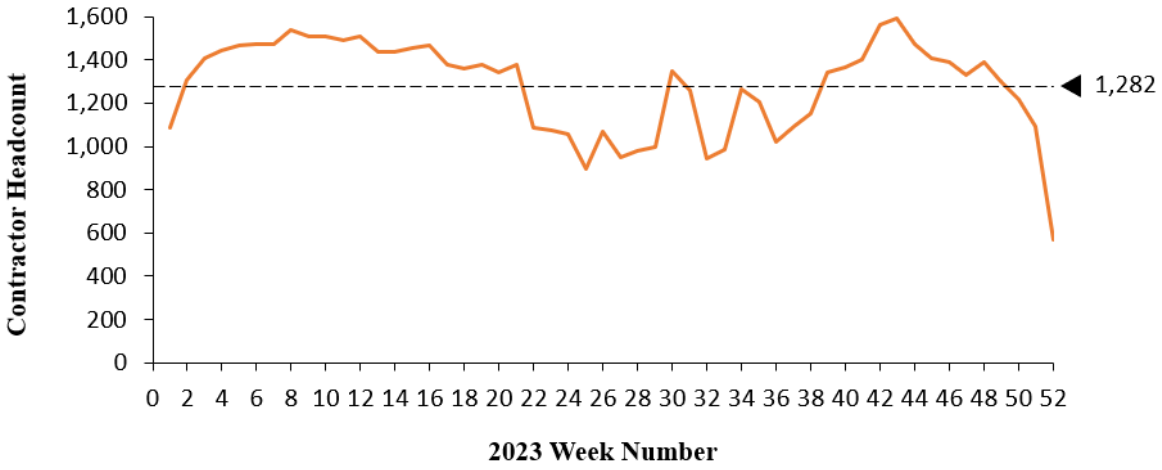
Table 18 – 2023 DTE and Contractor Tree Trim Headcount

Facilitator – Arborists	13
Supervision	8
Regional Foresters	5
Strategy and Planning	9
Internal Employees involved with ETTP	**35**

2023 Average # of Contractors	**1,282**

[14] sysSAFI is the number of customer interruptions on a specific circuit divided by the number of system customer interruptions.
[15] MED stands for Major Event Days.

Chart 1 – 2023 Contract Tree Trim Headcount by Week



The 2023 average local journeymen trimmers were 641, and the number of local apprentices were 229. Outsourced journeymen trimmers averaged 412 for 2023. It is typical for the workforce numbers to fluctuate over the year, especially in the late fall when many outsource trimmers return to their home states for the holidays. The outsource trimmers then slowly return through the first quarter of the year based on the Company's capacity needs.

The Company is participating in three programs in an effort to increase the number of local trimmers. The three programs are the Parnall Correctional Facility Vocational Village Training Program, the City of Detroit Tree Trim Academy, and the IBEW Local 17 Traditional Boot Camp. Below is an update on each of the programs:

1. Parnall Correctional Facility The Parnall Tree Trimming program is designed to provide returning citizens the skills needed to start as an apprentice tree trimmer. DTE has partnered with the Michigan Department of Corrections to provide qualified instructors and the required training support within the prison facility before participants are released. The company has paired 30 graduates with jobs.

2. Tree Trim Academy – The Company has partnered with the City of Detroit, IBEW Local 17, and its tree-trimming contractors to develop and implement a pre-woodsman training pilot program to satisfy the demand for qualified tree trimmers. The pilot tree trimming academy is located within the City of Detroit and facilitates training that is aimed at preparing local resident candidates to work as woodsmen. Once candidates complete the pre-woodsman program, graduates enter the nine-day boot camp that was previously designed in partnership with the Company, IBEW Local 17, and the Company's tree-trimming contractors.

To date the tree trimming academy has trained and graduated 202 individuals. Graduates leave the program with sought after climbing experience, a Class B CDL, and a federally required pesticide Applicator certification.

3. Traditional Boot Camp – IBEW continues to hold regular scheduled boot camp training for apprentices. Current camps are conducted at their training facility in Wales, MI.

Section 6 – Incremental Funding for Tree Trim Program

On August 31, 2021, the Company proposed additional funding for the Tree Trim program in Case No. U-21128. Per the application, the Company would invest incremental funding into the Tree Trim Surge during the remainder of 2021 through 2023, beyond the authorized regulatory asset amounts, and would not seek recovery of the additional expenditures. This has the effect of advancing the Company's tree trimming efforts while avoiding future customer expense for those investments, thus providing an affordability benefit to customers. The Company's application was approved on November 4th, 2021, and the Company committed to $90 million of incremental funding for the Tree Trimming program.

In 2022, the Company spent $85.8 million of the incremental $90 million investment. The annual maintenance plan was developed based on the total budget, including the incremental $85.8 million. The Company did not distinguish specific circuits trimmed as part of the base budget compared to the incremental funding. However, the Company can calculate the incremental work the additional funding enabled us to complete. The additional $85.8 million allowed the Company to complete an extra 1,700 off-cycle miles in 2022 and lead the system to be 79% on-cycle at year end. These miles were focused in poor reliability areas and trimming was completed prior to the 2022 storm season.

In 2023, the remaining $4.2 million of the incremental funding was spent to support the Company's spot trimming program to address high-risk areas that were not on the 2023 maintenance plan. The spot trimming program and circuit impact are reviewed in Section 4.

Michigan Public Service Commission
DTE Electric Company
Assistance Disconnect Rates
Customer Service

Case No: U-21534
Exhibit: A-32
Schedule W1
Witness: J. E. Sparks
Page: 1 of 1

**Note: 2022 Data is refreshed as of 10/31/2023 and hence shut offs are counted only until that point*

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(m)	(n)	(o)
	LSP Program Year	2018			2019			2020			2021			2022		
Line	MEAP combinations and Shut off rate within 12 mos (Non-LSP)	Combo	Elec only	Gas only	Combo	Elec only	Gas only	Combo	Elec only	Gas only	Combo	Elec only	Gas only	Combo	Elec only	Gas only
1	a. MEAP	32%	29%	6%	19%	18%	6%	30%	27%	15%	23%	23%	9%	25%	26%	2%
2	b. MEAP and LIA	31%	21%	9%	18%	18%	3%	23%	22%	15%	18%	14%	9%	20%	18%	3%
3	c. MEAP and RIA	33%	27%	6%	22%	21%	7%	32%	30%	19%	24%	24%	10%	26%	27%	2%
4	d. MEAP and HHC	35%	36%	5%	21%	27%	6%	29%	13%	11%	22%	20%	5%	25%	21%	1%
5	e. MEAP + HHC + LIA	32%		0%	21%		8%	22%		0%	18%		14%	18%		0%
6	f. MEAP + HHC + RIA	35%	100%	5%	21%	27%	6%	30%	14%	11%	23%	20%	5%	26%	23%	1%
7	g. MEAP + LIA + RIA	31%		0%	19%	19%	5%	26%	18%	12%	22%	10%	28%	22%	17%	0%
8	h. MEAP + LIA + RIA + HHC	33%		0%	21%		0%	25%			22%		40%	22%		0%

	LSP Program Year	2018			2019			2020			2021			2022		
	Shut-off rate	Combo	Elec only	Gas only	Combo	Elec only	Gas only	Combo	Elec only	Gas only	Combo	Elec only	Gas only	Combo	Elec only	Gas only
9	a. LSP & shutoff															
10	0-75	10%	11%	6%	11%	10%	5%	9%	10%	6%	12%	10%	7%	13%	11%	6%
11	76-110	8%	9%	4%	9%	6%	5%	7%	7%	9%	10%	8%	3%	10%	8%	2%
12	111-150	8%	7%	3%	9%	7%	2%	8%	9%	11%	10%	8%	8%	10%	10%	5%
13	b. LSP and LIA & shutoff															
14	0-75	10%	11%	5%	11%	10%	4%	9%	10%	6%	11%	9%	7%	13%	11%	6%
15	76-110	8%	9%	0%	9%	7%	5%	7%	7%	9%	10%	8%	2%	10%	8%	2%
16	111-150	8%	7%	2%	9%	7%	3%	8%	9%	12%	9%	7%	7%	10%	9%	4%
17	c. LSP and RIA & shutoff															
18	0-75	14%	0%	6%	12%	18%	4%	20%	21%	8%	22%	22%	14%	23%	21%	8%
19	76-110	13%	0%	6%	9%	13%	6%	17%	14%	14%	20%	16%	7%	17%	15%	4%
20	111-150	14%	0%	5%	10%	17%	2%	19%	17%	15%	20%	19%	11%	17%	20%	7%
21	d. LSP and HHC & shutoff															
22	0-75	10%	0%	4%	11%	0%	2%	8%	0%	4%	10%	0%	3%	12%	0%	3%
23	76-110	8%	0%	3%	10%	0%	0%	5%	0%	16%	7%	0%	0%	8%	25%	0%
24	111-150	7%		5%	9%		0%	6%	0%	15%	8%		6%	11%	0%	3%
25	e. LSP + HHC + LIA & shutoff															
26	0-75	10%	0%	9%	11%		1%	7%		4%	9%	0%	1%	11%		3%
36	111-150	14%	0%	0%	9%	17%	2%	18%	15%	16%	19%	20%	10%	16%	21%	6%
37	h. LSP + LIA + RIA + HHC &shutoff															
38	0-75	11%		13%	12%		2%	15%		5%	18%		2%	19%		4%
39	76-110	9%		0%	10%		0%	12%		17%	15%		0%	13%		0%
40	111-150	8%		0%	8%		0%	11%		25%	15%		17%	16%		4%

Michigan Public Service Commission
DTE Electric Company
Projected Capital Expenditures
Distribution - Infrastructure Recovery Mechanism (IRM)
Proposed Investment and In-Service Levels
($000)

Case No.: U-21534
Exhibit: A-33
Schedule: X1
Witness: N. Foley
Page: 1 of 1

Line No.	(a) Description	(b) U-21297 Approved 2024 13 mos. ending *12/31/2024*	(c) U-21297 Approved 2025 12 mos. ending *12/31/2025*	(d) U-21534 Proposed 2026 12 mos. ending *12/31/2026*	(e) U-21534 Proposed 2027 12 mos. ending *12/31/2027*
1	**CAPITAL INVESTMENTS**				
2	Conversions	1,608	185,812	190,000	240,000
3	Subtransmission Redesign & Rebuild	5,546	53,819	55,000	65,000
4	Breaker Replacement Program	13,680	12,628	15,000	15,000
5	URD Replacement Program	14,625	13,500	15,000	20,000
6	Distribution Automation	26,406	24,375	105,000	180,000
7	Pole and Pole Top Maintenance & Modernization	-	-	150,000	200,000
8	**Total IRM Investments**	**61,865**	**290,134**	**530,000**	**720,000**
9	**Additions to PLANT IN SERVICE**				
10	Conversions	1,206	139,761	188,953	227,500
11	Subtransmission Redesign & Rebuild	4,159	41,750	54,705	62,500
12	Breaker Replacement Program	13,680	12,628	15,000	15,000
13	URD Replacement Program	14,625	13,500	15,000	20,000
14	Distribution Automation	26,406	24,375	105,000	180,000
15	Pole and Pole Top Maintenance & Modernization	-	-	150,000	200,000
16	Total IRM Investments	**60,077**	**232,015**	**528,658**	**705,000**

Case No. U-21534
Exhibit: A-33
Schedule: X2

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Case No. U-21534
Exhibit: A-33
Schedule: X3

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Michigan Public Service Commission
DTE Electric Company
Infrastructure Recovery Mechanism
Incremental Revenue Requirement - Distribution Operations
($000)

Case No.: U-21534
Exhibit: A-33
Schedule: X4
Witness: K. M. Vangilder

Line No.	(a) Description	(b) Source	(c) 13 mos. ending 12/31/2024	(d) 12 mos. ending 12/31/2025	(e) 12 mos. ending 12/31/2026	(f) 12 mos. ending 12/31/2027	(g) Total
			(1)	(1)			
1	**PLANT IN SERVICE**		*(prev. approved)*	*(prev. approved)*	*(proposed)*	*(proposed)*	
2							
3	Conversions	Exh A-33, Sch X1, Line 10	$ 1,206	$ 139,761	$ 188,953	$ 227,500	$ 557,420
4	Subtransmission Redesign & Rebuild	Exh A-33, Sch X1, Line 11	4,159	41,750	54,705	62,500	163,114
5	Breaker Replacement Program	Exh A-33, Sch X1, Line 12	13,680	12,628	15,000	15,000	56,309
6	URD Replacement Program	Exh A-33, Sch X1, Line 13	14,625	13,500	15,000	20,000	63,125
7	Distribution Automation (2)	Exh A-33, Sch X1, Line 14	26,406	24,375	105,000	180,000	335,781
8	Pole and Pole Top Maintenance & Modernization	Exh A-33, Sch X1, Line 15	-	-	150,000	200,000	350,000
9	**Total Plant In Service**		**$ 60,077**	**$ 232,015**	**$ 528,658**	**$ 705,000**	**$ 1,525,749**
10							
11	**Net Rate Base**						
12	Cumulative Plant In Service	Prior Yr plus L9	$ 60,077	$ 292,092	$ 820,749	$ 1,525,749	
13	Accumulated Depreciation	Prior Yr less L20	(1,227)	(8,417)	(31,140)	(79,052)	
14	Accum. Deferred Taxes	P2, L7	(266)	(1,781)	(6,409)	(15,708)	
15	Ending Net Rate Base	Sum of L12 thru L14	$ 58,584	$ 281,893	$ 783,201	$ 1,430,989	
16	Average Net Rate Base	L15 (PY+CY)/2	29,292	170,239	532,547	1,107,095	
17							
18	**Total Cost of Service**						
19	Return on Net Rate Base	L16 * Pre-tax rate of return (3)	2,551	14,825	49,016	101,898	168,290
20	Depreciation (1/2 yr conv.)	(4)	1,227	7,191	22,723	47,912	79,052
21	Property Taxes	P2, L30 + P2, L47	-	1,684	8,871	22,623	33,178
22	Total Cost of Service (COS) Requirement	L19 thru L21	$ 3,778	$ 23,700	$ 80,610	$ 172,433	$ 280,520

(1) 2024 and 2025 revenue requirement calculations utilize the same plant in service amounts, rate of return, depreciation rates, and property tax millage rates as those approved in the IRM for DTE Electric Rate Case No. U-21297

(2) Previously known as 4.8 kV Circuit Automation

(3) Pre-tax rate of return for 2026
Exhibit A-14, Schedule D1

	Weighted Cost	Pre-tax Multiplier	Pre-tax Rate of Return
Long-Term Debt	2.12%	1.000	2.12%
Common Equity	5.25%	1.350	7.09%
Total	7.37%		9.20%

(4) 2026 depreciation rate for Distribution Plant is 4.11% per Witness Uzenski Exhibit A-13, Schedule C6. Page 2, Line 9

Michigan Public Service Commission
DTE Electric Company
Infrastructure Recovery Mechanism
Incremental Revenue Requirement - Distribution Operations
($000)

Case No.: U-21534
Exhibit: A-33
Schedule: X4
Witness: K. M. Vangilder
Page: 2 of 2

Line No.	(a) Description	(b) Source	(c) 13 mos. ending 12/31/2024 (1) (prev. approved)	(d) 12 mos. ending 12/31/2025 (1) (prev. approved)	(e) 12 mos. ending 12/31/2026 (extension)	(f) 12 mos. ending 12/31/2027 (extension)
1	**Deferred Tax Expense**					
2	Tax Depreciation	Line 17	2,253	13,037	40,585	83,804
3	Book Depreciation	P1, L20	1,227	7,191	22,723	47,912
4	Timing Difference	Line 2 - Line 3	1,026	5,846	17,862	35,892
5	Deferred Tax Expense	Line 4 X 25.91%	$ 266	$ 1,515	$ 4,628	$ 9,300
6						
7	Accum. Deferred Tax Expense	Prior Yr plus L5	$ 266	$ 1,781	$ 6,409	$ 15,708
8						
9	**Tax Depreciation**		Year 1	Year 2	Year 3	Year 4
10	MACRS Tax Depr Rate (20 Year)		3.750%	7.219%	6.677%	6.177%
11						
12	Year 1 Additions	P1, L9 x P2, L10	2,253	4,337	4,011	3,711
13	Year 2 Additions	P1, L9 x P2, L10		8,701	16,749	15,492
14	Year 3 Additions	P1, L9 x P2, L10			19,825	38,164
15	Year 4 Additions	P1, L9 x P2, L10				26,438
16	Year 5 Additions	P1, L9 x P2, L10	-	-	-	-
17	Total Tax Depreciation	Sum of L12 thru L16	$ 2,253	$ 13,037	$ 40,585	$ 83,804
18						
19	**Property Tax - Plant In Service**		Year 1	Year 2	Year 3	Year 4
20	Factor	WP-SLW-1	0.96	0.93	0.90	0.86
21						
22	Year 1 Taxable Value	P1, L9 x P2, L20 x 50%	28,837	27,936	27,034	25,833
23	Year 2 Taxable Value	P1, L9 x P2, L20 x 50%		111,367	107,887	104,407
24	Year 3 Taxable Value	P1, L9 x P2, L20 x 50%			253,756	245,826
25	Year 4 Taxable Value	P1, L9 x P2, L20 x 50%				338,400
26	Year 5 Taxable Value	P1, L9 x P2, L20 x 50%	-	-	-	-
27	Total Taxable Value	Sum of L22 thru L26	$ 28,837	$ 139,303	$ 388,677	$ 714,466
28	Millage	Exh. A-13, Sch C7.1 (5)	57.500	57.500	56.000	56.000
29	Property Tax Assessed	L27 x L28	$ 1,658	$ 8,010	$ 21,766	$ 40,010
30	Property Tax Expense (Year lag)			$ 1,658	$ 8,010	$ 21,766
31						
32	**Property Tax - CWIP**		Year 1	Year 2	Year 3	Year 4
33	Cumulative Capital Investment	Prior Yr plus Exh A-33, Sch X1, L8	$ 61,865	$ 351,999	$ 881,999	$ 1,601,999
34	Cumulative Plant in Service	P1, L12	60,077	292,092	820,749	1,525,749
35	Cumulative CWIP	Line 33 - Line 34	1,788	59,908	61,250	76,250
36						
37	Factor	Exh. A-13, Sch C7.1	0.50	0.50	0.50	0.50
38						
39	Year 1 Taxable Value	P2, L35 x P2, L37 x 50%	447			
40	Year 2 Taxable Value	P2, L35 x P2, L37 x 50%		14,977		
41	Year 3 Taxable Value	P2, L35 x P2, L37 x 50%			15,313	
42	Year 4 Taxable Value	P2, L35 x P2, L37 x 50%				19,063
43	Year 5 Taxable Value	P2, L35 x P2, L37 x 50%	-	-	-	-
44	Total Taxable Value	Sum of L39 thru L43	$ 447	$ 14,977	$ 15,313	$ 19,063
45	Millage	Exh. A-13, Sch C7.1 (1)	57.500	57.500	56.000	56.000
46	Property Tax Assessed	L44 x L45	$ 26	$ 861	$ 858	$ 1,068
47	Property Tax Expense (Year lag)			$ 26	$ 861	$ 858

(1) 2024 and 2025 revenue requirement calculations utilize the same plant in service amounts, rate of return, depreciation rates, and property tax millage rates as those approved in the IRM for DTE Electric Rate Case No. U-21297

Michigan Public Service Commission
DTE Electric Company
Infrastructure Recovery Mechanism
Incremental Revenue Requirement - Distribution Operations
Example of $1.0 MM Under Investment
($000)

Case No.: U-21534
Exhibit: A-33
Schedule: X5
Witness: K. M. Vangilder
Page: 1 of 2

Line No.	(a) Description	(b) Source	(c) Year 1
1	**PLANT IN SERVICE**		
2	Capital Under Investment		$ (1,000)
3	**Total Plant In Service**		**$ (1,000)**
4			
5	**Net Rate Base**		
6	Cumulative Plant In Service	Prior Yr plus L3	$ (1,000)
7	Accumulated Depreciation	Prior Yr less L14	21
8	Accum. Deferred Taxes	P2, L7	5
9	Ending Net Rate Base	Sum of L6 thru L8	$ (975)
10	Average Net Rate Base	L9 (PY+CY)/2	(487)
11			
12	**Total Cost of Service**		
13	Return on Net Rate Base	(1)	(45)
14	Depreciation (1/2 yr conv.)	(2)	(21)
15	Property Taxes	(3)	-
16	Total Cost of Service (COS) Requirement	L13 thru L15	$ (65)

(1) The return on net rate base is determined using a permanent capital per-tax rate of return as calculated on Exhibit A-33, Schedule X4
(2) Depreciation rate for Distribution Plant is 4.11% per Witness Uzenski Exhibit A-13, Schedule C6. Page 2, Line 9
(3) Property tax epense is assessed based on asset balances at end of year. As such, there is no associated property tax in a one year view.

Michigan Public Service Commission
DTE Electric Company
Infrastructure Recovery Mechanism
Incremental Revenue Requirement - Distribution Operations
Example of $1.0 MM Under Investment
($000)

Case No.: U-21534
Exhibit: A-33
Schedule: X5
Witness: K. M. Vangilder
Page: 2 of 2

Line No.	(a) Description	(b) Source	(c) Year 1
1	**Deferred Tax Expense**		
2	Tax Depreciation	Line 19	(38)
3	Book Depreciation	P1, L14	(21)
4	Timing Difference	Line 2 - Line 3	(17)
5	Deferred Tax Expense	Line 4 X 25.91%	$ (5)
6			
7	Accum. Deferred Tax Expense	Prior Yr plus L5	$ (5)
8			
9			
10			
11	**Tax Depreciation**		
12	MACRS Tax Depr Rate (20 Year)		3.750%
13			
14	Year 1 Additions	P1, L3 x P2, L12	(38)
15	Year 2 Additions	P1, L3 x P2, L12	
16	Year 3 Additions	P1, L3 x P2, L12	
17	Year 4 Additions	P1, L3 x P2, L12	
18	Year 5 Additions	P1, L3 x P2, L12	-
19	Total Tax Depreciation	Sum of L14 thru L18	$ (38)

DTE Electric Company
Infrastructure Recovery Mechanism - Distribution Operations
Incremental Revenue Requirement by Voltage Class
(thousands of dollars)

IRM REVENUE REQUIREMENT

Cost of Service Study

DISTRIBUTION COSTS

Case No.: U-21534
Exhibit: A-33
Schedule: X6
Witness: H. J. Maroun
Page: 1 of 1

		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
		Total Electric	Residential Secondary	Commercial Secondary	Primary	Subtransmission	Transmission	D-9 OPL Residential	D-9 OPL Commercial	E-1 St Lght	E-2 Signals
	2024 - 13 mos. Ending 12/31/2024 /1	3,778									
1	IRM Revenue Requirement (Previously Approved)	3,778	2,311	1,008	301	29	-	6	13	107	3
	2025 - 12 mos. Ending 12/31/2025 /1	23,700									
2	IRM Revenue Requirement (Previously Approved)	23,700	14,502	6,323	1,886	184	-	35	79	673	16
	Allocation Factors										
3	PIS - Dist Direct 521T (521 excl Transmission)	100.000%	61.117%	27.471%	7.592%	0.622%	0.000%	0.142%	0.329%	2.656%	0.071%
	2026 - 12 mos. Ending 12/31/2026 /2	80,610									
4	IRM Revenue Requirement (Proposed)	80,610	49,267	22,145	6,120	502	-	114	265	2,141	57
	2027 - 12 mos. Ending 12/31/2027 /3	172,433									
5	IRM Revenue Requirement (Proposed)	172,433	105,387	47,370	13,091	1,073	-	244	567	4,580	122

1/- Amounts match the IRM Revenue Requirement by Class approved in the December 1, 2023 Order in Case No. U-21297
2/- Per Exhibit A-33, Schedule X4 page 1, line 22, col. (e)
3/- Per Exhibit A-33, Schedule X4 page 1, line 22, col. (f)

Michigan Public Service Commission
DTE Electric Company
IRM Surcharge Design

Case No. : U-21534
Exhibit: A-33
Schedule: X7
Witness: A. Willis
Page: 1 of 1

Line No.	(a) Distribution COS Class	(b) Residential Secondary	(c) Commercial Secondary (excl D4)	(d) D4	(e) Primary	(f) Sub transmission	(g) Transmission	(h) D9 OPL Residential	(i) D9 OPL Commerical	(j) E1 St Light	E2 Signals	Source
1	**2026**											
2	**Revenue Requirement**	$ 49,266,544	$ 17,821,482	$ 4,323,150	$ 6,119,628	$ 501,562	$ -	$ 114,215	$ 264,859	$ 2,141,277	$ 57,000	Maroun Exhibit A-33, Schedule X6
3												
4	**Determinant (MWh)**	15,268,251	8,660,829					6,023	27,202	123,056	59,731	Willis and Bellini Exhibit A-16, Schedule F3
5												
6	**Determinant (kW)**			4,867,687	25,771,207	5,642,510	14,837,522					Willis A-16, Schedule F3 (Rate Schedule D4), AW WP-6
7												
8	**2027**											
9	**Revenue Requirement**	$ 105,386,746	$ 38,122,178	$ 9,247,709	$ 13,090,581	$ 1,072,899	$ -	$ 244,318	$ 566,564	$ 4,580,436	$ 121,930	Maroun Exhibit A-33, Schedule X6
10												
11	**Determinant (MWh)**	15,268,251	8,660,829					6,023	27,202	123,056	59,731	Willis and Bellini Exhibit A-16, Schedule F3
12												
13	**Determinant (kW)**			4,867,687	25,771,207	5,642,510	14,837,522					Willis A-16, Schedule F3 (Rate Schedule D4), AW WP-6

Line No.		Proposed surcharge 2026	2027	Unit				
14								
15								
16	**Residential Secondary**							
17	All rates	0.003227	0.006902	$/kWh	@500 kWh	$ 1.61	$ 3.45	
18								
19	**Commercial Secondary**							
20	All rates (ex D4)	0.002058	0.004402	$/kWh				
21	Rate Schedule D4	0.8881	1.8998	$ / kW				
22								
23	**Primary**							
24	Primary	0.2375	0.5080	$/kW				
25	Subtransmission	0.0889	0.1901	$/kW				
26	Transmisson	0.0000	0.0000	$/kW				
27	Rate Schedule D10	0.000703	0.001504	$/kWh				
28	Rider 1.1 / 1.2 DV	0.002058	0.004402	$/kWh				
29	Rider 1.1 / 1.2 PV	0.000707	0.001512	$/kWh				
30	Rider 1.1 / 1.2 SV	0.000249	0.000532	$/kWh				
31	Rider 1.1 / 1.2 TV	0.000000	0.000000	$/kWh				
32	D13 PV	0.000434	0.000928	$/kWh				
33	D13 SV	0.000162	0.000347	$/kWh				
34	D13 TV	0.000000	0.000000	$/kWh				
35								
36	**Other**							
37	D9 OPL (Res)	0.018962	0.040561	$/kWh				
38	D9 OPL (Comm)	0.009737	0.020828	$/kWh				
39	E1 St Light	0.017401	0.037222	$/kWh				
40	E2 Signals	0.000954	0.002041	$/kWh				

MPSC Case No: U-21534

Requester: Staff

Question No.: STDE-2.5

Respondent: M. Guillaumin

Page: 1 of 1

Question: Witness Guillaumin – Steam, Hydro, and Other Generation

5. Referring to Exhibit A-12 Schedule B5.1 page 6, please explain why the BWEC Conference Room Building was not completed during the initial construction of BWEC. Do other DTE Electric power plants have a large conference room either within the plant or as a separate building? Why was the need not identified during the initial construction where it could have proceeded with the construction of the rest of the plant, likely at more economical cost rather than as a separate project after the plant has been in service for almost two years?

Answer: Please see pages 117 - 118 of my direct testimony. A BWEC conference room building was not completed during initial construction because it was not needed at the time. During construction of the plant, the large construction workforce used a significant number of temporary construction trailers to serve the purpose.

Other power plant sites converted original construction buildings into conference room buildings when construction was completed. Other plants also have large open spaces that are inherent in the design of the plant boiler / turbine buildings to temporarily accommodate the needs of craft labor. BWEC is an “open air” design with significantly less inherent building square footage as compared to other major DTE Electric power plants.

BWEC was constructed with 25 available workspaces to support fulltime employees. However, the conference room building is needed to accommodate surges of 100-plus onsite workforce supporting upcoming forced, routine, and major maintenance activities.

Attachment: None.

MPSC Case No: U-21534

Requester: Staff

Question No.: STDE-3.6b

Respondent: M. Guillaumin

Page: 1 of 1

Question: 6. Referring to the BWEC conference room project included on page 6 of Exhibit A- 12, Schedule B5.1, it is stated that the purpose of this conference room is to allow for hosting of large meetings with external personnel, please detail:

b. Has the need for this type of hosting space arisen since BWEC began commercial operations?

Answer: Yes. The conference room building is needed to accommodate surges in the site workforce supporting upcoming routine and major maintenance activities.

During construction of the plant, the large construction workforce used a significant number of temporary trailers to serve the purpose. Those temporary trailers were removed from the site when construction was completed.

Attachment: None.

MPSC Case No: U-21534

Requester: Staff

Question No.: STDE-3.6c

Respondent: M. Guillaumin

Page: 1 of 1

Question: 6. Referring to the BWEC conference room project included on page 6 of Exhibit A- 12, Schedule B5.1, it is stated that the purpose of this conference room is to allow for hosting of large meetings with external personnel, please detail:

c. If the answer to part (b) is yes, then please detail the frequency, length, and number of personnel that did not have proper accommodations.

Answer: The current office configuration provides the fulltime employees of Blue Water Energy Center with 25 available workspaces for their daily use. The 25 workspaces will not be sufficient when the site workforce surges to 100-plus personnel in support of routine and major maintenance activities. Routine maintenance activities are expected twice every year, and major maintenance is expected every four years. The duration of use and specific number of personnel will depend on the work performed. However, in general, the BWEC conference room will be used for months during each routine and major maintenance activity.

Attachment: None.

MPSC Case No: U-21534

Requester: Staff

Question No.: STDE-3.6d

Respondent: M. Guillaumin

Page: 1 of 1

Question: 6. Referring to the BWEC conference room project included on page 6 of Exhibit A- 12, Schedule B5.1, it is stated that the purpose of this conference room is to allow for hosting of large meetings with external personnel, please detail:

d. What is the current solution if there is the need to host a large meeting or have additional personnel on site beyond BWEC's hosting capabilities? Please identify the costs of making these alternate accommodations if any have been made so far.

Answer: Without the BWEC conference room building, the Company would need to utilize a varying number of trailers to support the projected routine and major maintenance outages. The cost of utilizing trailers to support future BWEC operations is expected to exceed $15 million.

Attachment: None.

MPSC Case No: U-21534

Requester: Staff

Question No.: STDE-10.1a-c

Respondent: M. Guillaumin

Page: 1 of 1

Question: 1. Referencing the Company's discovery response STDE-3.6d:

a. Please explain how the Company develop the estimate of at least $15 million in costs to support future BWEC operations without a conference room? Did the Company conduct an analysis to calculate this cost? If so, please explain.

b. What are the assumptions for this estimated cost of $15 million? Was this estimated calculated assuming the standard outage schedule described in STDE-3.6 for the assumed life of BWEC?

c. Please provide any analysis, in its native format with all formulae intact, if such an analysis exists.

Answer: Yes, the Company conducted an analysis to calculate this cost. The Company evaluated two alternatives to constructing the BWEC conference room building and the construction of a BWEC Conference Room Building was demonstrated to be the most economic choice. Please see the attachment labelled "U-21534 STDE-10.1a BWEC Conference Room Building Cost Analysis" for the cost analysis.

Attachment: U-21534 STDE-10.1a BWEC Conference Room Building Cost Analysis

Excerpt from Attachment U-21534 STDE-10.1a BWEC Conference Room Building Cost Analysis

Case No.: U-21534
Exhibit: A-34
Schedule: Y1
Witness: M. E. Guillaumin
Page: 6 of 8

Conference Room / Outage Support Building Project
Option 1 Scenario
Construct Conference Room Building and Rent Single Wide Trailers

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
Total Annual Capital Costs (Directs)	$2,970,341	$305,000	$235,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Annual Trailer Rental Costs Plus O&M Costs (Directs)		$166,063	$267,621	$177,891	$184,117	$190,561	$307,101	$459,301	$475,377	$492,015	$664,747	$527,059	$545,506	$564,598	$762,813	$604,812	$625,980	$647,890	$875,345	$694,036	$718,327	$743,468	$1,004,479	$796,422	$824,296	$853,147	$1,152,663	$913,912	$945,899
Total Annual Capital Costs (Directs + Indirects)	$3,462,718	$366,427	$284,336								$0										$0								
Total Annual Trailer Rental Costs Plus O&M Costs (Directs + Indirects)		$173,536	$279,664	$185,896	$192,402	$199,136	$320,921	$479,970	$496,769	$514,156	$694,661	$550,776	$570,053	$590,005	$797,139	$632,028	$654,149	$677,045	$914,736	$725,267	$750,651	$776,924	$1,049,680	$832,261	$861,390	$891,538	$1,204,532	$955,038	$988,465

Total Capital Cost for Life of the Plant	**$4,113,481**
Total O&M Costs for Life of the Plant	**$17,958,790**

Excerpt from Attachment U-21534 STDE-10.1a BWEC Conference Room Building Cost Analysis

BWEC
Conference Room / Outage Support Building Project
Option 2 Scenario
Purchase Double Wide Trailers Every 10 years and Rent Single Wide Trailers

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
Total Annual Capital Costs (Directs)	$2,306,250	$470,000	$400,000	$0	$0	$0	$0	$0	$0	$0	$1,942,595	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2,740,222	$0	$0	$0	$0	$0	$0	$0	$0
Total Annual Trailer Rental Costs Plus O&M Costs (Directs)		$249,095	$416,334	$266,836	$276,176	$285,842	$477,753	$558,324	$577,865	$598,091	$858,351	$640,690	$663,114	$686,323	$984,978	$735,206	$760,938	$787,571	$1,130,285	$843,666	$873,194	$903,756	$1,297,028	$968,126	$1,002,011	$1,037,081	$1,488,369	$1,110,947	$1,149,830
Total Annual Capital Costs (Directs + Indirects)	$2,660,109	$564,658	$483,977								$2,260,143										$3,171,364								
Total Annual Trailer Rental Costs Plus O&M Costs (Directs + Indirects)		$260,304	$435,069	$278,844	$288,603	$298,705	$499,252	$583,449	$603,869	$625,005	$896,977	$669,521	$692,954	$717,207	$1,029,302	$768,290	$795,181	$823,012	$1,181,147	$881,631	$912,488	$944,425	$1,355,394	$1,011,692	$1,047,101	$1,083,750	$1,555,346	$1,160,940	$1,201,573

Total Capital Cost for Life of the Plant	**$9,140,250**
Total O&M Costs for Life of the Plant	**$22,601,029**

Excerpt from Attachment U-21534 STDE-10.1a BWEC Conference Room Building Cost Analysis

Case No.: U-21534
Exhibit: A-34
Schedule: Y1
Witness: M. E. Guillaumin
Page: 8 of 8

BWEC
Conference Room / Outage Support Building Project
Option 3 Scenario
Rent Double Wide Trailers and Rent Single Wide Trailers

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
Annual Capital Costs (Directs)		$1,545,000	$400,000	$0	$0	$0	$0	$0	$0	$0	$65,840	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Annual O&M Costs (Directs)		$1,050,668	$1,120,740	$992,439	$1,027,175	$1,063,126	$1,286,075	$1,394,014	$1,442,805	$1,493,303	$1,887,830	$1,774,881	$1,655,651	$1,713,599	$2,055,551	$1,835,650	$1,899,898	$1,966,395	$2,358,792	$2,106,451	$2,316,350	$2,503,645	$2,706,768	$2,417,201	$2,501,803	$2,589,366	$3,106,079	$2,773,794	$3,050,191
Total Annual Capital Costs (Directs + Indirects)		$1,827,967	$472,533	$0	$0	$0	$0	$0	$0	$0	$77,780	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Annual Trailer Rental Costs Plus O&M Costs (Directs + Indirects)		$1,097,948	$1,171,173	$1,037,099	$1,073,397	$1,110,966	$1,343,948	$1,456,745	$1,507,731	$1,560,501	$1,972,782	$1,854,751	$1,730,156	$1,790,711	$2,148,051	$1,918,255	$1,985,394	$2,054,882	$2,464,938	$2,201,241	$2,420,586	$2,616,309	$2,828,573	$2,525,975	$2,614,384	$2,705,888	$3,245,853	$2,898,615	$3,187,449

Total Capital Cost for Life of the Plant	**$2,378,280**
Total O&M Costs for Life of the Plant	**$56,524,303**

Steam, Hydraulic, and
Other Power Generation -- Non-Routine
($000)

Line No.	Description	Actual From STDE-2.1a Nov-23	Dec-23	Actual From STDE-2.1b Jan-24	Feb-24	Mar-24	Apr-24	Exhibit Projection from Working Model Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24
1	**Steam Power Generation - Non-Routine Additions:**												
2	Belle River Fuel Conversion	177	858	7,352	4,462	6,429	119	(330)	1,520	13,312	3,796	6,205	289
3	Belle River Bottom Ash Basin Modification (CCR)	65	(9)	80	(148)	26	-	2	-	-	-	-	-
4	Monroe Dry Fly Ash Conversion (ELG)	5,412	872	254	307	388	180	5,412	951	305	228	180	184
5	Monroe Bottom Ash Conversion (ELG)	448	651	1,775	938	1,754	1,511	445	350	2,014	980	866	394
6	Monroe FGD Wastewater (ELG)	21	12	8	11	11	8	21	68	83	83	83	83
7	Monroe Dry Fly Ash Haul Road	-	-	-	-	-	-	-	-	-	-	-	-
8	Site Security Project 11504	63	(7)	35	48	207	251	240	249	108	50	203	732
9	Site Security Project 18700	-	-	-	-	-	-	-	-	-	-	-	-
10	Site Security Project 18906	291	113	252	200	201	561	279	211	101	53	71	46
11	Site Security Project 20061	-	-	-	-	-	-	16	-	-	-	-	-
12	NERC Compliance Project 18885	33	(10)	-	-	-	-	31	-	-	-	-	-
13	NERC Compliance Project 19895	-	-	-	-	-	-	-	-	-	-	-	-
14	Sibley Quarry Landfill Modification (CCR)	115	175	33	(23)	0	97	107	176	8	-	-	-
15	Sibley Quarry Conveyor Installation (CCR)	-	-	-	-	-	-	-	-	-	-	-	-
16	Sibley Quarry Infrastructure Modification (CCR)	-	-	-	-	-	-	-	-	-	-	-	-
17	Sibley Quarry Landfill Dewatering and Discharging Line	-	-	-	-	-	-	-	-	-	-	-	-
18	Total Steam Power Generation - Non-Routine	6,626	2,654	9,789	5,796	9,015	2,728	6,223	3,525	15,932	5,190	7,607	1,728
19	**Steam Power Generation - Non-Routine Removals:**												
20	Monroe Bottom Ash Basin Closure (CCR)	736	1,051	(171)	(17)	1,707	1,673	834	1,200	476	1,520	1,497	2,080
21	Monroe Fly Ash Basin Closure (CCR)	940	1,202	123	146	708	247	940	1,903	158	158	196	305
22	St. Clair Bottom Ash Basin Closure (CCR)	-	-	-	-	-	-	-	-	-	-	-	-
23	Harbor Beach Decommissioning	-	-	-	-	-	-	-	-	-	-	-	-
24	Conners Creek Sea Wall	-	-	-	-	-	-	-	-	-	-	-	-
25	River Rouge Decommissioning	2,154	3,401	(627)	1,959	1,101	1,359	2,154	3,401	(642)	2,272	968	978
26	St Clair Decommissioning	1,738	1,757	1,730	1,349	935	875	1,738	1,874	1,478	1,468	1,230	1,079
27	Trenton Channel Decommissioning	5,170	8,774	1,723	4,673	3,008	6,507	5,170	5,930	4,868	3,479	2,749	2,777
28	Trenton Channel Sea Wall	22	39	17	20	16	17	22	32	38	73	72	72
29	Steam Power Generation - Non-Routine Removals - TOTALS	10,760	16,224	2,795	8,130	7,475	10,678	10,859	14,340	6,375	8,971	6,711	7,291
30	Steam Power Generation - Non-Routine - TOTALS	17,385	18,879	12,584	13,926	16,490	13,406	17,082	17,865	22,307	14,161	14,319	9,019
31	**Hydraulic Power Generation - Non-Routine:**												
32	Ludington Upgrades	1,179	(5,940)	-	-	-	-	1,179	(5,940)	-	-	-	-
33	Hydraulic Power Generation - Non-Routine - TOTALS	1,179	(5,940)	-	-	-	-	1,179	(5,940)	-	-	-	-
34	**Other Power Generation - Non-Routine:**												
35	Blue Water Energy Center (CCGT)	(95)	45	145	24	16	14	30	30	50	50	50	50
36	BWEC Transmission Upgrades	-	-	-	-	-	-	-	-	-	-	-	-
37	Blackstart Project 10570 & 20255	59	347	518	471	366	386	165	537	488	528	157	318
38	Blackstart Project 17611	26	1,151	61	20	15	170	19	1,212	853	476	1,126	606
39	Blackstart Project 18320	722	156	84	83	63	98	1,073	821	120	14	14	-
40	Slocum Battery Pilot	771	556	282	1,084	1,328	1,408	771	551	1,348	1,347	2,533	1,907
41	Trenton Channel Energy Center BESS	882	65	135	165	93	23,825	882	59	133	132	131	133
42	Northeast 11-1 Decommissioning	40	113	1	0	1	26	106	181	58	17	90	94
43	Other Power Generation - Non-Routine - TOTALS	2,405	2,433	1,225	1,847	1,883	25,927	3,046	3,390	3,050	2,566	4,100	3,108
44	**TOTAL NON-ROUTINE CAPITAL EXPENDITURES**	20,969	15,372	13,809	15,773	18,373	39,333	21,307	15,316	25,357	16,726	18,419	12,128

	November 2023 through April 2024
Total Actual	123,628
Total Projected in Rate Case	109,253
Amount Actuals are above Projection in Rate Case	14,375

Michigan Public Service Commission
DTE Electric Company
AIP, AIP Executives and REP Operating Measure Results: 2019 - 2023

Case No.: U-21534
Exhibit No.: A-35
Schedule No: Z1
Witness: M.A. Fix
Page No.: 1 of 1

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)
		AIP						AIP Executives						REP						
Line No	Description	2019	2020	2021	2022	2023	Average	2019	2020	2021	2022	2023	Average	2019	2020	2021	2022	2023	Average	Combined Average
1	**DTE Electric**																			
2	Less than Threshold	4	3	4	2	6		4	3	4	2	6		4	3	4	2	6		
3	Between Threshold and Target	3	0	2	2	1		3	0	2	2	1		3	0	2	2	1		
4	Target	0	1	0	1	0		0	1	0	1	0		0	1	0	1	0		
5	Between Target and Maximum	4	6	3	3	1		4	6	3	3	1		2	5	2	2	0		
6	Maximum	2	4	0	1	1		2	4	0	1	1		2	4	0	1	1		
7		13	14	9	9	9		13	14	9	9	9		11	13	8	8	8		
8																				
9	Sum of Performance for all measures	1,124%	1,544%	483%	790%	389%		1,124%	1,544%	483%	847%	425%		774%	1,273%	366%	637%	238%		
10																				
11	Average Performance	86.5%	110.3%	53.6%	87.8%	43.2%	76.3%	86.5%	110.3%	53.6%	94.1%	47.2%	78.3%	70.3%	97.9%	45.7%	79.6%	29.8%	64.7%	
12																				
13	**Nuclear Generation**																			
14	Less than Threshold	3	1	2	4	4		3	1	2	4	4		3	1	2	3	4		
15	Between Threshold and Target	0	1	3	2	0		0	1	3	2	0		0	0	2	1	0		
16	Target	0	1	0	0	0		0	1	0	0	0		0	1	0	0	0		
17	Between Target and Maximum	3	1	1	0	2		3	1	1	0	2		1	1	1	0	1		
18	Maximum	2	3	1	2	2		2	3	1	2	2		2	3	1	3	2		
19		8	7	7	8	8		8	7	7	8	8		6	6	6	7	7		
20																				
21	Sum of Performance for all measures	803%	786%	550%	411%	593%		803%	786%	550%	461%	657%		433%	660%	432%	521%	413%		
22																				
23	Average Performance	100.3%	112.3%	78.6%	51.3%	74.1%	83.3%	100.3%	112.3%	78.6%	57.6%	82.1%	86.2%	72.2%	110.0%	72.0%	74.5%	58.9%	77.5%	
24																				
25	**DTE LLC**																			
26	Less than Threshold	5	5	3	1	6		5	5	3	1	6		5	5	3	1	6		
27	Between Threshold and Target	3	0	1	1	1		3	0	1	1	1		3	0	1	1	1		
28	Target	0	1	0	2	0		0	1	0	2	0		0	1	0	2	0		
29	Between Target and Maximum	4	6	4	3	1		4	6	4	3	1		3	5	3	2	0		
30	Maximum	5	5	0	1	0		5	5	0	1	0		4	5	0	1	0		
31		17	17	8	8	8		17	17	8	8	8		15	16	7	7	7		
32																				
33	Sum of Performance for all measures	1,631%	1,732%	533%	864%	222%		1,631%	1,732%	533%	924%	235%		1,207%	1,439%	404%	678%	88%		
34																				
35	Average Performance	96.0%	101.9%	66.6%	107.9%	27.8%	80.0%	96.0%	101.9%	66.6%	115.5%	29.4%	81.9%	80.5%	90.0%	57.7%	96.9%	12.6%	67.5%	
36																				
37	**Total**																			
38	Less than Threshold	12	9	9	7	16		12	9	9	7	16		12	9	9	6	16		
39	Between Threshold and Target	6	1	6	5	2		6	1	6	5	2		6	0	5	4	2		
40	Target	0	3	0	3	0		0	3	0	3	0		0	3	0	3	0		
41	Between Target and Maximum	11	13	8	6	4		11	13	8	6	4		6	11	6	4	1		
42	Maximum	9	12	1	4	3		9	12	1	4	3		8	12	1	5	3		
43		38	38	24	25	25		38	38	24	25	25		32	35	21	22	22		
44																				
45	Sum of Performance for all measures	3,558%	4,063%	1,566%	2,064%	1,204%		3,558%	4,063%	1,566%	2,231%	1,316%		2,414%	3,373%	1,202%	1,837%	739%		
46																				
47	Average Performance	93.6%	106.9%	65.2%	82.6%	48.1%	79.3%	93.6%	106.9%	65.2%	89.3%	52.7%	81.5%	75.4%	96.4%	57.2%	83.5%	33.6%	69.2%	76.7%
48																				
49																				
50	**Total**																			
51	Less than Threshold	12	9	9	7	16		12	9	9	7	16		12	9	9	6	16		
52	Between Threshold and Target	6	1	6	5	2		6	1	6	5	2		6	0	5	4	2		
53	Target	0	3	0	3	0		0	3	0	3	0		0	3	0	3	0		
54	Between Target and Maximum	11	13	8	6	4		11	13	8	6	4		6	11	6	4	1		
55	Maximum	9	12	1	4	3		9	12	1	4	3		8	12	1	5	3		
56	Total Measures	38	38	24	25	25		38	38	24	25	25		32	35	21	22	22		
57																				
58	Total Measures at Target and Above	20	28	9	13	7		20	28	9	13	7		14	26	7	12	4		
59																				
60	Percentage of Measures at Target and Above	52.6%	73.7%	37.5%	52.0%	28.0%	48.8%	52.6%	73.7%	37.5%	52.0%	28.0%	48.8%	43.8%	74.3%	33.3%	54.5%	18.2%	44.8%	47.4%

Michigan Public Service Commission
DTE Electric Company
Employee Savings Plan: Updated Staff

Case No.: U-21534
Exhibit No.: A-35
Schedule No: Z2
Witness: M.A. Fix
Page No.: 1 of 1

Line No.	(a) Description	(b) 2018	(c) 2019	(d) 2020	(e) 2021	(f) 2022	(g) 2023	(h) 2019	(i) 2020	(j) 2021	(k) 2022	(l) 2023	(m) 5 Yr. Avg.
								Percent Change					
1	Expense	25,610	27,471	28,478	29,079	29,699	30,188	7.27%	3.67%	2.11%	2.13%	1.65%	3.36%
2													
3	Capitalized	15,416	16,152	17,763	18,846	19,488	19,831	4.77%	9.97%	6.10%	3.41%	1.76%	5.20%
4													
5	Total	41,026	43,623	46,241	47,925	49,187	50,019	6.33%	6.00%	3.64%	2.63%	1.69%	4.06%
6													
7	O&M %	62.4%	63.0%	61.6%	60.7%	60.4%	60.4%						
8	Capitalized %	37.6%	37.0%	38.4%	39.3%	39.6%	39.6%						
9	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%						
10													
11	Actual Expense	27,722	29,730	30,838	31,164	31,509	30,722						
12	Benefits Transfer	(2,112)	(2,259)	(2,360)	(2,085)	(1,973)	(3,435)						
13	Other Benefits Correction					163							
14	Net of corrections	25,610	27,471	28,478	29,079	29,699	27,287						
15	Capitalization Adjustment (1)						2,901						
16	Adjusted Expense	25,610	27,471	28,478	29,079	29,699	30,188						
17													
18	Actual Capitalized	13,304	13,893	15,403	16,761	18,090	19,461						
19	Benefits Transfer	2,112	2,259	2,360	2,085	1,917	3,271						
20	Other Benefits Correction					(519)							
21	Net of corrections	15,416	16,152	17,763	18,846	19,488	22,732						
22	Capitalization Adjustment (1)						(2,901)						
23	Adjusted Capitalized	15,416	16,152	17,763	18,846	19,488	19,831						
24													
25	Actual Total	41,026	43,623	46,241	47,925	49,599	50,183						
26	Benefits Transfer	-	-	-	-	(56)	(164)						
27	Other Benefits Correction	-	-	-	-	(356)	-						
28	Net of corrections	41,026	43,623	46,241	47,925	49,187	50,019						
29	Capitalization Adjustment						-						
30	Adjusted Total	41,026	43,623	46,241	47,925	49,187	50,019						
31													
32	Recorded O&M %					60.4%	54.6%						
33	Recorded Capitalized %					39.6%	45.4%						
34	Total					100.0%	100.0%						
35													
36	(1) Sponsored by T.M. Uzenski												

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Michigan Public Service Commission
DTE Electric Company
Active Healthcare Expense: Updated Staff
($000's)

Case No.: U-21534
Exhibit No.: A-36
Schedule No: AA1
Witness: J. K. Hooper
Page No.: 1 of 1

Line No.	(a) Description	(b) 2018	(c) 2019	(d) 2020	(e) 2021	(f) 2022	(g) 2023	(h) 2019	(i) 2020	(j) 2021	(k) 2022	(l) 2023	(m) 5 Yr. Avg
								Percent Change					
1	Active Healthcare Expense	43,853	43,907	41,351	51,269	50,126	49,589						
2													
3	Active Healthcare Costs Capitalized	24,329	26,512	25,850	33,015	32,871	32,520						
4													
5	Total Active Healthcare Costs	68,182	70,419	67,201	84,284	82,997	82,109						
6	Employees	6,795	6,896	6,848	6,751	6,697	6,547						
7	Cost/Employee	10.034	10.212	9.813	12.485	12.393	12.541	1.77%	(3.90%)	27.22%	(0.73%)	1.20%	5.11%
8													
9	O&M %	64.3%	62.4%	61.5%	60.8%	60.4%	60.4%						
10	Capitalized %	35.7%	37.6%	38.5%	39.2%	39.6%	39.6%						
11	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%						
12													
13	Actual Expense	43,853	43,907	41,351	51,269	50,126	43,241						
14	Capitalization Adjustment						5,663						
15	One-Time Reduction: PBM Credit (1)						685						
16	Adjusted Expense	43,853	43,907	41,351	51,269	50,126	49,589						
17													
18	Actual Capitalized	24,329	26,512	25,850	33,015	32,871	37,734						
19	Capitalization Adjustment (1)						(5,663)						
20	One-Time Reduction: PBM Credit						449						
21	Adjusted Capitalized	24,329	26,512	25,850	33,015	32,871	32,520						
22													
23	Actual Total	68,182	70,419	67,201	84,284	82,997	80,975						
24	Capitalization Adjustment						-						
25	One-Time Reduction: PBM Credit						1,134						
26	Adjusted Total	68,182	70,419	67,201	84,284	82,997	82,109						
27													
28	Recorded O&M %					60.4%	53.4%						
29	Recorded Capitalized %					39.6%	46.6%						
30	Total					100.0%	100.0%						
31													
32	(1) Sponsored by T.M. Uzenski												

Michigan Public Service Commission
DTE Electric Company
Active Healthcare Costs: 2017- 2023
($000's)

Case No.: U-21534
Exhibit No.: A-36
Schedule No: AA2
Witness: J. K. Hooper
Page No.: 1 of 1

Line No.	(a) Description	(b) 2017	(c) 2018	(d) 2019	(e) 2020	(f) 2021	(g) 2022	(h) 2023 (1)	(i) Percent Difference
1	Active Healthcare Costs	69,193	68,182	70,419	67,201	84,284	82,997	82,109	
2									
3	Employees	6,582	6,795	6,896	6,848	6,751	6,697	6,547	
4									
5	Cost/Employee	10,512	10,034	10,212	9,813	12,485	12,393	12,541	
6									
7	Annual Percentage Change		(4.55%)	1.77%	(3.90%)	27.22%	(0.73%)	1.20%	
8									
9	Five-Year Average of Annual Percent Change						3.96%	5.11%	29.0%
10									
11	Compound Annual Growth Rate						3.35%	4.56%	36.3%
12									
13									
14	(1) Adjusted for one-time PBM credit								

Michigan Public Service Commission
DTE Electric Company
General Benefits Expense: Updated Staff
($000's)

Case No.: U-21534
Exhibit No.: A-36
Schedule No: AA3
Witness: J. K. Hooper
Page No.: 1 of 1

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)
Line								**Percent Change**					
No.	**Description**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2019**	**2020**	**2021**	**2022**	**2023**	**5 Yr. Avg**
1	General Benefits Expense	2,447	2,411	2,360	2,285	2,198	2,262	(1.47%)	(2.12%)	(3.19%)	(3.80%)	2.93%	(1.53%)
2													
3	General Benefits Capitalized	1,151	1,187	1,181	1,213	1,207	1,242	3.15%	(0.57%)	2.73%	(0.50%)	2.93%	1.55%
4													
5	Total General Benefits	3,598	3,598	3,541	3,498	3,405	3,505	0.01%	(1.60%)	(1.21%)	(2.65%)	2.93%	(0.51%)
6													
7													
8	O&M %	68.0%	67.0%	66.7%	65.3%	64.6%	64.6%						
9	Capitalized %	32.0%	33.0%	33.3%	34.7%	35.4%	35.4%						
10	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%						
11													
12	Actual Expense	2,447	2,411	2,360	2,285	2,198	1,305						
13	Capitalization Adjustment (1)						131						
14	One-Time Reductions:												
15	Tuition Reimbursement						406						
16	Employee Service Awards						420						
17	Total One-Time Adjustments	-	-	-	-	-	826						
18	Adjusted Expense	2,447	2,411	2,360	2,285	2,198	2,262						
19													
20	Actual Capitalized	1,151	1,187	1,181	1,213	1,207	920						
21	Capitalization Adjustment (1)						(131)						
22	One-Time Reductions:												
23	Tuition Reimbursement						223						
24	Employee Service Awards						231						
25	Total One-Time Adjustments	-	-	-	-	-	454						
26	Adjusted Capitalized	1,151	1,187	1,181	1,213	1,207	1,242						
27													
28	Actual Total	3,598	3,598	3,541	3,498	3,405	2,225						
29	Capitalization Adjustment						-						
30	One-Time Reductions:												
31	Tuition Reimbursement						629						
32	Employee Service Awards						651						
33	Total One-Time Adjustments	-	-	-	-	-	1,280						
34	Adjusted Total	3,598	3,598	3,541	3,498	3,405	3,505						
35													
36	Recorded O&M %					64.6%	58.7%						
37	Recorded Capitalized %					35.4%	41.3%						
38	Total					100.0%	100.0%						
39													
40	(1) Sponsored by T.M. Uzenski												

Michigan Public Service Commission
DTE Electric Company
Benefit Administration Fees Expense: Updated Staff
($000's)

Case No.: U-21534
Exhibit No.: A-36
Schedule No: AA4
Witness: J. K. Hooper
Page No.: 1 of 1

Line No.	(a) Description	(b) 2018	(c) 2019	(d) 2020	(e) 2021	(f) 2022	(g) 2023	(h) 2019	(i) 2020	(j) 2021	(k) 2022	(l) 2023	(m) 5 Yr. Avg.
								Percent Change					
1	Benefit Administration Fee Expense	7,451	6,193	5,448	6,442	6,697	5,788	(16.89%)	(12.02%)	18.25%	3.95%	(13.57%)	(4.06%)
2													
3	Benefits Administration Fee Capitalized	4,745	3,730	3,538	4,296	4,454	3,850	(21.39%)	(5.15%)	21.44%	3.67%	(13.57%)	(3.00%)
4													
5	Total Benefits Administration Fees	12,196	9,923	8,986	10,739	11,151	9,638	(18.64%)	(9.44%)	19.50%	3.84%	(13.57%)	(3.66%)
6													
7	O&M %	61.1%	62.4%	60.6%	60.0%	60.1%	60.1%						
8	Capitalized %	38.9%	37.6%	39.4%	40.0%	39.9%	39.9%						
9	Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%						
10													
11	Actual Expense	7,451	6,193	5,448	6,442	6,697	5,280						
12	Capitalization Adjustment (1)						508						
13	Adjusted Expense	7,451	6,193	5,448	6,442	6,697	5,788						
14													
15	Actual Capitalized	4,745	3,730	3,538	4,296	4,454	4,358						
16	Capitalization Adjustment (1)						(508)						
17	Adjusted Capitalized	4,745	3,730	3,538	4,296	4,454	3,850						
18													
19	Actual Total	12,196	9,923	8,986	10,739	11,151	9,638						
20	Capitalization Adjustment						-						
21	Adjusted Total	12,196	9,923	8,986	10,739	11,151	9,638						
22													
23	Recorded O&M %					60.1%	54.8%						
24	Recorded Capitalized %					39.9%	45.2%						
25	Total					100.0%	100.0%						
26													
27	(1) Sponsored by T.M. Uzenski												

Michigan Public Service Commission
DTE Electric Company
Benefits Adjustments: Summary
($000's)

Case No.: U-21534
Exhibit No.: A-36
Schedule No: AA5
Witness: J. K. Hooper
Page No.: 1 of 1

Line No.	(a) Description	(b) Source	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
				Company Updates						
			Adjusted	Escalation		Projected		Adjustment	Attorney	Adjustment to Attorney
			2023	2024	2025	2025	Staff	to Staff	General	General
1	Active Healthcare Expense	Ex. A-36, Sch AA1	49,589	2,533	2,662	54,784	53,918	865	52,947	1,837
2	Escalation Percent	Ex. A-36, Sch AA1		5.11%	5.11%					
3										
4	General Benefits Expense	Ex. A-36, Sch AA3	2,262	(11)	(11)	2,239	1,051	1,188		
5	Escalation Percent	Ex. A-36, Sch AA3		(0.51%)	(0.51%)					
6										
7	Benefit Administration Fees Expense	Ex. A-36, Sch AA4	5,788	(212)	(204)	5,372	4,708	664		
8	Escalation Percent	Ex. A-36, Sch AA4		(3.66%)	(3.66%)					
9										
10	Employee Savings Plan Expense (1)	Ex. A-35, Sch Z2	30,187	1,225	1,275	32,688	29,547	3,141		
11	Escalation Percent (1)	Ex. A-35, Sch Z2		4.06%	4.06%					
12										
13										
14	(1) Sponsored by M.A. Fix									

Michigan Public Service Commission
DTE Electric Company
Shared Asset Adjustment and O&M for Proposed IT Project Disallowances
($000)

Case No: U-21534
Exhibit: A-37
Schedule: BB1
Witness: T.M. Uzenski
Page: 1 of 1

Line No.	(a) Description	(b) 12 mo. Ended 12/31/2022	(c) 12 mo. Ended 12/31/2023	(d) 12 mo. Ended 12/31/2024	(e) 12 mo. Ended 12/31/2025	(f) Reduction to Test Period Shared Asset Revenue	(g) Reduction to Proposed O&M Disallowance
		Proposed Disallowances to Shared Asset Projects					
	Corporate Support IT						
1	EOL Replacements	500,000	-	-	-	38,675	-
2	Corporate Applications	-	430,600	2,213,200	2,475,000	128,023	128,306
3	Plant and Field	-	688,800	1,093,400	1,764,200	102,149	89,550
4	Information Technology for IT	-	249,000	3,324,400	339,000	159,796	21,984
5	Information Protection Security	-	395,800	1,326,400	1,121,600	87,981	34,205
6	Infrastructure Operations	-	4,618,800	3,523,500	7,122,200	525,217	202,556
7	Enterprise Data Analytics	-	400,000	312,200	306,000	45,781	18,352
8	**Subtotal Corporate Support IT**	**500,000**	**6,783,000**	**11,793,100**	**13,128,000**	**1,087,623**	**494,952**
	Customer Service IT						
9	Customer Service IT	-	2,467,200	3,604,000	3,078,800	373,313	135,587
10	**Subtotal Customer Service IT**	**-**	**2,467,200**	**3,604,000**	**3,078,800**	**373,313**	**135,587**
	Facilities						
11	Renovation - WCB 1 Conference Rooms	-	4,810,319	-	-	161,157	-
12	Office space updates - Audio/Video	-	-	4,000,000	-	67,963	-
13	Office space updates - WCB	-	1,454,987	1,000,000	-	65,736	-
14	Office space updates- GO	-	-	1,500,000	-	25,486	-
15	Office space updates - SB	-	-	1,000,000	-	16,991	-
16	Office space updates - Plaza	-	-	500,000	-	8,495	-
17	**Subtotal Facilities**	**-**	**6,265,306**	**8,000,000**	**-**	**345,828**	**-**
18	**Total Reduction to Shared Asset Revenue/Proposed O&M Disallowance**	**500,000**	**15,515,506**	**23,397,100**	**16,206,800**	**1,806,764**	**630,539**

Note: The shared asset calculation is based on calendar year spend on a one year lag.

COPY of STDE-4.3d

Case No.: U-21534
Exhibit: A-37
Schedule: BB2
Witness: T.M. Uzenski

Projected Vehicle and Equipment Purchases (1/1/25 to 12/31/2025)

Make	Model	Forecasted Cap Ex
ALTEC	AD108	90,001.00
ALTEC	AD108	90,003.00
ALTEC	AD108	90,004.00
AIS	CUSTOM	90,002.00
FORD	E350	85,000.00
FORD	EDGE	50,000.00
FORD	F150	65,000.00
FORD	F150	65,000.00
FORD	F150	65,000.00
FORD	F150	65,000.00
FORD	F150	65,000.00
FORD	F150	65,000.00
FORD	F150	65,000.00
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FORD	FOCUS	50,000.00	
FORD	FOCUS	50,000.00	
GENIE	GS2646	50,000.00	
POLARIS	RGR-12	35,000.00	
		$ 42,595,010.00	**Total**

Michigan Public Service Commission
DTE Electric Company
Incentive Plan Metrics from Case No. U-20836

Case No: U-21534
Exhibit: A-37
Schedule: BB3
Witness: T. M. Uzenski
Page: 1 of 1

Copy of Exhibit from Case No. U-20836

Michigan Public Service Commission
DTE Electric Company
2021 Annual Incentive Plan and Rewarding Employees Plan Metrics:
DTE Energy Corporate Services LLC

Case No.: U-20836
Exhibit: A-21
Schedule: K4
Witness: M. S. Cooper
Page: 1 of 1

Line No.	(a) Category	(b) Measure	(c) Weight AIP	(d) Weight REP	(e) Threshold	(f) Target	(g) Maximum
1	Financial Performance						
2		DTE Energy Operating Earnings Per Share	20.00%	20.00%	$6.17	$6.47	$6.77
3							
4		DTE Energy Cash From Operations	20.00%	20.00%	$2,736	$3,040	$3,344
5							
6	Total Financial Measures		40.00%	40.00%			
7							
8	Customer Satisfaction						
9		Net Promoter Score	12.00%	12.00%	43%	45%	47%
10							
11		MPSC Customer Complaints	8.00%	8.00%	1,967	1,905	1,760
12							
13			20.00%	20.00%			
14	Safety & Engagement						
15		DTE Energy Employee Engagement-Gallup	5.00%		4.18	4.32	4.43
16							
17		DTE Energy OSHA Recordable Incident Rate	5.00%	7.50%	0.79	0.64	0.46
18							
19		DTE Energy OSHA DART Rate	5.00%	7.50%	0.39	0.32	0.20
20							
21			15.00%	15.00%			
22	Operating Excellence:Electric						
23		Fossil Power Plant Reliability (ROF)	6.25%	6.25%	7.8%	6.8%	5.8%
24							
25		SAIDI Excluding Major Event Days	6.25%	6.25%	149	137	123
26							
27		Nuclear On-Line Unit Capacity Factor (UCF)	12.50%	12.50%	97.6%	98.5%	98.8%
28							
29			25.00%	25.00%			
30							
31	Total Operating Measures		60.00%	60.00%			
32							
33	Total		100.00%	100.00%			

Michigan Public Service Commission
DTE Electric Company
System Demand Tests

Case No.: U-21534
Exhibit: A-38
Schedule: CC1
Witness: H. Maroun

DTE Electric Company
FERC Tests for Coincident Peak Allocation

Line	(a) Year	(b) CP	(c) Peak	(d) Peak as % Single High	(e) Ave Off Peak	(f) Off Peak as % of Single High (e)/(b) 1CP	TEST 1 (g) Difference (d) - (f)	TEST 2 (h) Lowest Peak as % of High	TEST 3 (i) Off-Peak Month Higher than Peak?	TEST 4 (j) Average of 12 Peaks as % of High
1	2018	1CP	11,418					55%		
2		3 CP	11,192	98%	7,917	69%	29%		No	
3		4 CP	11,248	99%	7,479	66%	33%		No	
4		12 CP	8,735							77%
5	2019	1CP	10,630					58%		
6		3 CP	10,207	96%	7,261	68%	28%		No	
7		4 CP	9,995	94%	6,998	66%	28%		No	
8		12 CP	7,997							75%
9	2020	1CP	11,005					45%		
10		3 CP	10,593	96%	6,798	62%	34%		No	
11		4 CP	10,165	92%	6,538	59%	33%		No	
12		12 CP	7,747							70%
13	2021	1CP	10,992					55%		
14		3 CP	10,721	98%	7,057	64%	33%		No	
15		4 CP	10,233	93%	6,844	62%	31%		No	
16		12 CP	7,973							73%
17	2022	1CP	10,933					54%		
18		3 CP	10,858	99%	6,977	64%	35%		No	
19		4 CP	10,305	94%	6,768	62%	32%		No	
20		12 CP	7,947							73%
21	2023	1CP	10,340					59%		
22		3 CP	9,417	91%	7,173	66%	25%		No	
23		4 CP	9,648	93%	6,777	62%	31%		No	
24		12 CP	7,734							75%
25	Average	3 CP					31%			
26	Average	4 CP					31%			
27	Average							54%	None	74%
28	Precedent for 12 CP						18 to 19%	70% range	Yes	Min 81%
29	Precedent for 3 or 4 CP						16 to 31%	below 60%	No	

Michigan Public Service Commission
DTE Electric Company
System Demand Tests

Case No.: U-21534
Exhibit: A-38
Schedule: CC1
Witness: H. Maroun
Page: 2 of 2

DTE Electric Company Monthly Peaks (MW)
Annual Report to the MPSC (Form P-521, page 401b, column d)

Line		2018	2019	2020	2021	2022	2023
1	January	7,358	7,514	6,664	6,537	6,825	6,402
2	February	6,956	6,910	6,621	6,679	6,569	6,560
3	March	6,609	6,934	6,155	6,265	6,225	6,124
4	April	6,322	6,153	4,919	6,001	6,032	6,288
5	May	10,361	6,804	8,968	8,770	9,681	8,477
6	June	11,287	9,879	10,060	10,321	10,933	9,029
7	July	11,317	10,630	11,005	10,850	10,839	9,907
8	August	10,971	10,112	10,715	10,992	10,802	9,315
9	September	11,418	9,359	8,878	8,768	8,647	10,340
10	October	8,277	7,890	5,897	7,517	5,921	7,634
11	November	6,954	6,731	6,446	6,329	6,289	6,399
12	December	6,995	7,050	6,636	6,651	6,604	6,334
13	12 Max	11,418	10,630	11,005	10,992	10,933	10,340
14	3 CP	11,192	10,207	10,593	10,721	10,858	9,417
15	4 CP	11,248	9,995	10,165	10,233	10,305	9,648
16	12 CP	8,735	7,997	7,747	7,973	7,947	7,734
17	3 Off Peak	7,917	7,261	6,798	7,057	6,977	7,173
18	4 Off Peak	7,479	6,998	6,538	6,844	6,768	6,777
19	12 Min	6,322	6,153	4,919	6,001	5,921	6,124
20	4 Min	10,971	9,359	8,878	8,768	8,647	9,029
21	3 Min	10,971	9,879	10,060	10,321	10,802	9,029
22	Off-Peak max	10,361	7,890	8,968	8,770	9,681	8,477

Michigan Public Service Commission
DTE Electric Company
SRM Capacity Charge Comparison
(thousands of dollars)

Case No. U-21534
Exhibit: A-38
Schedule: CC2
Witness: H. J. Maroun
Page: 1 of 1

		(a)	(b)
		Total Electric	
		As-Filed Revised	Rebuttal
	CAPACITY COSTS DETERMINATION		
1	Net Production Costs Rev. Req. (Exh A-16 Sch F1.1 Line 31)	$ 3,213,177	$ 3,213,177
2	Less Fuel (Exh A-16 Sch F1.1 Line 6)	(914,888)	(914,888)
3	Less MERC Rev Req (Exh A-16 Sch F1.5 Page 6 Line 9)	(6,463)	(6,463)
4	Less MISO Energy in PP (Exh A-13 Sch C4 Lines 21-22)	(40,376)	(40,376)
5	Less Other Energy in PP (WP A16 F1 Page 29 Line 8)	(260,787)	-
6	Less Variable O&M (Exh A-16 Sch F1.5 Page 5 Line 8)	(33,569)	(33,569)
7	Subtotal	$ 1,957,094	$ 2,217,881
8			
9	Proj 2025 Energy Sales Rev Net of Fuel (Exh A-26 Sch P3 Line 23)	(983,347)	(1,244,134)
10			
11	Capacity Revenue Requirement (Line 7 + Line 9)	$ 973,747	$ 973,747
12			
13	SRM Capacity Charge Demand (DTE 2022 10-K, Page 9 / net gen capacity 11,717 MW + long-term contracts 560 MW)	12,277 MW	12,277 MW
14			
15	SRM Capacity Charge per MW-Year (Line 11 / Line 13 x 1,000)	79,315	79,315
16			
17	SRM Capacity Charge per MW-Day (Line 15 / 365)	217.30	217.30
18			
19	**Allocator**		
20	Sch 200B 4 CP Excl R10 (Alloc. 251)	100.0000	100.0000
21			
22	**Revenue Requirement**		
23	Capacity Revenue Requirement (Line 11 * Line 20/100)	$ 973,747	$ 973,747
24	Non-Capacity Revenue Requirement (Line 25 less Line 23)	2,239,430	2,239,430
25	Total Production Revenue Requirement (Exh A-16 Sch F1.1 Line 31)	$ 3,213,177	$ 3,213,177

Comparison of ROE Witness Samples

		Villadsen [A]	Ufolla [B]	Coppola [C]	Walters [D]	Bandyk [E]
Sample Companies						
ALLETE	[1]	1				1
Alliant Energy	[2]	1	1	1	1	
Ameren Corp.	[3]	1	1	1	1	1
American Electric Power	[4]	1	1		1	1
Avangrid Inc	[5]		1			
Avista Corp.	[6]	1		1	1	1
Black Hills	[7]	1		1	1	1
Centerpoint Energy	[8]	1	1		1	1
CMS Energy Corp.	[9]	1	1	1	1	1
Consolidated Edison Inc	[10]		1	1		
Dominion Energy	[11]		1			
Duke Energy	[12]	1			1	1
Edison Int'l	[13]	1			1	1
Entergy Corp.	[14]	1	1		1	1
Evergy, Inc.	[15]	1	1		1	1
Eversource Energy	[16]		1			
Exelon Corp.	[17]	1			1	1
IDACORP, Inc.	[18]	1		1	1	1
MGE Energy	[19]	1			1	1
NextEra Energy, Inc.	[20]	1			1	1
NorthWestern Corp	[21]	1		1	1	1
OGE Energy	[22]	1	1		1	1
Otter Tail Corp.	[23]	1			1	1
Pinnacle West Capital	[24]	1	1		1	1
PNM Resources	[25]			1		
PPL Corporation	[26]		1			
Public Serv. Enterprise	[27]	1	1	1	1	1
Sempra Energy	[28]	1	1		1	1
Southern Co.	[29]	1			1	1
WEC Energy Group	[30]	1	1		1	1
Xcel Energy Inc.	[31]	1	1		1	1
Count		25	18	10	24	24

Sources and Notes:
[B]: From Ufolla workpaper, 21534 Schedule D V5 Ufolla, tab Proxy Group.
[C]: From Coppola Workpaper, Exhibit AG-26 to 34 Cost of Capital U-21534, tab Peer Group.
[D]: From Walters Workpaper, U-21534 ABATE's Direct Testimony of Christopher Walters, Exhibit AB-5.
[E]: From Bandyk Workpaper, Bandyk workpapers U-21534, tab Hamada Beta.

Walters CAPM

		Kroll Normalized MRP [1]	Risk Premium Derived MRP [2]	Average FERC MRP S&P 500 DCF Derived MRP [3]	Average
Current Beta					
Risk Free Rate	[A]	4.67%	4.30%	4.30%	
Market Risk Premium	[B]	5.00%	7.30%	8.45%	
Beta	[C]	0.94	0.94	0.94	
CAPM	[D]	9.38%	11.19%	12.27%	10.95%
Current S&P Global Market Intelligence Data					
Risk Free Rate	[E]	4.67%	4.30%	4.30%	
Market Risk Premium	[F]	5.00%	7.30%	8.45%	
Beta	[G]	0.86	0.86	0.86	
CAPM	[H]	8.99%	10.61%	11.60%	10.40%
Average	[I]	9.19%	10.90%	11.94%	10.67%
Median	[J]	9.19%	10.90%	11.94%	10.90%

Sources and Notes: From Walters workpaper.
[I]: ([D]+[H])/2.
[J]: The median of [D] and [H].

Walters DCF

		Proxy Low Value [1]	Proxy High Value [2]	Average [3]
Model				
Constant Growth DCF Model (Consensus Analyst Growth Rate)	[A]	7.46%	12.49%	10.43%
Multi-Stage Growth DCF Model	[B]	7.07%	10.24%	8.83%
Average	[C]	7.27%	11.37%	9.63%
Median	[D]	7.27%	11.37%	9.63%

Sources and Notes: From Walters workpaper.

Walters Summary

		Average [1]	Median [2]
Method			
CAPM	[A]	10.67%	10.90%
DCF	[B]	9.32%	9.32%
Risk Premium	[C]	9.95%	10.27%
Average	[D]	9.98%	10.16%
Median	[E]	9.95%	10.27%

Sources and Notes: From Walters workpaper.

Coppola DCF

		DCF ROE for Proxy Company [1]
Company		
Alliant Energy	[A]	N/M
Ameren	[B]	9.71%
Avista	[C]	11.04%
Black Hills	[D]	8.73%
Consolidated Edison	[E]	9.35%
IDACORP	[F]	8.40%
Northwestern	[G]	10.20%
PNM Resources	[H]	8.38%
Public Service Enterprise Group	[I]	9.65%
Average	[J]	9.43%
Median	[K]	9.50%

Sources and Notes:
From Coppola workpaper. Eliminating CMS Energy as an outlier as its estimated ROE is less than the BBB utility bond yield.

Coppola Summary

		Weight [1]	Cost of Equity [2]
Method			
DCF	[A]	33.33%	9.43%
CAPM	[B]	33.33%	10.57%
Risk Premium	[C]	33.33%	10.10%
Calculated Cost of Common Equity	[D]		10.04%
Rounding	[E]		0.05%
Cost of Common Equity for Rate Case Purpose	[F]		10.09%

Sources and Notes: From Coppola workpaper. Assigning equal weightings to the three methods. Eliminating CMS Energy as an outlier in DCF method.

Ufolla Summary

		Proxy Low Value [1]	Proxy High Value [2]	Proxy Average [3]
Table 1				
CAPM	[A]	9.29%	11.67%	10.23%
DCF	[B]	4.32%	16.32%	9.78%
Risk Premium	[C]	8.63%	10.05%	9.34%
Total	[D]	7.41%	12.68%	9.79%
Midpoint of low and high	[E]	10.05%		
Median	[F]	10.05%		
Table 2				
CAPM (using 4% as risk free rate)	[G]	9.44%	11.82%	10.38%
DCF	[H]	8.10%	11.03%	9.76%
Risk Premium	[I]	8.63%	10.05%	9.34%
Total	[J]	8.72%	10.97%	9.83%
Midpoint of low and high	[K]	9.85%		
Median	[L]	9.85%		

Sources and Notes: From Ufolla workpaper. Adjusting risk free rate as 4% in CAPM methodology. Excluding Dominion Energy in Table 2 as it is an outlier in DCF methodology. OGE Energy growth is calculated as the sample average, excluding negative earnings growth, in DCF methodology.

DTE Energy Capital Structure

Market Capitalization ($ Millions)	[A]	$	24,863
Long Term Debt ($ Millions)	[B]	$	19,256
Market Equity Percentage	[C]		56.35%

Sources and Notes:
[A]: From S&P Cap IQ Pro, as of 8/7/2024.
[B]: From S&P Cap IQ Pro, as of FQ2 2024.
[C]: [A]/([A]+[B]).

Bandyk DCF

		Overall After -Tax Cost of Capital [1]	Debt Percentage (%) [2]	Representative Cost of BBB Rated Utility Debt [3]	DTE Electric's Representative Income Tax Rate [4]	Market Equity Percentage (%) [5]	Estimated Cost of Equity [6]
Multi Stage							
Market equity percentage at 56.35%	[A]	6.80%	43.65%	5.70%	25.70%	56.35%	8.79%
Market equity percentage at 50%	[B]	6.80%	50.00%	5.70%	25.70%	50.00%	9.36%
Single Stage							
Market equity percentage at 56.35%		7.72%	43.65%	5.67%	25.74%	56.35%	10.43%
Market equity percentage at 50%		7.72%	50.00%	5.67%	25.74%	50.00%	11.22%

Sources and Notes: From Bandyk workpapers. Market equity percentage of 56.35% is calculated using DTE's market capitalization and long term debt value as of 8/7/2024.

Change of ROE Recommendation Since U-21297

Year		Villadsen [A]	Ufolla [B]	Coppola [C]	Walters [D]
2023	[1]	10.25%	9.80%	9.80%	9.55%
2024	[2]	10.50%	9.90%	9.85%	9.60%

Sources and Notes:
[B][1]: From Direct Testimony of Ufolla, June 13, 2023, p. 4.
[B][2]: From Direct Testimony of Ufolla, July 26, 2024, p. 6.
[C][1]: From Direct Testimony of Coppola, June 13, 2023, p. 11.
[C][2]: From Direct Testimony of Coppola, July 26, 2024, p. 10.
[D][1]: From Direct Testimony of Walters, June 13, 2023, p. 3.
[D][2]: From Direct Testimony of Walters, July 26, 2024, p. 10.

Impact of Financial Leverage

		As-Filed				Financial Leverage at 50% Equity											
		Risk-free rate [1]	Average Beta [2]	Average MRP [3]	Original CAPM ROE [4]	Beta [5]	Debt Beta [6]	Villadsen Sample Average Common Equity to Market Value Ratio [7]	Villadsen Sample Average Preferred Equity to Market Value Ratio [8]	Villadsen Sample Average Debt to Market Value Ratio [9]	Income Tax Rate [10]	Asset Beta: With Taxes [11]	DTE Electric's Representative Regulatory % Debt [12]	DTE Electric's Representative Regulatory % Equity [13]	Estimated Equity Beta (With Taxes) [14]	ROE (relevered at 50% with taxes) [15]	Difference (with taxes) [16]
Ufolla	[A]	3.85%	0.94	6.80%	10.23%	0.94	0.1	58%	0%	42%	25.7%	0.65	50%	50%	1.05	10.99%	0.76%
Coppola	[B]	4.05%	0.91	7.17%	10.57%	0.91	0.1	58%	0%	42%	25.7%	0.63	50%	50%	1.02	11.35%	0.77%
Walters	[C]	4.42%	0.90	6.92%	10.67%	0.90	0.1	58%	0%	42%	25.7%	0.62	50%	50%	1.01	11.42%	0.74%

Sources and Notes:
[1] - [4]: From Ufolla, Coppola and Walters workpapers. Eliminating Walters historical beta.
[5]: From Ufolla, Coppola and Walters workpapers.
[6]: Assuming debt beta is 0.1.
[7] - [9]: Taking average from Villadsen Direct sample.
[10]: Assuming DTE Electric's tax rate of 25.7%.
[11]: [5]*[7]/([7]+[8]+[9]*(1-[10]))+[6]*([8]+[9]*(1-[10]))/([7]+[8]+[9]*(1-[10])).
[12]: DTE Electric's representative regulatory debt percentage.
[13]: DTE Electric's representative regulatory equity percentage.
[14]: [11]+[12]*(1-[10])/[13]*([11]-[6]).
[15]: [1]+[3]*[14].
[16]: [15]-[4].

Rate Case History (Past Rate Cases)

List: None
Company List: All
States: All
Years: 2024
Service Type: Electric

State	Company	Parent Company Ticker	Docket	Rate Case Service Type	Case Type	Increase Authorized	
						Date	Return on Equity (%)
Arkansas	Oklahoma Gas and Electric Co.	OGE	D-18-046-FR (2023 update)	Electric	Vertically Integrated	3/7/2024	NA
Arizona	Arizona Public Service Co.	PNW	D-E-01345A-22-0144	Electric	Vertically Integrated	3/5/2024	9.55
Arizona	UNS Electric Inc.	FTS	D-E-04204A-22-0251	Electric	Vertically Integrated	1/30/2024	9.75
Indiana	AES Indiana	AES	Ca-45911	Electric	Vertically Integrated	4/17/2024	9.90
Indiana	Indiana Michigan	AEP	Ca-45933	Electric	Vertically Integrated	5/8/2024	9.85
Kentucky	Kentucky Power Co.	AEP	C-2023-00159	Electric	Vertically Integrated	1/19/2024	9.75
Louisiana	Cleco Power LLC		D-U-36923	Electric	Vertically Integrated	6/19/2024	NA
Michigan	Consumers Energy Co.	CMS	C-U-21389	Electric	Vertically Integrated	3/1/2024	9.90
Michigan	Indiana Michigan Power Co.	AEP	C-U-21461	Electric	Vertically Integrated	7/2/2024	9.86
New Mexico	Public Service Co. of NM	TXNM	C-22-00270-UT	Electric	Vertically Integrated	1/3/2024	9.26
South Carolina	Dominion Energy South Carolina	D	D-2024-34-E	Electric	Vertically Integrated	8/8/2024	9.94
South Carolina	Duke Energy Carolinas LLC	DUK	D-2023-388-E	Electric	Vertically Integrated	6/20/2024	9.94
South Dakota	MDU Resources Group	MDU	D-EL23-020	Electric	Vertically Integrated	8/13/2024	NA
South Dakota	NorthWestern Energy Group	NWE	D-EL23-016	Electric	Vertically Integrated	1/9/2024	NA
Texas	Southwestern Public Svc Co.	XEL	D-54634	Electric	Vertically Integrated	4/11/2024	NA
Virginia	Virginia Electric & Power Co.	D	C-PUR-2023-00101	Electric	Vertically Integrated	2/28/2024	9.70
Washington	PacifiCorp	BRK.A	D-UE-230172	Electric	Vertically Integrated	3/19/2024	NA
West Virginia	Monongahela Power Co.	FE	C-23-0460-E-42T	Electric	Vertically Integrated	3/26/2024	9.80

min w/ PNM	9.26
min w/o PNM	9.55
max	9.94

S&P Capital IQ PRO

Public Service Company of New Mexico: NM: C-22-00270-UT | Rate Case Profile

State Name	New Mexico
Commission Ranking	Below Average / 1
Company	Public Service Company of New Mexico
Action or Status	Final order isssued, non-fuel rate increase authorized
Docket	C-22-00270-UT

Case History

EVENT DATE	ACTION OR STATUS	RATE CHANGE
12/5/2022	Non-fuel electric rate increase requested by company	$63.8E
6/23/2023	Rate increase recommended by staff	$31.1E
12/8/2023	Rate increase recommended by hearing examiners	$6.1E
1/3/2024	Final order isssued, non-fuel rate increase authorized	$15.3E

Rate Case Summary

	PRESENT CASE: REQUESTED BY COMPANY 12/5/2022	PRESENT CASE: AUTHORIZED BY COMMISSION 1/3/2024	PREVIOUS CASE: AUTHORIZED BY COMMISSION 12/20/2017
Rate Change Amount ($)	63,765,315	15,300,000	10,271,699
Rate Change/ Revenue (%)	8.80	NA	1.50
Rate Case Test Year End Date	12/31/2024	12/31/2024	12/31/2018
Rate Base ($)	2,713,016,290	2,557,000,000	2,363,888,108
Rate Base Valuation Method	Average	Average	Average
Return on Equity (%)	10.25	9.26	9.58
Common Equity to Total Capital (%)	52.00	49.61	49.61
Rate of Return (%)	7.12	6.47	7.23

Footnotes

On 1/4/24, the PRC issued an errata order with immaterial corrections.
On 1/29/24, PSNM filed a motion for rehearing of various components of the commission's rate order. The commission effectively rejected the motion on 2/19/24.
On 3/14/24, PSNM filed a notice indicating that it is appealing the decision to the state supreme court.

REBUTTAL TESTIMONY OF DAVID W. ISAKSON
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recommendation that the Commission review the entire book from top to bottom should be rejected because it is duplicative and unspecific in its purpose.

Q. Can the Commission rely on GLREA witness Rafson's direct testimony or exhibits to support any recommendations in the instant case?

A. No. As shown throughout this rebuttal, GLREA witness Rafson's direct testimony should not be relied upon by the Commission in any of its decisions regarding either GLREA's, the Company's, or any other parties' proposals in the instant case. The fundamental misunderstanding of basic regulatory theory and practice means that any evidence, arguments, counter arguments, or recommendations made by GLREA witness Rafson should be dismissed by the Commission as unsupported.

MI-MAUI — Streetlighting; Contribution in aid of construction

Q. Does Staff agree that existing streetlighting customers subsidize new streetlighting customers?

A. No. MI-MAUI argues that "The subsidization occurs because those [new] costs are recovered in the rates that *all* customers pay, meaning new-light customers will end up paying less for the installation of the light due to the contributions of existing customers through their rates."[32] This is partially true. The true part is that if a customer takes new streetlighting service, they will pay the same base rates as other existing streetlighting customers after their contribution in aid of construction (CIAC) payment. Included in those same base rates is the added cost

[32] Direct Testimony of MI-MAUI witness Richard Bunch, p 6, lines 9-11.

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of serving those same new customers. The incorrect part is that the new customers will end up paying less for the installation than existing customers. Two customers paying the same rate will pay the same rate as long as they are both customers. A new customer does not get grandfathered into existing rates while the current customers are saddled with the cost to connect new customers. There are not two tiers of lighting rates – before and after – depending on when and where two similarly situated customers came to be in the Company's lighting service. Additionally, MI-MAUI hints at a possible reason for cost subsidy may be that growth in the lighting class is occurring in areas that are less densely populated but provided no evidence to show that it is the case.[33]

MI-MAUI incorrectly frames the addition of new streetlighting customers as if those customers will not pay the same rates as other customers on the same rate.

Q. Does MI-MAUI correctly calculate the supposed subsidy between new and existing lighting customers?

A. MI-MAUI calculates the subsidy between customers by taking the net present value of the directly allocated depreciation expense for Rate UUL per light per year and finds that in total a customer pays per $709 streetlight.[34] When the $100 CIAC payment is included, then a new customer pays a lifetime amount of $809 for each new installation. MI-MAUI then avers that the remainder of the cost of the new streetlight installation falls *to all other customers*. This is not so. New customers will pay the same rates as current customers, which means *they also*

[33] Direct Testimony of MI-MAUI witness Richard Bunch, p 6, lines 11-14.
[34] Direct Testimony of MI-MAUI witness Richard Bunch, p 6, line 20 through page 7, line 10.

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pay for the new streetlights added to the system. Current day customers were once new customers themselves, and yet they also paid the same rates as their contemporaries when they began their service under streetlighting tariffs.

Essentially, every customer was once a new customer that likely increased the cost to serve their customer class, which is why all similarly situated customers pay the same base rates. Also, utility equipment used to serve customers does not last forever and must eventually be upgraded or replaced. Should existing customers not be expected to pay rates that include the cost of replacing end-of-life equipment because the equipment serving their load still works? Yes, they should, if not only for the fact that those customers with currently serviceable equipment will, undoubtedly, one day require replacement equipment of their own.

MI-MAUI makes a similar complaint that existing customers will end up paying for a new luminaire that is not lighting up their street.[35] However, new customers could make the same complaint that their rates will pay for existing lights over someone else's street. All streetlighting customers are part of the same streetlighting class which take service in a similar fashion from the Company; therefore they all do, and should, pay the same base rates.

Q. Does MI-MAUI also mischaracterize the effect of adding new customers to the lighting class?

A. Yes. MI-MAUI claims that it is untrue that other customer benefit from having "more lights across which to apply the costs of providing service" because the

[35] Direct Testimony of MI-MAUI witness Richard Bunch, p 7, lines 7-10.

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population of taxpayers is not growing evenly across the Company's service territory.[36] First, the Company does not collect taxes or allocate service based on tax base. Second, regardless of where new customers enter the system, they will still contribute to their class's share of revenue requirement responsibility. Class billing determinants used to set lighting rates are unaffected by where, physically, that load growth occurs. Just because a new streetlight goes into service where population growth is happening does not mean the revenue from those lights will not offset the same class revenue requirement.

Q. If the Commission approves MI-MAUI's proposal to charge customers the full cost of new streetlighting installations, is any credit for the return on or of investment necessary?

A. No. If the customer is required to pay the full cost of its streetlight installation, then the asset should be considered fully depreciated and therefore never actually enter into the Company's plant-in-service. Therefore, these assets will never produce a return on or of the investment, so MI-MAUI's proposal should result in a credit of zero for these customers. However, MI-MAUI calculates that the credit should equal 9.4 years of tariff payments for any given light, which should be credited against the CIAC assessed to the customer.[37] This figure is based on the net present value of the return on and of existing average lighting rate base. This means that according to MI-MAUI's own calculations, the average new lighting customer will have fully paid for their lights via base rates in less than a decade. All this shows is that eventually those new lighting customers will fully entered

[36] Direct Testimony of MI-MAUI witness Richard Bunch, p 7, lines 11-20.
[37] Direct Testimony of MI-MAUI witness Richard Bunch, p 9, lines 8-12.

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into rate base alongside all their class peers, and no change to CIAC is actually necessary. It is unclear how setting CIAC to, essentially, 100% less 9.4 years of tariff payments will have MI-MAUI's desired effect of reducing new business expense, which MI-MAUI identifies as a driver of the lighting class's revenue deficiency.

Q. MI-MAUI recommends that the entirety of the new business expense for streetlighting should be disallowed because those costs should be borne only by new customers.[38] Does that fit with MI-MAUI's proposed CIAC credit?

A. No. It is unclear who would pay the expense related to 9.4 years of tariff payments that represent MI-MAUI's CIAC offset credit. Logically, the revenue shortfall created by issuing MI-MAUI's proposed CIAC credit would be paid for by all lighting customers. So new lighting customers would pay the full cost of installation, receive a credit worth 9.4 years of revenue, and then pay full rates that included the missing revenue from the credit. As Staff understands it, this process would not create MI-MAUI's intended effect of eliminating a subsidy between new and existing customers—which Staff disputes. This is because instead of the class paying the proposed $3.94M for new business in base rates, they would end up paying nearly, if not the same, amount in CIAC revenue offset costs. Furthermore, under MI-MAUI's lighting CIAC proposal, there is no reason for a new customer to take service under company-owned lighting provision in the first place, because the customer would have already paid off the entire cost of the new lighting installation.

[38] Direct Testimony of MI-MAUI witness Richard Bunch, p 11, lines 4-6.

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Q. Does MI-MAUI's proposed lighting CIAC policy contradict its position in the concurrent DTE electric general rate case?

A. Yes. In DTE's electric rate case U-21297, MI-MAUI advocated for the elimination of CIAC charges for the conversion to LED lights. In that case MI-MAUI argued that the basic reason to assess a CIAC fee was if the customer receives a special service or benefit then other customers should not have to pay for it through rates.[39]

Q. Please summarize Staff's analysis of MI-MAUI's streetlighting CIAC proposal.

A. Requiring new customers to first pay off their entire embedded costs of service minus a credit assuming they will be in service for 9.4 years and then entering those new customers into service paying the same rates as their peers is not only convoluted and incorrect, but also unnecessary. Using MI-MAUI's math and assumptions, it would be far simpler to inquire with the Company about the longevity of the average lighting customer, and if the average customer retains lighting service for longer than 9.4 years, we could assume that customers tend to eventually pay their way into the embedded costs of serving them and not require a CIAC payment at all. Again, that is all supposing one agrees with MI-MAUI's conversion of the net present value of depreciation expense and rate design revenue into years. As explained by MI-MAUI in the DTE electric case, CIAC should be used for special circumstances where the customer's attachment to the Company's system requires unique investment not otherwise required for other customers in its class, or otherwise socialized for all similarly situated customers.

[39] See MI-MAUI Initial Brief in MPSC Case No. U-21297, p 7. (link)

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Staff argues that new lighting customers are not distinct from existing customers because of their newness and should therefore not be charged more in CIAC than what was already approved by the Commission.

For these reasons the Commission should reject MI-MAUI's proposal to collect CIAC for the full cost of new streetlight installations minus a revenue credit.

Q. Is it fair to compare lighting installation and removal costs as context for MI-MAUI's lighting CIAC proposal?[40]

A. No. Lighting installation and lighting removal are not equal and opposite activities for cost recovery and thus should not necessarily be treated the same. The key difference between the two activities is that after installation the customer begins contributing revenue to the Company for its service, but after its removal the customer no longer pays base rates that would include the cost of the removal. Installation implies that the customer will join the lighting class and eventually cover the cost of their installation by continuing to pay base rates long enough and by absorbing the cost of subsequent new installations via new business expense. All customers were once new customers, after all. Removal implies that the customer is leaving the class, and thus there will be no future opportunity for them to pay for the cost of said removal.

[40] Direct Testimony of MI-MAUI witness Richard Bunch, p 10, lines 1-21.

MPSC Case No: U-21534

Requester: MAUI

Question No.: MAUIDE-4.28b

Respondent: R. Bellini

Page: 1 of 1

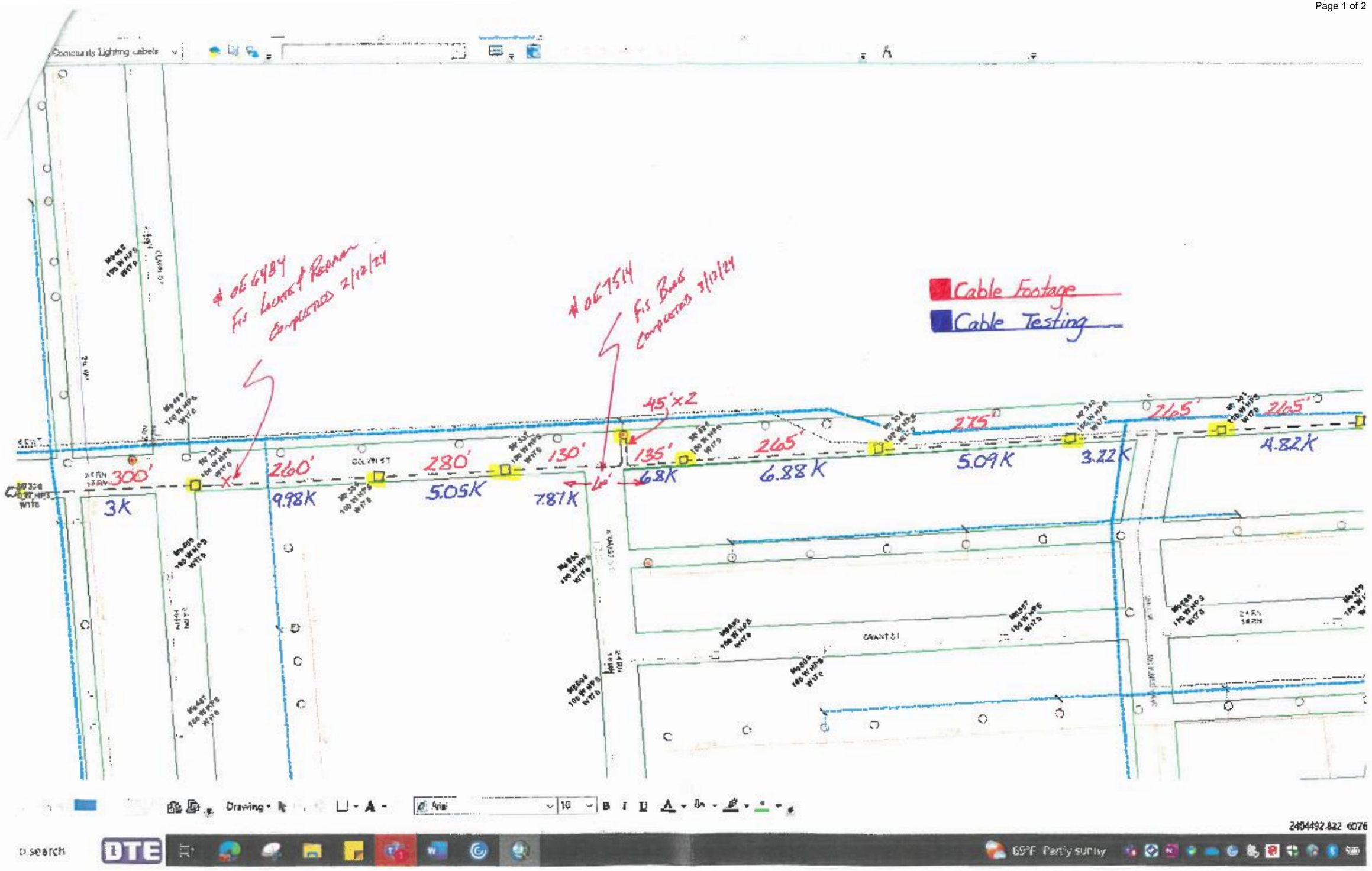
Question: Refer to the table titled "O&M 2024 Rate Case Test Period" in witness Bellini's Lighting Rate Model workpaper, Assumptions worksheet, rows 21-33.

b. Please provide O&M actual cost data for calendar years 2019-2023 inclusive, in the same format as the referenced table.

Answer: Please see below table for actual cost data in the format requested:

	Year				
O&M Category	**2019**	**2020**	**2021**	**2022**	**2023**
Group Relamping	$ -	$ 384,929	$ 175,601	$ 48,551	$ -
Streetlight Inspection	$ 108,068	$ 123,004	$ 121,192	$ 93,694	$ 30,160
Streetlight Painting	$ 238,674	$ 76,027	$ 139,845	$ 124,311	$ 72,726
LED Washing	$ 248,946	$ 165,412	$ 132,839	$ 136,691	$ -
Night Patrols	$ -	$ 287,224	$ 392,909	$ 322,608	$ 139,483
Supervisory & Administration	$ 1,211,979	$ 1,184,387	$ 1,450,714	$ 1,317,958	$ 1,159,891
Cancelled Projects/Other	$ 66,304	$ 7,048	$ 4,580	$ 3,444	$ 21,778
Outage Restoration	$ 6,519,039	$ 4,972,381	$ 5,300,190	$ 5,322,901	$ 6,667,615
OPL Outage Restoration	$ 813,078	$ 606,053	$ 568,260	$ 665,636	$ 778,858
Capitalization Credit	$(5,941,230)	$(4,519,892)	$(3,666,926)	$(4,045,128)	$(5,452,658)
Damage Claims	$ 457,577	$ 501,653	$ 587,062	$ -	$ (12,996)
Total	**$ 3,722,435**	**$ 3,788,226**	**$ 5,206,266**	**$ 3,990,666**	**$ 3,404,857**

Attachment: None.


Cable Footage
Cable Testing
0676484
Fis Locate & Repair
Completed 3/12/24
0677514
Fis Bore
Completed 3/13/24
45'x2
300'
3K
260'
9.98K
280'
5.05K
130'
7.87K
135'
6.8K
265'
6.88K
275'
5.09K
3.22K
265'
4.82K
COLVIN ST
GRANT ST

2nd- this is a RETURN TO LOCATION after multiple events for same location/complaint since January 2024. Please have your crews do the following:

* TROUBLESHOOT & Repair/Replace all listed assets* as necessary to return to working order.
* Test cable to see if this is a candidate for cable replacement.
* In Kloudgin include photos of all assets for confirmation of status.
* see included (and attached) ESRI Circuit map for reference.

3rd- once the job is complete, please reply to this email with findings of results from cable test and recommendation for cable replacement.

*assets:

M7334
M7335
M7336
M7337
M7338
M7339
M7340
M7341
M7342

** see attached spreadsheet listing previous events as downloaded from Kloudgin.
***see attached ESRI- Circuit Map.

If you have any questions please let me know.

system reliability and maintain the quality of power delivered to customers. The current state of the Company's grid will be discussed next in Section 4. Section 5 will revisit the impacts of scenarios in determining the gaps that need to be addressed to improve the system.

4 State of the Grid

4.1 Current Electric System Overview

DTEE's distribution grid includes approximately 31,000 miles of overhead distribution lines and 14,500 miles of underground distribution lines. Its service territory encompasses 7,600 square miles and includes approximately 2.3 million residential, commercial and industrial customers. DTEE's electrical grid consists of six voltage levels: 120kV, 40kV, 24kV, 13.2kV, 8.3kV and 4.8kV. Maps depicting the distribution and subtransmission voltages across the service territory can be found in Exhibit A.1. in Appendix A.

As many of DTEE's distribution assets have been in operation for several decades, a significant portion of the distribution system's equipment is reaching, or has exceeded, the typical industry lifespan, resulting in a higher occurrence of outage events when compared to peer utilities. Older equipment may have deteriorated due to long exposure to the elements, but in many cases this equipment was also built to less resilient standards of the past. Certain areas of the distribution system are in locations difficult to access such as backyards or wooded areas. Distribution lines in abandoned alleyways are particularly challenging to access, causing delays in restoration efforts and complicating equipment maintenance. Additionally, the electric system faces limitations on capacity in some areas, which at times present difficulties in accommodating new customer loads. The Company has seen a growing number of outages, particularly during extreme weather. Redesign and modernization will improve reliability and help to meet the evolving demands of today's energy landscape.

Under some conditions, the color temperature of an LED or HPS light source does not affect the visual performance of drivers. However, as mentioned above, color contrast can be improved by the selection of the light source. National Cooperative Highway Research Program (NCHRP) research evaluated driver visual performance by measuring the detection distance of pedestrians at two different offset distances (2 and 10 ft on the right shoulder) and under two speeds (35 and 55 mi/h), three light sources (3000K, 4000K, and 5000K LEDs), and two surround ratios (high and low). Visual performance was maximized under the 4000K LED at both offset distances (Figure 10) and speeds (Figure 11), especially at the higher surround ratio. This result indicates that at higher speeds, 4000K LED lighting might be beneficial for increasing driver visibility (Engineering & Medicine, 2020). Similarly, other research has shown that the use of 4000K light sources generally improves object detection distance (Clanton & Associates & Virginia Tech Transportation Institute, 2014; Mutmansky et al., 2010)

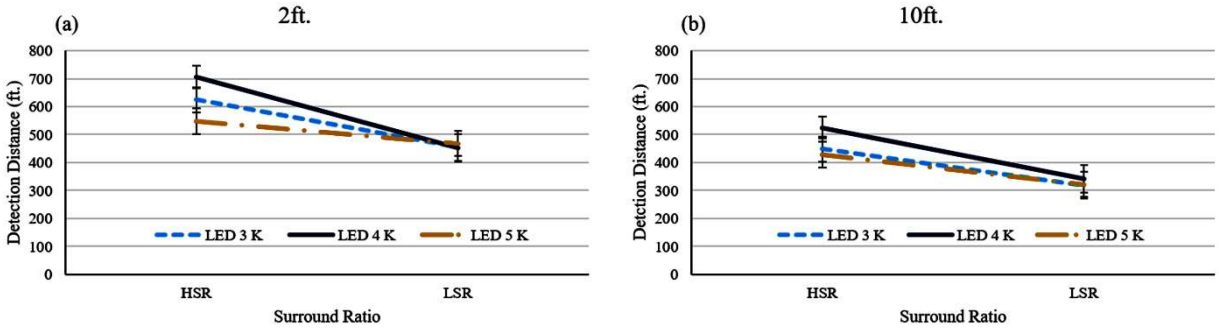


Figure 10. Line graphs. Effect of light source, surround ratio, and offset on the detection distance of pedestrians (Engineering & Medicine, 2020).

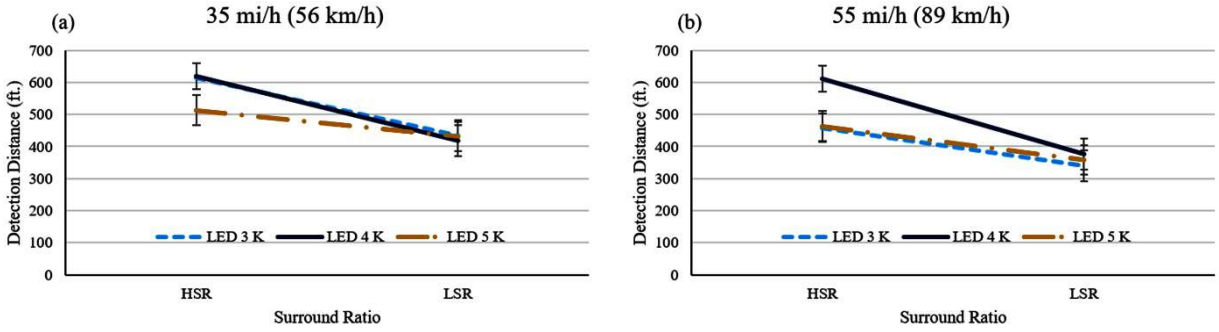


Figure 11. Line graphs. Effect of light source type, surround ratio, and speed on the detection distance of pedestrians (Engineering & Medicine, 2020).

The CIE S 026/E:2018 international standard (Commission Internationale de l'Eclairage, 2018) defines spectral sensitivity functions, quantities, and metrics to describe the ability of optical radiation to stimulate each of the five photoreceptor types that can contribute to retina-mediated non-visual effects of light in humans via the melanopsin-containing ipRGCs. CIE S 026/E:2018 is applicable to visible optical radiation in the wavelength range of 380 to 780 nm. It also includes information on the effects of age and field of view when quantifying retinal photoreceptor stimulation for ipRGC-influenced responses to light. An α-optic calculation toolbox and user guide were developed and are available through CIE.

The benefits of increasing the lighting level reach a plateau beyond which there are diminishing returns. It is therefore recommended that lighting not exceed the required maintained level by more than 50%.

Given the vast differences in LED product performance, it is worth properly evaluating the performance of lighting designs. Lighting calculation software and the power of computing systems have evolved, resulting in quick and easy lighting calculations that provide methods to optimize a lighting design.

One area IES RP-8-21 and AASHTO G-7 have not specified is the maximum average maintained illuminance or luminance level. This has led to an impression that increasing the illuminance or luminance level will always improve visibility and safety. However, the benefits of increasing the lighting level reach a plateau beyond which there are diminishing returns. Figure 21 and Figure 26 demonstrate the diminishing returns observed in detection distance and night-to-day crash rate ratio when the lighting level exceeds 12 lux (Bhagavathula & Gibbons, 2019; Gibbons, Guo, Medina, Terry, Du, Lutkevich, & Li, 2014). This threshold level will vary with speed and road class; however, these figures show that over-lighting does not inevitably produce additional benefits, and lighting beyond the level defined in IES RP-8-21 and AASHTO G-7 may not have any real value. Therefore, it is recommended that lighting not exceed the maintained lighting level specified for the roadway by more than 50%. The 50% is a maximum target to allow for variability in the designs and is not absolute. Designers are encouraged to get as close as possible to the required maintained level while not going below that level.

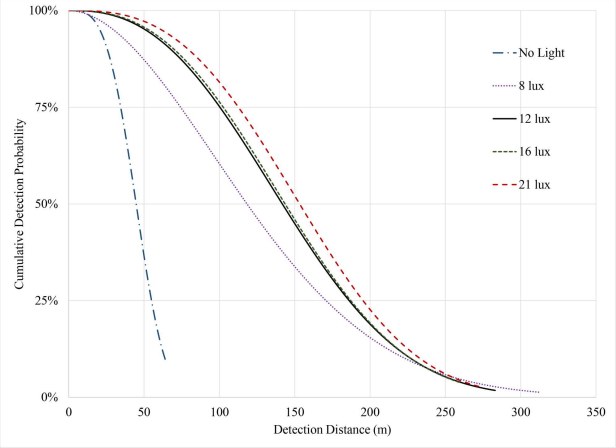


Figure 26. Line graph. Detection distances at various lighting levels (Bhagavathula & Gibbons, 2019).

Typically, when lighting is mounted on utility poles, the necessary lighting levels are difficult to achieve since the pole spacing is defined by the power line design as opposed to the lighting design. In some cases, the poles are two to three times further apart than the distance required for achieving the minimum recommended uniformity ratios (this is often referred to as “half code” lighting). The rationale for half code is that some lighting is better than no lighting, even if well below the requirements (i.e., install half the lighting and get half the benefit). However, reductions in the required lighting

Selecting the most appropriate lighting system is best done through lighting design and calculation on a per-project basis as opposed to using a one-size-fits-all approach.

Michigan Public Service Commission
DTE Electric Company
Revised 100W HPS Analysis With LLF

IES RP-8-22_Maintained Avg. Pavement Luminance (Cd/SqM)

				100 Watt HPS		58 Watt LED		37 Watt LED		30 Watt LED		27 Watt LED	
Local_Average Luminance (Lavg) for A,B,C,F,G				0.3		0.3		0.3		0.3		0.3	
Collector_Average Luminance (Lavg) for D, E				0.4		0.4		0.4		0.4		0.4	
				Initial Output (No LLF)	Adjusted with LLF	Initial Output (No LLF)	Adjusted with LLF	Initial Output (No LLF)	Adjusted with LLF	Initial Output (No LLF)	Adjusted with LLF	Initial Output (No LLF)	Adjusted with LLF
100 A	Local	Low Pedestrian	R2 R3	0.72	0.50	0.94	0.64	0.7	0.48	0.57	0.39	0.51	0.35
				140%	68%	213%	115%	133%	60%	90%	30%	70%	17%
100 B	Local	Low Pedestrian	R2 R3	0.43	0.30	0.52	0.36	0.43	0.29	0.35	0.24	0.26	0.18
				43%	0%	73%	19%	43%	-2%	17%	-20%	-13%	-41%
100 C	Local	Low Pedestrian	R2 R3	0.51	0.36	0.59	0.40	0.46	0.32	0.44	0.30	0.33	0.23
				70%	19%	97%	35%	53%	5%	47%	1%	10%	-25%
100 D	Collector	Medium Pedestrian	R2 R3	0.34	0.24	0.45	0.31	0.32	0.22	0.26	0.18	0.23	0.16
				-15%	-40%	13%	-23%	-20%	-45%	-35%	-55%	-43%	-61%
100 E	Collector	Medium Pedestrian	R2 R3	0.66	0.46	0.87	0.60	0.64	0.44	0.53	0.36	0.47	0.32
				65%	16%	118%	49%	60%	10%	33%	-9%	18%	-19%
100 F	Local	Low Pedestrian	R2 R3	0.33	0.23	0.45	0.31	0.36	0.25	0.29	0.20	0.26	0.18
				10%	-23%	50%	3%	20%	-18%	-3%	-34%	-13%	-41%
100 G	Local	Low Pedestrian	R2 R3	0.35	0.25	0.46	0.32	0.33	0.23	0.27	0.19	0.24	0.16
				17%	-18%	53%	5%	10%	-25%	-10%	-38%	-20%	-45%
Average percent over or under avg. luminance (Lavg) target				47%	3%	88%	29%	43%	-2%	20%	-18%	1%	-31%

Luminaire Type	Analysis Results applying Light Loss Factor
100W HPS Cobra Head (DTE)	100 Watt HPS over-lights target Luminance by 3% on average (Acceptable practice per FHWA Lighting Handbook (*))
58W GreenCobra (DTE)	58 Watt LED over-lights target Luminance by 29% on average (Acceptable practice per FHWA Lighting Handbook (*))
37W GreenCobra (Leotek Crossover Table)	37 Watt LED under-lights target Luminance by -2% on average (Not Acceptable)
30W GreenCobra (Leotek Crossover Table)	30 Watt LED under-lights target Luminance by -18% on average (Not Acceptable)
27W GreenCobra (Leotek Crossover Table)	27 Watt LED under-lights target Luminance by -31% on average (Not Acceptable)

MPSC Case No. U-21534
Responding Party: MI-MAUI
Requestor: DTE Electric
Question No.: DEMAUI-4

DEMAUI-4[1]:

Witness Bunch states on page 68, line 1 through line 2 of his direct testimony "…Leotek has not disavowed the chart that the Commission used in U021297…" What discussions did MI-MAUI have with Leotek to understand their position on the crossover chart that is no longer available on their website? Please provide all written forms of communication with Leotek on this matter.

Response:

MI-MAUI has not had any discussions with Leotek regarding its crossover chart.

All written forms of communication on which this testimony was based are found in the Company response to MAUIDE-5.48 and attachments 1, 2 and 3.

Date: August 2, 2024

Respondent: Richard Bunch

[1] Note: renumbered to continue numbering from First Set of Discovery by DTE to MI-MAUI. Previously DEMAU-1.

advanced LED technology. As the Company ramps up its burnout replacement program to convert streetlights across its system, these customers were worried that they would pay twice—once when they paid to have their lights exchanged and again when the system wide conversion of lights at burnout is included in the Company's base rates. To address this concern, the Company is proposing to add a four-year conversion credit for customers who paid to convert to their streetlights to a LED technology prior to the Commission order approving the burnout replacement program in Case No. U-18322.

Q. Which exhibit contains the rate design changes you described above?

A. The present and proposed rate designs are shown in Exhibit A-16 (HWM-3), Schedule F-3. The proposed electric rates are calculated to collect the jurisdictional revenue requirement contained in Exhibit A-16 (HWM-2), Schedule F-2.1. Both the present and proposed electric charges are applied to the billing determinants to calculate the test year revenues shown in Exhibit A-16 (HWM-1), Schedule F-2, and are the source of the proposed charges that appear in the redlined tariffs filed by Company witness Barnes in this case.

Q. What is the monthly bill impact to customers under the Company's proposed rate design?

A. The monthly customer bill impacts for each rate schedule are shown in Exhibit A-16 (HWM-4), Schedule F-4.

II. DISTRIBUTED GENERATION TARIFF

Q. Please provide an overview of the Inflow/Outflow method.

A. The Inflow/Outflow method is an eloquent solution—simple, transparent, and accurate—that leverages investments in advanced metering infrastructure for designing and implementing a DG Program. Under this design, customers with solar or wind generation

DEAA-2.1bi

Question:

Witness Naheedy states on page 2, lines 18 through 20, "…from 2020 through 2022, Ann Arbor's City-owned streetlights experienced an average annual outage rate of 9%..."

b. Please provide for Ann Arbor owned and maintained streetlights for years 2020 – 2023 in native format with formulas intact:
    i. Total number of customer reported outages logged.

Answer:

This information is unavailable because the City of Ann Arbor does not separately track customer reported outages.

Respondents:

Cyrus Naheedy

Attachments:

None.

DEAA-2.1ci

Question:

Witness Naheedy states on page 2, lines 18 through 20, "…from 2020 through 2022, Ann Arbor's City-owned streetlights experienced an average annual outage rate of 9%..."

c. Describe Ann Arbor's outage management systems used to collect its outage data (i.e., smart streetlight nodes, outage management systems, etc. Specifically:
    i. Do these systems allow for identification of root cause analysis (i.e., luminaire failure, cable failure)? If yes, please explain which attributes are tracked.

Answer:

Ann Arbor's outage management system allows identification of root cause analysis only to the extent that the person responding to an outage may include a possible root cause as a comment in the record for the work order associated with the outage. However, the system does not track any specific attributes.

Respondents:

Cyrus Naheedy

Attachments:

None.