Environmental Protection Agency (EPA)

Climate Pollution Reduction Grant (CPRG) Phase II Implementation Grants

El Paso Metropolitan Statistical Area Application

Chihuahuan Desert Carbon Mitigation Beltway

Appendix A:

Greenhouse Gas Reduction Technical Appendix

GHG Reduction Calculation Technical Appendix

General Method Description and Results

There are six distinct projects that were assessed for greenhouse gas (GHG) emissions reductions:

1. Tree planting
2. Shrub planting
3. Solar lighting
4. Rooftop solar
5. Trail expansion vehicle miles traveled (VMT) reduction
6. Energy efficiency program for commercial buildings

Different GHG reduction calculation methodologies were used for each project type, as described in detail below. In general, emissions reductions were calculated by comparing a baseline case to a proposed project case, as shown in the following equation:

Emissions Reduced = Baseline Case Emissions – Proposed Case Emissions

For the baseline and proposed cases, total emissions were calculated each year from 2025-2050. The annual emissions in the proposed case were subtracted from the annual emissions in the baseline case to calculate the emissions reduced for those specific years. Cumulative emissions reduced were calculated by summing annual emissions reduced each year. General assumptions across all projects include:

- Project installation/construction begins late 2026 and all projects are fully completed by the end of 2028.
- Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report global warming potentials (GWP) were used to calculate metric tons of carbon dioxide equivalent ($MTCO_2e$).

Cumulative and annual GHG reductions for each project type and across projects are provided in Table 1 and Table 2 below.

Table 1 Cumulative GHG Reductions

Years	Cumulative $MTCO_2e$ Reduced
2025-2030	329,633
2025-2050	1,243,130

Table 2 Annual GHG Reductions by Project

	$MTCO_2e$ Reduced						
Year	**Tree Planting**	**Shrub Planting**	**Solar Lighting**	**Rooftop Solar**	**Trail VMT Reduction**	**Building Energy Efficiency**	**Total**
2025	-	-	-	-	4	-	4
2026	444	49	166	208	70	31,055	31,992
2027	887	98	293	369	169	54,960	56,776
2028	1,331	147	383	481	295	47,808	50,444
2029	1,331	147	325	409	338	101,642	104,192
2030	1,331	147	268	337	379	83,763	86,225
2031	2,774	147	246	310	417	76,975	80,870
2032	2,774	147	225	282	456	70,187	74,071
2033	2,774	147	203	255	449	63,398	67,227
2034	2,774	147	181	228	443	56,610	60,384
2035	2,774	147	160	200	437	49,822	53,540
2036	2,774	147	150	188	430	46,715	50,404
2037	2,774	147	140	175	424	43,608	47,269
2038	2,774	147	130	163	418	40,502	44,134

	MTCO$_2$e Reduced						
Year	**Tree Planting**	**Shrub Planting**	**Solar Lighting**	**Rooftop Solar**	**Trail VMT Reduction**	**Building Energy Efficiency**	**Total**
2039	2,774	147	120	150	412	37,395	40,998
2040	2,774	147	110	138	406	34,288	37,863
2041	2,774	147	106	133	401	33,044	36,605
2042	2,774	147	102	128	395	31,801	35,346
2043	2,774	-	98	123	389	30,557	33,941
2044	2,774	-	94	118	383	29,313	32,682
2045	2,774	-	90	113	378	28,069	31,425
2046	2,774	-	96	121	372	30,034	33,397
2047	2,774	-	102	129	367	31,999	35,371
2048	2,774	-	109	137	362	33,963	37,345
2049	2,774	-	115	145	356	35,928	39,318
2050	2,774	-	121	152	364	37,893	41,305
TOTAL	**60,810**	**2,354**	**4,132**	**5,192**	**9,315**	1,161,328	1,243,130

Tree Planting

Baseline Case

For the baseline case scenario, the project area is primarily hardscape and contains minimal/negligible existing landscaping. The project team assumed baseline emissions are zero as there are no net emissions or removals. Therefore, all tree planting associated with the proposed project will result in a net carbon removal.

Proposed Case

For the proposed case scenario, 60,539 trees will be planted along the trail and trail nodes. Carbon sequestration from trees was calculated using the iTree Planting tool created by the USDA Forest Service. The iTree tool quantifies cumulative carbon sequestered over the lifetime of the project. The net sequestration value accounts for gross sequestration minus losses due to decomposition. Carbon dioxide sequestration values in the tool are derived from species-based biomass equations. A detailed description of the methodology and references used can be found in the Understanding i-Tree: 2021 Summary of Program and Methods document. To calculate annual sequestration rates, the cumulative carbon sequestered calculated in iTree was divided by the number of project years. It should be noted that tree sequestration rates increase each year and peak as they reach maturity, so actual annual tree sequestration rates are not constant each year. The net emissions impact of the trees does not account for replanting trees after tree death or emissions associated with fertilizer use or tree maintenance, which the project team assumed to be minimal. Tool inputs are listed below:

Tool used: iTree Planting version 2.7.0[1]

Tool Inputs:

- Location: El Paso, Texas
- Years for project:
    - 5 (2026-2030)
    - 25 (2026-2050)
- Tree mortality: 3% per year (iTree recommended default)
- Diameter at breast height at planting: 3 inches

Tree species and quantity: The total number of trees to be planted was divided evenly among the 8 targeted species (see table 3)

[1] https://planting.itreetools.org/

Table 3 Trees Species and Quantity

Tree Name	iTree Species Name	# of Trees Planted
Texas Honey Mesquite "Thornless"	Mesquite	7,567
Chinese Pistache	Chinese Pistache	7,567
Palo Verde	Palo Verde	7,567
Lacebark Elm	Chinese Elm	7,567
Escarpment Live Oak	Quercus fusiformis/Plateau Oak	7,567
Monterrey Oak	Monterrey Oak	7,567
Sweet Acacia "Sierra Sweet"	Vachellia spp (Genus)	7,567
Mexican Redbud	Mexican Redbud	7,567
	Total	**60,539**

Uncertainties

- Growth rate estimates can have a substantial impact on carbon sequestered. The estimated growth is based on the tree species, condition, and crown light exposure of the measured tree, which are all user inputs in the iTree tool.
- The actual mortality rate could differ depending on the growing conditions, which would impact net sequestration.
- Decomposition estimates in the iTree tool are rudimentary and based on various assumptions of mortality and decomposition rates.

Durability of Reductions

- The project's landscape architect and trail cost estimation consultant assumed that the project’s tree lifespan is approximately 40 years, so reductions will occur beyond 2050. However, the project uses a 3% annual mortality rate to be conservative in sequestration calculations, as recommended by iTrees guidance.
- Reduction permanency depends on the trees’ actual lifespan and end-of-life scenario. Currently, iTree assumes trees will decompose on site, which will release carbon back into the atmosphere. However, trees that are converted to wood products can lock up the carbon stored in their biomass for 50+ years, as opposed to releasing it back to the atmosphere through decomposition.[2] In the future, the projects’ trees may be used in wood products or other end-of-life scenarios that are not considered currently.

Shrub Planting

Baseline Case

For the baseline case scenario, the project area is primarily hardscape and contains minimal/negligible existing landscaping. The project team assumed baseline emissions are zero as there are no net emissions or removals. Therefore, all shrub planting associated with the proposed project will result in a net carbon removal.

Proposed Case

For the proposed case scenario, 127,728 shrubs will be planted along the trail and trail nodes. Carbon sequestration from shrubs was calculated using the Pathfinder tool developed by CMG Landscape Architecture and Atelier Ten through the Climate Positive Design initiative.[3] The net sequestration value accounts for gross sequestration minus losses due to plant decomposition. All data used to calculate sequestration and decomposition for shrubs was obtained (and modified as noted) from EG McPherson’s study produced by USDA Forest Service.[4] As the tool calculates cumulative carbon sequestered over 50 years, values for annual carbon sequestered were calculated by dividing the cumulative carbon sequestered by 50 years. The project's landscape architect and trail cost estimation consultant assumed the project’s shrubs lifespan is approximately 15 years and CPRG funds will not be used to replace shrubs when they die. Therefore, annual shrub carbon sequestration estimates for this application fall to zero by 2043. Net sequestration at any given point in time accounts for the carbon stored in the undecomposed biomass. In practice, a small percentage of the carbon sequestered by shrubs is fixed into the soil for the long term, but soil carbon storage is not counted explicitly in the Pathways tool. The emissions impact associated with fertilizer use or shrub maintenance is not included and are assumed to be minimal. Tool inputs are presented below:

Tool Used: Pathfinder version t2[5]
Tool Inputs:

- Location: El Paso, Texas

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[2] Climate Positive Design. “Landscape Carbon Calculator / Pathfinder: Methodology, Data Sources and Metrics Summary”. July 31, 2020
[3] https://app.climatepositivedesign.com/
[4] McPherson, EG.; Simpson, JR. (1999). Carbon dioxide reduction through urban forestry: Guidelines for professional and volunteer tree planters. Gen. Tech. Rep. PSWGTR-171. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture
[5] https://app.climatepositivedesign.com/

- Growth Zone: Central
- Plant Type: Evergreen Medium Shrubs (5-gallon)
- Quantity of Shrubs: 127,728

Uncertainties

- Sequestration rates differ depending on the shrub species – the Pathfinder tool assumes all shrubs have the same sequestration rate, which impacts total sequestration potential.

Durability of Reductions

- The project's landscape architect and trail cost estimation consultant assumed shrub lifespan to be approximately 15 years. CPRG funds will not be used to replace shrubs when they die, so shrub carbon sequestration due to CPRG funding falls to zero in 2043.
- The permanency of reductions depends on the shrubs' actual lifespan.

Solar Lighting

Baseline Case

In the baseline case, emissions come from electricity generation that is used to power existing trail lights and streetlights as well as new trail lights that will be installed along the trail extension. Table 4 shows the baseline scenario assumptions:

Table 4 Baseline Lighting and Energy Use

Baseline Lighting	Quantity	Type	Wattage	Hours of use/day	kWh/year
Existing: Trail Lights	613	LED	50	12	134,247
Existing: Streetlights	271	LED	150	12	178,047
Future Installation: Trail Lights	7,706	LED	50	12	1,687,614

The project team assumed that the annual kWh used will remain constant from 2025-2050. To calculate annual CO_2e emissions, annual electricity use was multiplied by the specific regional electricity emissions factor for that year. Discussion of how electricity emission factors were calculated is included separately in the "Electricity Emissions Factor Forecasts" section of this appendix. GHG emissions were calculated in Microsoft Excel.

Proposed Case

In the proposed case, all existing trail lights, existing streetlights, and planned trail lights will be replaced with solar lights.[6] The solar systems on the lights will generate 100% of the lighting electricity needs due to motion sensors and "self-learning" capabilities that allow for predictive adaptation to environmental conditions and lighting requirements. Therefore, all lighting-related emissions will be reduced to zero in the proposed case, and GHG reductions will equal the emissions produced by lighting in the baseline case.

Uncertainties

- Some of the existing lights use photosensors and some use timers, so the actual hours of use per day may vary.

Durability of Reductions

- The GHG reductions from using solar lights are permanent for as long as the lights are in operation. The solar batteries and LEDs will need to be replaced during project lifetime to ensure continuous operation.
- The lifespan of the solar lights will extend beyond 2050, so therefore GHG reductions will continue to occur past 2050.

Rooftop Solar

Baseline Case

In the baseline case, annual emissions were calculated by multiplying the annual electricity use by the specific regional grid electricity emissions factor for that year. Annual electricity use was calculated by estimating the annual kWh that will be generated by the proposed solar project (see Proposed Case below). The project team assumed that the annual kWh used will remain constant from 2025-2050. Discussion of how electricity emission factors were calculated is included separately in the "Electricity Emissions Factor Forecasts" section of this appendix. GHG emissions were calculated in Microsoft Excel.

Proposed Case

In the proposed case, a 2 MW rooftop solar system will be installed and all electricity generated by the system will be consumed on-site. Total kWh/year generated from the solar system was calculated in NREL's PVWatts Calculator. Rooftop solar will reduce the associated electricity emissions to zero. Therefore, the total GHGs reduced is equal to the emissions produced in the baseline case. PVWatts tool inputs are described below:

[6] https://www.firstlighttechnologies.com/wp-content/uploads/2022/09/Spec-Sheet-First-Light-IPL.pdf

Tool Used: PVWatts version 8.2.1[7]
Tool Inputs:

- Location: El Paso, Texas
- DC System Size: 2 MW (2,000 kW)
- Module Type: Standard
- Array Type: Fixed (roof mount)
- System Losses: 14.08% (default)
- Tilt: 20 deg (default)
- Azimuth: 180 deg (default)

Uncertainties

- The default assumptions in PVWatts (e.g., system loses, tilt, azimuth) may slightly differ from the actual installed system, which will impact the total kWh output.

Durability of Reductions

- The GHG reductions from using rooftop solar are permanent for as long as the system is in operation and the host facility continues to use the system generated electricity. The industry standard lifespan for most solar panels is 30-35 years, which would extend beyond the 2050 timeframe. Therefore, GHG reductions will continue to occur past 2050.[8]

Trail Expansion VMT Reduction

Baseline Case

The team estimated baseline and proposed case VMT using the El Paso MPO regional travel demand model and EPA's travel efficiency assessment method (TEAM). The vehicle emissions factors are the same for the baseline and proposed cases. CO_2 emission factors are from the EPA Emission Factors Hub.[9] Vehicle fuel economy and CH_4 and N_2O emission factors are based on national values from ICLEI.[10] ICLEI projects passenger car and light truck fuel economies by applying CAFE Standard impacts. Heavy truck fuel economy projections are from the EIA. ICLEI derives vehicle emission factor data from EPA data.

Proposed Case

In the proposed case the entire proposed Paso del Norte Trail (PDN) is constructed, with segments opening in phases between 2026 and 2028. This includes sections of shared-use path and on-street bike lanes. In addition, complete streets improvements will take place on Rio Vista Road, Buford Road, and Moon Road in the City of Socorro. These projects would intersect with the Paso del Norte trail and help connect it to surrounding communities. The additional pedestrian and bicycle connectivity and safety provided by the trail are estimated to move some vehicles trips to these active transportation modes. In addition, other trail projects are planned for the region between 2028 and 2050 which will further enhance network connectivity.

Tool Used: EPA's Travel Efficiency Assessment Method (TEAM) in combination with the El Paso MPO Regional Mobility Strategy (RMS) Travel Demand Model
Tool Inputs:

- 2022, 2032, and 2050 baseline model outputs for business-as-usual (BAU) for average weekdays
- Coded build alternative for 2022, 2032, and 2050 networks to include PDN Train facilities
- Enhanced number of speed-feedbacks of the model (10)

Table 5-Table 9 present travel modeling assumptions and results from this analysis.

Table 5 List of Assumptions and Factors

Day Type	Days per Year	Holiday Days	Days Over 100°F days in El Paso[11]	Annualization Factor	Percentage of Weekday VMT	Percentage Recreational
Weekday	261	8	23	230	-	-
Saturday	52	0	5	47	98%	90%
Sunday	52	0	5	47	75%	95%
Total	365	8	33	324	-	-

[7] https://pvwatts.nrel.gov/
[8] https://www.energy.gov/eere/solar/end-life-management-solar-photovoltaics
[9] https://www.epa.gov/climateleadership/ghg-emission-factors-hub
[10] https://docs.google.com/spreadsheets/d/1KXmtHoxl-mPXz0ujidtj76woUcK-RN9ITMRy-gMoUls/edit#gid=1929834944
[11] https://www.weather.gov/epz/elpaso_100_degree_page

Assumptions

1. Using EPA TEAMS methodology[12] in combination with El Paso MPO Regional Model[13]
2. Assuming recreational trips do not reduce VMT
3. Assuming Saturday trips are 90% recreational and Sunday trips are 95% recreational
4. Interpolating between modeled years (shown in blue text in Table 6)
5. Adjusting the interpolation by % implementation for years 2025 to 2028
6. Assuming no change in VMT for trucks (light and heavy)

Sources

1. National Household Travel Survey (https://nhts.ornl.gov/)

Table 6 Input to TEAM tool for 2022, 2032, and 2050

Year	2022	2032	2050
El Paso MPO Area (Square miles)	1,240.00	1,240.00	1,240.00
PDN Trail + Complete Streets LINK length (Miles)	**0.61**	**75.84**	**75.84**
Entire Region Bike LINK length (Miles)	**185.37**	**294.57**	**340.43**
BAU Bike Lanes (Miles)	369.52	437.47	529.18
Scenario Bike Lanes (Miles)	370.73	589.14	680.85
BAU Bike Lane Miles / Sq Mile (Miles/Sq Miles)	0.30	0.35	0.43
Scenario Bike Lane Miles / Sq Mile (Miles/Sq Miles)	0.30	0.48	0.55
Increase in Cycling Mode Share (Percentage)	0.00%	0.12%	0.12%
Avg. Bike Trip Length (Miles)	2.5	2.5	2.5

Table 7 Year 2022 BAU and Scenario: Average Weekday VMT Change

Mode of Travel	Business as Usual (Person trips)	Scenario Change in Bike Trips (Person trips)	Change in non-Bike Trips (Person trips)	Scenario Trips (Person trips)	Occupancy (Persons per vehicle)	Change in VMT (Miles)
Drive Alone	1,399,968		-14	1,399,954	1.0	-34
2 Person HOV	866,280		-8	866,272	2.0	-11
3+ Person HOV	779,048		-8	779,040	3.5	-5
Transit Drive Access	2,005		0	2,005		
Transit Walk Access	29,363		0	29,363		
Bike	9,517	32		9,549		
Walk	142,027		-1	142,026		
Total	3,228,208	32	-32	3,228,208		**-50**

[12] https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P101358W.pdf
[13] https://www.elpasompo.org/

Table 8 Year 2032 BAU and Scenario: Average Weekday VMT Change

Mode of Travel	Business as Usual (Person trips)	Scenario Change in Bike Trips (Person trips)	Change in non-Bike Trips (Person trips)	Scenario Trips (Person trips)	Occupancy (Persons per vehicle)	Change in VMT (Miles)
Drive Alone	1,480,523		-1,817	1,478,706	1.0	-4,541
2 Person HOV	917,013		-1,125	915,888	2.0	-1,406
3+ Person HOV	818,556		-1,004	817,552	3.5	-717
Transit Drive Access	1,966		-2	1,964		
Transit Walk Access	30,353		-37	30,316		
Bike	10,487	4,167		14,654		
Walk	148,118		-182	147,936		
Total	3,407,016	4,167	-4,167	3,407,016		**-6,665**

Table 9: Year 2050 BAU and Scenario: Average Weekday VMT Change

Note, while construction of the PDN trail is expected to be completed by 2028, other trail projects are planned for the region between 2028 and 2050, which will further enhance network connectivity.

Mode of Travel	Business as Usual (Person trips)	Scenario Change in Bike Trips (Person trips)	Change in non-Bike Trips (Person trips)	Scenario Trips (Person trips)	Occupancy (Persons per vehicle)	Change in VMT (Miles)
Drive Alone	1,634,876		-2,006	1,632,870	1.0	-5,015
2 Person HOV	1,019,337		-1,251	1,018,086	2.0	-1,563
3+ Person HOV	904,019		-1,109	902,910	3.5	-792
Transit Drive Access	1,886		-2	1,884		
Transit Walk Access	31,046		-38	31,008		
Bike	11,615	4,602		16,217		
Walk	159,582		-196	159,386		
Total	3,762,361	4,602	-4,602	3,762,361		**-7,371**

Table 10 presents the modeled annual and daily VMT reductions per year through 2050. Rows highlighted in grey are VMT reduction results calculated through the TEAM tool. Other values are the result of interpolation and post processing results from 2025, 2032 and 2050. The values shown in green are weekday VMT reductions for 2025, 2032 and 2050, which correspond to the values presented in Table 7-Table 9.

Table 10 Annualized VMT for Years 2022 to 2050

Percentage Construction Complete of PDN trail	VMT Reduction (Miles)				
	Year	**Yearly** (Miles)	**Weekday** (Miles)	**Saturday** (Miles)	**Sunday** (Miles)
	2022	11,892	50	5	2
	2023	11,892	50	5	2
	2024	11,892	50	5	2
0%	2025	11,892	**50**	5	2
33%	2026	218,271	923	90	35

Percentage Construction Complete of PDN trail	VMT Reduction (Miles)				
	Year	Yearly (Miles)	Weekday (Miles)	Saturday (Miles)	Sunday (Miles)
67%	2027	535,656	2,266	222	85
100%	2028	949,977	4,019	393	151
	2029	1,106,324	4,681	458	175
	2030	1,262,671	5,342	523	200
	2031	1,419,019	6,004	587	225
	2032	1,575,366	**6,665**	652	250
	2033	1,581,321	6,690	654	251
	2034	1,587,275	6,716	657	252
	2035	1,593,229	6,741	659	253
	2036	1,599,183	6,766	662	254
	2037	1,605,138	6,791	664	254
	2038	1,611,092	6,816	667	255
	2039	1,617,046	6,842	669	256
	2040	1,623,000	6,867	672	257
	2041	1,628,955	6,892	674	258
	2042	1,634,909	6,917	677	259
	2043	1,640,863	6,942	679	260
	2044	1,646,818	6,967	681	261
	2045	1,652,772	6,993	684	262
	2046	1,658,726	7,018	686	263
	2047	1,664,680	7,043	689	264
	2048	1,670,635	7,068	691	265
	2049	1,676,589	7,093	694	266
	2050	1,742,086	**7,371**	721	276

Uncertainties

- Fuel economies and emission factors are based on national values that may not reflect local vehicle types and could therefore impact the actual total emissions reduced.
- Forecasted projects beyond those included in this grant application are not assured to be constructed; the additional network projects planned for construction between 2028 and 2050 are not guaranteed to be funded and/or constructed on schedule.
- The outcomes rely on assumptions about trail use during hot weather and the number of days over 100ºF, which could vary substantially due to climate change.

Durability of Reductions

- Reductions are permanent if the trail is effectively supporting travel mode switching from fossil fuel travel modes to active or micromobility travel modes (e.g., biking, walking, e-scooters).

Energy Efficiency Program for Commercial Buildings

Baseline Case

The baseline case considers consumption data used for the development of the GHG inventory for the PCAP. The entire commercial and industrial sectors use 2,845,000 MWh. These data was acquire directly from the electric utility, El Paso Electric, for year 2019. The project team assumed that consumption will remain constant from 2025-2050. To calculate annual CO_2e emissions reduction, annual electricity baseline use was multiplied by a $/kwh=0.055 factor. This factor shows the investment needed for reducing 1 kwh of consumption. This approach is based on an ACEEE report[14] that stated that "*the average levelized cost per saved kilowatt-hour was 2.4 cents…*". The project team has used a more conservative cost of 5.5 cents to address supply chain and inflation uncertainties. Multiplying 5.5 cents by the annual investment budget and by the regional emissions factor for that year resulted in the reduction of consumption per year. Discussion of how electricity emission factors were calculated is included separately in the "Electricity Emissions Factor Forecasts" section of this appendix. GHG emissions were calculated in Microsoft Excel.

Proposed Case

In the proposed case all energy conservation measures (ECMs) installed through this program will achieve, at least, a 40% reduction from the baseline scenario. This percentage is consistent with ACEEE's "Moving the Needle on Comprehensive Commercial Retrofits' report which concludes that "*Comprehensive retrofits achieve 15–40% energy savings in participating buildings, which is 2.5 to 7 times more savings than typical single-measure strategies attain*"[15].

Uncertainties

– Actual $/kwh and therefore emission reductions are conservative. Reductions may vary depending on the ECMs installed.

Durability of Reductions

The GHG reductions from installing ECMs are permanent while the systems are in operation. The systems will need to be maintain and replaced, in some cases, during project lifetime to ensure continuous operation.

The lifespan of the systems, if maintain and operated correctly, will extend beyond 2050, so therefore GHG reductions will continue to occur past 2050.

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Electricity Emissions Factor Forecast

Electricity emissions factors were forecast using NREL's Cambium 2023 Mid-Case Scenario data for the West Connect South generation and emissions assessment (GEA) region (see Table 11).[16][17] The Mid-Case Scenario represents a business-as-usual scenario that considers electric sector policies as they existed in September 2023. The emissions factors reflect the average emission rate of all generation within a region for the specified duration of time and no adjustment is made for imported or exported electricity. Cambium 2023 provided forecast values every five years starting in 2025 and ending in 2050. The project team interpolated interim year (e.g., 2026, 2027) emissions factors using this data. Emission factors were converted to $MTCO_2e$ using the IPCC Fifth Assessment Report 100-year GWP values.

Table 11 Electricity Emission Factor Forecast

Year	$MTCO_2e$/MWh	Year (cont.)	$MTCO_2e$/MWh (cont.)*
2025	0.1905	**2038**	0.0446
2026	0.1708	**2039**	0.0411
2027	0.1511	**2040**	0.0377
2028	0.1315	**2041**	0.0363
2029	0.1118	**2042**	0.0350
2030	0.0921	**2043**	0.0336
2031	0.0847	**2044**	0.0322
2032	0.0772	**2045**	0.0309
2033	0.0697	**2046**	0.0330
2034	0.0623	**2047**	0.0352
2035	0.0548	**2048**	0.0374
2036	0.0514	**2049**	0.0395
2037	0.0480	**2050**	0.0417

* GEA's long-term projected emissions factors can fluctuate for various reasons (e.g., new natural gas plants, nuclear plants closing, etc.), resulting in emissions factors that increase or decrease from year to year.

[14] Cohn, C. 2021.The Cost of Saving Electricity for the Largest U.S. Utilities: Ratepayer-Funded Efficiency Programs in 2018. Washington, DC: ACEEE. Topic Brief. aceee.org/topic-brief/2021/06/cost-saving-electricity-largest-us-utilities-ratepayer-funded-efficiency

[15] Srivastava, R. and J. Mah. 2022. Moving the Needle on Comprehensive Commercial Retrofits. Washington, DC: American Council for an Energy-Efficient Economy. aceee.org/researchreport/b2203.

[16] https://www.nrel.gov/analysis/cambium.html

[17] https://www.nrel.gov/docs/fy23osti/84916.pdf

Uncertainties

- Electricity emission factor forecasts have inherent uncertainty. NREL noted the following on its Cambium 2023 forecasting: "Although we strive to capture relevant phenomena as comprehensively as possible, the models used to create the data are unavoidably imperfect, and the future is highly uncertain."[18]

[18] https://www.nrel.gov/docs/fy24osti/88507.pdf