Cumulative Greenhouse Gas Emissions Methodology | Minneapolis Coalition

Methodology Summary

The City of Minneapolis Green Cost Share program awards grants to support voluntary air pollution and greenhouse gas emissions reductions projects. Data from these projects provides a real-world basis for our greenhouse gas emissions projections included in our Climate Pollution Reduction Grant (CPRG) application. We used the data from 330 Green Cost Share projects, emissions factors from eGrid, and the proposed non-admin budget to complete our emissions forecast.

Data period

We based our projections on Green Cost Share projects completed between 2021 and 2023. These three years include the most up-to-date data on solar and energy efficiency projects in the Minneapolis-Saint Paul metro. Including pre-2021 would skew our total project cost and city contribution estimates due to the impacts of pandemic-induced inflation.

Project and Property Type

We proposed to use CPRG funds to help businesses reduce their energy bills and cut greenhouse gases. We will incentivize the adoption of solar and energy efficient technologies. For the best comparison we only use data from solar and energy efficiency projects completed in a small, commercial, industrial, or non-profit business. 330 projects from 2021-2023 matched this definition.

Emissions Reduction Calculation Inputs

To calculate a reasonable emissions reduction projection through 2050 we needed:

1. Median or average year-one energy savings.
2. Lifetime energy savings projections.
3. How many projects we could complete with the proposed budget.
4. Emissions factors from 2025-2050

Year One Energy Savings

Every Green Cost Share applicant submits estimated annual energy savings. Applicants must support their estimates with output from a reporting tool (e.g., PVWatts, Helioscope, or an energy modeling software), utility estimates, or another approved analysis.

We use the annual energy savings from all 330 projects to calculate average and median energy saved. The estimates are split between solar and efficiency projects, and all therms saved are converted to kilowatt hours (1 therm = 29.3 kWh).

Project Type	Median kWh_Year 1	Average kWh_Year 1
Solar	53,585	116,324
Energy Efficiency	21,423	67,889

Lifetime

Green Cost Share program staff use a variety of sources to calculate estimated lifetime energy savings. For solar projects staff forecast production over 25 years. Staff use an annual degradation factor of 0.5% and the following formula (where i = the number of years since the year the array was built).

$$\sum_{i=0}^{24} kWh_{Year1} * (1 - 0.5\%)^{i}$$

For energy efficiency projects staff use the State of Minnesota's Technical Reference manual (TRM). This manual lists hundreds of efficiency measures and their measure life. Staff use the project data available to forecast savings by measure or use a weighted average across all measures by project. Lifetime savings are therefore the year one savings projected out for the measure life without degradation in savings.

Estimated Number of Projects

Summary Table 1 shows how we calculated the estimated number of projects we propose to complete with CPRG. We base our estimates on (1) the average grant amount from the Green Cost Share, (2) the proposed breakdown between solar and energy efficiency projects, and (3) the non-staff budget request.

Summary Table 1: Estimated number of projects

Row	Metric	Total	Solar	Efficiency	Source
A	Budget Request_Non-Staff	$7,971,000	$1,594,200	$6,376,800	Row B * Total Budget
B	Percent of Budget	100%	20%	80%	CPRG proposal
C	Average City Contribution	$14,828	$23,259	$11,272	Program Data 21-23
D	Est. Projects_2025-2028	635	69	566	Row A / Row C
E	Est. Projects_annual (Rounded)	159	17	142	Row D / 4 years

Emissions Factors 2025-2050

There are multiple sources of emissions factors, each with different positives and negatives. EPA's eGrid reports annual emissions factors for carbon dioxide equivalents (CO2e), ozone (NOx), and sulfur Dioxide (SO2), but without projections. E.I.A. has projections, but only for the entire MROW region. To calculate our emissions factors, we applied the annual percent changes in the emissions factors from E.I.A.'s 2023 Annual Energy Outlook for MROW with high IRA implementation to the Minnesota specific eGrid emissions factors.

Estimated Emissions Reductions

To estimate emissions reductions, we created a spreadsheet with three interconnected worksheets. Worksheet 1 is a solar project projection, worksheet 2 is an efficiency project projection, and worksheet 3 is our emissions factors.

Solar

Worksheet 1 has 69 identical projects, 17 additional projects (Summary Table 1) a year between 2025 and 2028. Each project produces the median energy savings (53,585 kWh) in its first year. We degraded the median solar production 0.5% a year for 24 years after the initial year (total measure life = 25). The result is a table of estimated kilowatt hour production for 69 identical solar projects based on the median energy savings for the Green Cost Share.

Energy Efficiency

Worksheet 2 has 568 projects, 142 additional projects (Summary Table 1) a year between 2025 and 2028. Each project saves the median amount of energy (21,423) in its first year. Using the distribution in the lifetime energy savings from the Green Cost Share we vary the measure life from 3-20 years. The result is a table of estimated kilowatt hour savings for 568 projects based on the median energy savings and distribution of measure lives from the Green Cost Share.

Final calculations

We started by summing the energy savings from each year between 2025 and 2050. Next, we used a HLOOKUP function based on the year to multiply that total by the emissions factors for the corresponding year. We then summed the total emissions saved for each of the three emission types (CO2e, NOx, SO2) from 2025-2030 and 2025-2050. Finally, we divided those savings by the proposed solar and efficiency budget (see Summary Table 1) to get our $/Metric ton number. Summary Table 2 contains the results of our projections.

Summary Table 2: CPRG Emissions Projections Results

	Solar	Efficiency
Metric Tons CO2e_2025-2030	3,049.25	10,159.28
$/metric ton CO2e_2025-2030	$523	$628
Metric Tons CO2e_2025-2050	10,336.62	20,125.11
$/metric ton CO2e_2025-2050	$154.23	$316.86
Metric Tons SO2 & NOx_2025-2030	3.08	10.25

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1. Background and Data Selection

1.1. Background

The Climate Pollution Reduction Grant (CPRG) application requires applicants to provide emissions projections for, at a minimum, Carbon Dioxide Equivalent (CO2e) emissions. Applicants must have a total emissions reduction between 2025 and 2030, and for 2025-2050. Applicants must also report on the dollar per metric ton ($/mt) across those same periods. This means applicants need some idea on the nature (type and energy saved) and number of projects they can complete with their proposed budget.

1.2. Data Selection

To ground our emission analysis in real-world energy savings and cost data we chose to pull data from the City of Minneapolis Green Cost Share program. For over a decade the Green Cost Share program has awarded grants to support voluntary air pollution and greenhouse gas emissions reductions projects. Though many coalition partners have similar programs in their cities, the Green Cost Share is the largest and therefore had the most data to base our projections on.

We selected Green Cost Share projects completed between 2021 and 2023. These three years include the most up-to-date data on solar and energy efficiency projects in the Minneapolis-Saint Paul metro. Including pre-2021 would skew our total project cost and city contribution estimates due to the impacts of pandemic-induced inflation. For the best match the properties included in this application limited the data to solar and energy efficiency projects completed in a small, commercial, industrial, or non-profit business only.

1.3. Calculation Inputs

Estimating reasonable emissions reductions over multiple decades requires more than just historic data from the Green Cost Share. Though this data is the basis for our projections we also need to incorporate the following.

A. Median or average year-one energy savings.
B. Lifetime energy savings projections.
C. How many projects we could complete with the proposed budget.
D. Emissions factors from 2025-2050

2. Estimating Energy Savings

The following section describes how the Green Cost Share estimates year one energy savings for all energy efficiency and solar projects. This data is important for calculating the median and mean energy savings for our projections.

2.1 Solar

Every solar applicant to the Green Cost Share submits a PVWatts or equivalent report (e.g. Helioscope). Reports must list the estimated annual kilowatt hours - Alternating Current (kWh-AC) produced by the solar array, system losses, panel orientation, weather data, and project location. City staff check these reports against the number submitted on the application to ensure they match.

2.2 Energy Efficiency

Every energy efficiency applicant to the Green Cost Share Program must submit estimated energy savings in kWh-AC and/or Therms (Th). Applicants support their estimates with either a utility report, a third-party calculation, or work with City staff to perform calculations using the Minnesota Technical Reference Manual (TRM).

2.2.1 Utility Reports

In Minnesota each investor-owned utility (IOU) has energy conservation goals outlined in the Conservation Improvement Program (CIP) and Energy Conservation Optimization Act (ECO Act). Minneapolis is served by Xcel Energy (Electric) and CenterPoint Energy (Gas). Both utilities work with program implementers to offer a range of services (Table 1).

The City of Minneapolis partners with implementers to provide energy audit and energy savings calculation support to Green Cost Share applicants. Implementers perform an energy audit and provide the applicant with a report. Reports often contain energy savings estimates based on the TRM. City staff check these reports against the number submitted on the application to ensure they match.

Table 1: Xcel Energy and CenterPoint Energy Conservation Program Implementers

Utility Program	Provider	Services	Customers
Home Energy Squad	Center for Energy and Environment	Energy audits, Navigation support, instant quotes.	Residential (1-4 units)
Multifamily Building Energy Efficiency Program	Frontier Energy	Energy audits, Navigation Support, energy savings estimates, utility rebates.	Residential (≥ 5 units)
One Stop Efficiency Shop	Center for Energy and Environment	Energy audits, energy savings estimates, navigation support, utility rebates.	Business, Commercial, non-profit
Business Energy Efficiency Grant	Minnesota Waste Wise Foundation	Energy audits, navigation support.	Business, Commercial
Energy Design Assistance	Franklin Energy	Energy audits, energy modeling, utility rebates.	New construction, recommissions

2.2.2 Third-Party Calculations

Not every applicant for the Green Cost Share goes through a utility program. In these cases, applicants must submit their own energy savings calculations or modeling reports. Documents must have enough information about the equipment being installed so that application reviewers can verify the estimates. Often the contractor working with the applicant will be able to provide the required documents. City staff check these numbers against the number submitted on the application to ensure they match.

2.2.3 Minnesota Technical Reference Manual

The Minnesota Technical Reference Manual (TRM) is a standard set of methodologies, inputs, and assumptions that utility program implementers reference when developing, implementing, and reporting on their programs as outlined in Minnesota Statute 216B.215, subd. 1d. These methodologies are the basis for many of the reports outlined above. The TRM is updated yearly by a group led by the Minnesota Department of Commerce.

Green Cost Share program staff maintain calculation worksheets using the algorithms listed in the TRM for common types of energy efficiency measures. Staff use these worksheets to help applicants calculate estimated energy savings. This occurs primarily with small residential properties and with emergency replacements that don't go through program implementers. Staff work with applicants to gather the information needed by the TRM algorithm. This could include but is not limited to:

Heating, ventilation, and air conditioning	Air Sealing and Insulation
○ Status of current equipment (end of life or early replacement) ○ Efficiency levels (e.g., AFUE, HSPF, SEER, UEF) ○ Size (btu/hr or tons)	○ Pre and Post R-Values and blower door results. ○ Square footage of insulated area. ○ Information on the new or existing HVAC equipment.

When completed, staff must save a copy of the completed calculations in the associated project application folder and record the results in the energy savings field in the application database.

2.2.4 Projection Input 1: Median Energy Savings

The first important input into our emissions reductions forecast is calculating what the energy savings from a typical project are. Using the 330 projects from in the Green Cost Share program we calculated the median and average annual energy savings. We calculated one estimate for solar and one for efficiency projects, and all therms saved are converted to kilowatt hours (1 therm = 29.3 kWh). The results are shown in Table 2.

Table 2: Annual Energy Savings Estimates

Project Type	Median kWh_Year 1	Average kWh_Year 1
Solar	53,585	116,324
Energy Efficiency	21,423	67,889

We will use the median kWh_Year 1 savings for both energy efficiency and solar as our model project.

3. Estimated Lifetime Energy Savings

Estimated lifetime historic calculations from the Green Cost Share tell us how to project our year-one energy savings from Section 2. They will also help determine a reasonable distribution of measure lives. The following section describes how Green Cost Share staff calculate these savings estimates.

3.1 Inputs and Assumptions

We use the inputs in Table 3 to calculate lifetime energy savings. Overall staff must consider how long the equipment will last, if savings degrade over time, and how energy costs change over the life of the project.

Table 3: Estimated Lifetime Energy Savings Inputs

Description	Inputs	Source
Annual Solar Output Deflator	**0.5%**	NREL, 2018, Source Link
Annual Efficiency Savings Deflator	**NA[1]**	
Measure Life		
Solar	**25 years**	NREL, 2018, Source Link
Energy Efficiency	**Varies[2]**	Minnesota Technical Reference Manual

1: Program staff do not use a savings deflator to account for equipment degradation for energy efficiency projects. Staff use the full year-one estimated savings each year for the whole of the measure life.

2: The estimated measure life for each individual measure as listed in the Minnesota Technical Reference Manual. The Minnesota Department of Commerce limits the measure life of any given measure to a maximum of 20 years.

3.2 Solar Calculations

A. Start with the annul kWh-AC production from the PVWatts or Helioscope report (kWh_{Year1}).

B. Deflate kWh_{Year1} by 0.5% for the next 24 years using the following formula. Start with i=0 since the first year's solar production is equal to the estimates in the report and therefore is not deflated until year 2 (i=1). Do this for each year to get a yearly production estimate over 25 years.

$$\sum_{i=0}^{24} kWh_{Year1} * (1 - 0.5\%)^i$$

3.3 Energy Efficiency Calculations

Lifetime energy savings for energy efficiency projects are based on the State Technical Reference manual and the initial estimates provided in an application. There are two methods we use. Method one we look at each efficiency measure individually. Method 2 we use a weighted average of measure life across multiple measures. Method 2 is used when Green Cost Share staff only had aggregate savings information for all measures in an application.

3.3.1 Method 1: By measure

Use this method when you have individual energy savings values for each measure completed in the property.

A. Using the project proof of work documents, add a new measure line to the project for each measure.
B. Go to State's Technical Reference Manual site.
C. Open the version that matches the year the measure was completed (i.e. v 4.0 is for 2024). The manual is split up into Residential, Commercial/Industrial, Agriculture, and Electric Utility Infrastructure. We only use the Commercial/Industrial Sections for CPRG.
D. Find and click on the measure in the table of contents. Record the page number, measure life, and number of measures in the lifetime savings measure line.
E. Copy the estimated energy savings for that measure for the number of years the TRM says that measure will last (i.e. Furnace = 20 years, so should have 20 years of energy savings).

3.3.2 Method 2: Weighted Average

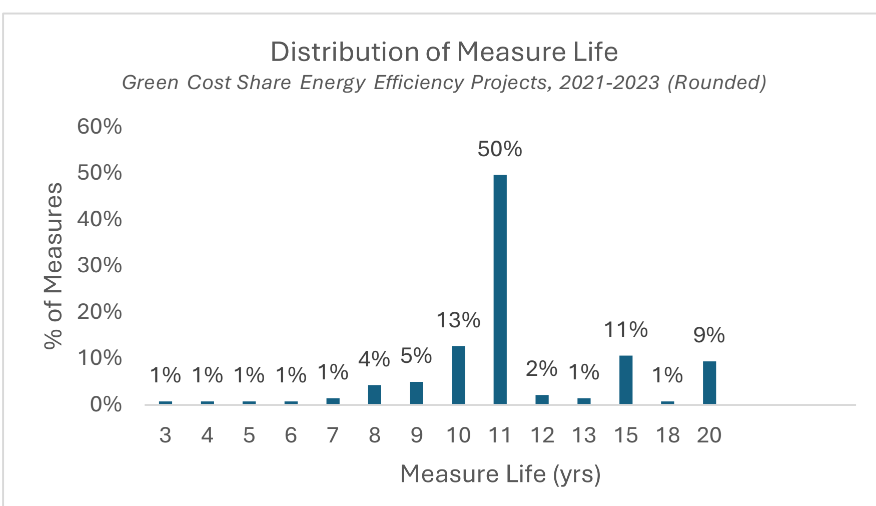
*Use this method when you **ONLY** have total energy savings values across all measures completed in the property.*

A. Using the proof of work documents, add a new aggregate measure line to the project.
B. Go to State's Technical Reference Manual site.
C. Open the version that matches the year the measure was completed (i.e. v 4.0 is for 2024). The manual is split up into Residential, Commercial/Industrial, Agriculture, and Electric Utility Infrastructure. We only use the Commercial/Industrial Sections for CPRG.
D. Find and click on the measure in the table of contents. Record the page number, measure life, and number of measures in the lifetime savings measure line.
E. Calculate the weighted average of the measure lives of all measures using the measure life (MLife) and number of measures ($\#_M$) divided by the sum of all measures installed.

$$\boldsymbol{Measure\ Life} = \frac{(\boldsymbol{MLife_{M1} * \#_{M1}}) + (\boldsymbol{MLife_{M2} * \#_{M2}}) \ldots + (\boldsymbol{MLife_{Mn} * \#_{Mn}})}{\boldsymbol{Total\ Number\ of\ Measures\ Installed}}$$

3.3.3 Projection Input 2: Lifetime Energy Savings Model

For the second input into our emission reduction model, we once again tapped the historic data from the Green Cost Share Program. For solar, every project is forecasted for 25 years. For energy efficiency, we copied the distribution of measure life years from our Green Cost Share data to model how many projects will have a given life year in the model.



4. Estimating Air Emissions Reductions

4.1 Carbon Dioxide Emissions

To calculate Carbon Dioxide reductions, we pull from Xcel Energy Community Energy Reports, eGrid, and, for the purposes of long-term projection, the Energy Information Administration. Each of these emissions factors has different pros, cons, and uses as outlined in Table 4.

Table 4: Carbon Emissions Factors

Name	Source	Pro's	Con's
Community Energy Reports	Xcel Energy	Most Minneapolis Specific emissions factor, so the most accurate emissions factor.	Xcel does not project out the emissions factors in these reports. Only reports Carbon Dioxide emissions factors.
eGRID	U.S. EPA	Has emissions factors for Minnesota and for other greenhouse gases and some criteria air pollutants.	Does not project out the emissions factors. Specificity is limited to Minnesota as a whole.
Annual Energy Outlook	U.S. E.I.A.	Has emissions factors for other greenhouse gases and some criteria air pollutants. Projects emissions factors over multiple decades.	Specificity is limited to the entire Midcontinent West region. This includes many states with very different grid mixes and policies.

The Carbon Emissions factor between these sources differs significantly. In 2022 Xcel's emissions factor was 611 lbs./MWh. This is lower than the eGrid Minnesota specific rate (768 lbs./MWh), and significantly lower than the E.I.A MROW rate (870 lbs./MWh).

In the Green Cost Share they use the Carbon Emissions Factor reported by Xcel Energy. This emissions factor is the most accurate to projects happening in the City since it is specific to Xcel Energy's operations in Minnesota. Each year Green Cost Share staff save the new Xcel emissions factor into their database and cross calculate the emissions factor for a given year with the corresponding years' energy savings (from Section 2). However, as stated above, this is only done on an annual basis and not projected out into the future.

4.2 Other Air Pollutants

Since Xcel Energy does not report on other air emissions factors Green Cost Share staff use the U.S. Environmental Protection Agency's eGRID emissions factors. Like the Xcel Community Energy reports, EPA reports eGRID emissions factors annually for the previous year. Staff download a copy of the summary data tables and record the emissions factors in their database. Next, they use the energy savings projections (from Section 2) to calculate the estimated air pollution reduced each year when the new emissions factor is released.

NOTE: Since eGrid does not separate out emissions factors for electricity and gas usage we need to convert our therms of gas saved to megawatt hours in the cross-table calculation.

State	Total output emission rates (lb/MWh)						
	CO_2	CH_4	N_2O	CO_2e	Annual NO_x	Ozone Season NO_x	SO_2
MD	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ME	336.6	0.090	0.013	342.7	0.3	0.3	0.316
MI	1,009.3	0.095	0.014	1,015.7	0.7	0.7	0.756
MN	**768.2**	**0.082**	**0.012**	**773.8**	**0.5480**	**0.6**	**0.234**

Table title: 3. State Output Emission Rates (eGRID2022)

Overall, by combining the more accurate Carbon Dioxide emissions factor from the community energy reports with the other Minnesota Specific emissions factors for other air pollutants, staff end up with a reasonable estimate of emissions reductions from Green Cost Shae projects. Staff argue that these estimates are more accurate than using the eGrid emissions factors only since Carbon Dioxide Emissions are higher for all of Minnesota than Xcel Energy.

4.3 CPRG Modifications

To apply to the Climate Pollution Reduction Grants applicants are required to project out emissions reductions from multiple pollutants over many decades. This means projecting out the emissions factors over those same periods. As stated above neither of the currently used sources of emissions factors offer multi-decade projections.

4.3.1 Annual Energy Outlook | U.S. E.I.A.

The U.S. Energy Information Administration provides an energy outlook reporting tool. This tool allows users to input various assumptions (i.e. High vs. Low technology adoption scenarios) and see the impact over multiple decades. We worked with the Minnesota Pollution Control Agency (MPCA) to pull emissions factors using a high uptake scenario.

Unfortunately, this source is the least specific to projects in the metro. The MROW region includes multiple states with very different grid mixes and less ambitious carbon reduction policies than both Minnesota and the Minneapolis-Saint Paul metro. This works well for the MPCA since they have a view of the entire state, but using these emissions factors in Minneapolis would overestimate the total emissions reductions.

4.3.2. Projections Input 3: Emissions Factors

The image below shows the CO2 emissions projections from the Annual Energy Outlook provided by the MPCA.

A. We know that these emission factors are an overestimate for the Minneapolis-Saint Paul metropolitan area.
B. We know that we need additional emissions factors for other air pollutants for the CPRG application.
C. We believe that the carbon emissions factors and other emissions factors related to energy generation are highly correlated. Emission factors of methane, NO_x, N_2O, and SO_2 should change at relatively the same rate as the carbon emission factor.

Given these assertions we took the percent change in carbon emissions factors from the Annual Energy Outlook to project out the Minnesota specific eGrid emissions factors. Table 5 outlines the emissions factors we use based on this combination of emissions factors sources.

Year	Carbon Dioxide Emisisons (MMst)	Total Electricity Generation (BkWh)	Carbon Dioxide Emissions (MMT)	CO2 per generation (MMT/TWh = 1 Metric Ton / MWh)
2050	35.24003	253.4459	31.9698	0.1261
2049	34.76382	251.4181	31.5377	0.1254
2048	33.73315	252.5786	30.6027	0.1212
2047	33.2505	251.8522	30.1649	0.1198
2046	33.58945	252.0402	30.4723	0.1209
2045	33.2485	251.2611	30.163	0.1200
2044	33.24053	250.7645	30.1558	0.1203
2043	32.58873	249.4855	29.5645	0.1185
2042	32.13326	248.4087	29.1513	0.1174
2041	31.76171	248.0938	28.8142	0.1161
2040	31.01524	246.1364	28.137	0.1143
2039	30.40629	245.96	27.5846	0.1122
2038	28.96581	244.3105	26.2778	0.1076
2037	37.24937	247.2231	33.7926	0.1367
2036	36.35543	244.9158	32.9816	0.1347
2035	34.8012	242.4302	31.5716	0.1302
2034	34.92679	245.1624	31.6856	0.1292
2033	34.844	247.1854	31.6105	0.1279
2032	33.97866	250.0864	30.8254	0.1233
2031	32.70235	247.3684	29.6676	0.1199
2030	32.57092	245.5695	29.5483	0.1203
2029	35.14468	231.9925	31.8833	0.1374
2028	47.93321	225.6004	43.485	0.1928
2027	73.01955	212.6621	66.2433	0.3115
2026	82.15732	216.6351	74.5331	0.344
2025	89.79768	220.4372	81.4645	0.3696
2024	97.60178	224.7802	88.5443	0.3939
2023	91.20486	220.9298	82.741	0.3745
2022	98.31823	225.8818	89.1943	0.3949

Table 5: Proposed Emissions Factors

	MROW Emissions Rates			eGrid Emissions Rates Minnesota (lb.s/MWh)					
Year	CO2 (MT/MWh)	CO2 (lbs./Mwh)	Percent Change	CO2	CH4	N2O	CO2e	NOx	SO2
2022	0.3949	870.75	NA	768.20	0.082	0.012	773.80	0.548	0.234
2023	0.3745	825.77	-5.17%	728.52	0.078	0.011	733.83	0.520	0.222
2024	0.3939	868.55	5.18%	766.25	0.082	0.012	771.84	0.547	0.233
2025	0.3696	814.97	-6.17%	718.98	0.077	0.011	724.23	0.513	0.219
2026	0.3440	758.52	-6.93%	669.18	0.071	0.010	674.06	0.477	0.204
2027	0.3115	686.86	-9.45%	605.96	0.065	0.009	610.38	0.432	0.185
2028	0.1928	425.12	-38.11%	375.05	0.040	0.006	377.79	0.268	0.114
2029	0.1374	302.97	-28.73%	267.28	0.029	0.004	269.23	0.191	0.081
2030	0.1203	265.26	-12.45%	234.02	0.025	0.004	235.73	0.167	0.071
2031	0.1199	264.38	-0.33%	233.24	0.025	0.004	234.94	0.166	0.071
2032	0.1233	271.88	2.84%	239.86	0.026	0.004	241.60	0.171	0.073
2033	0.1279	282.02	3.73%	248.80	0.027	0.004	250.62	0.177	0.076
2034	0.1292	284.89	1.02%	251.33	0.027	0.004	253.17	0.179	0.077
2035	0.1302	287.09	0.77%	253.28	0.027	0.004	255.12	0.181	0.077
2036	0.1347	297.01	3.46%	262.03	0.028	0.004	263.94	0.187	0.080
2037	0.1367	301.42	1.48%	265.92	0.028	0.004	267.86	0.190	0.081
2038	0.1076	237.26	-21.29%	209.31	0.022	0.003	210.84	0.149	0.064
2039	0.1122	247.40	4.28%	218.26	0.023	0.003	219.85	0.156	0.066
2040	0.1143	252.03	1.87%	222.35	0.024	0.003	223.97	0.159	0.068
2041	0.1161	256.00	1.57%	225.85	0.024	0.004	227.50	0.161	0.069
2042	0.1174	258.87	1.12%	228.38	0.024	0.004	230.04	0.163	0.070
2043	0.1185	261.29	0.94%	230.52	0.025	0.004	232.20	0.164	0.070
2044	0.1203	265.26	1.52%	234.02	0.025	0.004	235.73	0.167	0.071
2045	0.1200	264.60	-0.25%	233.44	0.025	0.004	235.14	0.167	0.071
2046	0.1209	266.58	0.75%	235.19	0.025	0.004	236.90	0.168	0.072
2047	0.1198	264.16	-0.91%	233.05	0.025	0.004	234.75	0.166	0.071
2048	0.1212	267.25	1.17%	235.77	0.025	0.004	237.49	0.168	0.072
2049	0.1254	276.51	3.47%	243.94	0.026	0.004	245.72	0.174	0.074
2050	0.1261	278.05	0.56%	245.30	0.026	0.004	247.09	0.175	0.075

5. Projection Input 4: Number of Projects

The last input needed for our emissions reduction forecast is an estimate on how many projects the coalition partners can do with the amount of funding proposed in our CPRG application. To do this we did the following:

A. Calculated the average grant award (City Contribution) of the Green Cost Share project data, one average for efficiency projects, and one average for solar projects.
B. Multiplied the total budget request dedicated to project funding ($7,971,000) by our proposed project breakdown between solar and energy efficiency projects.
C. Divided the proposed budget for solar and energy efficiency by the average cost from step A.
D. Divided the total number of project by the number of years of our proposal (4).

Table 6: Estimated number of projects

Row	Metric	Total	Solar	Efficiency	Source
A	Budget Request_Non-Staff	$7,971,000	$1,594,200	$6,376,800	Row B * Total Budget
B	Percent of Budget	100%	20%	80%	CPRG proposal
C	Average City Contribution	$14,828	$23,259	$11,272	Program Data 21-23
D	Est. Projects_2025-2028	635	69	566	Row A / Row C
E	Est. Projects_annual (Rounded)	159	17	142	Row D / 4 years

6. Results

To estimate emissions reductions, we created a spreadsheet with three interconnected worksheets. Worksheet 1 is a solar projection, worksheet 2 is an efficiency projection, and worksheet 3 is our emissions factors. As a reminder the model includes inputs from…

Input 1: Median Annual Energy Savings	Section 2.2.3
Input 2: Lifetime energy savings distribution	Section 3.3.3
Input 3: Emissions Factors	Section 4.3.2
Input 4: Number of Projects per year	Section 5

6.1. Modeled Solar Lifetime Energy Savings

In worksheet 1 we projected out the lifetime energy savings for 69 identical solar projects. The table immediately below shows the inputs used.

Input 1: Median Annual Energy Savings	53,585 kWh
Input 2: Lifetime energy savings distribution	25 years
Input 4: Number of Projects per year	17 (69 total)

Each year between 2025 and 2028 we added 17 additional median solar projects. Each project produces 53,585 kWh in the first year. We then degraded the median solar production 0.5% a year for 24 years after the initial year (total measure life = 25). The result is a table of estimated kilowatt hour production for 69 identical solar projects based on the median energy savings for the Green Cost Share.

6.2. Modeled Energy Efficiency Lifetime Energy Savings

In worksheet 2 we projected out the lifetime energy savings for 568 energy efficiency projects. The table immediately below shows the inputs used.

Input 1: Median Annual Energy Savings	21,423 kWh
Input 2: Lifetime energy savings distribution	3-20 years
Input 4: Number of Projects per year	142 (568 total)

Each year between 2025 and 2028 we added 142 additional projects. Each project saves the median amount of energy (21,423) in its first year. However, unlike with solar projects, we did not give every project the same measure of life. We used the distribution in measure life from the Green Cost Share to give the 142 projects different measure lives, so although they all have the same median energy savings, they do not all save energy for the same number of years. Overall; 66% (94) had a life of 10-13 years, 11% (15) a life of 15, 10% (14) a life of 18-20, 11% (15) a life of 7-9, and the remaining 4% (4) a life of 3-6 years.

6.3. Energy Efficiency

We began by summing the energy savings from each year between 2025 and 2050. Next, we used a HLOOKUP function based on the year to multiply that total by the emissions factors for the corresponding year. We then summed the total emissions saved for each of the three emission types (CO2e, NOx, SO2) from 2025-2030 and 2025-2050. Finally, we divided those savings by the proposed solar and efficiency budget (see Table 7) to get our $/Metric ton number. Summary Table 2 contains the results of our projections.

Table 7: CPRG Emissions Projections Results	Solar	Efficiency
Metric Tons CO2e_2025-2030	3,049.25	10,159.28
$/metric ton CO2e_2025-2030	$523	$628
Metric Tons CO2e_2025-2050	10,336.62	20,125.11
$/metric ton CO2e_2025-2050	$154.23	$316.86
Metric Tons SO2 & NOx_2025-2030	3.08	10.25