Technical Manual for The Local Government Financial Analysis and Carbon Emissions Assessment Tool

Created by Tyler Swanson

Developed With the Support of The University of Michigan Graham Sustainability Institute, 2026 Catalyst Leadership Circle Fellowship, City of Rockford, Michigan, and Village of Milford, Michigan.

Originally Developed for The City of Rockford, Michigan and Village of Milford, Michigan

1st Edition

July 14, 2026

This material is based upon work supported by the Department of Energy and the Michigan Department of Environment, Great Lakes, and Energy (EGLE) under Award Number EE0008653. The views expressed herein do not necessarily reflect those of the United States Government or any agency thereof. Find this document and more about the CLC Fellowship that supported this project at graham.umich.edu/clcf.

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EVER FORWARD

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Table of Contents

A Note on Generative AI Use in Tool Development 4

About The Creator 4

1. Why Was This Tool Created? 5

2. What Does This Tool Do? 5

2.1 General Tool Function 6

2.2. The 'BACKEND' Sheet 7

2.3. The 'MEASURE' Sheets 10

2.4. The 'COMPARISON' Sheet 11

2.5. Revising for Future Analysis 13

Section 2.5 Table 1: Revising the Backend sheet 13

Section 2.5 Table 2: Revising the Measure sheets 14

Section 2.5 Table 3: Revising the Comparison sheet 15

2.6. Data Sources and Assumptions 15

2.7. Limitations 16

Appendix 16

Appendix Table 1 - "Categories" Table Inputs 16

Appendix Table 2 - "Categories" Table Input Explanations 21

Appendix Table 3 - "Energy_Type" Table Inputs 26

Appendix Table 4 - "Energy-Type" Table Input Explanations 27

Appendix Table 5 - "Emissions" Table Inputs 28

Appendix Table 6 - "Emissions" Table Input Explanations 28

Appendix Table 7 - "PV Calculations" Table Inputs 29

Appendix Table 8 - "PV Calculations" Table Input Explanations 30

Appendix Table 9 - "Carbon Emissions Calculations" Table Inputs 32

Appendix Table 10 - "Carbon Emissions Calculations" Table Input Explanations 33

Appendix Table 11 - Measure Sheet Functions 35

A Note on Generative AI Use in Tool Development

At the time of this tool's development, generative artificial intelligence (AI) is a rapidly emerging technology with highly disruptive potential. This note explains the type of and extent to which generative AI was utilized in developing the *Local Government Financial Analysis and Carbon Emissions Assessment Tool.*

Google's Gemini generative artificial intelligence platform was utilized in developing this tool. Google Gemini assisted with the following tasks in development:

- Initial scoping of the line items that must be considered in conducting financial analysis of energy efficiency measures.
- Identifying relevant excel functions that the tool uses to make calculations.
- Providing realistic sample data to verify the functionality of the tool.

Information provided by Google Gemini was verified by the tool's creator prior to its inclusion in the tool. The tool's ultimate user interface was designed by the creator.

About The Creator



This tool was created by Tyler Swanson. At the time of this tool's publication, Tyler is a Ph.D. student in the Department of Community Sustainability at Michigan State University. Tyler majors in Community Sustainability and Environmental Science & Policy and is pursuing a graduate certificate in community engagement. Tyler's research focuses on the intersection of rural community development and the renewable energy transition, studying how rural communities react to energy development and how such development may be designed to increase fairness to host communities. Tyler developed this tool as a member of the 2026 Catalyst Leadership Circle Fellowship hosted by the University of Michigan's Graham Sustainability Institute.

1. Why Was This Tool Created?

The *Local Government Financial Analysis and Carbon Emissions Assessment Tool* (hereafter referred to as "the tool") was initially designed for The City of Rockford, Michigan and Village of Milford, Michigan, though it is intended to be adaptable for local governments anywhere. The tool was created to support Rockford and Milford's sustainability efforts by providing a quick and easy tool for simultaneously comparing the financial viability and emissions reductions potential of a wide variety of sustainability initiatives related to scope 1 and 2 carbon emissions. At the time of writing, Rockford has a Sustainability and Climate Action Plan (S-CAP) with a goal of achieving net-zero emissions at the local level by 2050. Concurrently, Milford has an Energy Master Plan (EMP) that seeks to reduce energy consumption in city-owned buildings by 10% by 2030. While both municipalities have enacted plans to pursue sustainability, each lacks a dedicated local government employee for achieving the success of their plan. The City of Rockford's sustainability efforts are led by the Sustainability Committee (SusCom), a wholly volunteer group of city residents led by a nine-member board that directs committee strategy and liaises with the city government. The Village of Milford's efforts are led by the Assistant Village Manager. This tool is intended to assist both Rockford's SusCom and Milford's Assistant Village Manager to identify sustainability initiatives that have the highest financial viability and emissions reduction potential.

2. What Does This Tool Do?

The tool is one part of a larger deliverable package intended to provide Rockford and Milford with a plan that helps both municipalities begin a path toward achieving their sustainability goals. The City of Rockford specifically requested a tool that would help local stakeholders assess the financial viability and emissions reduction potential of a wide range of scope 1 and 2 emissions reduction measures. Emissions reduction measures included in this version of the tool include HVAC and electricity efficiency projects, electrification of vehicles and lawn maintenance equipment, renewable energy subscriptions, and on-site renewable energy generation. This tool is designed specifically for analyzing projects related to these measures; however, this technical manual will include instructions regarding the adaptation of the tool for assessing other projects.

First, this section will provide a general overview of how the tool is designed to function. The rest of this technical manual is dedicated to explaining the functionality of the tool. The manual begins with the 'BACKEND' sheet that houses the input line items necessary for calculation. Next, the manual covers the 'MEASURE' sheets where inputs on specific projects are entered to generate calculations. Then, the manual covers the 'COMPARISON' sheet where the calculations of all assessed measures are displayed next to each other for easy comparison. Finally, the manual covers instructions for adapting the tool for future project assessments.

2.1 General Tool Function

The tool is comprised of eight sheets: *Cover Sheet, Comparison, Measure A, Measure B, Measure C, Measure D, Measure E,* and *Backend*. This subsection provides a brief overview of each sheet's function, capability, and intended use. In-depth descriptions of sheet designs and formulae are covered in its respective subsection.

- The *Cover Sheet* provides basic information on the name of the tool, credits to developers, and the edition of the tool. The information on the cover sheet should only change if subsequent editions of the tool are published, and older versions of the tool will be archived, though still accessible, online.
- The *Comparison* sheet serves to automatically display comparisons between each of the sustainability measures that are considered in various *Measure* sheets. End users should not enter data in any cell except for the "Notes" column, which can be used to enter additional information about a project that is not accounted for in the financial analysis or carbon emissions assessment. End users may enter data into the *Measure* column if they wish to add more measures for comparison. Instructions on how to add new measurements to the tool are described in section 2.5.
- The *Measure* sheets are duplicates of each other. Each sheet allows an end user to analyze a single project. The first edition of this tool provides space for end users to compare up to five projects at a time (Measures A-E). Within each *Measure* sheet, an end user should only interact with the cells highlighted in orange or purple. The measure sheet uses the information input by the user to calculate a range of financial, energy, and carbon metrics, and key outputs of interest are automatically displayed on the *Comparisons* sheet.
    - A cell highlighted in purple indicates that it functions as a drop-down box. The measure sheets have five drop-down boxes.
        - The first box is for selecting the project category. The end user should select a project category that aligns most closely with the sustainability measure taking place.
        - The second box is for selecting the energy types that are relevant to the sustainability measure.
        - The third box is for selecting the carbon emissions metrics specific to each energy type.
        - The fourth box is for selecting the project category in the same way that the first box does. The difference with this box is that it determines what line items are displayed in the present value calculator rather than the line items that the end user needs to input.
        - The fifth and final box is also used to select the project category. This box determines what line items are displayed in the carbon emissions calculator.

  - A cell highlighted in orange indicates that the end user must input a value in the cell for the calculator to function. Cells requiring end-user input include:
    - Project name (Cell B2)
    - Project category-specific inputs (Cells C6:C38)
    - Adjustable variables (Cells M11, M13-M18)
- The *Backend* sheet provides the core infrastructure that the rest of the tool functions from. The sheet features five data tables, each corresponding with the options available in the drop-down boxes in the *Measure* sheets. These tables can be edited to add or remove new project type categories and to create new input features.

2.2. The 'BACKEND' Sheet

Basic Function

The *Backend* sheet contains five tables, each of which functions to allow customization of project inputs, energy metrics, and carbon metrics in the *Measure* sheets. Essentially, the *Backend* sheet is the infrastructure on which the rest of the tool runs.

Categories Table Design

Table 1 in the *Backend* sheet, "Categories" ranges from cells A2:F28. The table contains seven columns, with each corresponding to a particular type of energy emissions reduction strategy. The names of the columns are:

1. HVAC Efficiency Emissions Reduction Strategy (Scope 1)
2. Electrification of HVAC Emissions Reduction Strategy (Scope 1 and 2)
3. Vehicle Emissions Reduction Strategy (Scope 1)
4. Lawn Maintenance Emissions Reduction Strategy (Scope 1)
5. Electricity Efficiency Emissions Reduction Strategy (Scope 2)
6. Renewable Energy Subscription Emissions Reduction Strategy (Scope 2)
7. On-Site Electricity Generation Emissions Reduction Strategy (Scope 2)

Each column contains the same number of content categories, which are:

1. Current Asset Context
2. Energy Context

3. New Asset Cost Context (This is called "Subscription Details") for the "Renewable Energy Subscription Emissions Reduction Strategy"
4. New Asset Energy Efficiency Context
5. Emissions Factor Context

The inputs requested from each emissions reduction strategy in the table are listed in Appendix Table 1. Explanations of each input's inclusion in the table are included in Appendix Table 2.

Energy_Type Table Design

Table 2 in the *Backend* sheet, "Energy_Type" ranges from cells A33:D38. The table contains four columns, with each corresponding to a combination of energy sources that an emissions reduction strategy may affect. The names of the columns are:

1. Natural Gas Only
2. Electricity Only
3. Natural Gas & Electricity
4. Vehicle Fuel & Electricity

The rows of this table do not require any input from the end user. Rather, they are give context to automated calculations performed by the *Measure* sheets. The inputs requested from each emissions reduction strategy in the table are listed in Appendix Table 3. Explanations of the inputs are described in Appendix Table 4.

Emissions Table Design

Table 3 in the *Backend* sheet, "Emissions" ranges from cells A41:D45. Similar to the "Energy_Type" table, this table contains four columns, with each corresponding to the emission sources that a particular emissions reduction strategy may affect. The columns included in this table are:

1. Natural Gas Only
2. Electricity Only
3. Natural Gas & Electricity
4. Vehicle Fuel & Electricity

The rows of this table do not require any input from the end user. Rather, they give context to automated calculations performed by the *Measure* sheets. The inputs requested from each emissions reduction strategy in the table are listed in Appendix Table 5. Explanations of the inputs are described in Appendix Table 6.

PV Calculations Table Design

Table 4 in the *Backend* sheet, "PV Calculations" ranges from cell A49:G60. This table contains a the same columns as the "Categories' table:

1. HVAC Efficiency Emissions Reduction Strategy (Scope 1)
2. Electrification of HVAC Emissions Reduction Strategy (Scope 1 and 2)
3. Vehicle Emissions Reduction Strategy (Scope 1)
4. Lawn Maintenance Emissions Reduction Strategy (Scope 1)
5. Electricity Efficiency Emissions Reduction Strategy (Scope 2)
6. Renewable Energy Subscription Emissions Reduction Strategy (Scope 2)
7. On-Site Electricity Generation Emissions Reduction Strategy (Scope 2)

The rows of this table do not require any input from the end user. Rather, they give context to automated calculations performed by the *Measure* sheets. The inputs requested from each emissions reduction strategy in the table are listed in Appendix Table 7. Explanations of the inputs are described in Appendix Table 8.

Carbon Emissions Calculations Table Design

Table 4 in the *Backend* sheet, "PV Calculations" ranges from cell A49:G60. This table contains the same columns as the "Categories" and "PV Calculations" table:

1. HVAC Efficiency Emissions Reduction Strategy (Scope 1)
2. Electrification of HVAC Emissions Reduction Strategy (Scope 1 and 2)
3. Vehicle Emissions Reduction Strategy (Scope 1)
4. Lawn Maintenance Emissions Reduction Strategy (Scope 1)
5. Electricity Efficiency Emissions Reduction Strategy (Scope 2)
6. Renewable Energy Subscription Emissions Reduction Strategy (Scope 2)

7. On-Site Electricity Generation Emissions Reduction Strategy (Scope 2)

The rows of this table do not require any input from the end user. Rather, they give context to automated calculations performed by the *Measure* sheets. The inputs requested from each emissions reduction strategy in the table are listed in Appendix Table 9. Explanations of the inputs are described in Appendix Table 10.

2.3. The 'MEASURE' Sheets

The *Measure* sheets are the primary location for end users to enter information about a project. The current edition of the tool includes five measure sheets designated by letters A-E, allowing end users to compare up to five different emissions reduction measures simultaneously. While the measure sheets are designated with unique letters, the content of each sheet is identical to the others.

Using The Sheet

For best results, end users should only interact with cells highlighted in purple or orange. An end user may choose to edit other cells to further customize the tool to their needs, but note that this may result in pre-set functions not working, and the tool not performing as expected. Cells highlighted in yellow (Cells B6, G18, and G28) are drop-down selection cells. The following cells contain the following drop-down selections:

Cell B6 – Project Category Selection (Linked to "Categories" Table from *Backend* sheet)

Cell G18 – Energy Type Metrics of Interest Selection (Linked to "Energy_Type" Table from *Backend* sheet).

Cell G28 – Carbon Metrics of Interest Selection (Linked to "Emissions" Table from *Backend* sheet).

End users should select the drop-down option that best aligns with the emissions reduction strategy, energy type, and emissions associated with their project. Cells highlighted in orange (B2; C12:C15; C17:C22; C24:C28; C30:C33; C35:C38; M11, M13:M18) require input from the end user. The following cells require the following inputs. **Note that line items with an asterisk must be populated for the calculator to output the correct values.**

Cell B2 – Project Name (To be displayed on *Comparisons* sheet).

Cells C12:C15 – Current Asset Context Inputs

Cells C17:C22 – Energy Context Inputs

Cells C24: C28 – New Asset Cost Context Inputs

Cells C30:C33 – New Asset Energy Efficiency Context Inputs

Cells C35:C38 – Emissions Factor Context Inputs

Cells M11, M13:M18: - Adjustable Variable Inputs

As inputs are entered into each cell, the *Measure* sheet automatically uses the inputs to calculate the outputs of six key variables:

- Net Implementation Cost
- Net Present Value
- Return on Investment (ROI) Break-Even Point
- Total Lifetime Energy Savings
- Total MTCO2e Savings
- Cost Per MTCO2e Reduced

These outputs are displayed in the "Metrics of Interest" box comprising cells F9:I37. The "Metrics of Interest" box includes three sub-boxes that make the calculations for the key variables:

- Financial Metrics of Interest
- Energy Type Metrics of Interest
- Carbon Metrics of Interest

The content of the "Metrics of Interest" box relies on a range of functions that references both the inputs entered by the end user in the orange highlighted cells, and another set of calculations made in the "PV Calculation Timeline" box ranging from cells K22:AM35 and the "GHG Emissions Timeline" box ranging from cells K38:AM49. A description of the function type, code, and explanation of each function used in the *Measure* sheet is detailed in Appendix Table 11.

2.4. The 'COMPARISON' Sheet

The *Comparison* sheet is the primary sheet for comparing the analytical outputs of the different energy efficiency measures under consideration. Currently, the *Comparison* sheet is designed to compare between 5 measures simultaneously; however, it can be easily expanded to compare infinite measures. An explanation of how to expand the *Comparison* sheet is included in Table 3. This sheet

contains the "Measure Comparisons Sheet" table, which features 10 columns that highlight key information about each measure under analysis for easy comparison. The columns on the table are:

1. Measure
    a. This column lists the measure ID (ex. *Measure A*) and includes a hyperlink to the sheet referenced, allowing for easy navigation between measures.
2. Project Category
    a. This column contains an "=" function that sets each cell in the column equal to the project category selected in cell B6 of the corresponding measure sheet.
3. Project name
    a. This column contains an "=" function that sets each cell in the column equal to the project name entered in cell B2 of the corresponding sheet.
4. Subject of measurement
    a. This column contains an "=" function that sets each cell in the column equal to the name of the asset under analysis entered in cell C12 of the corresponding sheet.
5. Net Implementation Cost
    a. This column contains an "=" function that sets each cell in the column equal to the net implementation cost calculated in cell H13 of the corresponding sheet.
6. Net Present value
    a. This column contains an "=" function that sets each cell in the column equal to the net present value calculated in cell H14 of the corresponding sheet.
7. ROI Break-Even Point
    a. This column contains an "=" function that sets each cell in the column equal to the net present value calculated in cell H15 of the corresponding sheet.
8. Lifetime MtCO2e Savings
    a. This column contains an "=" function that sets each cell in the column equal to the lifetime MtCO2e savings calculated in cell H34 of the corresponding sheet.
9. Cost per MtCO2e Savings

a. This column contains an "=" function that sets each cell in the column equal to the cost per MtCO2e savings calculated in cell H35 of the corresponding sheet.

10. Notes
    a. This is a column where end users can input notes about a project that they want to keep in mind when comparing different measures.

Once the table is populated with data, the sheet will automatically create comparative bar charts displaying the net present value, break-even point, and net implementation cost of the projects listed on the sheet.

2.5. Revising for Future Analysis

This tool is designed with adaptability in mind, and its capabilities can be expanded with relatively little effort. Table 1 contains instructions on how to revise the *Backend* sheet. Table 2 contains instructions on how to revise the *Measure* sheets. Table 3 contains instructions on how to revise the *Comparison* sheet.

Section 2.5 Table 1: Revising the Backend sheet

Function	How to
Change Cell Content	First, click once on the cell that you want to change. Second, press the "Backspace" key on your keyboard to clear the cell. Third, Enter the new line item text you wish to include.
Insert a new table row	First, determine where you want the new row to be located in the table. Second, right click on the row number directly below where you want to add the new row. Third, select Insert on the menu that appears near the cursors. (Note that this may cause formatting changes in the *Measure* sheets since a new row has been added to the table. To avoid formatting errors, you can add a new row at the bottom of the table. To do this, instead of right clicking on the number of the row to access the Insert button, click and drag your cursor over the bottom row of all columns in the table, then select right click. Now, the insert button will have an arrow next to it. Hovering over that arrow will give you the option to add a row below, and will thus add a new row to the table.
Deleting a row	Deleting a row is not advised, as it can cause similar formatting issues in the *Measures* sheet to those caused by adding a new row. Instead, consider clearing the cell content.
Adding a column	First, right click on the table column header directly to the right of where you want the column to go. Second, click the "Insert Column to The Left" button. A new column will appear. Give the column a name using the same conventions of the other columns and fill the table with line items according to the conventions used by the other table columns.

Section 2.5 Table 2: Revising the Measure sheets

Function	How to
Add new line items to the "Category-Specific Input" Box	This function is not performed in the *Measure* sheet. To revise line items of this box, reference Section 2.5 Table 1.
Add new line items to the "Energy Type Metrics of Interest" or "Carbon Metrics of Interest" sections of the "Metrics of Interest" Box.	This function is not performed in the *Measure* sheet. To revise line items of this box, reference Section 2.5 Table 1. Note that if every time new line item is added to the "Energy_Type" table, a row will have to be entered between the energy type metrics of interest and carbon metrics of interest sections to keep the "Energy_Type" table from spilling onto the Carbon Metrics of Interest section. To do this, select cell G27 "Carbon Metrics of Interest", click with your mouse, and select insert. Choose the "Shift cells d own" option on the popup box that appears and click "OK"
Add new financial metrics of interest	First, determine where you want the new line item to be located. Second, highlight the "Metric" and "Value" cells directly below where you want the new line item to be located (you can highlight the two blank cells below the ROI Break -Even Point if you want the new line item to be at the bottom). Third, click with your mouse and select insert, then select "Shift cells down" and "OK" when the popup box appears.
Add a new value formula to a line item.	First, determine what you want the new line item to do. Second, reference Appendix Table 7 to determine whether a similar function exists in the sheet. If a similar function exists, copy it to the new value cell and tailor it to your needs, making sure to reference correct cells. If a similar function is not listed in the Appendix, you can use a google research or generative AI program to help you determine the excel function that will perform the calculations you seek or consult with me.
Add a new variable to the "Adjustable Variables" box.	First, determine what new variable you want to add, and what line-item inputs it relates to. Second, determine where to locate the variable. Note that I do not recommend adding rows to the "Adjustable Variables" box, as this can cause shifts in the timeline below that break its function. I advise adding variables and values in columns to the right of the existing "Adjustable Variables" box or adding them below the "Timeline" box. Third, be sure to include the new adjustable variable as a referenced cell in the line-item value it will affect.
Add a new row to the "Timeline" box.	First, determine what the new row will calculate, and what metric value it relates to. All rows in the "Timeline" box should relate to a key output in the "Metrics of Interest" box. Second, Click and drag from cells L33:AL33 to highlight them, then right click and select insert. Then select "Shift cells down" and "OK" when the pop-up box appears. Reference Appendix Table 7 to understand

	the conventional logic for "Timeline" Box functions and ensure it is properly applied to your new calculation.
Add a new *Measure* sheet	First, click on any *Measure* sheet. Second, click "Move or Copy" in the box that appears with your cursor. Third, select the sheet that you want the new measure sheet to appear directly before in the excel file. Fourth, select the "Create a copy" checkbox and click "OK"

Section 2.5 Table 3: Revising the Comparison sheet

Function	How to
Link a new *Measure* sheet	First, type the sheet name in the *Measure* column and press the "Enter" key on your keyboard. Second, click on the cell containing the new measure sheet name and select "link" from the menu. Third, select "Place in this document" on the left side of the pop-up menu. Fourth, select the corresponding sheet name in list and select "OK"
Add a new row to the "Measure Comparisons Sheet" Table	First, highlight the row of cells in the table directly below where you want the new row to be. Second. Right click and select insert, then select "insert row above". Make sure the proper functions are included in each column by referencing section 2.4.
Add a new column to the "Measure Comparisons Sheet" Table	First, select the table column header directly to the right where you want the new column to be located. Second, click on the right and select "insert" then "Table column(s) to the left".
Add a new function to the table.	First, reference section 2.4 to see how the existing functions were created. This table should not feature any functions that require input on the Comparison sheet. All input should be made on the Measure sheet.

2.6. Data Sources and Assumptions

All data on emissions factors is gathered from the United States Environmental Protection Agency's Greenhouse Gas Emissions Calculator: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

The Social Cost of Carbon is gathered from Rennert et al. (2025): https://www.rff.org/publications/explainers/social-cost-carbon-101/

The price escalation percentages are just hypothetical but can be estimated using data from the United States Energy Information Administration or by looking at utility cost changes for the building over time.

2.7. Limitations

This tool is intended to be user friendly and adaptable to the needs of any end user. However, limitations to the tool's use do exist. First, accurately calculating the metrics of interest requires an accurate estimate of how much energy consumption will be avoided by a project. Obtaining an accurate estimate can be difficult, especially if the end user has limited capacity to conduct a thorough benchmarking assessment. One workaround to this limitation is to use measure sheets to generate estimates of different savings scenarios. An end user could test a high, low, and medium savings scenario based on online research or estimates from the project installer.

Another limitation to this model is that it does not currently include a mechanism for assessing projects that require financing. While this will not be a limitation for end users who are not financing their projects, it may hinder the utility for end users who are considering taking out loans to finance a project. End users can work around this limitation by referencing section 2.5 and revising the tool to meet their needs.

Appendix

Appendix Table 1 - "Categories" Table Inputs

Note: An "X" denotes that the line item is a required input for calculating financial viability and carbon emissions reduction for the emissions reduction strategy it is associated with.

		Emissions Reduction Strategy						
	Line Item	HVAC Efficiency	HVAC Electrification	Vehicle Emissions	Lawn Maintenance	Electricity Efficiency	Renewable Energy Subscription	On-Site Electricity Generation
Current Asset Context	Building Name	X	X			X		X
	Building Construction Year	X	X			X		
	Building Square Footage	X	X			X		
	Fleet Segment/Vehicle ID(s)			X				
	Model Year			X				
	Vehicle Class			X				
	Equipment Type				X			
	Equipment Quantity				X			
	Baseline Annual Operating Hours				X			
	Technology Type							X
	System Size (kW DC)							X
	Current Asset Annual Pre-Construction O&M Costs	X	X	X	X	X		X

Energy Context	Past 36 months Total Building Natural Gas Consumption	X	X					
	Per/Mcf Natural Gas Bill Costs ($)	X	X					
	Past 36 Months Total Building Electricity Consumption (kWh)	X	X			X		
	Per/kWh Electricity Bill Cost ($)	X	X	X	X	X		X
	Demand Charges ($/kW) (if applicable)	X	X	X	X	X		X
	Annual Miles Traveled per Vehicle			X				
	Current Vehicle Fuel Economy (MPG)			X				
	Average Price per Gallon of Gasoline ($)			X	X			

	Average Price per Gallon of Diesel			X	X			
	Current Fuel Consumption Rate (gallons/hour				X			
	Fixed Interconnection Costs ($)							X
	Expected Annual Production (kWh)							X
New Asset Cost Context (Subscription Details)	New Asset Cost (Total) ($)	X	X			X		X
	New Asset Cost – Vehicle ($)			X				
	New Asset Cost - Charging Infrastructure ($)			X	X			
	New Asset Cost – Maintenance Tool ($)				X			
	Total Project Labor Cost ($)	X	X			X		X

	Total Project Rebates ($)	X	X	X	X	X		X
	New Asset Annual Post-Construction O&M Costs ($)	X	X	X	X	X		X
	Total Annual kWh Subscribed						X	
	Per/kWh Subscription Price						X	
New Asset Energy Efficiency Context	Expected Annual Mcf Avoided	X	X					
	Expected Annual kWh Avoided	X				X		
	Expected Annual kWh Added		X	X	X			
	Expected Annual Fuel Gallons Avoided			X	X			
	New Vehicle Efficiency (kWh per mile)			X				
	New Tool Task Efficiency				X			

	(Minutes per watt-hour							
	Useful Life (Years)	X	X	X	X	X	X	X
Emissions Factor	Natural Gas – 1 Mcf of Natural Gas = 0.055 MTCO2e	X	X	X	X	X		X
Emissions Factor	Electricity – 1 Gal. Gasoline = 0.009 MTCO2e	X	X	X	X	X	X	X
	Gasoline – 1 Gal. Gasoline = 0.009 MTCO2e			X	X			
	Diesel – 1 Gal Diesel = 0.008 MTCO2e			X	X			

Appendix Table 2 - "Categories" Table Input Explanations

Current Asset Context	Building Name	This input does not factor in any of the calculations made on the *MEASURE* sheets. However, the *COMPARISON* sheet references this input to allow for comparisons of different measures applied to the same building or comparisons of the same measure applied to different buildings.
	Building Construction Year	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.

	Building Square Footage	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
	Fleet Segment/Vehicle ID(s)	This input does not factor in any of the calculations made on the *MEASURE* sheets. However, the *COMPARISON* sheet references this input to allow for comparisons of different measures applied to save the fleet or vehicle or comparisons of the same measure applied to different fleets or vehicles.
	Model Year	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
	Vehicle Class	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
	Equipment Type	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
	Equipment Quantity	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
	Baseline Annual Operating Hours	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
	Technology Type	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
	System Size (kW DC)	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
	Current Asset Annual Pre-Construction O&M Costs	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
Energy Context	Past 36 months Total Building Natural Gas Consumption	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.

	Per/Mcf Natural Gas Bill Costs ($)	This input is used to calculate the annual natural gas savings yielded by an energy efficiency project.
	Past 36 Months Total Building Electricity Consumption (kWh)	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
	Per/kWh Electricity Bill Cost ($)	This input is used to calculate the annual electricity savings yielded by an energy efficiency project.
	Demand Charges ($/kW) (if applicable)	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
	Annual Miles Traveled per Vehicle	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
	Current Vehicle Fuel Economy (MPG)	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
	Average Price per Gallon of Gasoline ($)	This input is used to calculate the annual gasoline savings yielded by an energy efficiency project.
	Average Price per Gallon of Diesel	This input is used to calculate the annual diesel savings yielded by an energy efficiency project.
	Current Fuel Consumption Rate	This input is used to calculate the annual diesel savings yielded by an energy efficiency project.

	(gallons/hour_	
	Fixed Interconnection Costs ($)	This input is used to calculate the implementation costs of on-site electricity generation measures.
New Asset Cost Context	New Asset Cost (Total) ($)	This input is used to calculate the implementation costs for measures relating to HVAC, electricity efficiency, and on-site electricity generation. This value should equal the total cost of the asset itself, but not any labor associated with its installation or operation.
	New Asset Cost – Vehicle ($)	This input is used to calculate the implementation costs for measures relating to vehicles.
	New Asset Cost - Charging Infrastructure ($)	This input is used to calculate the implementation costs for measures relating to vehicle and lawn maintenance equipment. s. This value should represent infrastructure such as batteries, battery chargers, or related infrastructure that is not the vehicle or equipment itself.
	New Asset Cost – Maintenance Tool ($)	This input is used to calculate the implementation costs for measures relating to lawn maintenance equipment.
	Total Project Labor Cost ($)	This input is used to calculate the implementation costs for measures relating to HVAC, electricity efficiency, and on-site electricity generation. This input should reflect the total cost of the labor used for installing new upgrades but should not reflect operation and maintenance labor costs.
	Total Project Incentives ($)	This input should equal the sum of all rebates, grants, or other cost reductions associated with the measure under consideration.
	New Asset Annual Post-Construction O&M Costs ($)	This input applies to all energy efficiency measures. The input should equal the sum of all costs that are related to operating and maintaining the new energy efficiency measure in a year. This input is used to calculate the Net Present Value and Return on Investment Break-Even Point.

	Total Annual kWh Subscribed	This input only applies to projects where the end user is considering subscribing to a renewable energy program offered by a solar developer, energy utility, or other company. This input should equal the total kilowatt-hours (kWh) of renewable energy that the end-user's agency is purchasing on an annual basis.
	Per/kWh Subscription Price	This input only applies to projects where the end user is considering subscribing to a renewable energy program offered by a solar developer, energy utility, or other company. This input should equal the price per kilowatt-hour (kWh) above the normal electricity price that the end-user's agency is being charged for participating in a renewable energy subscription program.
New Asset Energy Efficiency Context	Expected Annual Mcf Avoided	This input applies to HVAC efficiency and electrification measures. The input value is used to calculate the annual cost savings from avoided natural gas consumption and the total carbon emissions reduced by the measure.
	Expected Annual kWh Avoided	This input applies to HVAC efficiency and electricity efficiency measures. The input value is used to calculate the annual cost savings from avoided electricity consumption and the total carbon emissions reduced by the measure.
	Expected Annual kWh Added	This input applies to HVAC electrification, vehicle, and lawn maintenance efficiency measures. The input value is used to calculate the annual increase in electricity costs and emissions that will result from the measure, as each of these measures generally involves a fuel switch to electricity.
	Expected Annual Fuel Gallons Avoided	This input applies to vehicle and lawn maintenance equipment measures. The input value is used to calculate the annual cost savings from avoided gasoline or diesel consumption, and the total carbon emissions reduced by the measure.
	New Vehicle Efficiency (kWh per mile)	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
	New Tool Task Efficiency (Minutes per watt-hour	This input does not currently have a use in the spreadsheet. It is retained for future iterations of the spreadsheet.
	Expected Annual kWh Generation	This input applies to on-site electricity generation measures. The input value is used to calculate the annual cost savings from avoided electricity consumption, and the total carbon emissions reduced by the measure.

	Useful Life (Years)	This input applies to all energy efficiency measures. The input value is used to calculate the Net Present Value, Return on Investment Break-Even Point, Lifetime Energy Savings, and Total MTCO2e Savings of the measure.
Emissions Factor	Natural Gas – 1 Mcf of Natural Gas = 0.055 MTCO2e	This input applies to HVAC efficiency and HVAC electrification measures. The input value should always equal 0.055, as stated in the line item.
	Electricity - 1 kWh of Electricity = 0.0008 MTCO2e	This input applies to all energy efficiency measures. The value listed in the line item applies to end users in Rockford, Michigan and Milford, Michigan. End users from other locations should utilize the EPA's Greenhouse Gas Emissions Calculator to determine their electricity emissions factor: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results
	Gasoline – 1 Gal. Gasoline = 0.009 MTCO2e	This input applies to vehicle and lawn maintenance equipment measures. The input value should always equal 0.009, as stated in the line item.
	Diesel – 1 Gal Diesel = 0.008 MTCO2e	This input applies to vehicle and lawn maintenance equipment measures. The input value should always equal 0.008, as stated in the line item.

Appendix Table 3 - "Energy_Type" Table Inputs

Line Item	Energy Type			
	Natural Gas Only	Electricity Only	Natural Gas & Electricity	Vehicle Fuel & Electricity
Annual Natural Gas Savings – Year 1 Baseline	X		X	

Annual Electricity Savings – Year 1 Baseline		X	X	
Annual Added Electricity Costs – Year 1 Baseline			X	X
Annual Gasoline Savings – Year 1 Baseline				X
Annual Diesel Savings – Year 1 Baseline				X

Appendix Table 4 - "Energy_Type" Table Input Explanations

Line Item	Explanation
Annual Natural Gas Savings – Year 1 Baseline	This line item is associated with an automatic calculation in the *Measure* sheets. The data associated with this item will display the dollar value of expected natural gas savings in year 1 of the project.
Annual Electricity Savings – Year 1 Baseline	This line item is associated with an automatic calculation in the *Measure* sheets. The data associated with this item will display the dollar value of expected electricity savings in year 1 of the project.
Annual Added Electricity Costs – Year 1 Baseline	This line item is associated with an automatic calculation in the *Measure* sheets. The data associated with this item will display the dollar value of expected additional electricity costs in year 1 of the project.
Annual Gasoline Savings – Year 1 Baseline	This line item is associated with an automatic calculation in the *Measure* sheets. The data associated with this item will display the dollar value of expected gasoline savings in year 1 of the project.
Annual Diesel Savings – Year 1 Baseline	This line item is associated with an automatic calculation in the *Measure* sheets. The data associated with this item will display the dollar value of expected diesel savings in year 1 of the project.

Appendix Table 5 - "Emissions" Table Inputs

Line Item	Energy Type			
	Natural Gas Only	Electricity Only	Natural Gas & Electricity	Vehicle Fuel & Electricity
Natural Gas Emissions – Year 1 Baseline	X		X	
Annual Electricity Savings – Year 1 Baseline		X	X	
Electricity Grid Emissions – Year 1 Baseline			X	X
Gasoline Emissions – Year 1 Baseline				X
Diesel Emissions – Year 1 Baseline				X

Appendix Table 6 - "Emissions" Table Input Explanations

Line Item	Explanation
Natural Gas Emissions – Year 1 Baseline	This line item is associated with an automatic calculation in the *Measure* sheets. The data associated with this item will display expected MTCO2e emissions reductions in year 1 of the project.
Annual Electricity Savings – Year 1 Baseline	This line item is associated with an automatic calculation in the *Measure* sheets. The data associated with this item will display expected MTCO2e emissions reductions in year 1 of the project.
Electricity Grid Emissions – Year 1 Baseline	This line item is associated with an automatic calculation in the *Measure* sheets. The data associated with this item will display expected MTCO2e emissions reductions in year 1 of the project.
Gasoline Emissions – Year 1 Baseline	This line item is associated with an automatic calculation in the *Measure* sheets. The data associated with this item will display expected MTCO2e emissions reductions in year 1 of the project.

Diesel Emissions – Year 1 Baseline	This line item is associated with an automatic calculation in the *Measure* sheets. The data associated with this item will display expected MTCO2e emissions reductions in year 1 of the project.

Appendix Table 7 - "PV Calculations" Table Inputs

Line Item	HVAC Efficiency	Electrification of HVAC	Vehicle Emissions	Lawn Maintenance Emissions	Electricity Efficiency	Renewable Energy Subscription	On-Site RE Generation
Initial Cost	X	X	X	X	X	X	X
Annual Natural Gas Savings ($)	X	X					
Annual Electricity Savings ($)	X	X			X	X	X
Annual Gasoline Savings ($)			X	X			
Annual Diesel Savings ($)			X	X			
Annual Added Electricity Costs ($)		X	X	X		X	
Annual O&M Costs ($)	X	X	X	X	X		X
Net Cash Flow ($)	X	X	X	X	X	X	X
Cumulative Net Cash Flow	X	X	X	X	X	X	X

Present Value (PV) of Cash Flow	X	X	X	X	X	X	X
Cumulative Project Value (NPV)	X	X	X	X	X	X	X

Appendix Table 8 - "PV Calculations" Table Input Explanations

Line Item	Explanation
Initial Cost	This value is dependent on the net implementation cost displayed in cell H13. The cells in the table also contain an =IF function that checks to see the project year. Since these are initial costs, the value is only displayed in project year 0 as a negative number. For all other years, the value of the cell is equal to 0.
Annual Natural Gas Savings ($)	This value represents the total dollar value of natural gas savings that is expected to come from the emissions reduction strategy. The value in this row will always equal 0 in year 0 of the project, as the project is assumed to not yet be operational. In year 1, the value of the cell is equal to the value calculated in cell H20, as that is the year 1 baseline for natural gas savings. In year 2, the value of the cell switches to an =IF function that first checks to see whether cell is within the project lifespan. If the cell is outside of the project lifespan, it will return a blank value. If the cell is within the project lifespan, it will multiply the previous year's cell value by (1+$M$13) where M13 equals the Annual Per/Mcf Natural Gas Price Escalation.
Annual Electricity Savings ($)	This value represents the total dollar value of electricity savings that is expected to come from the emissions reduction strategy. The value in this row will always equal 0 in year 0 of the project, as the project is assumed to not yet be operational. In year 1, the value of the cell is equal to the value calculated in cell H21, as that is the year 1 baseline for electricity savings. In year 2, the value of the cell switches to an =IF function that first checks to see whether cell is within the project lifespan. If the cell is outside of the project lifespan, it will return a blank value. If the cell is within the project lifespan, it will multiply the previous year's cell value by (1+$M$14) where M14 equals the Annual Per/kWh Electricity Price Escalation.
Annual Gasoline Savings ($)	This value represents the total dollar value of gasoline savings that is expected to come from the emissions reduction strategy. The value in this row will always equal 0 in year 0 of the project, as the project is assumed to not yet be operational. In year 1, the value of the cell is equal to the value calculated in cell H23, as that is the year 1 baseline for gasoline savings. In year 2, the value of the cell switches to an =IF function that first checks to see whether cell is within the project lifespan. If the cell is outside of the project lifespan, it will return a blank value. If

	the cell is within the project lifespan, it will multiply the previous year's cell value by (1+$M$16) where M16 equals the Annual Per/Gal Gasoline Price Escalation.
Annual Diesel Savings ($)	This value represents the total dollar value of diesel savings that is expected to come from the emissions reduction strategy. The value in this row will always equal 0 in year 0 of the project, as the project is assumed to not yet be operational. In year 1, the value of the cell is equal to the value calculated in cell H24, as that is the year 1 baseline for diesel savings. In year 2, the value of the cell switches to an =IF function that first checks to see whether cell is within the project lifespan. If the cell is outside of the project lifespan, it will return a blank value. If the cell is within the project lifespan, it will multiply the previous year's cell value by (1+$M$15) where M15 equals the Annual Per/Gal Diesel Price Escalation.
Annual Added Electricity Costs ($)	This value represents the total dollar value of added electricity costs that is expected to come from the emissions reduction strategy. The value in this row will always equal 0 in year 0 of the project, as the project is assumed to not yet be operational. In year 1, the value of the cell is equal to the value calculated in cell H22, as that is the year 1 baseline for annual added electricity costs. In year 2, the value of the cell switches to an =IF function that first checks to see whether cell is within the project lifespan. If the cell is outside of the project lifespan, it will return a blank value. If the cell is within the project lifespan, it will multiply the previous year's cell value by (1+$M$14) where M14 equals the Annual Per/kWh Electricity Price Escalation.
Annual O&M Costs ($)	This value represents the annual operations and maintenance costs that will arise from the new emissions reduction strategy. The value in this row will always equal 0 in year 0 of the project, as the project is assumed to not yet be operational. For future years, all values are calculated using an =IF and SUMIFS function. First, the cell checks to see that it is still within the project lifespan. If not, the cell returns a blank value. If so, the cell searches the input table to find the Post-Construction O&M Costs line-item and enter the value into the cell.
Net Cash Flow ($)	All values in this row are calculated using an =IF and SUM function First, the cell checks to see that it is still within the project lifespan. If not, the cell returns a blank value. If so, the cell makes the following calculation: M24 + (SUM(M25:M28)-SUM(M29:M30))) Where M24 = Initial Cost; M25:M28 = Annual Natural Gas, Electricity, Gasoline, and Diesel Savings; and M29:M30 = Annual Added Electricity and O&M Costs.
Cumulative Net Cash Flow	The value of the cell in this row corresponding with year 0 is equal to the initial cost. After year 0, the value of the cell is calculated by adding the current year's net cash flow to the previous year's cumulative cash flow. This results in a buildup of net cash flow over the life of the project.
Present Value (PV) of Cash Flow	The value of the cell in this row corresponding with year 0 is equal to the initial cost. After year 0, the value of the cell is calculated using an =IF function. function First, the cell checks to see that it is still within the project lifespan. If not, the cell returns a blank value. If so, the cell makes the following calculation: (Column)31 / (1+

	$M$11)^(Column)23. Where (Column)31 is the Net Cash Flow for the year corresponding with the cell being calculated, M11 is the discount rate, and (Column)23 is the year for which the cell is being calculated.
Cumulative Project Value (NPV)	The value of the cell in this row corresponding with year 0 is equal to the initial cost. After year 0, the value of the cell is calculated by adding the current year's PV of Cash Flow to the previous year's Cumulative NPV Cash Flow. This results in a buildup of net cash flow over the life of the project.

Appendix Table 9 - "Carbon Emissions Calculations" Table Inputs

Line Item	HVAC Efficiency	Electrification of HVAC	Vehicle Emissions	Lawn Maintenance Emissions	Electricity Efficiency	Renewable Energy Subscription	On-Site RE Generation
Annual GHG Emissions Avoided (MtCO2e)	X	X	X	X	X	X	X
Value of Annual GHG Emissions Avoided ($)	X	X	X	X	X	X	X
Annual GHG Emissions Added (MtCO2e)		X	X	X			
Value of Annual GHG Emissions Added ($)		X	X	X			
Net Annual GHG Emissions	X	X	X	X	X	X	X

Avoided (MtCO2e)							
Net Value of Annual GHG Emissions Avoided ($)	X	X	X	X	X	X	X
Cumulative GHG Emissions Avoided (MtCO2e)	X	X	X	X	X	X	X
Cumulative Value of GHG Emissions Avoided ($)	X	X	X	X	X	X	X
Cumulative PV of GHG Emissions Avoided	X	X	X	X	X	X	X

Appendix Table 10 - "Carbon Emissions Calculations" Table Input Explanations

Line Item	Explanation
Annual GHG Emissions Avoided (MtCO2e)	This value will always equal 0 in year 0 of a project, as no GHG emissions have been avoided at that time. In year 1, the value will always equal the total annual GHG emission reductions from the "Carbon Metrics of Interest" Table. After year 1, an =IF function will check to determine whether the cell is within the project lifespan. If not, the cell will return a blank value. If so, the function will multiply the previous year's Annual GHG Emissions Avoided by (1-$M$18) where M18 equals the annual rate of decarbonization of the electric grid.
Value of Annual GHG Emissions Avoided ($)	This value will always equal 0 in year 0 of a project, as no GHG emissions have been avoided at that time. In year 1, the value will always equal the total annual GHG emission reductions from the "Carbon Metrics of Interest" Table multiplied by the social cost of carbon value in cell M17. After year 1, an =IF function will check to determine whether the cell is within the project lifespan. If not, the cell will return a blank value. If so, the function

	will multiply the current year's Annual GHG Emissions Avoided by M17 where M17 equals the social cost of carbon.
Annual GHG Emissions Added (MtCO2e)	This value will always equal 0 in year 0 of a project, as no GHG emissions have been added at that time. In year 1, the value will always equal the total annual GHG emission additions from the "Carbon Metrics of Interest" Table. After year 1, an =IF function will check to determine whether the cell is within the project lifespan. If not, the cell will return a blank value. If so, the function will multiply the previous year's Annual GHG Emissions Added by (1-$M$18) where M18 equals the annual rate of decarbonization of the electric grid.
Value of Annual GHG Emissions Added ($)	This value will always equal 0 in year 0 of a project, as no GHG emissions have been added at that time. In year 1, the value will always equal the total annual GHG emission additions from the "Carbon Metrics of Interest" Table multiplied by the social cost of carbon value in cell M17. After year 1, an =IF function will check to determine whether the cell is within the project lifespan. If not, the cell will return a blank value. If so, the function will multiply the current year's Annual GHG Emissions Added by M17 where M17 equals the social cost of carbon.
Net Annual GHG Emissions Avoided (MtCO2e)	This value will always equal 0 in year 0 of a project, as no GHG emissions have been added at that time. After year 0, an =IF function will check to determine whether the cell is within the project lifespan. If not, the cell will return a blank value. If so, the function will subtract the total GHG emissions added from the total GHG emissions avoided.
Net Value of Annual GHG Emissions Avoided ($)	This value will always equal 0 in year 0 of a project, as no GHG emissions have been added at that time. After year 0, an =IF function will check to determine whether the cell is within the project lifespan. If not, the cell will return a blank value. If so, the function will subtract the total value of GHG emissions added from the total value GHG emissions avoided.
Cumulative GHG Emissions Avoided (MtCO2e)	This value will always equal 0 in year 0 of a project, as no GHG emissions have been added at that time. In year 1, the value is equal to the net annual GHG emissions avoided in year 1. After year 1, an =IF function will check to determine whether the cell is within the project lifespan. If not, the cell will return a blank value. If so, the cell adds the current year's net annual GHG emissions avoided to the previous year's cumulative GHG emissions avoided.
Cumulative Value of GHG Emissions Avoided ($)	This value will always equal 0 in year 0 of a project, as no GHG emissions have been added at that time. In year 1, the value is equal to the net value of annual GHG emissions avoided in year 1. After year 1, an =IF function will check to determine whether the cell is within the project lifespan. If not, the cell will return a blank value. If so, the cell adds the current year's net value of annual GHG emissions avoided to the previous year's cumulative value of GHG emissions avoided.
Cumulative PV of GHG	This value will always equal 0 in year 0 of a project, as no GHG emissions have been added at that time. After year 0, an =IF function will check to determine whether the cell is within the project lifespan. If not, the cell will return

Emissions Avoided	a blank value. If so, the current year's cumulative value of GHG emissions avoided is divided by (1+$M$11)^(Project Year) where M11 equals the discount rate.

Appendix Table 11 - Measure Sheet Functions

Cell	Related Line Item	Unit Type	Function Type
H13	Net Implementation Cost	Dollars ($)	SUMIF
Function Code			
=SUMIF(B11:B596, "*New Asset Cost*", C11:C596) + SUMIF(B11:B596, "*Labor Cost*", C11:C596) + SUMIF(B11:B596, "*Interconnection*", C11:C596) + SUMIF(B11:B596, "*Cost - Vehicle*", C11:C596) + SUMIF(B11:B596, "*Cost - Charging Infrastructure*", C11:C596) + SUMIF(B11:B596, "*Cost - Maintenance*", C11:C596) - SUMIF(B11:B596, "*Incentives*", C11:C596)			
Explanation of Function			
This function is intended to add all potential project implementation costs, while subtracting the dollar value of any incentives that reduce the project cost. Specifically, the function searches Column B for the New Asset, Labor, Vehicle, Charging Infrastructure, and Maintenance tool costs, as well as the Incentives value. When a cell matching the line item searched for is found, the function adds the value associated with that line item to the equation. If the line item is not found in Column B, no corresponding value will be added to the function. Note that the exact name of the line items is not included in the function. This is a means for ensuring flexibility in the naming of line items and keeping the function short. Instead of having the exact name of the line item within the quotation marks, the function includes a snippet of the line item, enclosed by the * symbol. This tells the function to search for cells containing the string of text denoted within the * and include positive result values in the function. This way, the name of the line item can be somewhat changed without completely breaking the function, as long as the string of text included between the * symbols is not changed.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**

H14	Net Present Value	Dollars ($)	NPV

Function Code

=NPV ($M$11, $N$31: $AM$31) +$M$22

Explanation of Function

This is a standard application of Excel's net present value (NPV) function. The cell first references the discount rate (Cell M11), which can be adjusted by the end user. Then, the cell references the Present Value (PV) of Cash Flow row in the Timeline box. Lastly, the function adds to the initial cost of the project. The reference cells are locked with the $ symbol to ensure that they continue to be referenced if rows are added to or subtracted from the sheet.

Cell	Related Line Item	Unit Type	Function Type
H15	Return on Investment (ROI) Break-Even Point	Years	IF, XMATCH, ABS, INDEX, MATCH

Function Code

=IF (MAX (M30:AM30) <0, "Never", XMATCH (0, M30:AM30, 1) - 1 + ABS (INDEX (M30:AM30, MATCH (0, M30:AM30,1))) / INDEX (M30:AM30, MATCH (0,M30:AM30,1)+1))

Explanation of Function

This is one of the more complex formulas in the tool because it combines multiple functions. First, the formula analyzes the Cumulative Net Cash Flow row in the Timeline box (M30:AM39) using the IF function to determine whether the cumulative net cash flow ever becomes more than negative. If the net cash flow remains negative throughout the project lifespan, the formula will output "Never" in cell H15 to denote that the project never breaks even. If the project of the Cumulative Net Cash Flow ever breaks even or becomes positive, the formula uses the XMatch function to identify the whole total number of years before the initial project cost is recovered. Next, the ABS formula determines the exact unrecovered dollar amount at the end of the break-even year and turns it into a positive number, which is then divided by the following year's individual cash flow to figure out the exact fraction of the year at which the project breaks even.

Cell	Related Line Item	Unit Type	Function Type

H20	Annual Natural Gas Savings	Dollars ($)	SUMIFS
Function Code			
=SUMIFS (C$11:C$600, B$11: B$600, "Expected Annual Mcf Avoided") * SUMIFS (C$11:C$600, B$11: B$600, "*Per/Mcf*")			
Explanation of Function			
This formula uses the SUMIFS function, which checks a cell for a given set of criteria before determining whether to add a value to the formula. In this case, the function reads column B to look for the *Expected Annual Mcf Avoided" line item. If that line item is found, the value associated with it is added to the formula. Next, the function searches Column B for a line item that contains the text "Per/Mcf" which should only be associated with the cost of natural gas. If both line items are identified, they are multiplied together to calculate total cost savings from avoided natural gas consumption.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
H21	Annual Electricity Savings – Year 1 Baseline	Dollars ($)	SUMIFS
Function Code			
=SUMIFS (C$11:C$600, B$11: B$600, "Expected Annual kWh Avoided") * SUMIFS (C$11:C$600, B$11: B$600, "*Per/kWh*")			
Explanation of Function			
This formula uses the SUMIFS function, which checks a cell for a given set of criteria before determining whether to add a value to the formula. In this case, the function reads column B to look for the *Expected Annual kWh Avoided" line item. If that line item is found, the value associated with it is added to the formula. Next, the function searches Column B for a line item that contains the text "Per/kWh" which should only be associated with the cost of electricity. If both line items are identified, they are multiplied together to calculate total cost savings from avoided electricity consumption.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
H22	No Expected Added Electricity Costs	Dollars ($)	SUMIFS
Function Code			

=SUMIFS (C$11:C$600, B$11: B$600, "Expected Annual kWh Added") * SUMIFS (C$11:C$600, B$11: B$600, "*Per/kWh*")			
Explanation of Function			
This formula uses the SUMIFS function, which checks a cell for a given set of criteria before determining whether to add a value to the formula. In this case, the function reads column B to look for the *Expected Annual kWh Added" line item. If that line item is found, the value associated with it is added to the formula. Next, the function searches Column B for a line item that contains the text "Per/kWh" which should only be associated with the cost of electricity. If both line items are identified, they are multiplied together to calculate total cost of added electricity consumption.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
H23	No Expected Gasoline Savings	Dollars ($)	SUMIFS
Function Code			
=SUMIFS (C$11:C$600, B$11: B$600, "Expected Annual Fuel Gallons Avoided") * SUMIFS (C$11:C$600, B$11: B$600, "Average Price per Gallon of Gasoline")			
Explanation of Function			
This formula uses the SUMIFS function, which checks a cell for a given set of criteria before determining whether to add a value to the formula. In this case, the function reads column B to look for the *Expected Annual Fuel Gallons Avoided" line item. If that line item is found, the value associated with it is added to the formula. Next, the function searches Column B for a line item that contains the text "Average Cost per Gallon of Gasoline" which should only be associated with the cost of gasoline. If both line items are identified, they are multiplied together to calculate total savings from avoided gasoline consumption.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
H24	No Expected Diesel Savings	Dollars ($)	SUMIFS
Function Code			
=SUMIFS (C$11:C$600, B$11: B$600, "Expected Annual Fuel Gallons Avoided") * SUMIFS (C$11:C$600, B$11: B$600, "Average Price per Gallon of Diesel")			
Explanation of Function			

This formula uses the SUMIFS function, which checks a cell for a given set of criteria before determining whether to add a value to the formula. In this case, the function reads column B to look for the *Expected Annual Fuel Gallons Avoided" line item. If that line item is found, the value associated with it is added to the formula. Next, the function searches Column B for a line item that contains the text "Average Cost per Gallon of Diesel" which should only be associated with the cost of diesel. If both line items are identified, they are multiplied together to calculate total savings from avoided diesel consumption.

Cell	Related Line Item	Unit Type	Function Type
H25	Total Lifetime Energy Savings	Dollars ($)	SUM

Function Code

= (H20 + H21 + H23 + H24 - H22) *M12

Explanation of Function

This formula adds together all the cells related to expected savings and subtracts the cell representing expected added electricity costs. The result is multiplied by the useful life of the project to calculate the total expected energy cost savings over the project's lifetime.

Cell	Related Line Item	Unit Type	Function Type
H30	Natural Gas Emissions - Year 1 Baseline	MtCO2e	SUMIFS

Function Code

=SUMIFS (C$11:C$600, B$11: B$600, "Expected Annual Mcf Avoided") * SUMIFS (C$11:C$600, B$11: B$600, "*Natural Gas - 1 Mcf*")

Explanation of Function

This formula uses the SUMIFS function, which checks a cell for a given set of criteria before determining whether to add a value to the formula. In this case, the function reads column B to look for the *Expected Annual Mcf Avoided" line item. If that line item is found, the value associated with it is added to the formula. Next, the function searches Column B for a line item that contains the text "Natural Gas – 1 Mcf" which should only be associated with the emissions factor of natural gas. If both line items are identified, they are multiplied together to calculate total annual emissions reductions from natural gas consumption.

Cell	Related Line Item	Unit Type	Function Type
H31	Electricity Grid Emissions - Year 1 Baseline	MtCO2e	SUMIFS
Function Code			
=(SUMIFS(C$11:C$600,B$11:B$600,"Expected Annual kWh Avoided")*SUMIFS(C$11:C$600,B$11:B$600,"*kWh of Electricity*"))+(SUMIFS(C$11:C$600,B$11:B$600,"Expected Annual kWh Generation")*SUMIFS(C$11:C$600,B$11:B$600,"*kWh of Electricity*"))-SUMIFS(C$11:C$600,B$11:B$600,"Expected Annual kWh Added")*SUMIFS(C$11:C$600,B$11:B$600,"*kWh of Electricity*")		
Explanation of Function			
This formula uses the SUMIFS function, which checks a cell for a given set of criteria before determining whether to add a value to the formula. In this case, the function reads column B to look for the *Expected Annual kWh Avoided" line item. If that line item is found, the value associated with it is added to the formula. Next, the function searches Column B for a line item that contains the text "kWh of Electricity" which should only be associated with the emissions factor of electricity. Since this sheet also contains scenarios where electricity consumption is increased or replaced by on-site renewable energy generation, the SUMIFS function must also be applied to these items. Thus, the formula adds the expected avoided emissions from kWh of electricity either avoided by efficiency measures or generated on-site, while subtracting the value of expected increased emissions resulting from added electricity consumption.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
H32	Gasoline Emissions – Year 1 Baseline	MtCO2e	SUMIFS
Function Code			
=SUMIFS (C$11:C$600, B$11: B$600, "Expected Annual Fuel Gallons Avoided") * SUMIFS (C$11:C$600, B$11: B$600, "*Gasoline Emissions*")			
Explanation of Function			
This formula uses the SUMIFS function, which checks a cell for a given set of criteria before determining whether to add a value to the formula. In this case, the function reads column B to look for the *Expected Annual Fuel Gallons Avoided" line item. If that line item is found, the value associated with it is added to the formula. Next, the function searches Column B for a line item that contains the text "Gasoline Emissions" which should only be associated with the emissions factor of gasoline. If			

both line items are identified, they are multiplied together to calculate total annual emissions reductions from gasoline consumption.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
H33	Diesel Emissions - Year 1 Baseline	MtCO2e	SUMIFS
Function Code			
=SUMIFS (C$11:C$600, B$11: B$600, "Expected Annual Fuel Gallons Avoided") * SUMIFS (C$11:C$600, B$11: B$600, "*Diesel Emissions) *")			
Explanation of Function			
This formula uses the SUMIFS function, which checks a cell for a given set of criteria before determining whether to add a value to the formula. In this case, the function reads column B to look for the *Expected Annual Fuel Gallons Avoided" line item. If that line item is found, the value associated with it is added to the formula. Next, the function searches Column B for a line item that contains the text "Diesel Emissions" which should only be associated with the emissions factor of gasoline. If both line items are identified, they are multiplied together to calculate total annual emissions reductions from diesel consumption.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
H34	Total MTCO2e Savings	MtCO2e	SUM
Function Code			
=SUM (H30:H33) *M12			
Explanation of Function			
This formula calculates the total amount of carbon dioxide equivalent emissions that are avoided by the energy efficiency measure. First, the formula adds together all the cells associated with emission reductions (H30:H33). Then, the formula multiplies the summation by the useful life of the project (M12).			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
H35	**Cost Per MTCO2e Reduced**	Dollars ($)	IF

Function Code			
=IF(H34>0, H13/H34, "No Emissions Reduced")			
Explanation of Function			
This formula calculates the total cost of each MTCO2e expected to be reduced by the energy efficiency measure. First, the formula checks to determine that the value is greater than 0. If so, then the function divides the net implementation cost by the total MTCO23 of carbon emissions reduced to calculate the cost per MTCO2e. If the cell value is less than 0, then the function returns a string of text stating "No Emissions Reduced" as the measure would be a net MTCO2e emitter rather than reducer.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
M12	Project Lifespan (Years):	Years	=
Function Code			
=$C$33			
Explanation of Function			
This function sets the cell equal to cell C33, which is the line item on which an end user will report the expected useful life of a project.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
M21	**Year**	Years	SEQUENCE
Function Code			
=SEQUENCE (1, M12+1,0,1)			
Explanation of Function			
This function dynamically alters the *"Timeline"* Box to measure years equal to the useful life of the energy efficiency measure. The first value, 1, specifies that the sequence will only contain 1 row. The second value (M12 + 1) specifies that the sequence will cover several columns equal to the useful life of the project and add one (to account for year 0). The third value, 0, specifies that the sequence should start from 0 and the fourth value, 1, specifies that the sequence should count upward by one number at a time.			

Cell	Related Line Item	Unit Type	Function Type
M22	**Initial Cost**	Dollars ($)	IF
Function Code			
=IF (M21# = 0, -$H$13,0)			
Explanation of Function			
This cell imports the net implementation cost of the project into the "Timeline" box. First, the IF function checks to see that the cell above it is equal to 0. If so, then the function reports the net implementation cost in the box as a negative number to accurately reflect that it is a cost rather than saving of the project. If the above cell is greater than 0 (meaning the project is past year 0) then the function returns because we assume all implementation costs will be expended in year 0.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N23	**Annual Natural Gas Savings ($)**	Dollars ($)	IF
Function Code			
=IF (N$21="", "", $H$20)			
Explanation of Function			
This function imports the dollar value of annual natural gas savings to the "Timeline" box. First, the function checks to see whether the cell in row 21 of the corresponding cell (the year row) is blank. If the cell is blank, then the function reports a blank output. If the cell is not blank, then the function reports the annual natural gas savings value.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N24	**Annual Electricity Savings ($)**	Dollars ($)	IF
Function Code			
=IF (N$21="", "", $H$21)			
Explanation of Function			

This function imports the dollar value of annual electricity savings to the “Timeline” box. First, the function checks to see whether the cell in row 21 of the corresponding cell (the year row) is blank. If the cell is blank, then the function reports a blank output. If the cell is not blank, then the function reports the annual electricity savings value.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N25	**Annual Gasoline Savings ($)**	Dollars ($)	IF
Function Code			
=IF (N$21="", "", $H$23)			
Explanation of Function			
This function imports the dollar value of annual gasoline savings to the “Timeline” box. First, the function checks to see whether the cell in row 21 of the corresponding cell (the year row) is blank. If the cell is blank, then the function reports a blank output. If the cell is not blank, then the function reports the annual gasoline savings value.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N26	**Annual Diesel Savings ($)**	Dollars ($)	IF
Function Code			
=IF (N$21="", "", $H$24)			
Explanation of Function			
This function imports the dollar value of annual diesel savings to the “Timeline” box. First, the function checks to see whether the cell in row 21 of the corresponding cell (the year row) is blank. If the cell is blank, then the function reports a blank output. If the cell is not blank, then the function reports the annual diesel savings value.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N27	**Annual Added Electricity Costs ($)**	Dollars ($)	IF
Function Code			
=IF (N$21="", "", $H$22)			

Explanation of Function			
This function imports the dollar value of annual added electricity cost to the “Timeline” box. First, the function checks to see whether the cell in row 21 of the corresponding cell (the year row) is blank. If the cell is blank, then the function reports a blank output. If the cell is not blank, then the function reports the annual added electricity costs value.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N28	**Annual O&M Cost ($)**	Dollars ($)	IF, SUMIF
Function Code			
=IF (N21="", "", SUMIFS ($C$11: $C$600, $B$11: $B$600, "Post-Construction O&M Costs"))			
Explanation of Function			
This formula first uses an IF function to determine whether the value in row 21 (the year row) is blank. If the cell is blank, the formula outputs a blank value in the cell. If the cell is populated, meaning the project is within its useful lifespan, then the formula uses the SUMIFS function to search for the Post-Construction O&M Costs line item and enter the corresponding value into the function.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
M29	**Net Cash Flow ($)**	Dollars ($)	IF SUM
Function Code			
=IF (M21="","", M22 + (SUM (M23:M26)-SUM (M27:M28)))			
Explanation of Function			
This formula calculates the net cash flow of a single year of the project’s lifespan. First, the formula uses the IF function to determine whether the value in row 21 (the year row) is blank. If the cell is blank, the formula returns a blank value as it means the useful life of the project is over and no more values are being calculated. If the cell is populated, the project is within one its lifespan and the function adds together all the costs and savings associated with the project. Starting with row 22, which is the initial cost row, the formula then uses a SUM function to add together the values of cells M23:M26 (the rows denoting various energy savings). A second SUM function is used to add together the values of cells M27:M28 (the rows			

denoting added electricity costs and O&M costs). Finally, the total added costs are subtracted from the total savings to display the net cash flow for that year of the project.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
M30	**Cumulative Net Cash Flow**	Dollars ($)	=
Function Code			
=M29			
Explanation of Function			
This cell simply reports the value of the net cash flow for year 0, as there is no previous year value to which the net cash flow can be added.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N30	**Cumulative Net Cash Flow**	Dollars ($)	IF SUM
Function Code			
=IF (N21="","“, SUM(M30+N29))			
Explanation of Function			
This formula starts by using an IF function to check whether the cell in the corresponding column of row 21 (the year row) is blank. If so, the IF function returns to a blank value, If the cell is populated, then the IF function implements a SUM function that adds the current year’s net cash flow to the previous year’s net cash flow.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
M31	**Present Value (PV) of Cash Flow**	Dollars ($)	=
Function Code			
=M29			
Explanation of Function			

This cell reports the net cash flow of year 0, as there is no time difference from the present, eliminating the need to apply a discount rate.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N31	**Present Value (PV) of Cash Flow**	Dollars ($)	IF
Function Code			
=IF (N21 = "", "", N29 / (1 + M11) ^N21)			
Explanation of Function			
This function reports the present value of the net cash flow for a given year. The cell uses an IF function to determine whether the cell in row 21 of the corresponding column (the year row) is blank. If the cell in row 21 is blank, then the function returns a blank output, as the project is not within its lifespan. If the cell is populated, then the function divides the value of the cell in row 29 of the corresponding column (the net cash flow row) by 1 + the discount rate (note that the discount rate should be locked for easy automation) and raised to the power of the value in row 21 of the corresponding column (the year).			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
M32	**Cumulative Project Value (NPV)**	Dollars ($)	=
Function Code			
=M31			
Explanation of Function			
This cell reports the present value of cash flow in year 0, as there is no time difference from the present, eliminating the need to apply a discount rate.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N32	**Cumulative Project Value (NPV)**	Dollars ($)	IF

Function Code			
=IF (N21= "", "", M32+N31)			
Explanation of Function			
This formula starts by using an IF function to check whether the cell in the corresponding column of row 21 (the year row) is blank. If so, the IF function returns a blank value, If the cell is populated, then the IF function implements a SUM function that adds the current year's present value of cash flow to the previous year's present value of cash flow.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N40	**Annual GHG Emissions Avoided (MtCO2e)**	MtCO2e	IF
Function Code			
=IF(N$39="","",H31)			
Explanation of Function			
This formula starts by using an IF function to check whether the cell in the corresponding column of row 39 (the year row) is blank. If so, the IF function returns a blank value, If the cell is populated, then the IF function should reference the total amount of GHG emissions avoided from the "Carbon Metrics of Interest Table". Note that this function may have to be altered to select the proper GHG emissions cell.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
O40	**Value of Annual GHG Emissions Avoided (MtCO2e)**	$	IF
Function Code			
=IF(P$39="","", O40*(1-$M$18))			
Explanation of Function			
This formula starts by using an IF function to check whether the cell in the corresponding column of row 39 (the year row) is blank. If so, the IF function returns a blank value, If the cell is populated, then the IF function should reference the total			

amount of GHG emissions avoided in the previous year, multiplied by 1 – the annual decarbonization rate of the electricity grid.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N42	**Annual GHG Emissions Added (MtCO2e)**	MtCO2e	IF
Function Code			
=IF(P$39="","", O40*(1-$M$18))			
Explanation of Function			
This formula starts by using an IF function to check whether the cell in the corresponding column of row 39 (the year row) is blank. If so, the IF function returns a blank value, If the cell is populated, then the IF function should reference the total amount of GHG emissions added from the "Carbon Metrics of Interest Table". Note that this function may have to be altered to select the proper GHG emissions cell.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N43	**Value of Annual GHG Emissions Added (MtCO2e)**	$	IF
Function Code			
=IF(O$39="","",O42*$M$17)			
Explanation of Function			
This formula starts by using an IF function to check whether the cell in the corresponding column of row 39 (the year row) is blank. If so, the IF function returns a blank value, If the cell is populated, then the IF function multiply the Annal GHG Emissions Added for the current year by the social cost of carbon (M17)/			
Cell	**Related Line Item**	**Unit Type**	**Function Type**

N44	**Net Annual GHG Emissions Avoided**	MtCO2e	IF
Function Code			
=IF(N$39="", "", N40-N42)			
Explanation of Function			
This formula starts by using an IF function to check whether the cell in the corresponding column of row 39 (the year row) is blank. If so, the IF function returns a blank value, If the cell is populated, then the IF function subtracts the Annual GHG Emissions Added from the Annual GHG Emissions Avoided for the current year.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N45	**Net Value of Annual GHG Emissions Avoided**	$	IF
Function Code			
=IF(N$39="", "", N44*$M$17)			
Explanation of Function			
This formula starts by using an IF function to check whether the cell in the corresponding column of row 39 (the year row) is blank. If so, the IF function returns a blank value, If the cell is populated, then the IF function multiplies the Net Value of Annual GHG Emissions Avoided for the current year by the Social Cost of Carbon (M17)			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N40	**Net Value of Annual GHG Emissions Avoided**	$	IF
Function Code			
=IF(N$39="", "", N44*$M$17)			
Explanation of Function			

This formula starts by using an IF function to check whether the cell in the corresponding column of row 39 (the year row) is blank. If so, the IF function returns a blank value, If the cell is populated, then the IF function multiplies the Net Value of Annual GHG Emissions Avoided for the current year by the Social Cost of Carbon (M17)			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N46	**Cumulative GHG Emissions Avoided (MtCO2e)**	MtCO2e	=
Function Code			
=N44			
Explanation of Function			
This function occurs in year 1 of the project life, so the cumulative value can only be the Net Value of Annual GHG Emissions Avoided for the current year.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
O46	**Cumulative GHG Emissions Avoided (MtCO2e)**	MtCO2e	=IF
Function Code			
=IF(O$39="", "", N46+O44)			
Explanation of Function			
This formula starts by using an IF function to check whether the cell in the corresponding column of row 39 (the year row) is blank. If so, the IF function returns a blank value, If the cell is populated, then the IF function adds the current year's Net Annual GHG Emissions Avoided to the previous year's Cumulative GHG Emissions Avoided.			
Cell	**Related Line Item**	**Unit Type**	**Function Type**

N47	**Cumulative Value of Annual GHG Emissions Avoided**	$	IF
Function Code			
=IF(N39="", "", N46*$M$17)			
Explanation of Function			
This formula starts by using an IF function to check whether the cell in the corresponding column of row 39 (the year row) is blank. If so, the IF function returns a blank value, If the cell is populated, then the IF function multiplies the Cumulative Value of GHG Emissions Avoided for the current year by the Social Cost of Carbon (M17)			
Cell	**Related Line Item**	**Unit Type**	**Function Type**
N49	**Cumulative PV of GHG Emissions Avoided**	$	IF
Function Code			
=IF(N39="","",N47/(1+$M$11)^N39)			
Explanation of Function			
This formula starts by using an IF function to check whether the cell in the corresponding column of row 39 (the year row) is blank. If so, the IF function returns a blank value, If the cell is populated, then the IF function divides the Cumulative Value of GHG Emissions Avoided for the current year by one plus the discount rate (M11) raised to the power of the current year.			