

Overview of Pollution Prevention (P2) GHG-Cost and Hazardous Materials Calculators Training Module: 2011

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Purpose

- Review the Greenhouse Gas Calculator
 - Calculate GHG reductions from P2 activities*
- Review the Pollution Prevention Cost Calculator
 - Calculate cost savings from P2 activities*
- Describe the Hazardous Materials Calculator
 - Converts gallons to pounds for common hazardous materials

* Based on annual performance results



Background

- Assist P2 community in reporting EPA's outcome measures:
 - Million metric tons of carbon dioxide equivalents;
 - Pounds of pollutants reduced;
 - Gallons of water saved, and
 - Dollars saved through the adoption of P2 practices
- Enhance standardization for reporting performance results.
- Enhance transparency of methodologies.

P2 GHG Calculator

- The GHG Calculator is a tool to calculate changes in GHG emissions from P2 projects.
- Converts the activity values entered (e.g., kWh saved, gal. water reduced, etc.) to CO₂e
- Aggregates GHG reductions from individual projects and categories.
- Provides transparency for the data sources used through references and justification.

P2 GHG Calculator Addresses:

- Electricity Conservation
- Green Energy
- Stationary and Mobile Source Fuel Reduction/Substitution
- Greening Chemistry
- Water Conservation
- **Materials Management** (*under construction*)

P2 Cost Calculator

- Calculates the financial dollar savings from implementing a P2 activity
- EPA worked closely with the original developer's of the P2 cost calculator--- Pacific Northwest Pollution Prevention Research Center (PPRC)
- National P2 Results Data System enhanced based on this work :
(<http://www.p2rx.org/services/measurement.cfm>)
- New capacity for end users to enter in OWN unit cost per project, and different costs per project.

P2 Cost Calculator Addresses:

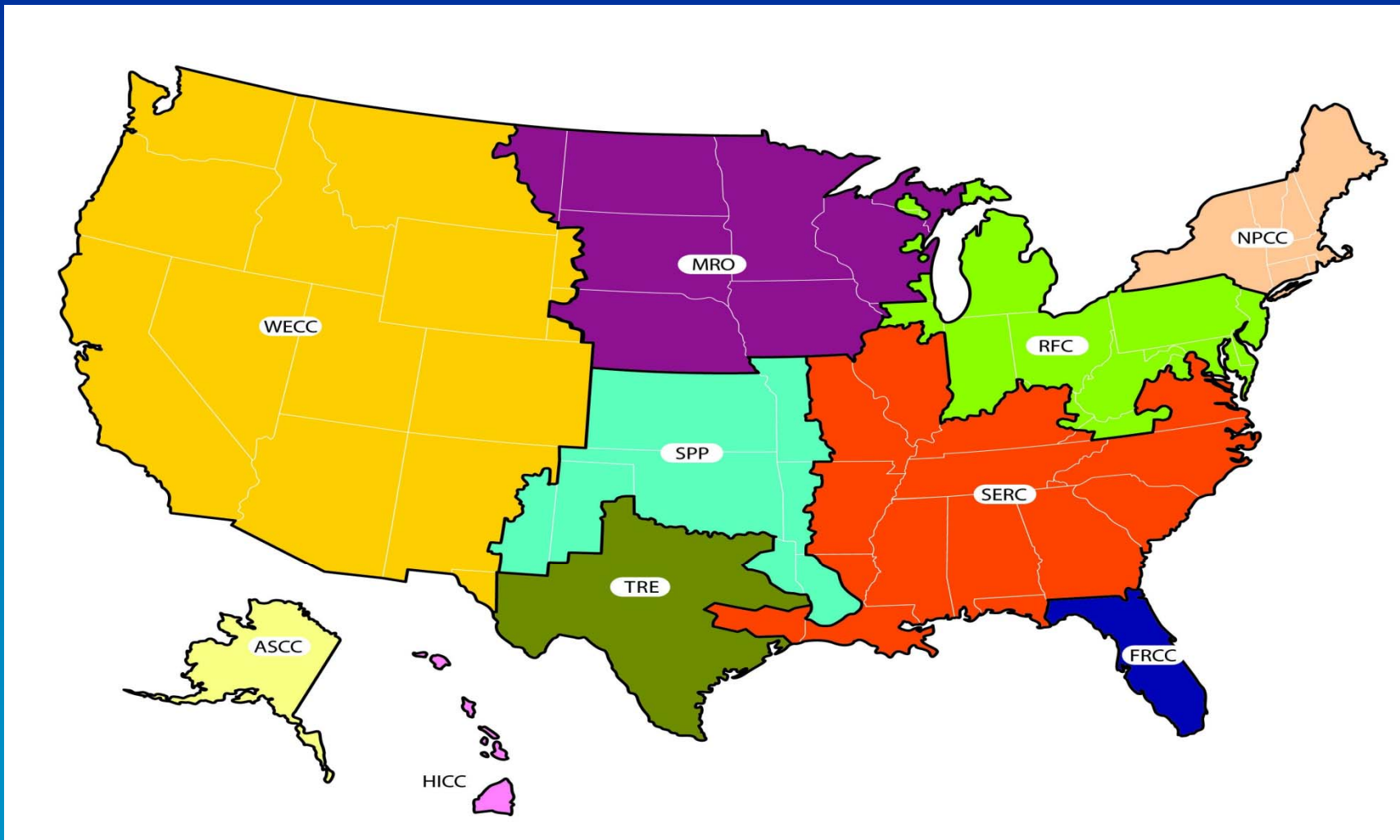
- Financial value of reducing:
 - Hazardous Inputs and Wastes
 - Air Emissions
 - Water Pollution
 - Water Use
 - Energy
 - Electricity
 - Non-Hazardous Inputs and Solid Waste (regions may be interested in tracking)

Overall, cost savings have been underreported.

Electricity Conservation Projects

- **GHG Calculator: Electricity Conservation Tab**
 - Reductions from electricity conservation are based on state-specific emissions factors (e-GRID)
 - End Users can select state specific or national average rates
- **Cost Calculator: Electricity Tab**
 - Reductions in traditional electricity use will result in **COST SAVINGS (\$)**

North American Electric Reliability Corporation (NERC) Region Representational Map



P2 Suite of Tools/Training

- **FAQs**
- **Hypothetical Examples**
- **Webinar-Presentation**
- **NPPR: //www.p2.org/category/general-resources/p2-data-calculators/**

Example 1: Electricity Conservation

GMC developed an electricity conservation program in their New Jersey facility that conserved 25,000 kWh.

INPUT

GHG Calculator: Electricity Conservation Tab

Electricity Conservation

State or US = NJ

Electricity Conserved = 25,000

Unit Reported = kWh

Cost Calculator: Electricity Tab

Electricity Conservation

Quantity Electricity Reduced = 25,000

Unit = kWh

User Defined Unit Cost of \$0.1040/kWh

OUTPUT

GHG Calculator = 21.247 MTCO₂e (in emissions reductions)

Cost Calculator = \$2,600 (in cost savings)

Ex. 1: GHG Calculator

Electricity Conservation: GHG Savings from Electricity Conservation								
<p>On this tab, a user can select a state or national version of the non-baseload output emissions rate for calculating GHG emission rates are from eGRID (EPA's Emission and Generation Resource Integrated Database). "Non-baseload" refers to the output from combustion generators, weighted towards those that operate during peak demand. "Non-baseload" excludes emission rate generators because they operate at full capacity even during baseload (low) demand. Peak demand is what is affected by energy conservation.</p>								
Type of Electricity Conservation		Electricity Conservation				CFL Bulbs		
How to use this tab: Instructions to obtain MTCO ₂ e		<p>Select a state or U.S. National to apply the state's NERC regional emission factor or the national emissions factor. Enter the annual amount of electricity conserved and choose unit from the drop-down menu. The next column converts all units to kWh. The final column displays the reduction in MTCO₂e.</p>				<p>Same directions as for the Electricity Conservation columns.</p>		
Calculation Description		<p> $MTCO_2e = \text{Electricity conserved} * (\text{kWh}/\text{user-specified units}) * (\text{national or regional value of the eGRID non-baseload output emission rate [MTCO}_2\text{e/kWh]})$ National rate: 0.000692 MTCO₂e/kWh NERC Regional rate: (0.000498 to 0.00090 MTCO₂e/kWh) <i>For national and regional formulas and details see Notes below.</i> Both national and regional versions of the rate (the eGRID non-baseload output emission rate) cover three gases: CO₂ emissions factor (MTCO₂e/kWh) + CH₄ emissions factor (MTCO₂e/kWh) + N₂O emissions factor (MTCO₂e/kWh). </p>				<p> $MTCO_2e = \text{Number of bulbs} * (49 \text{ kWh per bulb}) * (\text{national or regional value of the eGRID non-baseload output emission rate, expressed in MTCO}_2\text{e/kWh})$ <i>The rest of the description is the same as Electricity Conservation.</i> </p>		
		State or U.S. (Select)	Electricity Conserved (Input value)	Unit reported (Select)	Electricity Conserved (kwh)	GHG Reduction (MTCO ₂ e)	Number of CFL bulbs replacing conventional bulbs	GHG Reduction (MTCO ₂ e)
Example			GQ Co. worked with a facility in North Carolina that has conserved 10,000 kwh of electricity through a conservation activity.			GQ Co. replaced a total of 1,000 conventional lightbulbs with CFL bulbs in 8 NC facilities during one year.		
		NC	10,000	kwh	10,000	7.403	1,000	
Total Input- All Projects					25,000	21.247	-	
Project 1	NJ	25,000	kwh		25,000	21.247		
Project 2					-	-		
Project 3					-	-		

Ex. 1: Cost Calculator

Electricity							
This tab calculates dollars saved from conserving conventional electricity and net dollars spent purchasing green electricity. (positive or negative) calculated on this tab.							
Type of Activity	Conserving Conventional Electricity					Purchasing Green Electricity	
How to use this tab	Enter the quantity of electricity conserved, selecting the appropriate unit. Enter the unit cost if known or leave blank to populate with the national default value. The Savings column converts data entries into dollars saved.					Work in this area only; all related to purchasing green electricity and not buying conventional. Enter the quantity of green electricity purchased, enter the negative (use a minus sign) for the cost and green electricity cost in dollars (negative savings). If difference is not zero, enter the national default value for the negative difference. The Savings column converts data entries into dollars spent (negative savings).	
Calculation Description	Quantity of electricity reduced (user specified units) * unit cost (user-specified or default) = Dollar savings.					Quantity of electricity purchased (user specified or default) = Dollars spent.	
Default Unit Cost	\$0.1017 /kWh					-\$0.0175 /kWh	
	Electricity Conserved Quantity	Unit (select)	Unit Cost (\$/unit just selected)	kWh Reduced	Dollar Savings	Green Electricity Quantity	Unit (select)
<i>Example</i>	Installed energy-efficient lighting and reduced lighting and air conditioning usage at two commercial buildings.						
	1,700,000	kWh		1,700,000	\$ 172,890		
<i>Total Input - All Projects</i>				25,000	\$ 2,600		
<i>Project 1</i>	25,000.00	kWh	\$0.1040	25,000.00	\$ 2,600.00		(Select)
<i>Project 2</i>		(Select)		-	\$ -		(Select)
<i>Project 3</i>		(Select)		-	\$ -		(Select)
<i>Project 4</i>		(Select)		-	\$ -		(Select)
<i>Project 5</i>		(Select)		-	\$ -		(Select)

Green Energy Projects

- **GHG Calculator: Green Energy Tab**
 - Assumption in the calculator: No GHG emissions are associated with green power
 - 1 kWh of fossil-fuel electricity replaced with 1 kWh of renewably-generated electricity is the same as reducing electricity use by 1 kWh

- **Cost Calculator: Electricity Tab**
 - Purchase of “green electricity” will INCREASE costs
 - Calculator uses the mean of all 200 green power providers supplied by DOE

Example 2: Green Energy Project

- GMC's North Carolina facility purchased 40,000 kWh of green electricity.

INPUT

GHG Calculator: Green Energy Tab

Green Energy Electricity Displacing Fossil Fuel Energy

State or US = NC

Electricity Consumed from Renewable Energy = 40,000

Unit Reported = kWh

Cost Calculator: Electricity Tab

Purchased Green Electricity

Quantity Electricity Purchased = 40,000

Unit = kWh

OUTPUT

GHG Calculator = 29.613 MTCO₂e

Cost Calculator = - \$700 (negative)

Ex. 2: GHG Calculator

Green Energy: GHG Savings from Shifting to Green Energy Sources						
<p>This tab calculates GHG emission reductions that result from substituting green power for conventional power. In line with EPA's Green sources producing electricity with an environmental profile superior to conventional power and producing no GHG emissions. This includes (earth's heat), low-impact biomass, low-impact small hydro-electric sources, biodiesel, and fuel cells. For example, geothermal heat place of electricity. This excludes large hydro sources and those built prior to 1997. The tool calculates the switch to green power the GHG emissions from fossil fuels.</p> <p>This tab also calculates reductions from renewable energy certificates (RECs) purchased to offset emissions from conventional electricity. Renewable certificates, RECs are tradable market instruments sold separately from the electricity itself, which prove 1 MWh of electricity but does not require purchasing green power products certified by an independent third party as a matter of best practice. RECs, like electricity conservation and green energy, reduce a facility's Scope 2 indirect emissions, under international standards for reporting.</p>						
Green Energy	Green Energy Electricity Displacing Fossil Fuel Energy				Renewable Energy Certificate	
How to use this tab: Instructions to obtain MTCO ₂ e	Select a state or U.S. National to apply a state NERC regional emissions factor or national U.S. emissions factor. Enter annual amount of green electricity used, and choose unit from the dropdown menu. The column "GHG Reduction" converts the unit into MTCO ₂ e.				Select a state or U.S. National to apply a state NERC regional emissions factor or national U.S. emissions factor. Enter annual amount of green electricity used, and choose unit from the dropdown menu. The column "GHG Reduction" converts the unit into MTCO ₂ e.	
Calculation Description	<p>MTCO₂e = Electricity conserved * (kWh/user-specified units) * (national or regional value of the eGRID non-baseload output emission rate, expressed as MTCO₂e/kWh)</p> <p>National value of rate: 0.000692 MTCO₂e/kWh NERC Regional value of rate: (0.000498 to 0.00090 MTCO₂e/kWh)</p> <p><i>For a detailed derivation of national and regional conversion factors, see Notes below, where the formulas are presented with actual rates filled in.</i></p> <p>Both national and regional versions of the rate (the eGRID non-baseload output emission rate) cover three gases: CO₂ emissions factor (MTCO₂e/kWh) + CH₄ emissions factor (MTCO₂e/kWh) + N₂O emissions factor (MTCO₂e/kWh).</p> <p><i>See Notes below for more detailed information.</i></p>				<p>MTCO₂e = Electricity conserved * (kWh/user-specified units) * (national or regional value of the eGRID non-baseload output emission rate, expressed as MTCO₂e/kWh)</p> <p><i>The description of the calculation is the same as for Green Energy Electricity Displacing Fossil Fuel Energy.</i></p>	
	State or U.S. (Select)	Electricity Consumed from Renewable Energy (Input value)	Unit reported (Select)	Electricity Consumed from Renewable Energy (kwh)	GHG Reduction (MTCO ₂ e)	Volume of Certificate Purchased (kwh)
Example	NY	20,000	kwh	20,000	11.556	-
Total Input- All Projects				40,000	29.613	-
Project 1	NC	40,000	kwh	40,000	29.613	-
Project 2				-	-	-

Ex. 2: Cost Calculator

Electricity								
This tab calculates dollars saved from conserving conventional electricity and net dollars spent purchasing green electricity. The Aggregate tab will reflect the net cost savings (positive or negative) calculated on this tab.								
Type of Activity	Conserving Conventional			Purchasing Green Electricity				
How to use this tab	Enter the quantity of electricity conserved, selecting the appropriate unit. Enter the unit cost if known or leave blank to populate with the national default value. The Savings column converts data entries into dollars saved.			Work in this area only; all related cost trade-offs (user-specified or default) between buying green electricity and not buying conventional electricity will occur here. Enter the quantity of green electricity purchased, selecting the appropriate unit. For unit cost, enter the negative (use a negative sign) difference between conventional electricity cost and green electricity cost in the same units (green electricity costs more, producing a negative savings). If difference in unit cost is unknown leave blank to populate the national-default value for the negative differential. The Dollars Spent column converts data entries into dollars spent (negative savings).				
Calculation Description	Quantity of electricity reduced (user specified units) * unit cost (user specified or default) =			Quantity of electricity purchased (user specified units) * negative unit cost differential (user-specified or default) = Dollars spent.				
Default Unit Cost				-\$0.0175 /kWh				
	kWh Reduced	Dollar Savings		Green Electricity Quantity	Unit (select)	Unit Cost Difference (\$/unit just selected)	Green kWh Purchased	Dollars Spent (negative cost savings)
<i>Example</i>	Installed energy-efficient lighting and reduced lighting and air							
	1,700,000	\$ 172,890						
Total Input - All Projects	-	\$ -					40,000	\$ (700)
Project 1	-	\$ -		40,000.00	kWh		40,000.00	\$ (700.00)
Project 2	-	\$ -			(Select)		-	\$ -
Project 3	-	\$ -			(Select)		-	\$ -
Project 4	-	\$ -			(Select)		-	\$ -

Fuel Use Reduction Projects (Stationary Sources Tab)

- **GHG Calculator:**
 - Calculate GHG emissions reductions associated with reduced fuel use (climate registry & IPCC)
 - Includes emission factors for 14 common fuel types used to power stationary sources
- **P2 Cost Calculator: Fuel Use Tab**
 - Calculates savings from reduced energy use
 - Examples of data entry options include natural gas, heating oil, coal, etc.

Example 3: Reducing Fuel Use from a Stationary Source Example

GMC altered its production activities resulting in a reduction of 15,000 therms of natural gas annually.

INPUT

GHG Calculator: Stationary Sources Tab

Natural Gas or Compressed Natural Gas

Natural Gas Reduced = 15,000

Units = therms

Cost Calculator: Fuel Use Tab

Natural Gas

Amount Natural Gas Reduced = 15,000

Units = therms

OUTPUT

GHG Calculator = 79.812 MTCO₂e

Cost Calculator = \$11,250

Ex. 3: GHG Calculator

Stationary Sources: GHG Savings from Using Less Fuel and Greener Fuels						
Fuel	Natural Gas or Compressed Natural Gas (CNG)				Biodies	
How to use this tab: Instructions to obtain MTCO ₂ e	Enter the volume of natural gas or CNG reduced. Select from drop-down menu to indicate units. Next column converts the units into BTUs, and "GHG Reduction" converts the units into MTCO ₂ e.				Select biodiesel blend from drop-down menu (B20 (20% biodiesel), or B100 (100% biodiesel), or B5 (5% biodiesel), or B5 (Blend Unknown) (B5). Enter gallons of biodiesel blend reduced. Next column converts units into MTCO ₂ e.	
Calculation Description	$\text{MTCO}_2\text{e} = \text{Input Volume (BTU)} * (5.35\text{E-}05\text{kg CO}_2\text{e/ BTU}) * (1 \text{ MTCO}_2\text{e} / 1,000 \text{ kg CO}_2\text{e})$ <p>See notes below for emission factor derivation.</p>				$\text{MTCO}_2\text{e (B5; also Blend Unknown)} = \text{Volume (gal.)} * [0.05 * (3.06 \text{ kg CO}_2\text{e} / \text{gal. biodiesel}) + 0.95 * (10.5 \text{ kg CO}_2\text{e} / \text{gal. diesel})] * (1 \text{ MTCO}_2\text{e} / 1,000 \text{ kg CO}_2\text{e})$ $\text{MTCO}_2\text{e (B20)} = \text{Volume (gal.)} * [0.20 * (3.06 \text{ kg CO}_2\text{e} / \text{gal. biodiesel}) + 0.80 * (10.5 \text{ kg CO}_2\text{e} / \text{gal. diesel})] * (1 \text{ MTCO}_2\text{e} / 1,000 \text{ kg CO}_2\text{e})$ $\text{MTCO}_2\text{e (B100)} = \text{Volume (gal.)} * (10.5 \text{ kg CO}_2\text{e} / \text{gal. diesel}) * (1 \text{ MTCO}_2\text{e} / 1,000 \text{ kg CO}_2\text{e})$ <p>See notes below for emission factor derivation.</p>	
Example	GQ Co. replaced solvent bonding of plastic parts with ultrasonic bonding, thus reducing incineration of spent solvents and saving 10,000 therms of natural gas annually.				GQ Co. replaced 20,000 gallons of diesel with biodiesel. (STEP 2 of 2. For STEP 1, select "Fuel Oil or Diesel").	
	10,000	therms	1,000,000,000	53.208	B100	-20,000
	Natural Gas or CNG Reduced (Input value)	Units (Select)	Natural Gas or CNG Reduced (BTU)	GHG Reduction (MTCO ₂ e)	Blend (Select)	Biodiesel Reduced (gal)
Total Input- All Projects			1,500,000,000	79.812		
Project 1	15,000	therms	1,500,000,000	79.812		
Project 2				-		
Project 3				-		
Project 4				-		

Ex. 3: Cost Calculator

Fuel						
This tab calculates cost savings from using less fossil fuel or reducing activities which use fuel (e.g. vehicle from reduced vehicle travel, choose between vehicles miles reduced or motor gasoline (not both)).						
Type of Reduction	Natural Gas					
How to use this tab	Enter the quantity of natural gas reduced, selecting the appropriate unit. Enter the unit cost if known or leave blank to populate with default national value. The Savings column converts data entries into dollars saved.					Choose this me (gasoline reduc vehicle miles re blank to popula Savings column
Calculation Description	Unit quantity of natural gas reduced * unit cost (user-specified or default value) = Dollars saved. The calculator formula converts all units to therms.					Miles reduced Dollars saved.
Default Unit Cost	\$0.75 /therms					\$0
	Amount of Natural Gas Reduced	Unit (select)	Unit Cost (\$/unit just selected)	Therms Reduced	Dollar Savings	Miles Reduce
Example	Green building reduced heat usage at two commercial buildings.					
	150,000	therms		150,000	\$ 112,500	
Total Input - All Projects				15,000	\$ 11,250	
Project 1	15,000.00	therms		15,000	\$ 11,250.00	
Project 2		(Select)		-	\$ -	
Project 3		(Select)		-	\$ -	
Project 4		(Select)		-	\$ -	
Project 5		(Select)		-	\$ -	
Project 6		(Select)		-	\$ -	
Project 7		(Select)		-	\$ -	
Project 8		(Select)		-	\$ -	

Mobile Fuel Reduction / Substitution Projects

- **P2 GHG Calculator: Mobile Sources Tab**
 - Organized by carbon intensity-highest-lowest
 - Includes the ability to calculate savings from reduced vehicle and airplane miles
 - User enters *either* fuel reduced or vehicle/air miles avoided, BUT not BOTH
- **P2 Cost Calculator: Fuel Use Tab**
 - Calculates savings from reduced energy use
 - Examples of data entry options include vehicle miles driven & motor gasoline, jet fuel, etc.

Example 4: Reducing Air Miles Traveled

GMC upgraded its communications system allowing for greater adoption of videoconferencing, and saving 100,000 air miles traveled on short flights, and 800,000 air miles on long haul flights, avoiding 35 flights at an average flight cost of \$700.

INPUT

GHG Calculator: Mobile Sources Tab

Air Miles

Length of Flight = multiple distances

Calculator for Air Miles Reduced over Multiple Distances

Short haul: <300 miles = 100,000

Long haul: >700 miles = 800,000

Cost Calculator: Fuel Use Tab

Air Travel

Number of Flights Avoided = 35

Average Cost per Flight = \$700

OUTPUT

GHG Calculator = 178.268 MT_{CO₂e}

Cost Calculator = \$24,500

Ex. 4: GHG Calculator

Mobile Sources: GHG Savings from Reduced Fuel Use and Substitutions of Greener Fuel							
Fuel	Air Miles		Gasoline				
<p>How to use this tab: Instructions to obtain MTCO₂e</p>	<p>Select flight-length category from drop-down menu: short haul (<300 miles per one-way flight), medium haul (300 - 700 miles), long haul (> 700 miles), multiple distances, or distance unknown. If miles are all in one flight-length category or all in distance-unknown category, enter number of air miles reduced. "GHG Reduction" converts the units into MTCO₂e, by appropriate formulas. If multiple flight-lengths are involved, select "multiple distances" from the drop-down menu and use the "Calculator for Air Miles Reduced over Multiple Distance Ranges" table below to enter miles per category. Click the "Calculate" button to populate the "GHG Reduction" column per project.</p>		<p>Enter number of gallons of gasoline reduced. "GHG Reduction" converts the units into MTCO₂e.</p>				
<p>Calculation Description</p>	<p> $MTCO_2e \text{ (short haul)} = \text{Volume (air miles traveled)} * (0.28 \text{ kg CO}_2e / \text{mi})^{**} * (1 \text{ MTCO}_2e / 1,000 \text{ kg CO}_2e)$ $MTCO_2e \text{ (medium haul)} = \text{Volume (air miles traveled)} * (0.23 \text{ kg CO}_2e / \text{mi})^{**} * (1 \text{ MTCO}_2e / 1,000 \text{ kg CO}_2e)$ $MTCO_2e \text{ (long haul)} = \text{Volume (air miles traveled)} * (0.19 \text{ kg CO}_2e / \text{mi})^{**} * (1 \text{ MTCO}_2e / 1,000 \text{ kg CO}_2e)$ $MTCO_2e \text{ (unknown)} = \text{Volume (air miles traveled)} * (0.27 \text{ kg CO}_2e / \text{mi})^{**} * (1 \text{ MTCO}_2e / 1,000 \text{ kg CO}_2e)$ </p> <p><i>See notes below for emission factor derivation.</i></p>		<p> $MTCO_2e = \text{Input Volume (gal.)} * (8.84 \text{ kg CO}_2e / \text{gal})^{**} * (1 \text{ MTCO}_2e / 1,000 \text{ kg CO}_2e)$ </p> <p><i>See notes below for emission factor derivation.</i></p>				
<p style="text-align: center;">Example</p>	<p>New company policy on videoconferencing saved GQ Co. 100,000 air miles traveled on short flights over 3 years.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 30%;">short haul: <300 miles</td> <td style="width: 35%; text-align: center;">100,000</td> <td style="width: 35%; text-align: center;">27.985</td> </tr> </table>				short haul: <300 miles	100,000	27.985
short haul: <300 miles	100,000	27.985					
	Length of Flight(s) (Select)	Air Miles Reduced (miles)	GHG Reduction (MTCO ₂ e)	Gasoline Reduced (gal)	GHG Reduction (MTCO ₂ e)		
Total Input- All Projects		900,000	178.268	-	-		
<i>Project 1</i>	multiple distances	900,000	178.268		-		
<i>Project 2</i>			-		-		
Color Key	Calculator for Air Miles Reduced over Multiple Distance Ranges						
User enters value		Air Miles Reduced (miles)	GHG Reduction (MTCO ₂ e)	Calculate			
User selects option from drop-down menu	Project Total	900,000	178.268				
Do not change- calculation	multiple distances						
	short haul: <300 miles	100,000	27.985				
	medium haul: >300 - <700 miles		-				
	long haul: >700 miles	800,000	150.283				
	distance unknown		-				

Ex. 4: Cost Calculator

Fuel Use					
Type of Reduction	Air Travel			Crude Oil	
How to use this tab	Enter the number of flights avoided. Enter the unit cost of each flight. The Savings column converts data entries into dollars saved.			Enter the barrels of crude oil reduced known or leave blank to populate with value. The Savings column converts dollars saved.	
Calculation Description	Number of flights avoided * unit cost of flight (user-specified) = Dollars saved.			Crude oil barrels reduced * unit cost (default) = Dollars saved.	
Default Unit Cost				\$101.02 /barrel	
	Flights Avoided (#)	Unit Cost (\$/flight)	Dollar Savings	Reduced Barrels of Crude Oil	Unit Cost (\$/barrel)
<i>Example</i>					
Total Input - All Projects	35		\$ 24,500	-	
Project 1	35	\$700.00	\$ 24,500.00		
Project 2			\$ -		
Project 3			\$ -		
Project 4			\$ -		
Project 5			\$ -		
Project 6			\$ -		
Project 7			\$ -		
Project 8			\$ -		

Example 5: Substituting Towards Greener Fuel

GMC upgraded half of its vehicle fleet to run on biodiesel B100 instead of gasoline, saving 4,375 gallons of gasoline annually.

INPUT

GHG Calculator: Mobile Sources Tab

Gasoline

Gasoline Reduced (gal.) = 4,375

Biodiesel

Blend = B100

Biodiesel Reduced (gal.) = - 4,375 (substitution)

Cost Calculator: Fuel Use Tab

Motor Gasoline

Gallons Reduced = 4,375

OUTPUT

GHG Calculator (Aggregate Tab) = 25.291 MTCO₂e

Cost Calculator = \$15,352*

*The Cost Calculator does not include biodiesel cost data, therefore this output does not account for the cost of biodiesel but accounts for avoided cost of gasoline only. Checking on datasource.

Ex. 5: GHG Calculator

Mobile Sources: GHG Savings from Reduced Fuel Use and Substitutions of Greener Fuels							
Fuel	Gasoline		Biodiesel			Ethanol	
How to use this tab: Instructions to obtain MTCO ₂ e			Select biodiesel blend from drop-down: B5 (5% biodiesel), B20 (20% biodiesel), or B100 (100% biodiesel). If blend unknown, select "Blend Unknown" (selects conservative B5). Enter gallons of biodiesel blend. "GHG Reduction" converts units into MTCO ₂ e.			Select ethanol blend (E10, E15, E20, E25, E30, E35, E50, E85, E95, E99.8). If blend unknown, select "Blend Unknown" (selects conservative E10). Enter gallons of ethanol blend. "GHG Reduction" converts units into MTCO ₂ e.	
Calculation Description	MTCO ₂ e = Input Volume (gal.) * (8.84 kg CO ₂ e / gal) ** (1MTCO ₂ e / 1,000 kg CO ₂ e) <i>See notes below for emission factor derivation.</i>		MTCO ₂ e (B5; also Blend Unknown) = Volume (gal.) * [0.05 * (3.06 kg CO ₂ e / gal. biodiesel) + 0.95 * (10.22 kg CO ₂ e / gal. diesel)] ** (1MTCO ₂ e / 1,000 kg CO ₂ e) MTCO ₂ e (B20) = Volume (gal.) * [0.20 * (3.06 kg CO ₂ e / gal. biodiesel) + 0.80 * (10.22 kg CO ₂ e / gal. diesel)] ** (1MTCO ₂ e / 1,000 kg CO ₂ e) MTCO ₂ e (B100) = Volume (gal.) * (3.06 kg CO ₂ e / gal. biodiesel) ** (1MTCO ₂ e / 1,000 kg CO ₂ e) <i>See notes below for emission factor derivation.</i>			MTCO ₂ e (E10; also Blend Unknown) = Volume (gal.) * [0.10 * (4.65 kg CO ₂ e / gal. gasoline) + 0.90 * (10.22 kg CO ₂ e / gal. diesel)] ** (1MTCO ₂ e / 1,000 kg CO ₂ e) MTCO ₂ e (E85) = Volume (gal.) * (3.06 kg CO ₂ e / gal. corn-derived ethanol) ** (1MTCO ₂ e / 1,000 kg CO ₂ e) MTCO ₂ e (E100) = Volume (gal.) * (3.06 kg CO ₂ e / gal. cellulosic-derived ethanol) ** (1MTCO ₂ e / 1,000 kg CO ₂ e) <i>See below for more derivation.</i>	
Example			GQ Co. replaced 20,000 gallons of distillate fuel oil in a combustion turbine generator with 20,000 gallons of biodiesel. (STEP 2 of 2. For STEP 1, see the Stationary Sources tab, under "Distillate Fuel Oil or Diesel").				
			B100	-20,000	-61.223		
	Gasoline Reduced (gal)	GHG Reduction (MTCO ₂ e)	Blend (Select)	Biodiesel Reduced (gal)	GHG Reduction (MTCO ₂ e)	Blend (Select)	Corn Ethanol Reduced (gal)
Total Input- All Projects	4,375	38.684		(4,375)	(13.393)		
<i>Project 1</i>	4,375	38.684	B100	-4,375	(13.393)		
<i>Project 2</i>		-			-		

Ex. 5: GHG Calculator – Aggregate Tab

Aggregated GHG Reductions by Category and Project									
This tab calculates the GHG saving results per project from all tabs. To name a project, enter the project name in the first column. The name entered will appear automatically as the project name on all other tabs. For example, if Project 1 is named "Line 2 Upgrade", the Project 1 field in all tabs will be populated as "Line 2 Upgrade".									
	Electricity Conservation	Green Energy	Stationary Sources	Mobile Sources	Greening Chemistry	Water Conservation	Materials Management (under construction)	Total by project	Total by project
	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO _{2e})	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO _{2e})	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO _{2e})	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO _{2e})	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO _{2e})	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO _{2e})	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO _{2e})	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO _{2e})*	Reduction in Million Metric Tons of Carbon Dioxide Equivalent (MMTCO _{2e})**
Aggregate (All Projects)	-	-	-	25.291	-	-	-	25.291	0.0000253
Project 1	-	-	-	25.291	-	-	-	25.291	0.0000253
Project 2	-	-	-	-	-	-	-	-	-
Project 3	-	-	-	-	-	-	-	-	-
Project 4	-	-	-	-	-	-	-	-	-
Project 5	-	-	-	-	-	-	-	-	-
Project 6	-	-	-	-	-	-	-	-	-
Project 7	-	-	-	-	-	-	-	-	-
Project 8	-	-	-	-	-	-	-	-	-
Project 9	-	-	-	-	-	-	-	-	-
Project 10	-	-	-	-	-	-	-	-	-
Category	Description								
Electricity Conservation	GHG reductions from electricity conservation or reduced use of energy.								
Green Energy	GHG reductions from switching to greener or renewable energy sources.								
Stationary Sources	GHG reductions from reduced fuel use in stationary combustion sources.								
Mobile Sources	GHG reductions from reduced fuel use or substitution to greener fuels in mobile or transportation sources.								
Greening Chemistry	GHG reductions from reduced use of high global-warming-potential (GWP) chemicals.								
Water Conservation	GHG reductions from reduced water use.								
Materials Management (under construction)	GHG reductions from considering the lifecycle GHG impact of materials used.								

Ex. 5: Cost Calculator

Fuel Use					
Type of Reduction	Motor Gasoline			Diesel	
How to use this tab	Enter the gallons of motor gasoline reduced. Enter the unit cost if known or leave blank to populate with the national default value. The Savings column converts data entries into dollars saved.			Enter the gallons of diesel reduced. Enter the unit cost if known or leave blank to populate with the national default value. The Savings column converts data entries into dollars saved.	
Calculation Description	Gallons reduced * unit cost (user-specified or default) = Dollars saved.			Diesel gallons reduced * unit cost (user-specified or default) = Dollars saved.	
Default Unit Cost	\$3.509 /gal			\$3.786 /gal	
	Reduced Gallons of Gas	Unit Cost (\$/gal)	Dollar Savings	Reduced Gallons of Diesel	Unit Cost (\$/gal)
<i>Example</i>					
Total Input - All Projects	4,375		\$ 15,352	-	
<i>Project 1</i>	4,375.00		\$ 15,351.88		
<i>Project 2</i>			\$ -		
<i>Project 3</i>			\$ -		
<i>Project 4</i>			\$ -		
<i>Project 5</i>			\$ -		
<i>Project 6</i>			\$ -		
<i>Project 7</i>			\$ -		

Reducing and Substituting Away from High-GWP Chemicals Projects

- P2 GHG Calculator: Greening Chemistry Tab
 - Total of 95 chemicals in the Tool
 - Cross walk of IPCC and EPG GHG proposed Rule.
 - Emissions of gases are translated into CO₂ equivalents using Global Warming Potentials
 - The 100-year GWP is a measure of the global warming impact of a gas, relative to CO₂

Note: Cost reductions associated with the reduction of specific chemicals are not incorporated into the P2 Cost Calculator.

Example 6: Reducing and Substituting Away from High-GWP Chemicals

Through the combination of refrigerant tracking and improved leak detection, GMC saved 10,000 pounds of HFC-134a. They also replaced 1000 pounds of CFC-12 with HFC-134a.

INPUT

GHG Calculator: Greening Chemistry Tab

CFC-12

lbs. Chemical Avoided = 1,000

HFC-134a

lbs. Chemical Avoided = 9,000

OUTPUT

GHG Calculator (Aggregate Tab) = 10,2521.360 MTCO₂e

Ex. 6: GHG Calculator

Greening Chemistry: GHG Savings from Reduced Emission of GHG Chemicals Directly						
How to use this tab: Instructions to obtain MTCO ₂ e		Enter the mass of each chemical avoided for a project in the column "lbs. Chemical Avoided." Total lbs CO ₂ e avoided and MTCO ₂ e				
Calculation Description		MTCO ₂ e = lbs.Chemical Avoided * (100-year Global Warming Potential) ^a * (0.4536 kg / lbs.) * (1 MTCO ₂ e / 1,000 kg CO ₂)				
<i>Example</i>		GQ Co. improved leak detection for their use of sulphur hexafluoride in their own electrical distribution equipment, saving 600 lbs.				
Industrial Chemical Reduced	IPCC, EPA Reporting Program GHG Registry or all	Chemical Formula	CAS #	Global Warming Potential (100 year)	All Projects	Project 1
					Total GHG Reduction (MTCO₂e)	GHG Reduction (MTCO₂e)
					10,251.360	10,251.360
					Total lbs. CO₂e Avoided	lbs. CO₂e Avoided
					22,600,000	22,600,000
					lbs. Chemical Avoided	lbs. Chemical Avoided
Carbon dioxide	Both	CO2	124389	1	-	-
Methane	Both	CH4	74828	21	-	-
Nitrous oxide	Both	N2O	10024972	310	-	-
CFC-11	IPCC	CCl3F	75694	4,750	-	-
CFC-12	IPCC	CCl2F2	75718	10,900	1,000	1,000
CFC-13	IPCC	CClF3	75729	14,400	-	-
HFC-134a	Both	CH2FCF3	811972	1,300	9,000	9,000
HFC-143a	Both	CH3CF3	420462	3,800	-	-
HFC-152a	Both	CH3CHF2	75376	140	-	-
HFC-227ea	Both	CF3CHFCF3	431890	2,900	-	-
HFC-236fa	Both	CF3CH2CF3	690391	6,300	-	-
HFC-245fa	Both	CF3CH2CF2	468734	4,800	-	-

Water Conservation Projects

- **P2 GHG Calculator: Water Conservation Tab**
 - Water and energy conservation are linked through the energy that it takes to pump, treat & transport water
- **P2 Cost Calculator: Water Use Tab**
 - Calculates savings from reductions of incoming raw water (does not take into account heating water, but merely the amount of water that comes in originally) through a P2 activity

Example 7: Water Conservation

GMC improved cooling tower efficiency in their North Carolina plant through the installation of magnetic pulse technology and saved 35,000,000 gallons of water.

INPUT

GHG Calculator: Water Conservation Tab

Water Conservation

State or US = North Carolina

Non-heated Water Reduced (gallons) = 35,000,000

Cost Calculator: Water Use Tab

Water Use

State or US = North Carolina

Gallons Reduced = 35,000,000

OUTPUT

GHG Calculator = 85.508 MT_{CO₂e}

Cost Calculator = \$89,542

Ex. 7: GHG Calculator

Water Conservation: GHG Savings from Reduced Water Use						
<p>This tab converts water conservation into GHG emission reductions. The factor for converting gallons of water to kWh of energy is a national-survey average of the energy required to pump raw water to a treatment plant and distribute the water. This tab allows a user to choose either a national or state grid emission factor, which the tool will apply in its formula to convert kWh of energy used to MTCO₂e emissions.</p> <p>Unless hot water use is metered separately, it may be difficult to determine the energy use attributable to heating water from a gas or electricity bill. Therefore, this tool treats gas and electricity savings from heating less water as part of overall gas and electricity savings (which the user will capture in the Stationary Source and Electricity Conservation tabs). Only the quantity of water reduced is accounted for in this tab.</p>						
Water Use		Water Conservation (non-heated water)		Other Calculator		
How to use this tab: Instructions to obtain MTCO ₂ e		Select a state or U.S. National to designate where water was conserved. Enter gallons of non-heated water conserved. "GHG Reduction" converts the reduction into MTCO ₂ e.		Please describe your methodology and source if you are using an alternate calculator. Enter your input and MTCO ₂ e values on the project rows.		
Calculation Description		$\text{MTCO}_2\text{e} = \text{Water Conserved (gal.)} * (3,300 \text{ kwh} / 1,000,000 \text{ gal. water used}) * [\text{either National or Regional emissions factor}]$ <p>National Conversion factor: 0.000692 MTCO₂e/kwh Regional Conversion factor: (0.000498 to 0.00090 MTCO₂e/kwh)</p>				
<i>Example</i>		GQ Co. reduced blow-down losses in boilers at NY plants through acidification of water, saving 30 million gals of water.				
		NY	30,000,000	57.203		
<i>Total Input- All Projects</i>		State or U.S. (Select)	Non-heated Water Reduced (gallons)	GHG Reduction (MTCO ₂ e)	Input	GHG Reduction (MTCO ₂ e)
		35,000,000	85.508	-	-	
Project 1		NC	35,000,000	85.508		
Project 2				-		

Ex. 7: Cost Calculator

Water Use			
Type of Reduction	Water Use		
How to use this tab:	Select a State or "U.S. National" to designate where the water reduction is taking place. Enter the gallons of incoming raw water saved. "Savings from Reduced Water Use" converts the quantity reduced into a monetary value.		
Calculation Description	Savings from Reduced Water Use= gallons reduced * Unit Cost (\$/gal) charged by local utility for supplying water		
<i>Example</i>	Adopted "electrocoagulation" technology in metal finishing shop, reducing process water use/discharge by about 99% (5 million gallons/yr.)		
	CT	5,000,000	\$ 11,754
	State or U.S. (Select)	Gallons Reduced	Savings from Reduced Water Use (\$)
Total Input - All Projects			\$ 89,542
<i>Input Volume-Project 1</i>	NC	35,000,000	\$ 89,542.48
<i>Input Volume-Project 2</i>	(Select)		-
<i>Input Volume-Project 3</i>	(Select)		-
<i>Input Volume-Project 4</i>	(Select)		-
<i>Input Volume-Project 5</i>	(Select)		-
<i>Input Volume-Project 6</i>	(Select)		-
<i>Input Volume-Project 7</i>	(Select)		-
<i>Input Volume-Project 8</i>	(Select)		-
<i>Input Volume-Project 9</i>	(Select)		-
<i>Input Volume-Project 10</i>	(Select)		-

Water Pollution Reducing Projects

- **P2 Cost Calculator – Water Pollution Tab**
 - Calculates savings from reduced discharges of water pollutants
 - **Waste Water** includes contaminants in water and storm water discharged to sewer systems, septic systems, injection wells, and ground water
 - **Water Pollutants** include biochemical oxygen demand (BOD), chemical oxygen demand (COD), toxics, nutrients, total suspended solids (TSS)

Note: GHG reduction is not applicable to Water Pollution, thus this activity is not represented in the GHG Calculator. Similarly, other activities not represented in the GHG Calculator include Hazardous and Non-Hazardous Waste Reduction and Air Pollutants (NO_x, SO_x, VOCs, PM₁₀, VOCs, HAPs).

Example 8: Water Pollution Reduction

Through the adoption of a new filtration system in one of its plants, GMC reduced the quantity of BOD/COD discharged by 500 pounds.

INPUT

Cost Calculator: Water Pollution Tab

BOD/COD

State or US = North Carolina

Quantity Reduced = 500

Units = lbs.

OUTPUT

Cost Calculator = \$119

Ex. 8: Cost Calculator

Water Pollution							
Type of Reduction	Wastewater Discharge			BOD/COD			
How to use this tab:	Select a State or "U.S. National" to designate where the water discharge is reduced. Enter the gallons of wastewater reduced. "Savings from Reduced Wastewater Discharge" converts the quantity reduced into a monetary value.			Select a State or "U.S. National" to designate where the water pollution is reduced. Enter the quantity of BOD/COD reduced and select the units from the drop-down menu. "Savings from Reduced BOD/COD" converts the quantity reduced into a total monetary value.			
Calculation Description	Savings from Reduced Wastewater Discharge = gallons reduced * Unit Cost (\$/gal)			Savings from Reduced BOD/COD = quantity reduced * conversion factor (lbs/user-specified units) * Unit Cost (\$/lbs)			
Unit Cost (\$)							
Example	Adopted "electrocoagulation" technology in metal finishing shop in New Jersey, reducing process water use/discharge by about 99% (5 million gallons/yr.)						
	WI	5,000,000	\$ 13,795				
	State or U.S. (Select)	Gallons Reduced	Savings from Reduced Wastewater Discharge (\$)	Quantity Reduced	Units (Select option)	Pounds Reduced	Savings from Reduced BOD/COD (\$)
Total Input - All Projects		-	\$ -			500	\$ 119
Input Volume-Project 1	NC		\$ -	500	lbs	500.00	\$ 119
Input Volume-Project 2	(Select)		-		(Select)	-	-
Input Volume-Project 3	(Select)		-		(Select)	-	-
Input Volume-Project 4	(Select)		-		(Select)	-	-
Input Volume-Project 5	(Select)		-		(Select)	-	-
Input Volume-Project 6	(Select)		-		(Select)	-	-
Input Volume-Project 7	(Select)		-		(Select)	-	-
Input Volume-Project 8	(Select)		-		(Select)	-	-
Input Volume-Project 9	(Select)		-		(Select)	-	-

GHG Calculator: Aggregate Tab for All Example Projects

Aggregated GHG Reductions by Category and Project									
This tab calculates the GHG saving results per project from all tabs. To name a project, enter the project name in the first column. The name entered will appear automatically as the project name on all other tabs. For example, if Project 1 is named "Line 2 Upgrade", the Project 1 field in all tabs will be populated as "Line 2 Upgrade".									
	Electricity Conservation	Green Energy	Stationary Sources	Mobile Sources	Greening Chemistry	Water Conservation	Materials Management (under construction)	Total by project	Total by project
	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO ₂ e)	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO ₂ e)	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO ₂ e)	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO ₂ e)	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO ₂ e)	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO ₂ e)	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO ₂ e)	Reduction in Metric Tons of Carbon Dioxide Equivalent (MTCO ₂ e)*	Reduction in Million Metric Tons of Carbon Dioxide Equivalent (MMTCO ₂ e)**
Aggregate (All Projects)	21.247	29.613	79.812	203.559	10,251.360	85.508	-	10,671.099	0.0106711
Project 1	21.247	29.613	79.81	203.559	10,251.360	85.508	-	10,671.099	0.0106711
Project 2	-	-	-	-	-	-	-	-	-
Project 3	-	-	-	-	-	-	-	-	-
Project 4	-	-	-	-	-	-	-	-	-
Project 5	-	-	-	-	-	-	-	-	-
Project 6	-	-	-	-	-	-	-	-	-
Project 7	-	-	-	-	-	-	-	-	-
Project 8	-	-	-	-	-	-	-	-	-
Project 9	-	-	-	-	-	-	-	-	-
Project 10	-	-	-	-	-	-	-	-	-
Category	Description								
Electricity Conservation	GHG reductions from electricity conservation or reduced use of energy.								
Green Energy	GHG reductions from switching to greener or renewable energy sources.								
Stationary Sources	GHG reductions from reduced fuel use in stationary combustion sources.								
Mobile Sources	GHG reductions from reduced fuel use or substitution to greener fuels in mobile or transportation sources.								
Greening Chemistry	GHG reductions from reduced use of high global-warming-potential (GWP) chemicals.								
Water Conservation	GHG reductions from reduced water use.								
Materials Management (under construction)	GHG reductions from considering the lifecycle GHG impact of materials used.								

Cost Calculator: Aggregate Tab for All Example Projects

Aggregated P2 Cost Savings										
This tab calculates the cost saving results per project from all tabs. To name a project, enter the project name in the first column. The name entered will appear automatically as the project name on all other tabs. For example if Project 1 is named Electricity Conservation, the Project 1 field in all tabs will be populated as "Electricity Conservation".										
	Hazardous Inputs	Hazardous Waste	Air Emissions	Water Pollution	Water Use	Fuel Use	Electricity Use	Total by Project	Non-Hazardous Inputs	Non-Hazardous Waste
	cost savings (\$)	cost savings (\$)	cost savings (\$)	cost savings (\$)	cost savings (\$)	cost savings (\$)	cost savings (\$)	cost savings (\$)	cost savings (\$)	cost savings (\$)
Aggregate (all projects)	\$ -	\$ -	\$ -	\$ 119	\$ 89,542	\$ 51,102	\$ 1,900	\$ 142,663	\$ -	\$ -
<i>Project 1</i>	\$ -	\$ -	\$ -	\$ 119	\$ 89,542	\$ 51,102	\$ 1,900	\$ 142,663	\$ -	\$ -
<i>Project 2</i>	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<i>Project 3</i>	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<i>Project 4</i>	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<i>Project 5</i>	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<i>Project 6</i>	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<i>Project 7</i>	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<i>Project 8</i>	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<i>Project 9</i>	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<i>Project 10</i>	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Hazardous Materials: Gallons to Pounds

- Engineering tool-kit
 - Common solvents
 - Fuels and oils
 - Refrigerants
 - House hold pains
 - Auto paints
 - Metal working fluids
 - Liquids

 - Show tool

Questions-Comments-Feedback?

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