D. ZERO-EMISSION LAWN AND GARDEN

Introduction

Lawn and garden equipment are a source of emissions where operators and those nearby are often directly exposed due to the localized and handheld nature of their usage. The CAP Incentive Program[1] attempts to reduce this source of emissions for the commercial sector that functions near schools by providing incentive funds to replace old, gasoline-powered equipment with zero-emission (electric) variants. The methodology for calculating emission reductions achieved by these incentive projects is outlined below. The scope of calculations includes the residential sector as well due to the anticipation of future need and availability of information. There are two sources of emissions from lawn and garden equipment: exhaust and evaporative. At this time, these calculations account only for the exhaust emissions.

The aim of the methodology is to simplify calculations so the emission reductions for these projects can be estimated in bulk, as opposed to estimating emission reductions for individual replacements. This is accomplished by using population-weighted data from the Small Off-Road Engines 2020 Emissions Inventory Model[2] (SORE2020), and applying Carl Moyer methods to determine the criteria air pollutant emission reductions. This methodology quantifies emission reductions per unit of lawn and garden equipment replaced on an annualized basis and over the course of the total quantification period (project life). By doing this, the per unit emission reductions can be multiplied by the total number of units replaced in a project for a given lawn and garden equipment category. The lawn and garden equipment categories addressed by this methodology for both commercial and residential sectors are walk-behind mowers; ride-on mowers; handheld chainsaws; leaf blowers and vacuums; trimmers, edgers, and brushcutters; and commercial standing-ride mowers.

1. Zero-Emission Lawn and Garden Methodology

The methodology estimates emission reductions for criteria air pollutant co-benefits primarily based on Formula C-6 of the 2017 Carl Moyer Guidelines[3]. Emission reductions from NOx, ROG, and PM from lawn and garden replacement projects are estimated as the difference between the emission of the baseline and reduced equipment over the quantification period using Equations 1 and 2. Only zero-emission replacements are allowable under this program, so only the emission for the baseline units will

[1] CAP Incentive 2019 Guidelines
[2] MSEI - Documentation - Off-Road - Gasoline Equipment
[3] Carl Moyer Program 2017 Guidelines

need to be determined, and that will be equal to the total emission reductions per unit replaced.

Equation 1: NOx and PM Annual Emission Reductions

$$ER_{Annual} = ((EF_{ZH} + DP) \times HP \times LF \times Activity) / 907{,}200$$

Equation 1 Variables	*Description*	*Units*
ER_{Annual}	Annual Emission Reductions	tons/yr-unit
EF_{ZH}	Zero-hour Emission Factor	g/bhp-hr
DP	Deterioration Product	g/bhp-hr
HP	Engine Horsepower	hp/unit
LF	Load Factor	unitless
Activity	Annual Usage	hr/yr
907,200	Conversion Factor	g/ton

The criteria pollutant emission reductions are equal to the emission from the baseline equipment. The appropriate emission factor and deterioration product for either NOx or PM should be used to determine the emission reduction for that specific component. The emission reductions calculation for ROG must include the ROG fraction to convert from total hydrocarbons (THC) to ROG, Equation 2. The ROG fraction that should be used in Equation 2 has a value of 1.01, which is for exhaust emissions for small off-road gasoline engines from the year 2004 onwards[4].

[4] CARB 2020 Emissions Model for Small Off-Road Engines - SORE2020, page 48, Table 28: SORE 2020 Technical Documentation

Equation 2: ROG Annual Emission Reductions

$ER_{AnnualROG} = ((EF_{ZH} + DP) X RF X HP X LF X Activity) / 907,200$

Equation 2 Variables	*Description*	*Units*
ER_{Annual}	Annual ROG Emission Reductions	tons/yr-unit
EF_{ZH}	Zero-hour Emission Factor	g/bhp-hr
DP	Deterioration Product	g/bhp-hr
HP	Engine Horsepower	hp/unit
LF	Load Factor	unitless
Activity	Annual Usage	hr/yr
907,200	Conversion Factor	g/ton
RF	Conversion from THC to ROG	unitless

The deterioration product accounts for the increased emissions over time as the integrity of the specific equipment degrades from usage. In the deterioration product, the deterioration rate will be specific to each criteria pollutant, and the annual usage should match the value used in Equations 1 or 2. The project life is chosen to serve as the deterioration life of the equipment because it represents the emission reductions that the program is funding. Ordinarily in Formula C-6 of the Moyer Guidelines, the baseline engine's determination of its deterioration life includes the difference between the model year of the baseline equipment and the expected first year of operation of the replacement equipment. For Equation 3, this has been omitted, as that level of detail will not be expected to be reported for the lawn and garden source category, and it results in a more conservative estimate.

Equation 3: Deterioration Product

$DP = DR X Activity X PL/2$

Equation 3 Variables	*Description*	*Units*
DP	Deterioration Product	g/bhp-hr
DR	Deterioration Rate	$g/bhp\text{-}hr^2$
Activity	Annual Usage	hr/yr
PL	Project Life	yrs

In order to obtain the cumulative emission reductions, multiply the emission reductions calculated from Equations 1 or 2 by the project life. The project life used should match the value used in Equation 3.

The inputs for Equations 1 through 3 were all determined from population weighting of the data available from SORE2020. Detailed information on

SORE2020 can be found elsewhere[5], but in summary it contains the population data for the various equipment types, emission factor data, equipment data, engine data, and usage data needed to utilize Equations 1 through 3.

The parameters specified to run the SORE2020 model were: annual for the seasonality input, and a calendar year of 2025. The year 2025 was selected to serve as a representative year between 2020-2030. The model's outputs were then matched with its inputs using tools available in Microsoft Excel. These steps generated projected data for the year 2025 that was organized by commercial, vendor, and residential sectors, as well as by equipment type, horsepower group, and fuel type. Population weighting of the inputs necessary for Equations 1 through 3 was then performed for the following equipment categories: walk-behind mowers; ride-on mowers; handheld chainsaws; leaf blowers and vacuums; trimmers, edgers, and brushcutters; and commercial standing-ride mowers. This was done for both the residential and commercial sectors, with the vendor sector data included with the commercial sector. The results of this exercise are displayed in Tables 1 through 3[6].

[5] CARB 2020 Emissions Model for Small Off-Road Engines - SORE2020: SORE 2020 Technical Documentation

[6] A detailed demonstration of the population weighting calculations is available here: Community Air Protection Incentives Lawn and Garden Supplementary Data

Table 1: Equipment Inputs

Equipment Category	Load Factor (unitless)	Life (yr)	Horsepower (hp/unit)	Activity (hr/yr)
Residential Walk-Behind Lawn Mowers	0.36	9	3.9	19.0
Residential Ride-on Mowers	0.38	9	21.4	83.0
Residential Chainsaws	0.70	7	1.9	18.0
Residential Leafblowers/Vacuums	0.93	5	2.0	15.0
Residential Trimmers/Edgers/Brushcutters	0.91	5	1.2	15.0
Commercial Walk-Behind Lawn Mowers	0.36	5	3.9	161.6
Commercial Standing Ride Mowers[7]	0.36	5	3.9	161.6
Commercial Ride-on Mowers[8]	0.38	5	21.4	246.0
Commercial Chainsaws	0.70	4	1.9	100.9
Commercial Leafblowers/ Vacuums	0.93	4	2.0	172.3
Commercial Trimmers/Edgers/ Brushcutters	0.91	4	1.2	120.7

[7] Due to a SORE2020 data gap, the estimated values for Commercial Standing Ride Mowers for Table 1 is calculated using the SORE2020 data for Commercial Walk-Behind Lawn Mowers.

[8] Due to a SORE2020 data gap, the estimated Activity (hr/yr) for Commercial Ride-on Mowers is calculated using only vendor ride-on lawn mower activity data.

Table 2: Zero-Hour Emission Factors

Equipment Category	EF_{THCZH} (g/bhp-hr)	EF_{NOxZH} (g/bhp-hr)	EF_{PMZH} (g/bhp-hr)
Residential Walk-Behind Lawn Mowers	3.91	2.44	0.02
Residential Ride-on Mowers	2.84	1.51	0.01
Residential Chainsaws	44.55	1.46	0.61
Residential Leafblowers/Vacuums	29.08	0.72	0.59
Residential Trimmers/Edgers/Brushcutters	27.07	1.38	0.31
Commercial Walk-Behind Lawn Mowers	3.91	2.44	0.02
Commercial Standing Ride Mowers[9]	3.91	2.44	0.02
Commercial Ride-on Mowers	2.84	1.51	0.01
Commercial Chainsaws	44.55	1.46	0.61
Commercial Leafblowers/ Vacuums	29.08	0.72	0.59
Commercial Trimmers/Edgers/ Brushcutters	27.07	1.38	0.31

[9] Due to a SORE2020 data gap, the estimated values for Commercial Standing Ride Mowers for Table 2 is calculated using the SORE2020 data for Commercial Walk-Behind Lawn Mowers.

Table 3: Deterioration Rates

Equipment Category	DR_{THC} (g/bhp-hr²)	DR_{NOx} (g/bhp-hr²)	DR_{PM} (g/bhp-hr²)
Residential Walk-Behind Lawn Mowers	0.004	0.003	0.000
Residential Ride-on Mowers	0.003	0.002	0.000
Residential Chainsaws	0.109	0.004	0.000
Residential Leafblowers/Vacuums	0.069	0.002	0.000
Residential Trimmers/Edgers/Brushcutters	0.066	0.002	0.000
Commercial Walk-Behind Lawn Mowers	0.001	0.001	0.000
Commercial Standing Ride Mowers[10]	0.001	0.001	0.000
Commercial Ride-on Mowers	0.001	0.001	0.000
Commercial Chainsaws	0.019	0.001	0.000
Commercial Leafblowers/ Vacuums	0.017	0.001	0.000
Commercial Trimmers/Edgers/ Brushcutters	0.015	0.001	0.000

This population weighted data is used to establish a representative and conservative estimate of individual units. This allows a bulk emission reductions calculation to be performed for multiple units or vouchers in the same equipment category. To determine the total annual emission reductions for multiple units of a specific equipment category, the emission reductions calculated from Equations 1 and 2 are simply multiplied by the total number units replaced, as shown in Equation 4.

[10] Due to a SORE2020 data gap, the estimated values for Commercial Standing Ride Mowers for Table 3 is calculated using the SORE2020 data for Commercial Walk-Behind Lawn Mowers.

Equation 4: Total Annual Emission Reductions

$$TotER_{Annual} = ER_{Annual} \times Total\ Replaced$$

Equation 4 Variables	*Description*	*Units*
$TotER_{Annual}$	Annual emission reductions for multiple units replaced	tons/yr
ER_{Annual}	Annual emission reductions per unit	tons/yr-unit
Total Replaced	Total number of replacements or vouchers per equipment category	units

Once the total annualized emission reductions per criteria pollutant have been determined, Formula C-3 from the Moyer Guidelines can be applied to determine the annual weighted emission reductions for a specific equipment category, as shown in Equation 5. Cost-effectiveness is calculated the same way as Moyer Formula C-18, and utilizes the total weighted emission reductions determined from Equation 5.

Equation 5: Total Weighted Emission Reductions

$$TotER_{AnnualWT} = TotER_{AnnualNOx} + TotER_{AnnualROG} + 20 \times TotER_{AnnualPM}$$

Equation 5 Variables	*Description*	*Units*
$TotER_{AnnualWT}$	Total weighted annual emission reductions	tons/yr
$TotER_{AnnualNOx}$	Annual NOx emission reductions for multiple units replaced	tons/yr
$TotER_{AnnualROG}$	Annual ROG emission reductions for multiple units replaced	tons/yr
$TotER_{AnnualPM}$	Annual PM emission reductions for multiple units replaced	tons/yr

For this methodology, the only input that is not prescribed is the project life. This will allow districts and communities the flexibility to adjust the project life to the needs of their individual areas. However, the project life must be a minimum of three years per the CAP Incentive Guidelines[11] and must not exceed a maximum of the values presented in Table 1. The maximum value is

[11] CAP Incentive 2019 Guidelines, Chapter 5.D.6: [Community Air Protection Incentives 2019 Guidelines]

based on the population-weighted equipment life data from the SORE2020 Inventory.

2. Zero-Emission Lawn and Garden Sample Calculations

Example 1 Conditions: A commercial landscaping company participates in an incentive program which allows them to replace 50 gasoline-powered walk-behind mowers and 40 gasoline-powered chainsaws for zero-emission variants. The incentive program allows a maximum project life of 5 years for walk-behind mowers, and 4 years for chainsaws.

In order to calculate emission reductions for the equipment replaced, the calculation must be performed twice: once for the walk-behind mowers and separately for the chainsaws. Inputs for the formulas below are for the commercial walk-behind mowers and chainsaws and come from Tables 1 through 3.

<u>**Walk-behind Mowers**</u>

NOx ER per unit:

Equation 1: $ER_{AnnualNOx} = ((EF_{NOxZH} + DP_{NOx}) X\ HP\ X\ LF\ X\ Activity) / 907{,}200$

$ER_{AnnualNOx}$ *Variables*	*Inputs*	*Units*
EF_{NOxZH}	2.44	g/bhp-hr
DP_{NOx}	From Equation 3	g/bhp-hr
HP	3.9	hp/unit
LF	0.36	unitless
Activity	161.6	hr/yr

Equation 3: $DP_{NOx} = DR_{NOx}\ X\ Activity\ X\ PL/2$

DP_{NOx} *Variables*	*Inputs*	*Units*
DR_{NOx}	0.001	$g/bhp\text{-}hr^2$
Activity	161.6	hr/yr
PL	5	yrs

$DP_{NOx} = 0.404\ (g/bhp\text{-}hr)$

$ER_{AnnualNOx} = 7.11\ X\ 10^{-4}\ (tons/yr\text{-}unit)$

NOx ER Total:

Equation 4: $TotER_{AnnualNOx} = ER_{AnnualNOx}\ X\ Total\ Replaced$

$TotER_{AnnualNOx}$ *Variables*	*Inputs*	*Units*
$ER_{AnnualNOx}$	$7.11\ X\ 10^{-4}$	tons/yr-unit
Total Replaced	50	units

$TotER_{AnnualNOx} = 0.0356\ (tons/yr)$

ROG ER per unit:

Equation 2: $ER_{AnnualROG} = ((EF_{THCZH} + DP_{THC}) \times RF \times HP \times LF \times Activity) / 907{,}200$

$ER_{AnnualROG}$ Variables	***Inputs***	***Units***
EF_{THCZH}	3.91	g/bhp-hr
DP_{THC}	From Equation 3	g/bhp-hr
HP	3.9	hp/unit
LF	0.36	unitless
Activity	161.6	hr/yr
RF	1.01	

Equation 3: $DP_{THC} = DR_{THC} \times Activity \times PL/2$

DP_{ROG} Variables	***Inputs***	***Units***
DR_{THC}	0.001	$g/bhp\text{-}hr^2$
Activity	161.6	hr/yr
PL	5	yrs

$DP_{THC} = 0.404$ *(g/bhp-hr)*

$ER_{AnnualROG} = 0.001$ *(tons/yr-unit)*

ROG ER Total:

Equation 4: $TotER_{AnnualROG} = ER_{Annual} \times Total\ Replaced$

$TotER_{AnnualROG}$ Variables	***Inputs***	***Units***
$ER_{AnnualROG}$	0.001	tons/yr-unit
Total Replaced	50	units

$TotER_{AnnualROG} = 0.0545$ *(tons/yr)*

PM ER per unit:

Equation 1: $ER_{AnnualPM} = ((EF_{PMZH} + DP_{PM}) \times HP \times LF \times Activity) / 907{,}200$

$ER_{AnnualPM}$ *Variables*	*Inputs*	*Units*
EF_{PMZH}	0.02	g/bhp-hr
DP_{PM}	From Equation 3	g/bhp-hr
HP	3.9	hp/unit
LF	0.36	unitless
Activity	161.6	hr/yr

Equation 3: $DP_{PM} = DR \times Activity \times PL/2$

DP_{PM} *Variables*	*Inputs*	*Units*
DR_{PM}	0.000	$g/bhp\text{-}hr^2$
Activity	161.6	hr/yr
PL	5	yrs

$DP_{PM} = 0$ *(g/bhp-hr)*

$ER_{AnnualPM} = 5.002 \times 10^{-6}$ *(tons/yr)*

PM ER Total:

Equation 4: $TotER_{AnnualPM} = ER_{Annual} \times Total\ Replaced$

$TotER_{AnnualPM}$ *Variables*	*Inputs*	*Units*
$ER_{AnnualPM}$	5.002×10^{-6}	tons/yr-unit
Total Replaced	50	unit

$TotER_{AnnualPM} = 0.0003$ *(tons/yr)*

Total Weighted Emission Reductions from walk-behind mowers

Equation 5: $TotER_{AnnualWT} = TotER_{AnnualNOx} + TotER_{AnnualROG} + 20 \times TotER_{AnnualPM}$

$TotER_{AnnualWT}$ *Variables*	*Inputs*	*Units*
$TotER_{AnnualNOx}$	*0.0356*	tons/yr
$TotER_{AnnualROG}$	*0.0545*	tons/yr
$TotER_{AnnualPM}$	0.0003	tons/yr

$TotER_{AnnualWT} = 0.095$ *(tons/yr)*

Chainsaws

NOx ER per unit:

Equation 1: $ER_{AnnualNOx} = ((EF_{NOxZH} + DP_{NOx}) \times HP \times LF \times Activity) / 907{,}200$

$ER_{AnnualNOx}$ Variables	Inputs	Units
EF_{NOxZH}	1.46	g/bhp-hr
DP_{NOx}	From Equation 3	g/bhp-hr
HP	1.9	hp/unit
LF	0.70	unitless
Activity	100.9	hr/yr

Equation 3: $DP_{NOx} = DR_{NOx} \times Activity \times PL/2$

DP_{NOx} Variables	Inputs	Units
DR_{NOx}	0.001	g/bhp-hr^2
Activity	100.9	hr/yr
PL	4	yrs

$DP_{NOx} = 0.202$ *(g/bhp-hr)*

$ER_{AnnualNOx} = 2.46 \times 10^{-4}$ *(tons/yr-unit)*

NOx ER Total:

Equation 4: $TotER_{AnnualNOx} = ER_{AnnualNOx} \times Total\ Replaced$

$TotER_{AnnualNOx}$ Variables	Inputs	Units
$ER_{AnnualNOx}$	2.46×10^{-4}	tons/yr-unit
Total Replaced	40	units

$TotER_{AnnualNOx} = 0.0098$ *(tons/yr)*

ROG ER per unit:

Equation 2: $ER_{AnnualROG} = ((EF_{THCZH} + DP_{THC}) \times RF \times HP \times LF \times Activity) / 907{,}200$

$ER_{AnnualROG}$ Variables	***Inputs***	***Units***
EF_{THCZH}	44.55	g/bhp-hr
DP_{THC}	From Equation 3	g/bhp-hr
HP	1.9	hp/unit
LF	0.70	unitless
Activity	100.9	hr/yr
RF	1.01	unitless

Equation 3: $DP_{THC} = DR_{THC} \times Activity \times PL/2$

DP_{ROG} Variables	***Inputs***	***Units***
DR_{THC}	0.019	g/bhp-hr^2
Activity	100.9	hr/yr
PL	4	yrs

$DP_{THC} = 3.834$ *(g/bhp-hr)*

$ER_{AnnualROG} = 0.007$ *(tons/yr-unit)*

ROG ER Total:

Equation 4: $TotER_{AnnualROG} = ER_{Annual} \times Total\ Replaced$

$TotER_{AnnualROG}$ Variables	***Inputs***	***Units***
$ER_{AnnualROG}$	*0.007*	tons/yr-units
Total Replaced	40	units

$TotER_{AnnualROG} = 0.2892$ *(tons/yr)*

PM ER per unit:

Equation 1: $ER_{AnnualPM} = ((EF_{PMZH} + DP_{PM}) \times HP \times LF \times Activity) / 907{,}200$

$ER_{AnnualPM}$ Variables	*Inputs*	*Units*
EF_{PMZH}	0.61	g/bhp-hr
DP_{PM}	From Equation 3	g/bhp-hr
HP	1.9	hp/unit
LF	0.70	unitless
Activity	100.9	hr/yr

Equation 3: $DP_{PM} = DR \times Activity \times PL/2$

DP_{PM} Variables	*Inputs*	*Units*
DR_{PM}	0.000	g/bhp-hr^2
Activity	100.9	hr/yr
PL	4	yrs

$DP_{PM} = 0$ *(g/bhp-hr)*

$ER_{AnnualPM} = 9.023 \times 10^{-5}$ *(tons/yr-unit)*

PM ER Total:

Equation 4: $TotER_{AnnualPM} = ER_{Annual} \times Total\ Replaced$

$TotER_{AnnualPM}$ Variables	*Inputs*	*Units*
$ER_{AnnualPM}$	9.023×10^{-5}	tons/yr
Total Replaced	40	units

$TotER_{AnnualPM} = 0.0036$ *(tons/yr)*

Total Weighted Emission Reductions from walk-behind mowers

Equation 5: $TotER_{AnnualWT} = TotER_{AnnualNOx} + TotER_{AnnualROG} + 20 \times TotER_{AnnualPM}$

$TotER_{AnnualWT}$ Variables	*Inputs*	*Units*
$TotER_{AnnualNOx}$	*0.0098*	tons/yr
$TotER_{AnnualROG}$	*0.2892*	tons/yr
$TotER_{AnnualPM}$	*0.0036*	tons/yr

$TotER_{AnnualWT} = 0.371$ *(tons/yr)*

Example 2 Conditions: An air district hosts and a residential voucher exchange event for chainsaws. After the event, the district has 80 vouchers they provided that need to be reported. Each voucher is being counted as one residential chainsaw and the district has determined that each one will have a 3-year project life.

Inputs for the formulas below are for residential chainsaws and come from Tables 1 through 3.

<u>Chainsaws</u>

NOx ER per unit:

Equation 1: $ER_{AnnualNOx} = ((EF_{NOxZH} + DP_{NOx}) \times HP \times LF \times Activity) / 907{,}200$

$ER_{AnnualNOx}$ Variables	*Inputs*	*Units*
EF_{NOxZH}	1.46	g/bhp-hr
DP_{NOx}	From Equation 3	g/bhp-hr
HP	1.9	hp/unit
LF	0.70	unitless
Activity	18.0	hr/yr

Equation 3: $DP_{NOx} = DR_{NOx} \times Activity \times PL/2$

DP_{NOx} Variables	*Inputs*	*Units*
DR_{NOx}	0.004	$g/bhp\text{-}hr^2$
Activity	18.0	hr/yr
PL	3	yrs

$DP_{NOx} = 0.108$ *(g/bhp-hr)*

$ER_{AnnualNOx} = 4.14 \times 10^{-5}$ *(tons/yr)*

NOx ER Total:

Equation 4: $TotER_{AnnualNOx} = ER_{AnnualNOx} \times Total\ Replaced$

$TotER_{AnnualNOx}$ Variables	*Inputs*	*Units*
$ER_{AnnualNOx}$	*4.14×10^{-5}*	tons/yr
Total Replaced	80	units

$TotER_{AnnualNOx} = 0.0033$ *(tons/yr)*

ROG ER per unit:

Equation 2: $ER_{AnnualROG} = ((EF_{THCZH} + DP_{THC}) \times RF \times HP \times LF \times Activity) / 907{,}200$

$ER_{AnnualROG}$ *Variables*	*Inputs*	*Units*
EF_{THCZH}	44.55	g/bhp-hr
DP_{THC}	From Equation 3	g/bhp-hr
HP	1.9	hp/unit
LF	0.70	unitless
Activity	18.0	hr/yr
RF	1.01	unitless

Equation 3: $DP_{THC} = DR_{THC} \times Activity \times PL/2$

DP_{ROG} *Variables*	*Inputs*	*Units*
DR_{THC}	0.109	$g/bhp\text{-}hr^2$
Activity	18.0	hr/yr
PL	3	yrs

$DP_{THC} = 2.943$ *(g/bhp-hr)*

$ER_{AnnualROG} = 0.001$ *(tons/yr-unit)*

ROG ER Total:

Equation 4: $TotER_{AnnualROG} = ER_{Annual} \times Total\ Replaced$

$TotER_{AnnualROG}$ *Variables*	*Inputs*	*Units*
$ER_{AnnualROG}$	*0.001*	tons/yr
Total Replaced	80	units

$TotER_{AnnualROG} = 0.1013$ *(tons/yr)*

PM ER per unit:

Equation 1: $ER_{AnnualPM} = ((EF_{PMZH} + DP_{PM}) X HP X LF X Activity) / 907,200$

$ER_{AnnualPM}$ ***Variables***	***Inputs***	***Units***
EF_{PMZH}	0.61	g/bhp-hr
DP_{PM}	From Equation 3	g/bhp-hr
HP	1.9	hp/units
LF	0.70	unitless
Activity	18.0	hr/yr

Equation 3: $DP_{PM} = DR X Activity X PL/2$

DP_{PM} ***Variables***	***Inputs***	***Units***
DR_{PM}	0.000	g/bhp-hr^2
Activity	18.0	hr/yr
PL	3	yrs

$DP_{PM} = 0$ *(g/bhp-hr)*

$ER_{AnnualPM} = 1.610 X 10^{-5}$ *(tons/yr-unit)*

PM ER Total:

Equation 4: $TotER_{AnnualPM} = ER_{Annual} X Total Replaced$

$TotER_{AnnualPM}$ ***Variables***	***Inputs***	***Units***
$ER_{AnnualPM}$	$1.610 X 10^{-5}$	tons/yr-unit
Total Replaced	80	units

$TotER_{AnnualPM} = 0.0013$ *(tons/yr)*

Total Weighted Emission Reductions from walk-behind mowers

Equation 5: $TotER_{AnnualWT} = TotER_{AnnualNOx} + TotER_{AnnualROG} + 20 X TotER_{AnnualPM}$

$TotER_{AnnualWT}$ ***Variables***	***Inputs***	***Units***
$TotER_{AnnualNOx}$	*0.0033*	tons/yr
$TotER_{AnnualROG}$	*0.1013*	tons/yr
$TotER_{AnnualPM}$	*0.0013*	tons/yr

$TotER_{AnnualWT} = 0.130$ *(tons/yr)*