Appendix J

Recreational Watercraft
Emissions Inventory Methodology

November 2014

California Air Resources Board
Air Quality Planning and Science Division

EXECUTIVE SUMMARY

Recreational watercraft (RW) is a broad category of marine vessels that includes gasoline-powered spark-ignition marine watercraft (SIMW) and diesel-powered marine watercraft. The focus of this report is to support the emissions inventory developed for the California Air Resources Board's (ARB) proposed regulation to control evaporative emissions from SIMW. The regulation is needed in order to meet the 2007 State Implementation Plan (SIP) commitment to reduce reactive organic gas (ROG) emissions from SIMW.

To support the regulatory proposal, staff developed a revised emissions inventory model (PC2014) to estimate evaporative ROG emissions generated by SIMW in each region of the State. This emissions inventory revision focuses on evaporative emissions and builds on the previous ARB off-road model, OFFROAD2007. PC2014 contains updated inputs for population, hours of use (activity), growth rates, emissions factors, and the technology change from carbureted (CB) to fuel injected engines (FI), and changes in the population split between 2-stroke (G2) and 4-stroke (G4) gasoline engines. The updated inputs for emission factors, population, and activity are based upon in-house testing conducted at ARB, updated population and activity estimates from the California Department of Motor Vehicles (DMV), and a survey conducted by the California State University, Sacramento (CSUS). The inventory revision also accounts for the economic recession that began in December 2007.

The long useful life of RW coupled with the recent downturn in new boat sales due to the recession has led to an older average fleet age. As a result, it will take longer to realize the evaporative emissions benefits from the proposed regulation as the existing SIMW population operating in California is replaced by new compliant marine watercraft.

The table below summarizes the statewide summer RW ROG inventory for three critical air quality attainment deadlines in California: 2020, 2023, and 2035. There are no exhaust emissions benefits as the proposed regulation focuses solely on the control of evaporative emissions. By 2020, 2023, and 2035, the evaporative emissions benefits of the proposed regulation are estimated to be 0.15 tons per day (TPD), 0.34 TPD, and 1.06 TPD, respectively. Emissions reductions in 2020 and 2023 are presented for SIP comparison purposes. Emissions reductions in 2037 are presented based on the 20-year lifetime of a SIMW.

Statewide Summer ROG Emissions and Post Regulation Benefits (tons/day)

	2020			2023			2035		
	Exhaust	Evap	Total	Exhaust	Evap	Total	Exhaust	Evap	Total
Baseline	106.54	22.94	129.48	92.42	21.46	113.87	55.90	17.03	72.93
Proposed Regulation	106.54	22.79	129.33	92.42	21.12	113.53	55.90	15.97	71.87
Benefits	0.00	0.15	0.15	0.00	0.34	0.34	0.00	1.06	1.06

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I. BACKGROUND

Evaporative emissions from SIMW are a significant source of ROG, which are an important precursor to the formation of ground level ozone. Reductions in ROG are necessary for the California to comply ambient air quality standards for ozone.

The previous ARB off-road emissions inventory model (OFFROAD2007) was used to estimate emissions from off-road sources such as RW, lawn and garden equipment, construction equipment, and other types of off-road equipment. As part of the SIMW rulemaking, OFFROAD2007 was replaced with an updated stand-alone Microsoft Access-based model (PC2014) that was used to estimate RW exhaust and evaporative emissions. Because less than five percent of RW is diesel-powered, the majority of the evaporative emissions contribution from RW is SIMW. PC2014 has grouped RW into the six types listed in Table I-1.

Table I-1: Types of RW

Boat Type	Gasoline	Diesel
Outboard	X	
Inboard	X	X
Sterndrive	X	
Personal Watercraft	X	
Jet Boat	X	
Auxiliary Sailboat	X	X

A. DATA, METHODOLOGIES, AND ASSUMPTIONS

This document describes the data, methodologies, and assumptions applied in PC2014. It also describes the steps taken to estimate the emissions benefits of the proposed regulation. The following descriptions provide a brief overview of the data, methodologies, and assumptions.

Base Year Population and Model Year (MY) Distribution (2006 to 2013)

The base calendar year (CY) for the RW emissions inventory is 2013. Updated California Department of Motor Vehicle (DMV) registration data provided detailed information on the total population and MY distribution for each CY from 2006 to 2013. An estimate of the population of active and inactive (stored at households but not used) RW is included in PC2014.

Forecasting RW Populations and Age Distributions (2014 to 2050)

Staff used DMV registration data to reevaluate the projected life span of each RW type and to estimate the expected total life, useful life (or median life), and year-to-year survival ratios.

Forecasting Annual RW Sales

Staff used economic data from a 2014 UCLA Economic Forecast to estimate the near-term annual sales of RW (2014 to 2019). To forecast long-term annual sales (2020 and later), staff used an estimate of California's annual population growth as a surrogate.

Technology Shifts

Staff used ARB's marine engine certification database as well as sales information from manufacturers to estimate the split of gasoline 2-stroke (G2) and 4-stroke (G4) engines. The updated base year and future year RW populations have a greater proportion of G4 engines, which significantly lowers the estimate of exhaust emissions.

Activity

In 2009, ARB funded a CSUS phone survey of over 1,123 respondents (CSUS, 2009). Staff used the results of the survey to estimate the annual activity as well as the spatial allocations for operation and storage for RW.

Emissions Factors

Staff updated exhaust emissions factors based on ARB marine engine certification data. Evaporative emissions factors were also updated based on ARB in-house SIMW testing. Finally, weathering correction was applied to active and inactive SIMW to account for the evaporative rates that decline over extended storage periods. Weathering occurs when a SIMW is stored for extended time periods. The gasoline evaporative emissions rate starts to decline and reaches a steady state after most light-end molecules escape from liquid gasoline over an extended storage period.

Spatial Allocation

Exhaust and evaporative emissions (running loss and hot soak) that occur during RW operation were allocated to areas of operation. Other evaporative processes (diurnal and resting loss) were allocated to areas of SIMW storage. Both allocations are based on the CSUS activity survey.

Correction Factors

Temperature/Reid Vapor Pressure (RVP) correction is used to scale down the diurnal and resting loss evaporative emissions from the test temperature range of 65ºF to 105ºF to local temperature conditions experienced by SIMW during storage. This correction factor is based on normalized calculations of vapor generation from the fuel tank and permeation from fuel hoses using the Reddy equation (Reddy, 1989).

II. EMISSIONS CALCULATION METHODOLOGY

In this section, the data sources, methodology, assumptions, and algorithms used in developing the emissions inventory are described. Topics that require more detailed explanation are included in Section VI of this document.

The top-down process of calculating RW emissions starts with multiplying the population by activity, relevant emissions factors, and load factors, where applicable, resulting in the statewide uncorrected emissions. The statewide uncorrected emissions are then allocated to the local geographic area of interest (GAI) and adjusted with different correction factors to reflect the local conditions (e.g., ambient temperature and humidity correction). Final outputs of the emissions inventory are based on counties, air districts, and the state for specific CYs.

B. METHODOLOGY

1. EXHAUST EMISSIONS

Exhaust emissions are not affected by the proposed regulation, which focuses only on evaporative ROG emissions. However, for completeness, exhaust emissions are investigated and evaluated for the category. Exhaust emissions are estimated using the equation and variables listed below for ROG, total organic gases (TOG), oxides of nitrogen (NOx), carbon monoxide (CO), carbon dioxide(CO2), and particulate matter (PM) by RW type, age, and CY.

$$P_{i,y} = \sum Pop_{i,v} x\ EF_{i,v} x\ Hrs_{i,v} x\ Ave.\ Hp\ x\ Load\ Factor$$

Where,

P	= pollutant (HC, CO, NO_X, PM, CO_2)
Pop	= engine population
EF	= emissions factor
Hrs	= annual average use hours
Ave. Hp	= average horsepower
Load factor	= load factor
y	= scenario year (1990-2050)
i	= equipment type
v	= vintage (age of equipment)for year y

2. EVAPORATIVE EMISSIONS

The proposed regulation controls evaporative emissions through more stringent diurnal and permeation standards for SIMW with engines greater than 30 kW and harmonizes evaporative standards for SIMW with engines less than 30 kW. The evaporative emissions inventory is separated into four distinct processes: diurnal, resting loss, hot soak, and running loss. These are defined as:

- Diurnal: Emissions from vapor expansion and venting during the heating part of the diurnal temperature cycle. Fuel also permeates as a function of rising temperature from fuel lines and gas tanks and evaporates on the outside surfaces of these components. Diurnal emissions occur in equipment that is not in operation.
- Resting loss: Emissions that occur as a result of fuel permeation through rubber or plastic fuel system components such as fuel hoses and fuel tanks. They occur during the cooling part of the diurnal temperature cycle. Resting loss emissions occur in equipment that is not in operation.
- Hot soak: Emissions that occur after an engine is shut off as the temperature of equipment and fuel delivery systems rises and then gradually returns to ambient temperature.
- Running loss: Emissions that occur while the equipment is operating; and the temperature of the equipment and fuel delivery systems are above ambient temperature.

Note that the definition of diurnal in a regulatory context represents the sum of the diurnal and resting loss processes.

The basic equations for estimating evaporative emissions are provided below:

$$Diurnal/Resting = Population \; x \; EF_{Diurnal/Resting} \; x \; Temp/RVP \; Correction$$

$$Hot \; Soak = Population \; x \; EF_{Hot \; Soak} \; x \; RVP \; Correction$$

$$Running \; Loss = Population \; x \; EF_{Running \; Loss} \; x \; Activity \; x \; RVP \; Correction$$

Where,

$EF_{Diurnal/Resting}$	= gram per day for diurnal and resting losses
$EF_{Hot\ Soak}$	= gram per event of hot soak
$EF_{Running\ Loss}$	= grams per hour of running loss
Activity	= usage in hours per year
RVP Correction	= RVP correction factor (region specific)
Temp/RVP Correction	= temperature and RVP correction factor (region specific)

C. EMISSIONS INVENTORY INPUTS

1. ACTIVE AND INACTIVE ENGINE POPULATION

Staff used 2006 to 2013 CY DMV registration data to update the RW population. As shown in Table II-1, DMV has designated different codes to define vehicle usage. Based on the DMV definitions, staff divided the RW population into two groups: active and inactive. Active RW include the DMV registration code of “C”, “E”, or “S” whereas inactive RW include DMV registration code of “N”, “P”, or “R.”

Approximately 80 percent of the RW population is active and the rest is inactive. For this assessment, staff assumed inactive RW are not in use, therefore the only emissions associated with inactive RW are the evaporative emissions of ROG.

Table II-1:Definition of Active and Inactive Status

DMV code	Definition	Status
C	Currently registered	Active
E	Evidence of use	Active
S	Pending	Active
N	Not currently registered	Inactive
P	Planned non-operational	Inactive
R	Prior history	Inactive

DMV registration data is useful for identifying the population of RW in California, but does not account for RW with more than one engine. The CSUS survey information was used to supplement the DMV database and to estimate the average engine-to-RW ratio. Engine-to-RW ratios are applied to the population to determine the total active and inactive engine populations. Table II-2 shows the engine-to-RW ratios used for estimating engine population for outboard, inboard, and sterndrive. For PWC, jet drives, and sailboats with an auxiliary engine, staff assumed that there is only one engine per RW.

Table II-2: Engine-to-RW Ratio per RW Type

Boat Type	One engine	Two Engines	Three Engines+	Total Boats	Total Engines	Average Engine-to-RW Ratio
Inboard	117	35	0	152	187	1.23
Outboard	367	35	0	402	437	1.09
Sterndrive	295	16	1	312	330	1.06

2. LIFESPAN BY RW

We define the “total life” of a RW as the length of time when a population of RW is manufactured in a given year to the time when such population is removed. We define the “useful life” as the time a population of RW is manufactured to the time when half of the population is removed. This assessment is conducted on a RW-specific category basis. It is based on DMV registration data. We assume that the total life of the engine(s) in each RW is the same as the RW. In addition, we assume engine MY and RW MY is the same. Finally, we assume engines are not rebuilt or replaced during a RW’s life span.

Figure II-1 illustrates the age distribution of outboard based on DMV registration data. The figure plots age distributions for 2006, 2008, 2009, 2011, and 2013 CYs. The actual age distribution covers ages from -1 up to 110, with the bulk of the population at around 60 years. RW with an age of -1 represent early sales of a new MY. RW older than 60 years makes up a negligible fraction of the entire population. Therefore, staff assumed 60 years to be the total life for outboard RW.

Similarly, for the rest of the other five RW categories, staff analyzed age distributions within DMV data and estimated their total life, as summarized in Table II-3. For outboards, inboards, sterndrives, and sailboats with auxiliary engine, the total life is 60 years. For PWC and jet drives, the total life is 40 years and 50 years, respectively.

Figure II-1:Age Distribution of Outboard from DMV Data

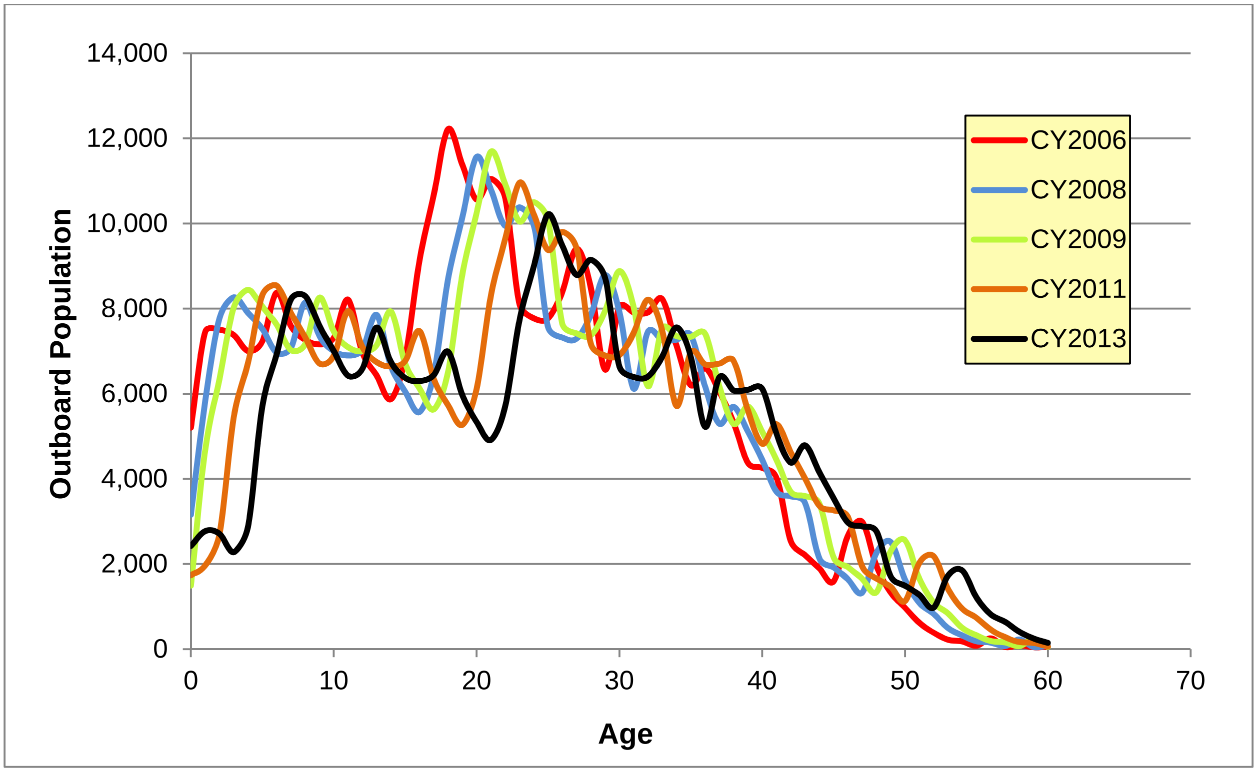


Table II-3:Total Life of RW

Boat Type	Total Life (year)
Outboard	60
Inboard	60
Sterndrive	60
PWC	40
Jet Drive	50
Auxiliary Sail	60

3. FORECASTING RW POPULATION BY AGE

Population growth for RW is based on incoming population (estimated by new RW annual sales) and the outgoing population (estimated by the survival rate).

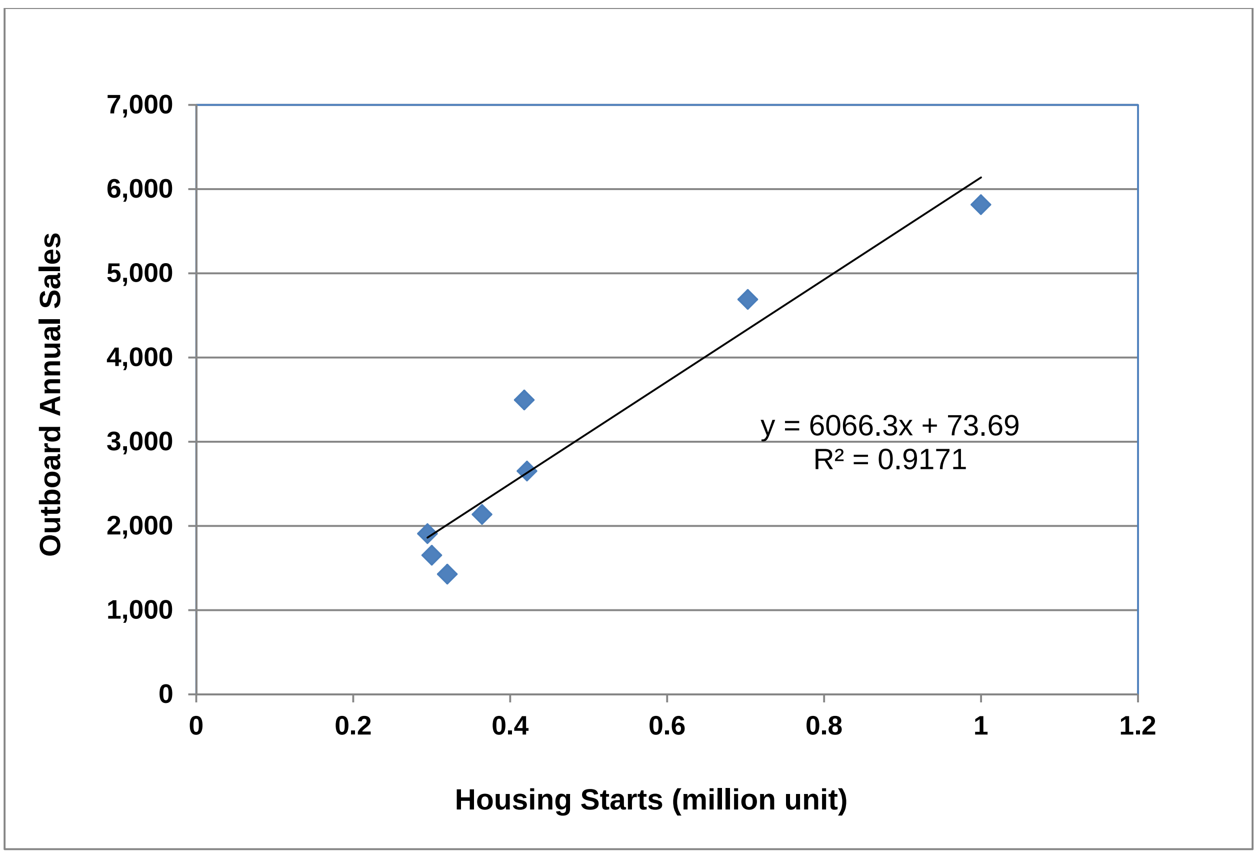
$$New\ Population = Old\ Population + New\ RW\ Sales - Scrapped\ Population\ (each\ age)$$

a. Annual RW Sales

Estimating future annual sales of RW is a challenging task as no direct forecasts are available. However, based on historical housing start data contained in the 2014 UCLA Economic Forecast Report (UCLA, 2014), we found that RW annual sales correlate well with nationwide housing starts.

As seen in Figure II-2, there is a good correlation between past nationwide housing starts and historical annual sales of outboard with R^2 of 0.92. Since the UCLA Economic Forecast Report also projects the future nationwide housing starts, staff used it as a surrogate to project future annual sales of outboard. Below, we illustrate the method to estimate the growth of annual sales using outboard as an example.

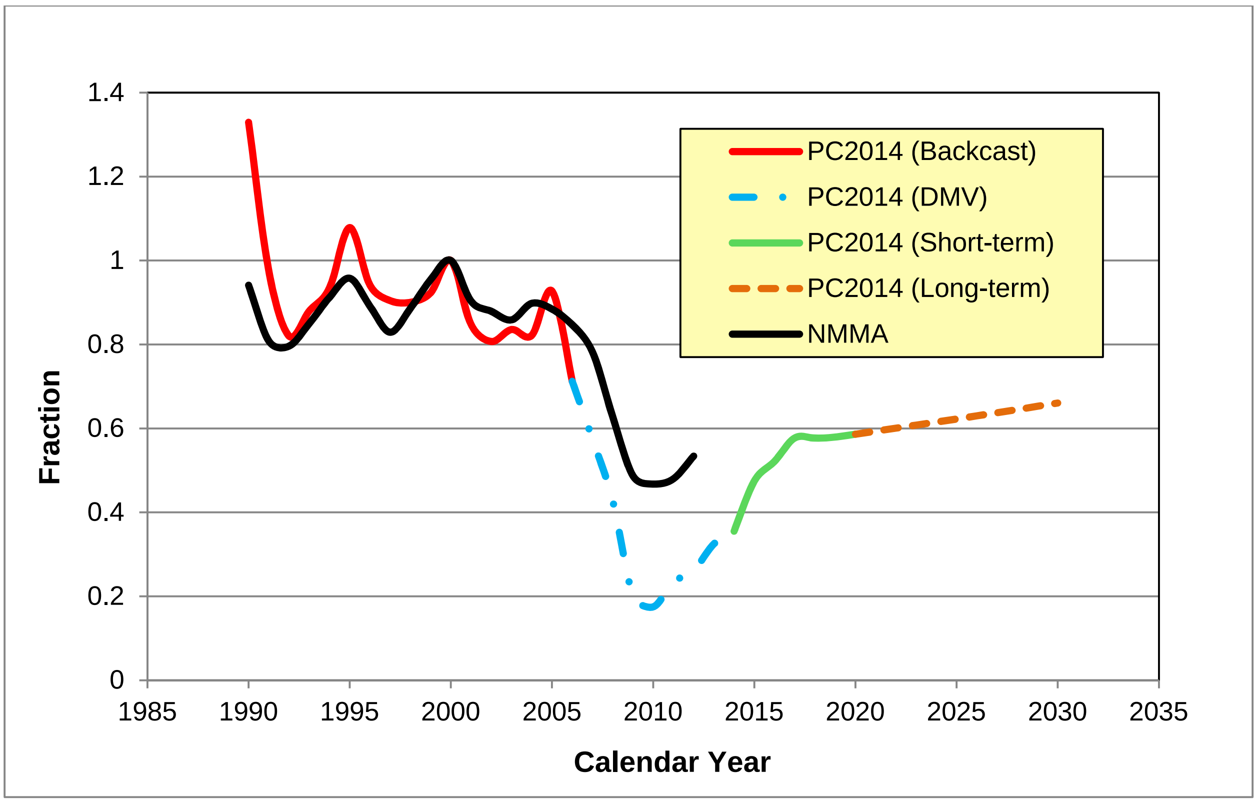
Figure II-2:Correlation of Annual Sales and Nationwide Housing Starts



Example Calculation: Forecasted Outboard Annual Sales

The National Marine Manufacturer Association (NMMA) tracks nationwide RW sales. However, because no California specific sales data are available, staff used the NMMA nationwide sales data to confirm the accuracy of the annual sales projection in PC2014. Staff compared the "new" RW population in PC2014 (defined as age=0) with NMMA's annual sales data from 1990 to 2013. As the NMMA data are nationwide and PC2014 is California-specific, all data was normalized to CY 2000 to facilitate a comparison. The general trend is in good agreement with the nationwide annual sales of outboard as shown in Figure II-3. An analysis of annual sales data suggests that the recent recession has had a greater impact on California sales than nationwide sales. The short-term annual sales forecast (2014 to 2019) is based on UCLA's projected nationwide housing starts, whereas the long-term annual sales forecast (2020 and beyond) is based on the historical annual growth rate of California human population (1.2 percent per year).

Figure II-3:Normalized Annual Sales of Outboard (PC2014 vs. NMMA)



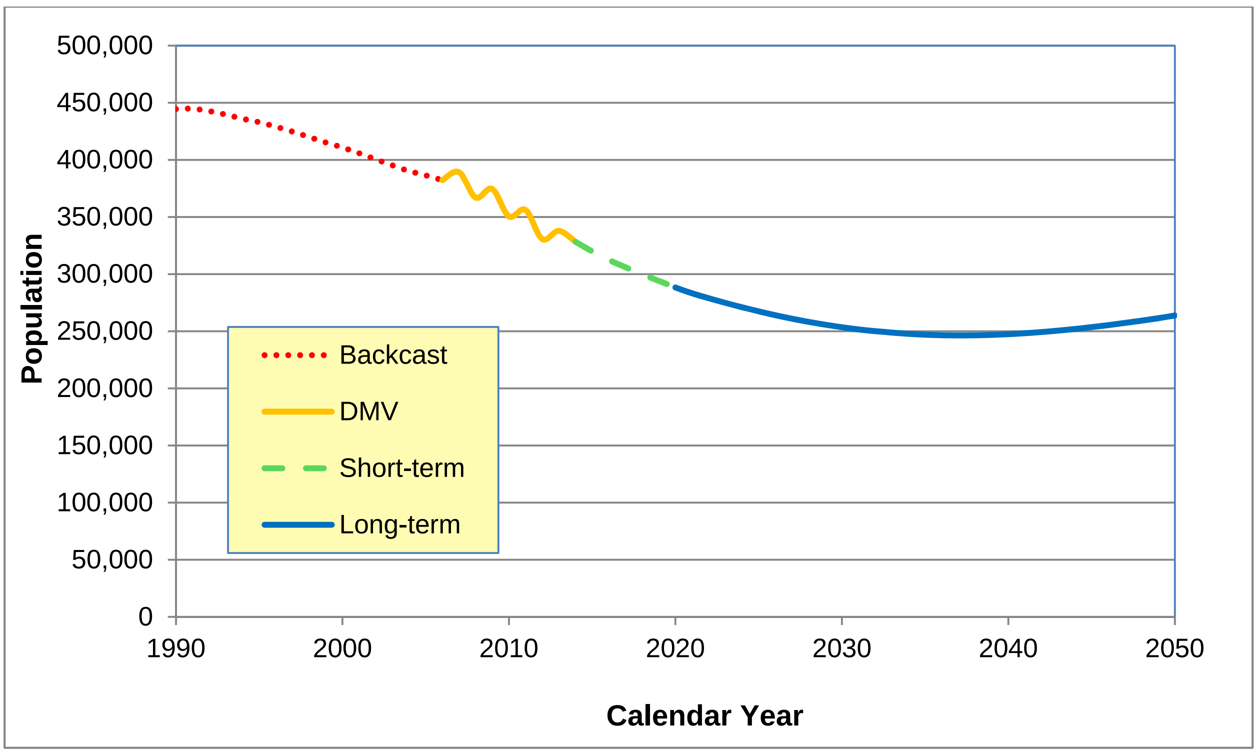
b. Survival Rate

The survival rate is used to estimate the year-to-year change of RW population. A fraction of the RW population is removed each year due to accidents, attrition, or being placed permanently out of service. Staff evaluated year-to-year changes of RW population using DMV registration data and estimated the survival rate for each RW category. Using the estimated survival rate, staff can determine the survival ratio between two populations of consecutive ages.

Ideally, the survival rate should decline starting from the first year the RW is sold. However, for discretionary items such as RW or recreational vehicles the trend is for the population to initially increase before it decreases due to attrition. In the case of RW, an initial increase in the survival rate is observed. This is due to newly manufactured RW being sold over the course of several years rather than in the same year in which it was manufactured. This trend is reflected in our survival rate estimates. More details on the estimate of survival rate for each RW type can be found in Attachment A and B of Section VI.

The outboard population is backcasted from 2005 to 1990, based on survival rate. Figure II-4 depicts actual DMV RW registrations from 2006 to 2013. It also depicts the forecast and backcast populations of outboard. Likewise, RW population is forecasted from 2014 to 2019 (short-term projection). For 2020 and beyond (long-term projection), the estimated RW population is based on the survival rate and forecast of annual sales. The outboard population declines proportionally, which is similar to the DMV registration data. The recent recession has contributed to a slow recovery of annual sales and caused a decline of the outboard population.

Figure II-4:Projection of Outboard Fleet Population



4. LOAD FACTORS

Engine load is the average operational level of an engine in a given application as a fraction of the engine manufacturer's maximum rated horsepower (Hp). Since emissions are directly proportional to engine horsepower, load factors are used in the inventory calculations to adjust the maximum rated horsepower to the horsepower levels typically observed during normal operation.

The load factors used in PC2014 are the same as those that were used in OFFROAD2007 as staff did not conduct any studies on the load factors for the current RW inventory update. For outboards, PWC, and sailboats with auxiliary engine, the load factors were based on data provided by Power System Research (PSR). For sterndrives and inboards, the load factors are based on the marine engine steady-state cycle (E-4) as shown in Table II-4.

Table II-4: Load Factors of RW

Boat Type	Load Factor	Data Source
Outboard	0.32	PSR
PWC	0.4	PSR
Sterndrive	0.21	Marine engine steady-state test cycle (E-4)
Inboard	0.21	Marine engine steady-state test cycle (E-4)
Jet Boat	0.21	Marine engine steady-state test cycle (E-4)
Auxiliary Sail	0.35	PSR

5. TECHNOLOGY AND HORSEPOWER SPLIT

Population estimates are split by technology type and horsepower group to match the emissions factors. Technology type refers to G2 or G4 engine types and whether the engine is carbureted (CB)or fuel injected (FI). Engine technology affects exhaust emissions. For example, a G2 engine produces more hydrocarbon (HC) exhaust emissions than a G4 engine. Likewise, horsepower affects the evaporative emissions rates; equipment with higher horsepower tends to have a larger fuel tank and, therefore, will have higher evaporative emissions rates.

Unlike automobiles, where the VIN number provides technology information, RW are assigned a Hull Identification Number (HIN), which does not provide similar information. The DMV database for RW was supplemented with engine technology data staff obtained from manufacturers and related websites to compile a database of equipment that manufacturers produce. Staff also reviewed the ARB marine engine certification database from 2001 to 2010. This database consists of data submitted by manufacturers for certification of equipment for sale in California. Information from the database includes model family, equipment type, fuel system, horsepower, engine certification level for pollutants, and projected sales in California.

Using the data gathered from websites and the marine engine certification database, staff compiled the technology and horsepower split by model year for each RW type in PC2014. It was observed that there was a technology shift from G2 to G4 engines around the early 1990s. In order to corroborate the information collected, staff requested data from marine engine manufacturers on the history of PWC and outboard engine production. Only one manufacturer provided limited propriety data on PWC and outboard. Table II-5 compares the technology split assumed in PC2014 with the manufacturer data. The comparison confirms a shift of technology in the marine engine industry from G2-CB to G4-FI, which is a cleaner technology for marine engines. Likewise, as shown in Table II-6, the horsepower split used in PC2014 is in good agreement with the manufacturer data.

Table II-5: Comparison of Technology Split

Equipment	Model Year	PC2014				Manufacturer Data			
		G2-CB	G2-FI	G4-CB	G4-FI	G2-CB	G2-FI	G4-CB	G4-FI
PWC	1980	100%	0%	0%	0%				
	1985	100%	0%	0%	0%				
	1990	100%	0%	0%	0%	100%			
	1995	100%	0%	0%	0%	100%			
	2000	64%	36%	0%	0%	100%			
	2005	0%	15%	0%	85%	8%			92%
	2010	0%	0%	0%	100%				100%
Outboard	1980	100%	0%	0%	0%				
	1985	100%	0%	0%	0%	95%		5%	
	1990	96%	4%	0%	0%	95%		5%	
	1995	78%	9%	13%	0%	90%	5%	5%	
	2000	25%	14%	61%	0%	4%	12%	84%	
	2005	0%	19%	37%	44%		5%	85%	10%
	2010	0%	19%	29%	52%			38%	62%

Table II-6: Comparison of Horsepower Group

Source	Model Year	Horsepower (Hp) Group						
		25	50	120	175	250	500	750
PC2014 (PWC)	1990	0%	85%	15%	0%	0%	0%	0%
	1995	0%	40%	60%	0%	0%	0%	0%
	2000	0%	20%	55%	25%	0%	0%	0%
	2005	0%	0%	43%	44%	13%	0%	0%
	2010	0%	0%	24%	20%	54%	3%	0%
Manufacturer (PWC)	1990		85%	15%				
	1995		40%	60%				
	2000			60%	40%			
	2005			60%	40%			
	2010			70%		30%		

6. EXHAUST EMISSIONS FACTORS

Exhaust emissions factors were primarily developed using the ARB marine certification database from 2001 to 2011 due to limited in-use exhaust emissions data on RW. Since MY 2001, all marine manufacturers have been required to certify to show compliance with the exhaust emissions standards.

Staff categorized the exhaust emissions factors by RW type, technology group, and MY group. Technology groups are subdivided into four main categories: G2-CB, G2-FI, G4-CB, and G4-FI. MY groups are subdivided into single MY or multiple MY groups that can be supported by the certification data.

Uncontrolled exhaust emissions factors for pre-2001 MYs are based on test data from Systems Applications International (1995). These factors are based on a 5-mode recreational marine test cycle. For MYs 2001 to 2010, the exhaust emissions factors are based on the certification database. For 2011 and later MYs, exhaust emissions factors are assumed to be the same as in 2010.

Because of the size of the final emissions factor table, only a portion of the exhaust emissions factors for outboard of 50 to 120 horsepower, and technology groups G2-CB (carburetor) and G4-FI (fuel injection) is presented in Table II-7. As illustrated in the table, for the technology group of G2-CB, there is an order of magnitude change in HC emissions for the presented MYs. A decrease in exhaust emissions due to different control technology is also indicated between G2-CB and G4-FI, especially for the earlier MYs.

Table II-7: Summary of Exhaust Emissions Factors for Outboard

Horsepower	Tech Group	MY	HC (g/bhp-hr)	CO (g/bhp-hr)	NOx (g/bhp-hr)	PM (g/bhp-hr)	CO2 (g/bhp-hr)
50 to 120	G2-CB	2003 and before	116.4	170.4	4.4	7.1	636.1
		2004 - 2007	24.3	43.0	6.0	7.1	636.1
		2008 and after	10.6	18.8	2.6	7.1	636.1
	G4-FI	2001 and before	13.3	180.3	3.8	0.1	708.4
		2002	9.2	180.3	3.8	0.1	708.4
		2003	8.5	166.3	4.5	0.1	708.4
		2004	8.5	180.3	4.1	0.1	708.4
		2005	8.3	180.3	3.8	0.1	708.4
		2006	8.3	195.0	4.6	0.1	708.4
		2007	8.5	195.0	4.7	0.1	708.4
		2008	8.6	175.0	4.7	0.1	708.4
		2009	8.8	140.8	4.2	0.1	708.4
		2010 and after	9.1	132.0	4.0	0.1	708.4

7. EVAPORATIVE EMISSIONS FACTORS

ARB has been active in collecting evaporative emissions data on different SIMW using a sealed housing for evaporative determination (SHED) at its Haagen-Smit Laboratory in El Monte, California. The purpose of such testing was to investigate the control efficiency of low permeable materials and to develop the in-use baseline evaporative emissions factors for SIMW. Hot soak, diurnal, and resting loss evaporative emissions were measured for each SIMW tested. Running loss tests were not performed due to design limitations of the SHED. The current design prevents the collection of data while a SIMW engine is running inside the SHED.

Diurnal and resting loss tests were conducted over a temperature range of65ºF to 105ºF. The RVP for test gasoline was kept close to seven pounds per square inch (psi). This is important because evaporative emissions are proportional to the vapor pressure of gasoline. Some SIMW were tested using gasoline with different ethanol concentrations (gasoline without ethanol [E0], gasoline with six percent ethanol [E6], and gasoline with ten percent ethanol [E10]) to investigate the impact of ethanol content on evaporative emissions.

After combining the data measured by ARB with evaporative emissions test data previously conducted by Automotive Testing Laboratory (ATL), staff was able to develop uncontrolled baseline emissions factors for more than 37 different SIMW. The detailed calculation process is described in Attachment B of Section VI.

Table II-8 summarizes the uncontrolled baseline emissions factors used in PC2014. Because of limited data, emissions factors are grouped by fuel system and horsepower. Uncontrolled diurnal and resting emissions factors can be more than double the hot soak emissions factors and account for most of the evaporative emissions from SIMW. While there is no difference in emissions factors for E6 and E10 fuel, there is a slight difference when using E0 (applied to CY 2003 and earlier).

Table II-8: Uncontrolled Evaporative Emissions Factors forPC2014

Type	Fuel System	HP Group	Hot Soak (g/event)		Diurnal & Resting (g/day)	
			E0	E6/E10	E0	E6/E10
Outboard	CB/FI	25 and less	6.1	6.7	19.6	23.8
		26+	12.9	14.1	27.8	33.6
	FI	All	7.6	8.3	21.8	26.4
Inboard/ Auxiliary sail	CB/FI	175 and less	9.5	10.4	17.9	21.7
		176+	25.0	27.3	29.0	35.1
Sterndrive	CB/FI	175 and less	6.9	7.5	16.1	19.5
		176+ Hp	11.3	12.3	28.1	34.0
PWC/Jet Drive	CB	All	6.1	6.6	14.7	17.8
	FI	All	2.8	3.0	8.2	9.9

Note: E0 fuel applies to CY2003 and earlier whereas E6/E10 fuel applies to CY2004 and later.

8. ACTIVITY

RW usage (e.g., hours used per year) is a critical component in estimating the RW emissions inventory. In 2009, ARB funded a CSUS phone survey of 1,127 randomly selected California RW owners to update the activity estimate for the RW emissions inventory.

Based on the information on annual days of operation and typical hours of usage per day, staff estimated the annual hours of operation for each type of RW listed in Table II-9. Attachment C of Section VI provides a detailed analysis showing how the activity was estimated for each type of RW.

Table II-9: Annual Activity for RW

RW Type	Average (hr/year)
Outboard	62
Inboard	60
Sterndrive	47
Auxiliary & Sail	78
PWC	42
Jet Drive	42

D. CORRECTION TO BASELINE EMISSIONS

1. CORRECTION FOR AMBIENT CONDITIONS AND FUEL RVP

Ambient temperature and humidity changes affect RW exhaust and evaporative emissions. Emissions can vary depending on where the RW is operated and stored. Baseline evaporative emissions factors are developed under controlled laboratory conditions.

Corrections are necessary to account for the differences between laboratory and real-world operation.

California is divided into 58 counties, 35 local air districts, and 15 air basins. The boundary of each air basin or air district does not necessarily coincide with each county's political boundaries. Emissions were estimated for each county, local air district, and air basin. A smaller unit of area, called a GAI, is used to represent the intersection of three political boundaries. The RW emissions inventory for 69 separate GAIs was developed. The correction accounts for their respective ambient temperature and humidity characteristics and seasonal fuel RVP requirement. The following section discusses the correction factors for evaporative and exhaust emissions to reflect the effect of local conditions such as seasonal variation of fuel RVP, temperature, and humidity.

a. Temperature/RVP Correction (Diurnal and Resting Loss)

Based on previous recommendations by the Eastern Research Group (2013), Temperature/RVP corrections are estimated for two main processes: vapor generation (uncontrolled system), and permeation.

Vapor Generation

The work to model the amount of vapor generated from the evaporation of gasoline was first undertaken by Wade in the 1960s, who established equations relating vapor generation to fuel temperature rise and several fuel properties, including RVP, distillation properties, density and molecular weight (Wade, 1967). These equations were used by the United States Environmental Protection Agency (U.S. EPA) for earlier versions of their on-road emissions model (MOBILE), as well as their off-road emissions model (NONROAD). In the 1980s, Reddy developed a simplified model for vapor generation based only on fuel temperature rise and RVP, and published model coefficients reflecting variations in altitude (sea level, Denver) and ethanol level (E0, E10) (Reddy, 1989).

For this analysis we used the Reddy equation for estimating grams of gasoline vapor generated per gallon of fuel tank vapor space. Our estimate used coefficients for sea level and E10 gasoline, as these are most reflective of California conditions:

$$\text{Vapor Generated (g/gal vapor space)} = A \times e^{B \times RVP} \left(e^{C \times T2} - e^{C \times T1}\right)$$

Where,

T1	= starting temperature
T2	= ending temperature
A	= 0.00875
B	=0.2056
C	=0.0430

Mass of Vapor Generated (grams) = Vapor Generated (g/gallon vapor space) x Fuel Capacity (gal) x (1- Fill %)

Note that the gasoline vapor model was developed for vehicles without sealed tanks or pressure relief valves, but has been adapted for SIMW. The amount of gasoline vapor restricted from venting to the atmosphere depends on the setting of the pressure relief valve. For example, the U.S. EPA estimates that the range of pressure relief valves installed on PWC varies from 0.5 to 4.0 psi. Reddy and the U.S.EPA independently assessed the impact of a 1.0 psi pressure relief valve on vapor generation. Both concluded that the pressure relief valve would reduce vapor generation by about 0.7 grams per gallon vapor space. This would apply to different temperature and RVP conditions, as the relief valve is operating at the same threshold regardless of the conditions under which vapor was generated (although the relative reduction may be quite different). Using the Reddy equation, staff assumes a 1.0 psi "trigger" for pressure relief valves and corrects the existence of a pressure relief valve by subtracting 0.7 grams/gallon off of the uncontrolled vapor generation rate.

Based on the discussion above, Attachment D provides an illustrative example calculation of vapor generation under various RVP and temperature conditions.

Permeation

The permeation process is assumed to include both fuel tank permeation and fuel hose permeation. The base permeation emissions factors are 10.7 g/m^2/day for tanks, and 222 g/m^2/day for hoses based on the U.S. EPA NONROAD model (E10 fuel). Temperature corrections for permeation in NONROAD are based on the assumption that permeation emissions double with every increase of 18ºF (10ºC) from a reference temperature. As a result, a temperature adjustment is applied to the hose or tank reference temperature when estimating the permeation emissions factor at a different temperature.

Hose permeation doubles with each 18ºF increase from the reference temperature of 73°F, and is estimated by the following equation:

$$TCF = 0.06013899 \times e^{0.03850818 \times T}$$

Tank permeation doubles with each 18ºF increase from the temperature of 85°F, and is estimated by the following equation:

$$TCF = 0.03788519 \times e^{0.03850818 \times T}$$

Finally, the diurnal and resting loss emissions are estimated by the following:

$$Diurnal = Vapor\ Generation + 0.5\ x\ (Tank\ Permeation + Hose\ Permeation)$$

$$Resting\ Loss = 0.5\ x\ (Tank\ Permeation + Hose\ Permeation)$$

By calculating the absolute values of diurnal and resting loss at 65ºF to 105ºF, as well as at other local temperature and fuel RVP conditions, staff was able to normalize all calculated values. These normalized values are used as the Temperature/RVP correction to adjust diurnal and resting loss emissions factors to the local temperature and fuel RVP conditions. The tank size and hose diameter that is assumed represents the typical fleet average and is not important in the final calculation as staff is only interested in the normalized values from different temperature and fuel RVP conditions. Attachment D provides a sample calculation of how the Temperature/RVP correction can be applied to diurnal and resting loss emissions conducted at different temperature profiles and fuel RVP.

b. RVP Correction (Hot Soak and Running Loss)

The RVP correction is applied to the hot soak and running loss evaporative emissions tests that are conducted with a fuel RVP of seven psi. When the winter fuel with an RVP of nine psi is used, the following formula is used:

$$CF_{RVP} = 0.3 \times RVP - 1.1$$

Applying RVP = nine psi, the above equation becomes 0.3 x 9-1.1 = 1.6 which is used for all GAI when winter fuel is used. For summer fuel (RVP is at seven psi), there is no correction for RVP, which indicates that CF_{RVP} is one.

c. Fuel Correction Factors(Exhaust Emissions)

The fuel correction factors (FCFs) are dimensionless multipliers applied to the basic exhaust emissions rates. The FCFs account for differences in the properties of certification fuels compared to those of commercially dispensed fuels. California went through three phases of reformulated gasoline in the past two decades: California Reformulated Phase 1 Fuel (1992 to 1995), California Reformulated Phase 2 Fuel (1996 to 2003), and California Reformulated Phase 3 Fuel (2004 and beyond). In those instances where engines or vehicles are not required to certify, FCFs are used to reflect the impact of changes in dispensed fuel over time as refiners respond to changes in fuel specific regulations compared to the fuel used to obtain the test data. E10 is the reference fuel assumed in PC2014, because it is the gasoline currently commercially sold in California. As a result, staff renormalized previous FCFs in OFFROAD2007 to E10 fuel (Sicat, 2007).

d. Temperature and Humidity Correction (Exhaust Emissions)

The temperature and humidity correction factors for exhaust emissions were developed as follows:

<u>Temperature Correction</u>

For hydrocarbons and NOx, the temperature correction factor is

$$CF_{Temp} = 10^{(T-75)a}$$

Where,

T = ambient temperature (°F)

a = coefficient for temperature correction

The coefficient for temperature correction depends on engine type and whether the ambient temperature is above or below 75°F as shown in Table II-10.

Table II-10: Coefficients for Temperature Correction

Pollutants	Low Temp (<75°F)		High Temp (>75°F)	
	G-2	G-4	G-2	G-4
CO	0	0	0.01494	-0.0146
HC	0	0	0.00484	-0.0113
NOx	0	0	0	-0.0059

To simplify the calculation methods used in developing the RW emissions inventory, staff applied the temperature correction on a daily basis to the average daily temperature. This approach captures the general trend of the correction factor without requiring calculations on an hourly basis. Finally, the exhaust temperature correction for a typical month is based on the hourly average of ambient temperatures between 9 a.m. to 4 p.m. to reflect the typical temperatures experienced by RW during operation.

<u>Humidity Correction for NOx</u>

For humidity correction for NOx, the correction factor is:

$$CF_{Humd} = 1 - 0.0038 \text{ x } (A - 75)$$

Where,
A = absolute humidity

The absolute or scenario humidity is derived from the relative humidity and ambient temperature based on the following equation:

$$ABH = RH \times (-0.09132 + 0.01594 \times T - 0.00029 \times T^2 + 0.00000437 \times T^3)$$

Where,
ABH = scenario humidity (grains/pound)
T = scenario temperature (ºF)
RH = relative humidity (%)

This equation is limited to use with ambient temperatures between 40ºF and 120ºF, and to predict absolute humidity values not greater than 200 grains/pound. If the ambient temperature is less than 40ºF, then 40ºF is used for the calculation. Similarly, if the ambient temperature is higher than 120ºF, then 120ºF is used for calculation. If the calculated absolute humidity is greater than 200 grains/pound, then only 200 grains/pound is used.

2. CONVERSION FACTORS FOR POLLUTANTS

As total hydrocarbons are measured from exhaust and evaporative emissions, it is necessary to apply a conversion to total hydrocarbon (THC)to estimate TOG, ROG, and methane (CH_4) emissions. Because gasoline content affects the composition of HC in evaporative and exhaust emissions, the conversion factors are different for California Reformulated Phase 1 Fuel (1992 to 1995), California Reformulated Phase 2 Fuel (1996 to 2003), and California Reformulated Phase 3 Fuel (2004 and beyond). In addition, the methodologies used for estimating fuel consumption and sulfur dioxide (SO_2) emissions are described.

ROG and TOG Correction

The conversion factor varies by CY (due to phase-in schedule of reformulated gasoline), engine type and emissions process (evaporative or exhaust). The conversion coefficients are listed in Table II-11.

Table II-11: Coefficients Used for TOG/ROG Conversion from THC

CY	Engine	Process	TOG	ROG
All	Diesel	Exhaust	THC*1.44	THC*1.21
	CNG/LPG	Exhaust	THC*0.99	THC*0.09
Pre-1996	Gasoline	Exhaust (G2)	THC*1.01	THC*0.92
		Exhaust (G4)	THC*1.04	THC*0.89
		Evaporative	THC*1.04	THC*1.04
1996-2003	Gasoline	Exhaust	THC*1.09	THC*1.00
		Evaporative	THC*1.12	THC*1.12
2004+	Gasoline	Exhaust	THC*1.10	THC*1.01
		Evaporative	THC*1.14	THC*1.14

CH_4

CH_4 is derived as a fraction of TOG. The formula is:

$$CH_4 = TOG \times Coefficients$$

The coefficients are shown in Table II-12.

Table II-12: Coefficients Used for CH_4 Conversion from TOG

Fuel Type	CY	Coefficients
G2	Pre-1996	0.0774
	1996-2003	0.0558
	2004+	0.0572
G4	Pre-1996	0.1132
	1996-2003	0.0558
	2004+	0.0572

<u>Fuel Consumption</u>

The fuel consumption correction factor is derived from mass balance using CO, CO_2 and with TOG, with units in tons per year. The formula for fuel consumption is:

Fuel Consumption = [(12.011/(12.011+Alpha x 1.008)) x TOG+0.429 x CO+0.273 x CO2]/(0.866 x 2000 x Fuel Density)

Where,
Alpha = 1.85
Density for gasoline = 6.17 lb/gal
Density for diesel = 7.1 lb/gal

<u>SO_2 Calculation</u>

The SO_2 correction factor is calculated based on sulfur content in the fuel and will differ by fuel type. The formula is:

SO_2 *(tpd)= FC x (S ppmw /*10^6*) x Fuel Density x 2 lb* SO_2 *per lb of S x ton/2000 lb*

Where,
FC =fuel consumption (gal/day)

3. SPATIAL ALLOCATION

Allocating emissions spatially is an important part of an emissions inventory development. While operating a RW, the exhaust, hot soak and running loss evaporative emissions are allocated to the area of operation (typically lakes or coastal areas). However, when the SIMW is stored, the diurnal and resting loss evaporative emissions occur at the storage location (typically residential areas or marina slips).

The CSUS survey results provided information on the location of storage and operation. From this information, staff was able to develop allocation factors for storage and operation based on four distinct ranges (differentiated by shading) within California. Staff used the allocation factors to spatially allocate storage and operation emissions as shown in Figure II-5 and Figure II-6.

Figure II-5: Area of Storage for PC2014

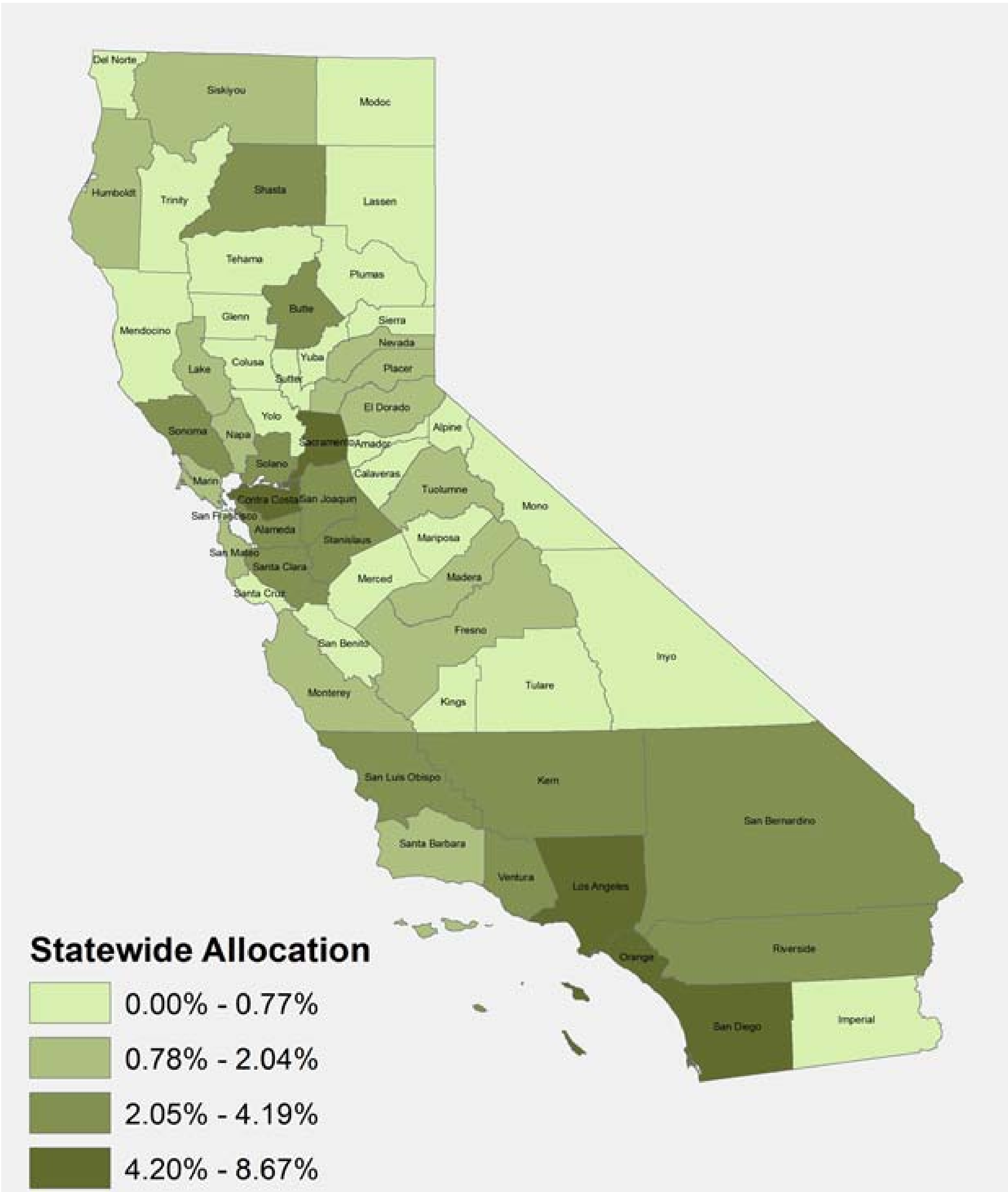
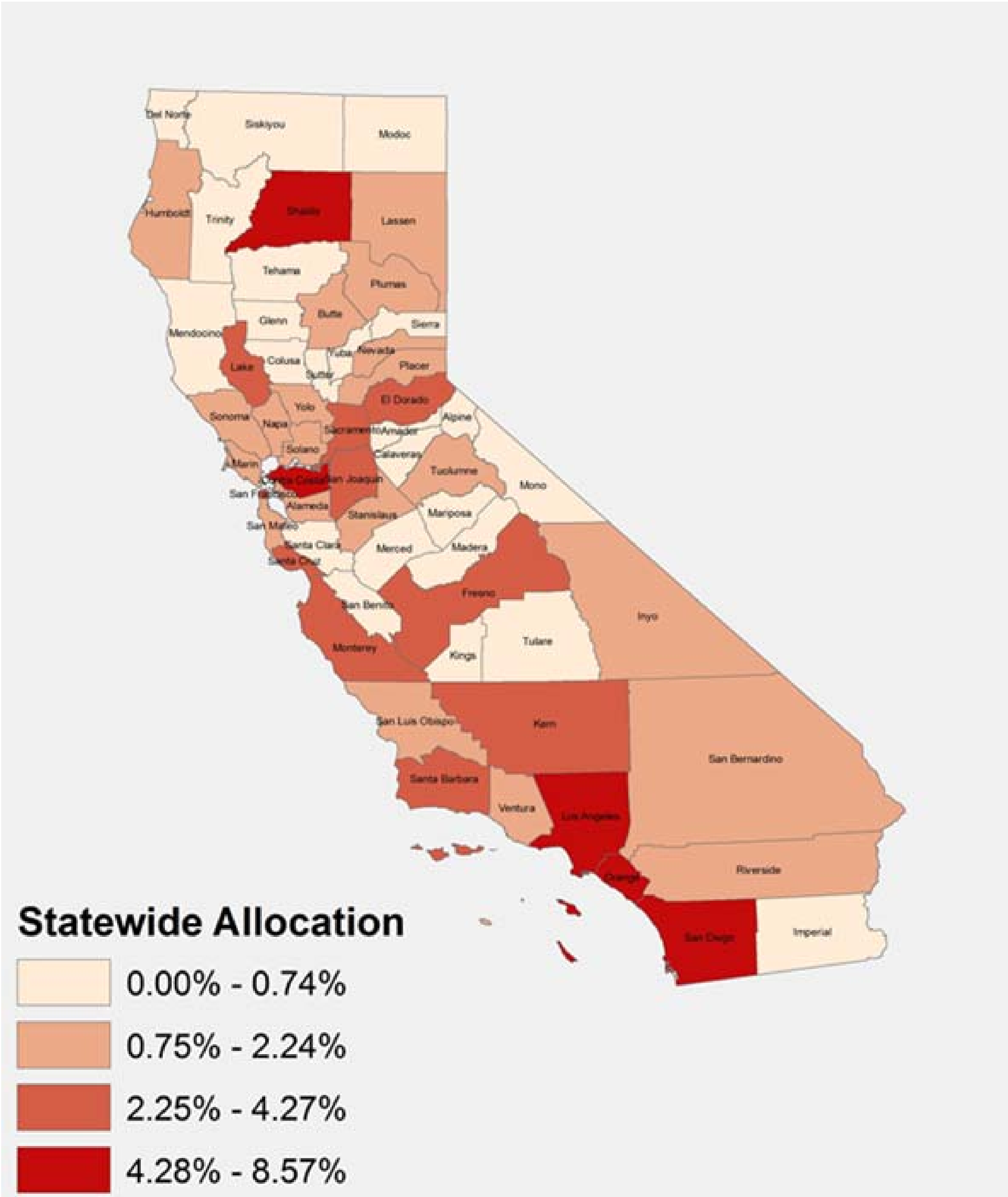


Figure II-6: Area of Operation for PC2014



Operation Allocation Factor

The operation allocation factor was derived using the CSUS survey data as shown in the following formula which uses the actual activities reported on the survey to weigh the allocation of emissions into specific counties:

$$AF_{OP,i} = \frac{\sum_j D_j \times H_j \times PT_{i,j}}{\sum_i \sum_j D_j \times H_j \times PT_{i,j}}$$

Where,

$AF_{OP,I}$	= the operation allocation factor for county i
D_j	= days of RW operation for respondent *j* per year
H_j	= hours of operation per day for respondent *j*
$PT_{i,j}$	= percent of time respondent *j* operates the RW in county *i*

Storage Allocation

Storage allocation was also derived using the CSUS survey data. Unlike on-road vehicles which are stored primarily at the address of the owner, RW can be stored at a marina or lake, which is different from the owner's or operator's home address. The CSUS survey included specific questions on the location where respondents typically store their RW. Instead of using the owner's address to develop the storage allocation, CSUS storage location data provides more realistic information on where the RW are actually stored. Based on storage location data, staff developed county-specific storage allocation factors for diurnal and resting loss emissions from SIMW.

4. SEASONALITY

To model seasonal variability in RW usage in California, staff analyzed the activity survey data collected by CSUS in 2009. Questionable survey responses were filtered out and not used for subsequent analysis based on the following criteria:

- Daily usage of RW greater than 10 hours.
- More than 365 days of usage reported in a year.

For each valid response, the total hours of use per year was calculated by multiplying the reported days of use per year by the reported hours of use per day.

The monthly usage frequency (MoUF) was developed for each of the four seasons: winter (December to February), spring (March to May), summer (June to August), and fall (September to November). The monthly usage was calculated using the following equation:

$$MoUF_i = \frac{THU \text{ x } UF_i}{3}$$

Where,

$MoUF_i$ = the monthly usage frequency for season *i*

THU = the total hours of usage per year

UF_i = the usage frequency for season *i*.

Since the seasonal definition in the PC2014 model is different from what was defined in the survey, the seasonal usage frequency (SUF) is calculated by summing the monthly usage frequency over the specified season. In the model, the summer season refers to the 6 months from May to October while the winter season refers to the remaining 6 months from November to April.

$$SUF_i = \sum_j MoUF_{i,j}$$

Where,

SUF_i = the seasonal usage frequency for a given season *i*

$MoUF_{j,I}$ = the *j* month usage frequency within a given season *i.*

The PC2014 model assumes summer months to include May through October and winter months to include November through April. The seasonality adjustment is calculated using the following equation:

$$SA_i = \frac{SUF_i}{\sum SUF_i}$$

Where,

SA_i = the seasonal adjustment factor for season i.

Using the methodology described above, the seasonality adjustment factor for RW is 1.48 for summer months and 0.52 for winter months.

5. LONG TERM STORAGE CORRECTION FOR ACTIVE AND INACTIVE SIMW

In the previous SIMW emissions inventory based on OFFROAD2007, evaporative emissions rates (diurnal and resting loss) are assumed to remain constant throughout all days of the year for active and inactive SIMW. This incorrectly assumes the liquid-phase composition of the tank fuel is constant (no depletion of volatile components over time and no impact of refueling of active SIMW). We assume that there are no evaporative emissions for diesel-powered watercraft. However, active SIMW are refueled more frequently and stored for much shorter periods between uses. The reverse is true for inactive SIMW. To improve the characterization of evaporative emissions, staff has developed correction factors for active and inactive SIMW.

For active SIMW, multi-day SHED testing of three SIMW over the average Los Angeles temperature profile of 65ºF to 82ºF was conducted. Results were used to correct the current diurnal and resting loss emissions factors, which are based on a 3-day average of diurnal and resting loss emissions. Based on the SHED tests, a correction factor of 0.72 was developed to correct the current diurnal and resting loss emissions factors. The details of the SHED test results are provided in Attachment E of Section VII.

For inactive SIMW, the majority of the diurnal emissions come from the venting of the fuel tank since there is very little fuel left in the fuel hoses. Instead of conducting diurnal and resting loss of a typical fuel tank for 12 months, staff decided to use a vapor-liquid equilibrium (VLE) mass balance to estimate the loss of gasoline vapor over 12 months based on the typical Los Angeles monthly temperature. Staff simplified the mass balance by selecting 12 major components in the gasoline. In short, staff developed a correction factor of 0.53 to adjust the diurnal and resting loss emissions factor for inactive SIMW (i.e., stored long term). The details of such VLE estimate and the development of the correction factor can be found in Attachment F of Section VII.

III. PC2014 MODEL

The PC2014 emissions inventory model is based on the Microsoft Access platform. Input information such as population, activity, emissions factors, correction factors, and spatial allocation are stored as Microsoft Access tables. The computation is comprised of queries that combine variables from different tables and carry out the calculation process.

A. INVENTORY ESTIMATE FOR THE SIMW RULEMAKING

Reductions associated with the federal rule have been applied to the uncontrolled baseline emissions. Specifically, reductions associated with U.S. EPA evaporative control measures have already been implemented since 2012. Both ARB and U.S. EPA evaporative controls focus on reducing the permeation of HC emissions through fuel tanks and fuel hoses. The U.S. EPA evaporative control is based on the use of low permeable materials for fuel hoses and fuel tanks while ARB's proposed evaporative control measure further tightens the permeation standard for fuel hoses and fuel tanks.

ARB conducted an in-house study to estimate the reduction of HC and ROG associated with the adopted U.S. EPA rule and proposed ARB regulation. Based on the data gathered on a SIMW that was tested for uncontrolled baseline emissions, U.S. EPA controls, and ARB proposed controls, staff was able to estimate the emissions reductions associated with these proposed controls.

The following table summarizes the percent reduction from baseline used in estimating the benefits of the U.S. EPA rule as well as ARB's proposed controls. As seen in Table III-1, for the control of hot soak from CB engines, U.S. EPA's adopted control measures result in a 27 percent reduction (2012 MY and later) from baseline hot soak emissions while ARB's proposed control measures result in an 83 percent reduction (2018 MY and later). Likewise, for the control of diurnal and resting loss emissions, U.S. EPA's adopted controls result in a 49 percent reduction (2012 MY and later) from baseline diurnal and resting loss emissions while ARB's proposed controls offer a 69 percent reduction (2018 MY and later).

Table III-1:Summary of Evaporative Reduction from Baseline

		Hot Soak		Diurnal and Resting Loss	
		2012 MY and later	**2018 MY and later**	**2012 MY and later**	**2018 MY and later**
CB	U.S. EPA Control	27%		49%	
	Proposed ARB Control		83%		69%
FI	U.S. EPA Control	57%		56%	
	Proposed ARB Control		65%		65%

B. CALCULATION PROCESS

The population input table includes six RW categories: outboard, inboard, sterndrive, PWC, auxiliary and sail, and jet drive. Each category includes active or inactive status, CY, MY, horsepower group, and technology. The technology group is subcategorized into diesel, G2-CB, G2-FI, G4-CB, and G4-FI. The activity input table provides the annual activity with respect to age while the emissions factor input tables include exhaust and evaporative emissions factors grouped by CY or technology.

The model output provides current baseline emissions (which include the U.S. EPA adopted control measures) and the ARB proposed regulation at the statewide, air district, and air basin levels, as well as by season and CY. End-users may also specify the RW type, RW status (active or inactive), technology, and horsepower prior to getting the emissions summary. Finally, the model is capable of providing outputs by MY for a given CY.

C. MODEL INSTALLATION AND USER GUIDE

The PC2014 model can be downloaded from ARB's website as follows:

http://www.arb.ca.gov/msei/categories.htm#offroad_motor_vehicles

The PC2014 model runs as an Microsoft Access database file. The model was developed in Microsoft Access 2010. Previous versions of Microsoft Access may not support all of the model's functionality. Unzipped, the files are about 1.2GB. When running the model, the file size can grow to approximately 2GB. Model runtime varies depending on the processing power of the computer on which the model is installed. Output is provided through the user interface. Details on the model installation and user guide can be found in Attachment H. Finally, the source code of PC2014 is provided in Attachment I.

IV. EMISSIONS RESULTS

The emissions benefits from ARB's proposed regulation are summarized in Table IV-I. To compare the emissions reductions to the SIP commitment, staff evaluated reductions associated with years in the 2007 SIP. The proposed regulation is expected to be implemented in MY 2018, and will require increasing control levels for SIMW manufactured starting in MY 2018 for SIMW with engines greater than 30 kW. A statewide benefit of 0.15TPD is observed starting in 2020. In 2023, the benefit increases to 0.34TPD, as more SIMW will be subject to the proposed regulation. By 2035, the statewide summer ROG benefit increases to 1.06TPD.

For the Bay Area Air Quality Management District, the ROG benefits are 0.03, 0.07, and 0.20TPD for 2020, 2023, and 2035, respectively. For the San Joaquin Valley Unified Air Pollution Control District, the ROG benefits are 0.02, 0.05, and 0.15TPD ROG for 2020, 2023, and 2035, respectively. Finally, for the South Coast Air Quality Management District, ROG benefits are 0.03, 0.07, and 0.22TPD for 2020, 2023, and 2035, respectively.

Table IV-1: Benefit of the Proposed Regulation for Summer Emissions (tons/day)

2020	Baseline		Proposed Regulation		Benefits	
	ROG	NOx	ROG	NOx	ROG	NOx
Statewide	129.48	24.74	129.33	24.74	0.15	0.00
Bay Area AQMD	23.57	4.49	23.54	4.49	0.03	0.00
SJV Unified APCD	17.74	3.32	17.72	3.32	0.02	0.00
South Coast AQMD	21.33	3.96	21.30	3.96	0.03	0.00

2023	Baseline		Proposed Regulation		Benefit	
	ROG	NOx	ROG	NOx	ROG	NOx
Statewide	113.87	23.90	113.53	23.90	0.34	0.00
Bay Area AQMD	20.76	4.34	20.69	4.34	0.07	0.00
SJV Unified APCD	15.57	3.21	15.52	3.21	0.05	0.00
South Coast AQMD	18.82	3.82	18.75	3.82	0.07	0.00

2035	Baseline		Proposed Regulation		Benefit	
	ROG	NOx	ROG	NOx	ROG	NOx
Statewide	72.93	22.06	71.87	22.06	1.06	0.00
Bay Area AQMD	13.37	4.01	13.16	4.01	0.20	0.00
SJV Unified APCD	9.85	2.96	9.70	2.96	0.15	0.00
South Coast AQMD	12.22	3.53	12.00	3.53	0.22	0.00

Attachment G provides a detailed breakdown of the evaporative emissions. For 2020 and 2023, the emissions benefits are small because the majority of the SIMW population is not covered by this regulation. By 2035, as more of the population is subjected to the proposed regulation, and the gradual turnover of older SIMW increases, more emissions benefits are expected.

V. REFERENCES

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VI. ATTACHMENTS

A. ESTIMATE OF SURVIVAL RATE

Survival rates are a commonly used variable in emission inventory development. The survival rate is the fraction of vehicles that remain in the fleet (i.e. survive) as they age from year zero (defined as when the model year matches the calendar year) and beyond. The survival rate fraction for a specific year can be applied against the number of vehicles sold in year zero to estimate the number of vehicles remaining in that specific year. For example, if the survival rate at year 10 is 0.85, that means that on average 85% of vehicles sold in year zero are still in the fleet ten years later.

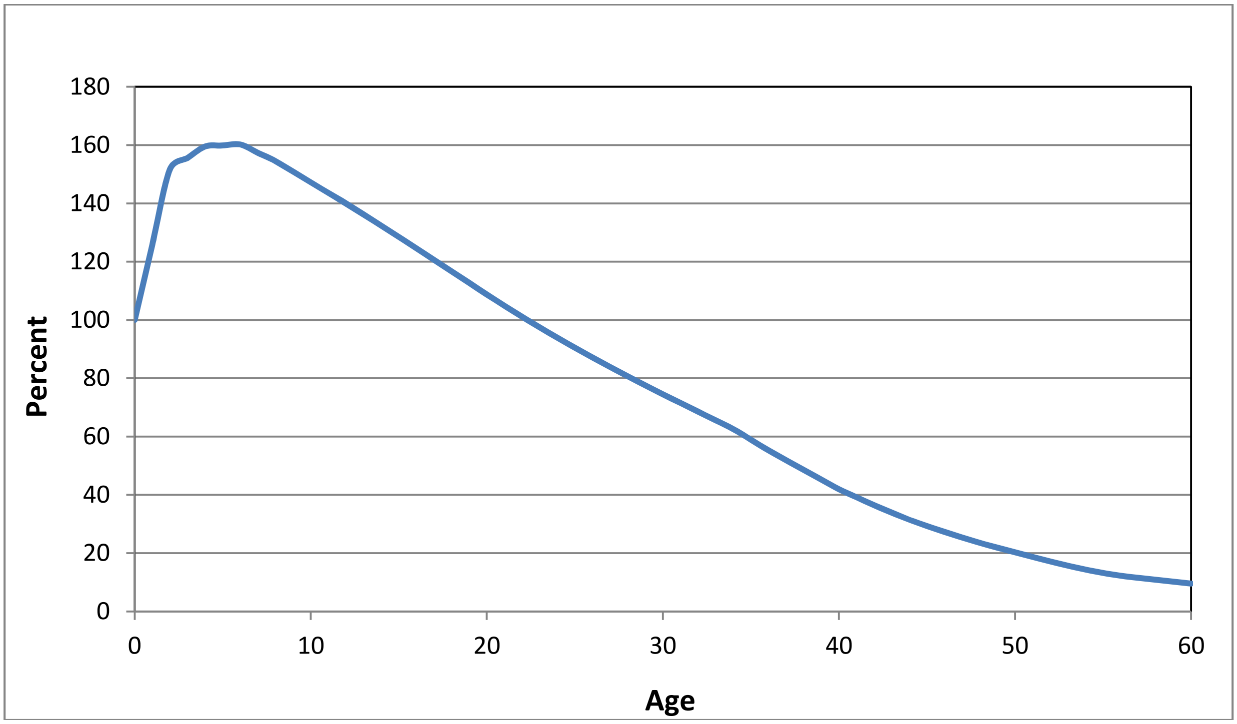
Survival rates are estimated using multiple years of registration data from the California Department of Motor Vehicles (DMV; more detail on how DMV data are analyzed is contained in the section below). Unlike with on-road automobiles, RW registration must be renewed with DMV every *two years*. The age distribution make-up of year-specific RW population is affected by a number of ownership circumstances that might transpire between two consecutive registrations (current versus prior registration two years earlier), including:

- Decline for re-registration of RW in the current year that was already registered in the prior years,
- Migration of a RW into California (positive migration) or out of California (negative migration),
- Whether a RW was unintentionally destroyed, and
- Scrappage (when a RW is intentionally destroyed and then disposed of, usually due to age).

In PC2014, the calculation of an age-specific RW population is based on the assumption that the survival rate for marine watercraft of a specific age represents all of the above factors that lead to a year-to-year change in population.

Figure VI-1, below, presents a plot of survival rates for Outboard RW. In this plot, the year zero base population is assumed to be '100' as a reference. Typically, the survial rate near the end of life span is close to 0. One peculiar issue with recreational vehicles, like RW, is that new model year inventories can take several years to sell out. As a result, survival rates for the first few years can actually be higher than the year zero rate. For example, it would not be too uncommon for a new 2011 model year boat to be sold in calendar year 2014. This is reflected in survival rates greater than 100 for ages less than 10.

Figure VI-1: Final Survival Rate for Outboard



B. ESTIMATE OF SURVIVAL *RATIO* FROM SURVIVAL RATE

The model is designed to use a variable called survival ***ratio***, *not the survival* ***rate***, to estimate age distribution of the population.

The **survival ratio**, which is not the same as suvival rate, refers to the ratio of population between two ages from two CYs. For example, the population of age 10 in CY 2012 is 50 and the population of age 11 in CY 2013 is 45, and the survival ratio at age 11 is 0.95. Typically, the survival ratio for off-road equipment ranges from 0.9 to 1.2.

To estimate the final survival rate and final survival ratio used in PC2014, staff first analyzed the DMV data and calculated the average survival ratios for two scenarios: with recession CYs and without CYs. Based on the average survival ratio for non-recession CYs, staff then constructed the final survival rate. Consequently, the final survival ratio was re-calculated based the final survival rate.

<u>Calculation Process</u>

As DMV includes the age distribution of RW for each calendar year, staff was able to track the change of population for multiple CYs. By following the change of populations of two specific ages at two CYs (e.g., age 10 in CY 2012 to age 11 in CY 2013), staff was able to estimate the average survival ratio between 2 specific ages of the entire life span for multiple pairs of consecutive CYs (e.g., CY 2007/CY2006, CY 2008/ CY2007, etc.).

Consequently, by multiplying the average survival ratio (between age 0 and age 1) to the reference population of 100 at age 0, staff could estimate the survived population at age 1. Likewise, by multiplying the average survival ratio (between age 1 and age 2) to the surviving population at age 1, staff could estimate the survived population at age 2. Finally, the survival rate is estimated by calculating the survived population for all ages based on the reference population at age 0.

Since RW owners are required to renew their RW registration every 2 years, the survival ratio is first calculated as the difference in the number of RW of a specific age registered with DMV between 2 consecutive registration years. Specifically, the number at age X in CY versus the number at age X+2 in CY+2 (e.g., age 2 in CY 2006 and age 4 in CY 2008). In other words, the survival ratios are developed for age 0, age 2, age 4, age 6 and so forth for the specified CYs.

Table VI-1 presents the DMV data that are used to develop the average survival ratio. By tracking the change of population every 2 years, staff developed the survival ratio for every 2 years. For instance, the population of age 12 in CY 2007 is 9,267 whereas the population of age 14 in CY2009 is 8,776, and the survival ratio between these 2 populations is 0.947. It should be noted that while the survival ratios between age 1 and age 3, and so forth, can also be calculated, such data are not used as the base population at age 1 is not known, whereas the reference population at age 0 is 100.

Ideally, the survival rate should decline with age. The increase of the RW population from age 2 to age 6 indicates that most marine watercraft are not sold in the same year that they are manufactured. They typically remain as part of the dealer inventory for 2 to 6 years before being sold.

The survival rate is also likely to be influenced by the economic conditions. RW owners may retain their RW for a longer period of time and delay a new purchase during poor economic conditions. The recent economic recession has definitely affected the survival rate. To estimate the survival rate with and without the impact of the recession, staff assumed the survival ratios developed from 2008/2006 and 2013/2011 would have minimal recession impact whereas the survival ratios developed from 2006 to 2013 would include the impact of recession. As expected, the average survival ratio developed with the recession years has a higher value in age 2 when compared to data without recession years.

The final survival rate (without recession impact) is based on the average survival ratio without impact from recession. Since the survival rates are developed only for age 0, age 2, age 4, and so forth, staff needed to interpolate those survival rates to estimate the final survival rate (see Table VI-2 and Figure VI-1). Based on the final survival rate, the final survival ratio at differant ages were then re-calculated for the outboard as shown in Table VI-2.

Table VI-1: Development of Outboard Average Survival Ratios

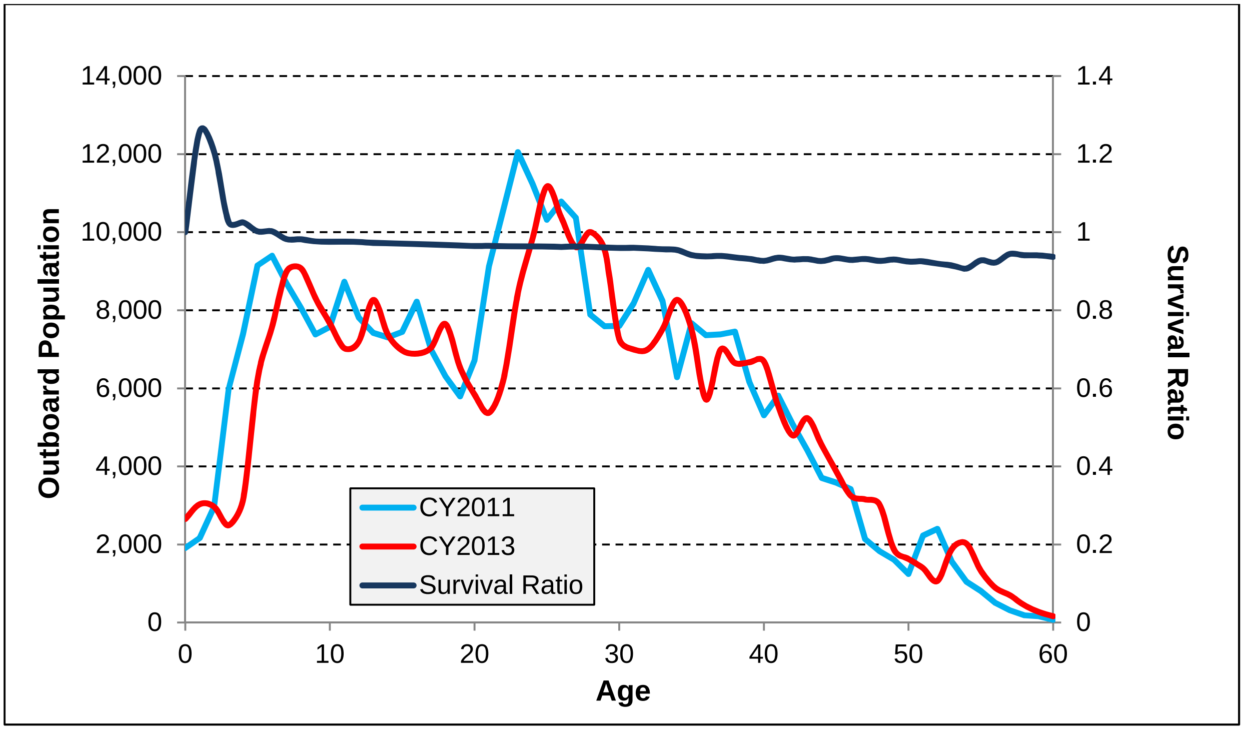
Age	2006	2007	2008	2009	2010	2011	2012	2013	2008/2006	2009/2007	2010/2008	2011/2009	2012/2010	2013/2011	Ave Survival Ratio w/ Recession	Ave Survival Ratio w/o Recession
0	5815	4689	3495	1651	1426	1908	2137	2651	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1	8327	7976	6437	5169	2614	2164	2703	3032								
2	8385	8913	8601	7012	5775	2968	2387	2965	1.479	1.495	1.653	1.797	1.673	1.555	1.609	1.517
3	8244	8634	9147	8879	7250	5987	3097	2491								
4	7827	8425	8743	9338	9038	7398	6078	3148	1.043	1.048	1.051	1.055	1.053	1.061	1.052	1.052
5	8071	7961	8327	8900	9283	9147	7463	6228								
6	9357	8210	7711	8438	8618	9397	8877	7572	0.985	1.002	0.986	1.006	0.982	1.023	0.997	1.004
7	8482	9508	7832	7773	7995	8695	8976	8987								
8	8120	8623	9011	7922	7318	8062	8222	9076	0.963	0.965	0.949	0.956	0.954	0.966	0.959	0.964
9	8003	8216	8137	9134	7468	7383	7596	8313								
10	8170	8113	7752	8258	8626	7575	6926	7665	0.955	0.958	0.957	0.956	0.946	0.951	0.954	0.953
11	9175	8270	7638	7846	7750	8731	7096	7027								
12	7791	9267	7784	7741	7349	7810	8169	7196	0.953	0.954	0.948	0.946	0.947	0.950	0.950	0.951
13	7185	7880	8691	7897	7253	7420	7267	8265								
14	6560	7255	7361	8776	7385	7307	6889	7385	0.945	0.947	0.949	0.944	0.937	0.945	0.945	0.945
15	7633	6626	6698	7427	8138	7446	6806	6970								
16	10181	7694	6164	6782	6915	8222	6941	6890	0.940	0.935	0.939	0.937	0.940	0.943	0.939	0.941
17	11914	10307	7129	6230	6259	6988	7570	7042								
18	13648	12025	9604	7191	5753	6308	6452	7646	0.943	0.935	0.933	0.930	0.933	0.930	0.934	0.937
19	12721	13785	11212	9721	6659	5795	5760	6536								
20	11803	12810	12795	11325	9041	6717	5307	5841	0.938	0.942	0.941	0.934	0.922	0.926	0.934	0.932
21	12343	11895	11956	12924	10513	9125	6148	5375								
22	11858	12447	11006	12089	12000	10594	8354	6228	0.933	0.944	0.938	0.935	0.924	0.927	0.933	0.930
23	9062	11953	11487	11114	11147	12051	9714	8441								
24	8689	9137	11032	11616	10234	11245	11064	9822	0.930	0.933	0.930	0.930	0.922	0.927	0.929	0.929
25	8682	8758	8378	11147	10658	10318	10257	11172								
26	9375	8759	8103	8461	10265	10784	9533	10372	0.933	0.926	0.931	0.928	0.932	0.922	0.929	0.927
27	10508	9473	8072	8208	7829	10370	9886	9618								
28	9497	10598	8689	8157	7496	7891	9431	10005	0.927	0.931	0.925	0.933	0.919	0.928	0.927	0.927
29	7338	9567	9725	8787	7518	7590	7194	9542								
30	8984	7399	8774	9824	8044	7598	6898	7265	0.924	0.927	0.926	0.932	0.920	0.921	0.925	0.922
31	8839	9023	6770	8888	8942	8176	6927	6996								
32	8839	8886	8253	6834	8142	9032	7404	7005	0.919	0.924	0.928	0.919	0.920	0.922	0.922	0.920
33	9189	8843	8040	8334	6205	8234	8173	7518								
34	7963	9007	8045	8133	7608	6285	7418	8267	0.910	0.915	0.922	0.920	0.911	0.915	0.916	0.913
35	6927	7535	8166	8118	7284	7667	5647	7514								
36	7375	6480	6825	8199	7322	7361	6904	5714	0.857	0.910	0.910	0.905	0.907	0.909	0.900	0.883
37	6757	6944	5860	6831	7441	7380	6558	6988								
38	5942	6312	6299	5850	6228	7454	6599	6648	0.854	0.903	0.913	0.909	0.901	0.903	0.897	0.879
39	4889	5567	5655	6307	5332	6164	6637	6667								
40	4757	4613	4926	5649	5820	5308	5555	6692	0.829	0.895	0.924	0.907	0.892	0.898	0.891	0.863
41	4509	4529	4094	4919	5169	5814	4835	5532								
42	2838	4303	3974	4089	4419	5086	5219	4793	0.835	0.887	0.897	0.900	0.897	0.903	0.887	0.869
43	2469	2730	3806	3978	3718	4415	4594	5237								
44	2121	2417	2358	3786	3606	3704	3888	4546	0.831	0.880	0.907	0.906	0.880	0.894	0.883	0.862
45	1779	2073	2124	2383	3427	3587	3256	3878								
46	2980	1723	1816	2132	2109	3419	3148	3253	0.856	0.882	0.894	0.903	0.873	0.878	0.881	0.867
47	3341	2932	1468	1825	1811	2140	3031	3156								
48	2181	3317	2508	1481	1589	1826	1854	3025	0.842	0.860	0.875	0.857	0.879	0.885	0.866	0.863
49	1485	2165	2784	2549	1245	1611	1623	1866								
50	1090	1472	1805	2831	2201	1243	1386	1630	0.828	0.853	0.878	0.839	0.872	0.893	0.860	0.860
51	688	1089	1203	1834	2379	2231	1054	1395								
52	436	679	920	1212	1554	2403	1849	1067	0.843	0.824	0.861	0.849	0.840	0.858	0.846	0.851
53	248	434	551	931	1031	1562	2010	1886								
54	202	245	356	554	806	1047	1317	2023	0.818	0.816	0.877	0.864	0.848	0.842	0.844	0.830
55	89	198	205	359	494	811	881	1328								
56	284	88	174	210	307	503	691	893	0.859	0.857	0.861	0.907	0.858	0.852	0.866	0.856
57	57	290	79	175	179	312	442	702								
58	102	61	252	80	158	185	268	446	0.889	0.904	0.912	0.879	0.874	0.888	0.891	0.888
59	50	100	55	261	71	162	160	273								
60	59	52	91	58	230	70	140	161	0.892	0.938	0.911	0.884	0.884	0.870	0.897	0.881

Figure VI-2 illustrates the final survival ratio for the outboard. As indicated earlier in Table VI-1, the “spike” around age 2 to age 6 is the delay of sales as most RW are not sold in the same year they are manufactured. Figure VI-2 also provides an example of survival ratio as seen from the shift of peaks and of age distributions of DMV data from CY2011 to CY2013.

Table VI-2: Final Survival Rate and Survival Ratio for Outboard

Age	Survival Rate	Survival Ratio
0	100	1
1	126	1.258
2	152	1.205
3	156	1.026
4	160	1.025
5	160	1.002
6	160	1.002
7	157	0.982
8	155	0.982
9	151	0.976
10	147	0.976
11	144	0.976
12	140	0.975
13	136	0.973
14	132	0.972
15	128	0.971
16	125	0.970
17	121	0.968
18	117	0.967
19	113	0.966
20	109	0.965
21	105	0.965
22	101	0.964
23	98	0.964
24	94	0.963
25	91	0.964
26	87	0.962
27	84	0.964
28	81	0.962
29	78	0.961
30	74	0.960
31	72	0.960
32	69	0.958
33	66	0.956
34	63	0.954
35	59	0.942
36	55	0.938
37	52	0.939
38	49	0.935
39	45	0.932
40	42	0.927
41	39	0.935
42	36	0.930
43	34	0.931
44	31	0.926
45	29	0.934
46	27	0.929
47	25	0.932
48	24	0.927
49	22	0.930
50	20	0.925
51	19	0.925
52	17	0.919
53	16	0.915
54	14	0.907
55	13	0.928
56	12	0.922
57	12	0.944
58	11	0.941
59	10	0.941
60	10	0.937

Figure VI-2: Final Survival Ratio for Outboard



C. EVAPORATIVE EMISSIONS FACTORS CALCULATION PROCESS

Evaporative emissions testing was conducted to estimate hot soak emissions (emissions after the engine is shut off) as well as diurnal and resting loss emissions (emissions from engine, fuel tank, and hoses due to the change of ambient temperature) from SIMW. Since the testing was not designed to measure running loss emissions from SIMW, the running loss basic emissions rates remain unchanged. Running loss emissions rates for SIMW are based on running loss emissions tests conducted by ATL (2003) on large spark-ignition engines.

Evaporative emissions tests were conducted in a SHED. Environmental conditions in the SHED were controlled to facilitate measuring the concentration of HCs emitted for each evaporative emissions process under simulated real-world conditions. Details of ARB's SHED test procedure are contained in the following document:

http://www.arb.ca.gov/msprog/offroad/recmarine/draft_tp1501.pdf

For development of the uncontrolled baseline emissions factors, staff combined test data from two sources: ATL testing conducted in 2003 and ARB conducted in-house testing from 2008 to 2012. The number of tests by SIMW type is summarized in Table VI-3.

Table VI-3: Sample Size of ATL and ARB Evaporative Emissions Test Data

Boat Type	ATL	ARB
Outboard	3	7
PWC	3	7
Sterndrive	3	9
Inboard	0	7
Total	9	30

Previously, the evaporative emissions factors for SIMW were based on nine boats tested by ATL. For PC2014, staff used both the ARB in-house evaporative test data and ATL test data to develop updated basic emissions rates for diurnal and resting loss as well as hot soak.

Since emissions testing under the two studies used different fuels, the test results had to be corrected for differences in fuel characteristics. First, staff made adjustments for variable RVP and ethanol content of tested fuels. Second, staff grouped the results according to engine technologies and horsepower group, where applicable. The following sections describe the process to standardize the test results so that results can be appropriately compared and analyzed.

RVP Adjustment

Evaporative emissions are influenced by the vapor pressure of the fuel. As a result, it is necessary to adjust tests to a reference level to facilitate comparisons among the results. Because ATL tests were conducted with a fuel RVP of 6.95 psi, this was used as the reference level.

ARB emissions tests were based on 3 fuels: E0 with an RVP of 6.95 psi, E6 with 6.8 psi, and E10 with 6.53 psi. In order to adjust all fuels to the reference 6.95 psi basis, staff applied adjustment factors to ARB's E6 and E10 results using the Reddy Equation through an empirical model developed by Dr. Sam Reddy named ReddyEvap:

http://evapconsulting.com/index.html

The ReddyEvap model was developed based on the testing of multiple on-road vehicles using different fuel blends and RVP combinations. Using this model, staff developed correction factors to correct ARB's E6 and E10 test results to a reference of 6.95 psi, as shown in Table VI-4.

Table VI-4: RVP Adjustment Based on ReddyEvap Model

RVP	Adjustment to 6.95 RVP
E6 (6.8 psi)	1.06
E10 (6.53 psi)	1.18

Effect of Ethanol Content on Evaporative Emissions

Evaporative emissions factors are influenced by the ethanol content in the fuel. In California, ethanol-blended gasoline with ethanol content of 6 percent (E6) and ethanol content of 10 percent (E10) were introduced in 2004 and 2010, respectively. To evaluate the impact of ethanol content on evaporative emissions rates, staff conducted a statistical analysis after converting test results to 6.95 psi. After being standardized, results showed no significant difference between E6 and E10, but did show a difference between E0 and either E6 or E10. As a result, test results for E6 and E10 were combined and averaged together. Table VI-5 compares the ratio of evaporative emissions from E0 against E6 and E10 (combined E6 and E10 data are denoted as E6 in the table). While the range of ratio differences can span between -8 to 28 percent for hot soak and 12 to 40 percent for diurnal and resting losses, the average evaporative emissions for E6/E10 is about 9 percent higher for hot soak and 21 percent higher for diurnal and resting loss when compared to E0 fuel.

Table VI-5: Effect of Ethanol on Hot Soak and Diurnal Emissions

		Hot Soak (g/event)			Diurnal/Resting (g/day)		
Equipment	**Fuel System**	**E0**	**E6**	**E6/E0 Ratio**	**E0**	**E6**	**E6/E0 Ratio**
1995 Sea Doo XP PWC	CB	2.59	3.33	1.28	7.98	8.94	1.12
2000 Bayliner Capri 1750 Sterndrive	CB	7.82	8.31	1.06	18.82	21.22	1.13
2004 Polaris MSX150 Turbo PWC	FI	2.39	2.2	0.92	7.24	10.16	1.4
2005 Kawasaki STX-12F PWC	FI	0.57	0.62	1.08	3.52	4.2	1.19
Average				1.09			1.21

Effect on Engine Technology

After the test data were adjusted for vapor pressure and fuel ethanol content, staff evaluated different types of engine technologies. The data show that CB engines have higher evaporative emissions than FI engines, due to CB engines having residual fuel remaining in the carburetor after use. As a result, test data were separated into CB and FI for each type of RW. In the case where there were not enough data to distinguish CB or FI, they are assumed to have the same emissions factor until more test data become available.

Effect on Fuel Tank Size

Staff also evaluated the relationship between evaporative emissions and fuel tank size. Using survey data from CSUS, staff calculated the average fuel tank size for each horsepower group based on survey responses from RW owners (second column, Table VI-6). As shown in the table, there is a reasonable correlation between average tank size and horsepower group. Therefore, engine horsepower could be used as a surrogate for the size of the fuel tank. While staff attempted to segregate the test data into different horsepower groups, the RW tested did not cover all ranges of horsepower groups. As a result, staff assumed emissions factors for horsepower less or equal to 175 are all the same, whereas the emissions factors for horsepower greater than 175 will be higher, where applicable.

Table VI-6: Correlation of Fuel Tank Size and Horsepower

Horsepower Group (Hp)	Fuel Tank Size (gal)	Sample Size
0-2 Hp	8	2
2-5 Hp	14.7	19
5-15 Hp	16.3	23
15-25 Hp	18.4	74
25-50 Hp	22.5	133
50-120 Hp	25.1	96
120-175 Hp	37.9	102
175-250 Hp	49.8	103
250-500 Hp	41.7	3
500+ Hp	51.8	23

Evaporative Emissions Factors

After adjusting raw test data to 6.95 psi, and separating data by ethanol content, fuel tank size, and engine technology, staff developed two sets of proposed evaporative emissions factors. Evaporative emissions factors were developed for E0 fuels which are applicable to CYs before 2004 (before the introduction of E6 fuel). For CY 2004 and beyond, evaporative emissions factors based on E6/E10 were developed. The emissions rates developed in our new analysis vary by SIMW type, horsepower group, and technology (see TablesVI-7 and VI-8). The new analysis also compared the baseline uncontrolled emissions factors, baseline with adopted U.S. EPA control in 2012, and ARB proposed control starting in 2018.

Table VI-7: Comparison of Diurnal and Resting Loss Emissions Factors

Type	HP Group	Diurnal and Resting Loss (g/day)*					
		Baseline (Uncontrolled) Emission Factors		Baseline (w/U.S. EPA Control) Emission Factors		ARB Proposed Control*	
		CB	FI	CB	FI	CB	FI
Outboard	0 to 25	23.8	26.4	12.1	11.6	12.1	11.6
	26 to 50	33.6	26.4	17.1	11.6	10.4	9.2
	51 to 120	33.6	26.4	17.1	11.6	10.4	9.2
	121 to 175	33.6	26.4	17.1	11.6	10.4	9.2
	176 and higher	33.6	26.4	17.1	11.6	10.4	9.2
Inboard/ Auxiliary Sail	0 to 50	21.7	21.7	11.1	9.5	6.7	7.6
	51 to 120	21.7	21.7	11.1	9.5	6.7	7.6
	121 to 175	21.7	21.7	11.1	9.5	6.7	7.6
	176 and higher	35.1	35.1	17.9	15.4	10.9	12.3
Sterndrive	0 to 50	19.5	19.5	9.9	8.5	6.0	6.8
	51 to 120	19.5	19.5	9.9	8.5	6.0	6.8
	121 to 175	19.5	19.5	9.9	8.5	6.0	6.8
	176 and higher	34.0	34.0	17.3	14.9	10.5	11.9
Jet Drive/ PWC	0 to 50	17.8	9.9	9.1	4.4	5.5	3.5
	51 to 120	17.8	9.9	9.1	4.4	5.5	3.5
	121 to 175	17.8	9.9	9.1	4.4	5.5	3.5
	176 and higher	17.8	9.9	9.1	4.4	5.5	3.5

*For CY2018 and later

Table VI-8: Comparison of Hot Soak Emissions Factors

Type	HP Group	Hot Soak (g/event)*					
		Baseline Uncontrolled Emission Factors		Baseline (w/ U.S. EPA Control) Emission Factors		ARB Proposed Control* Emission Factors	
		CB	FI	CB	FI	CB	FI
Outboard	0 to 25	6.7	8.3	4.9	3.6	4.9	3.6
	26 to 50	14.1	8.3	10.3	3.6	2.4	2.9
	51 to 120	14.1	8.3	10.3	3.6	2.4	2.9
	121 to 175	14.1	8.3	10.3	3.6	2.4	2.9
	176 and higher	14.1	8.3	10.3	3.6	2.4	2.9
Inboard/ Auxiliary Sail	0 to 25	10.4	10.4	7.6	4.5	7.6	4.5
	26 to 50	10.4	10.4	7.6	4.5	1.8	3.6
	51 to 120	10.4	10.4	7.6	4.5	1.8	3.6
	121 to 175	10.4	10.4	7.6	4.5	1.8	3.6
	176 and higher	27.3	27.3	19.3	11.7	4.6	9.6
Sterndrive	0 to 25	7.5	7.5	5.5	3.2	5.5	3.2
	26 to 50	7.5	7.5	5.5	3.2	1.3	2.6
	51 to 120	7.5	7.5	5.5	3.2	1.3	2.6
	121 to 175	7.5	7.5	5.5	3.2	1.3	2.6
	176 and higher	12.3	12.3	9.0	5.3	2.1	4.3
Jet Drive/ PWC	0 to 25	6.6	3.0	4.8	1.3	4.8	1.3
	26 to 50	6.6	3.0	4.8	1.3	1.1	1.1
	51 to 120	6.6	3.0	4.8	1.3	1.1	1.1
	121 to 175	6.6	3.0	4.8	1.3	1.1	1.1
	176 and higher	6.6	3.0	4.8	1.3	1.1	1.1

*Note for CY2018 and later

D. ACTIVITY ANALYSIS

Developing an updated estimate of RW activity was a critical portion of this emissions inventory update. In 2009, CSUS conducted a survey of RW usage and related information under ARB contract. Only registered RW were selected for sampling. The survey collected 1,126 respondents by telephone. The main information used in calculating the annual activity estimates were:(1) the age of equipment at the time of the interview, (2) the number of operating days used in the last year, (3) the typical months per year when used, and (4) the hours per day during which the RW are typically used. The equation used to estimate the annual activity is:

$$Annual\ Activity = Number\ of\ Operating\ Days(per\ year)\ x\ Typical\ Hours(per\ day)$$

The survey data was divided into six RW types and annual activity was calculated by age for each RW type. Since the sample sizes for PWC and jet drive were small, staff combined both data for analysis.

Figures VI-2 to VI-6 illustrate the CSUS survey-based activity distribution by RW age. The figures show a high level of variability in the annual activity data ranging from high usage to no usage (some RW owners indicated that they had no activity over the past year). Because of the high spread in the data, it is difficult to establish a best fit curve with an acceptable fit. Staff attempted to use a regression fit, but the associated R^2 values were far too small. As a result, annual activity is estimated based on the average activity per each type of RW (dark black line in each plot).

As the 2009 survey was conducted in the beginning of the recent recession (around 2008), the annual activity is likely to be influenced by the economic conditions. The survey data may not reflect the annual activity for non-recession years. To reflect the change of activity with respect to economic conditions, additional surveys on a periodic basis will be needed to estimate a more representative annual activity.

Figure VI-3: Annual Activity of Outboard by Age

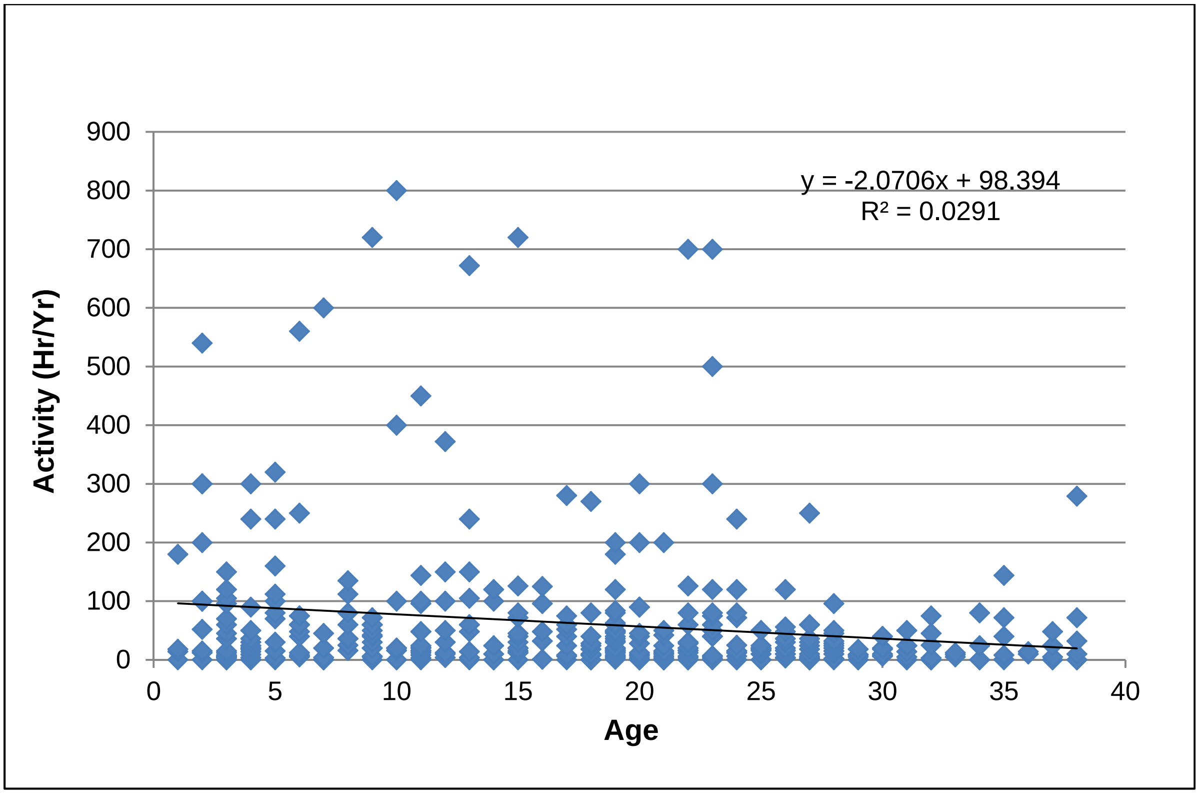


Figure VI-4: Annual Activity of Inboard by Age

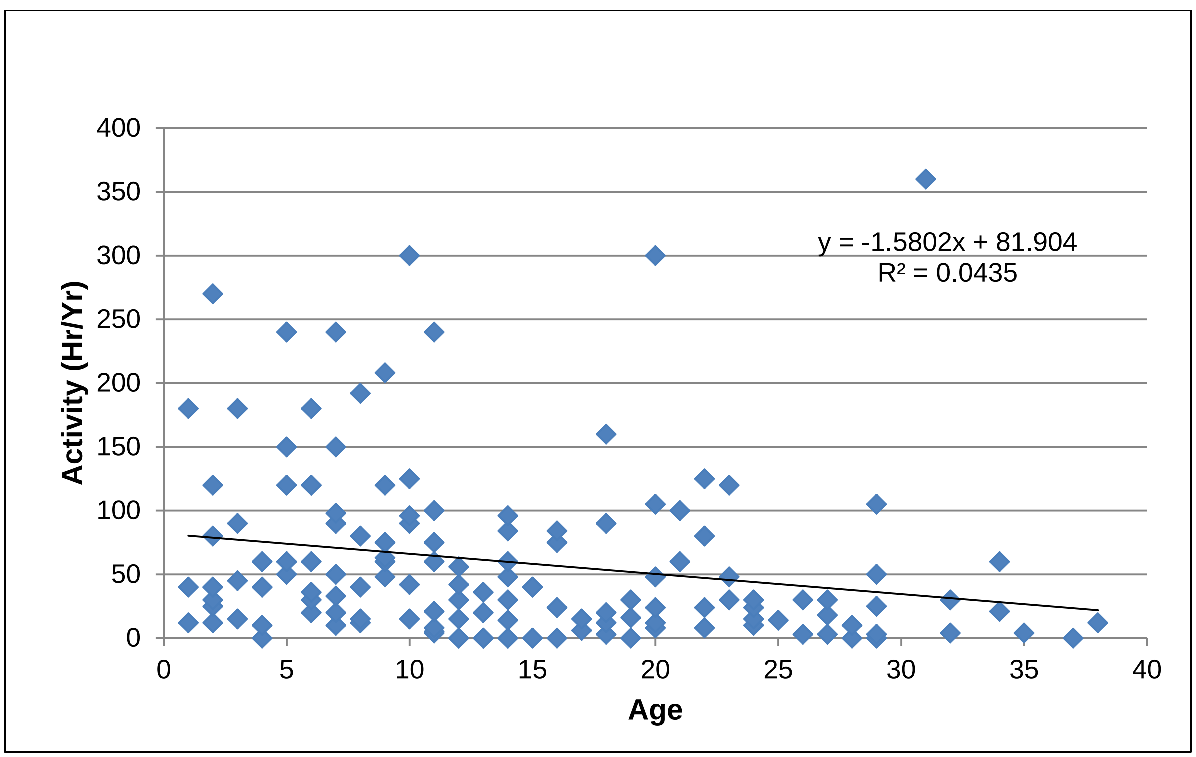


Figure VI-5: Annual Activity of Sterndrive by Age

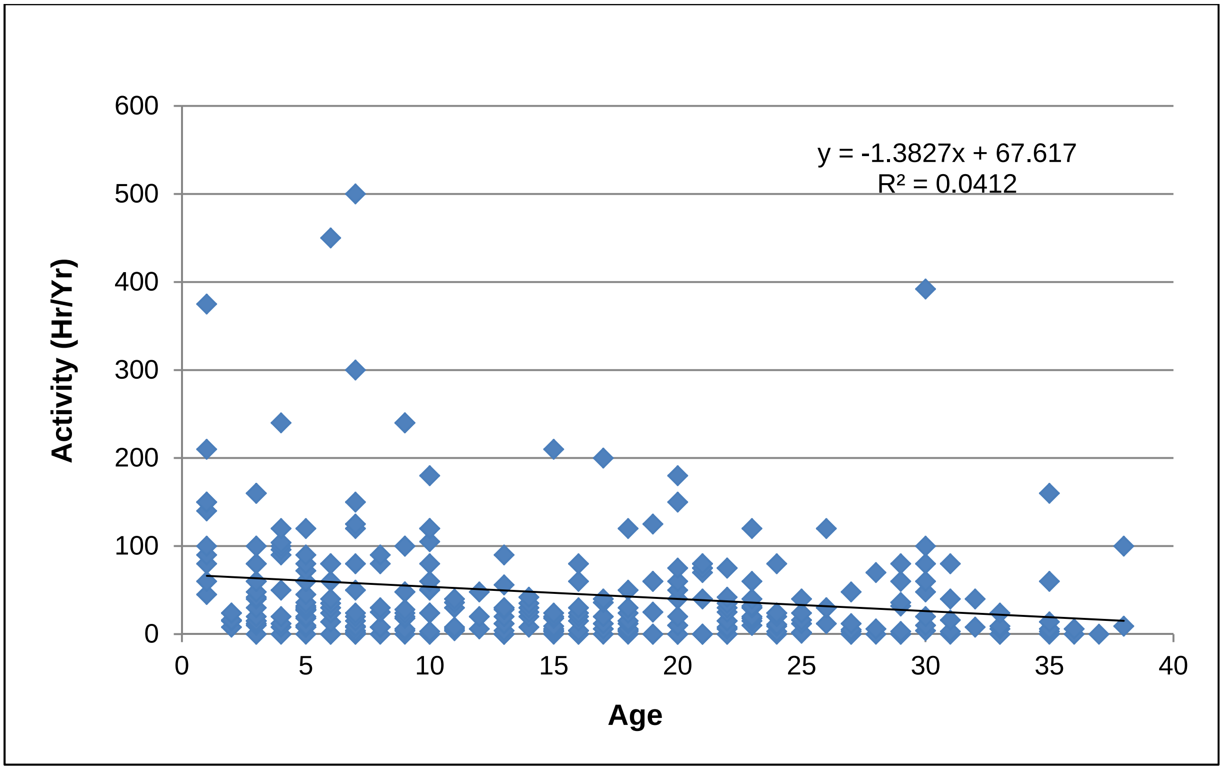


Figure VI-6: Annual Activity of Sailboats with Auxiliary Engine by Age

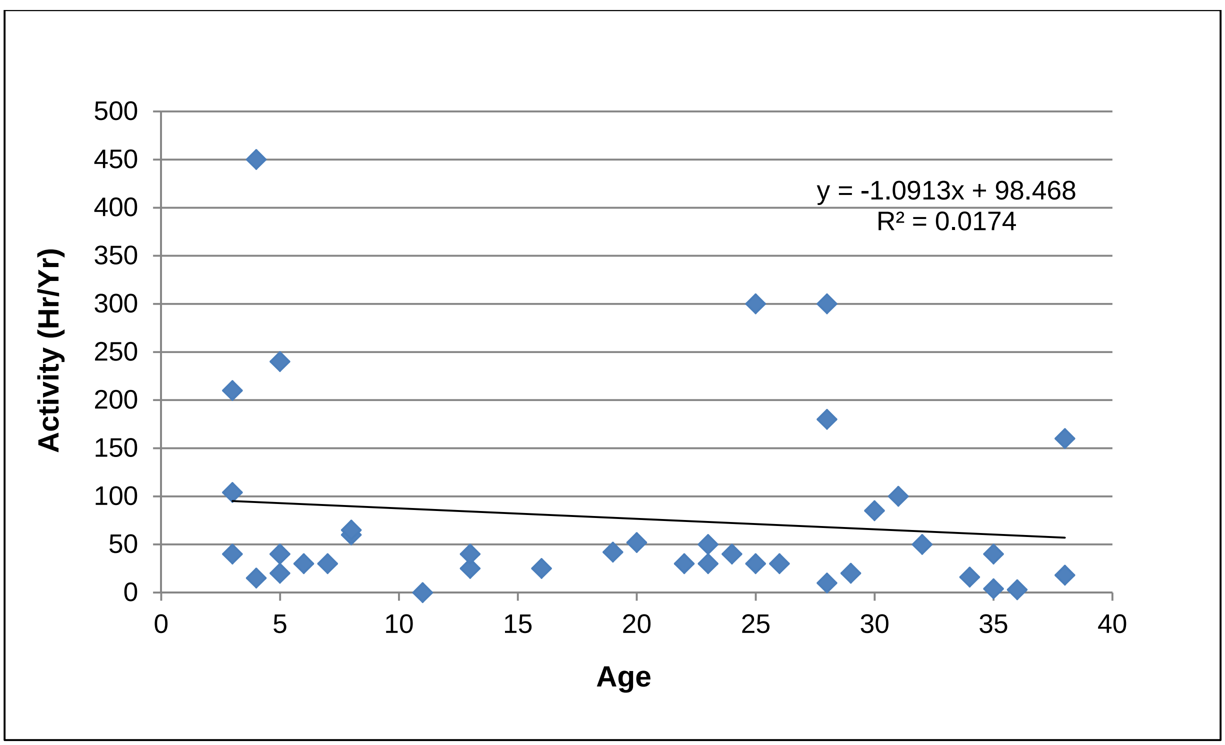
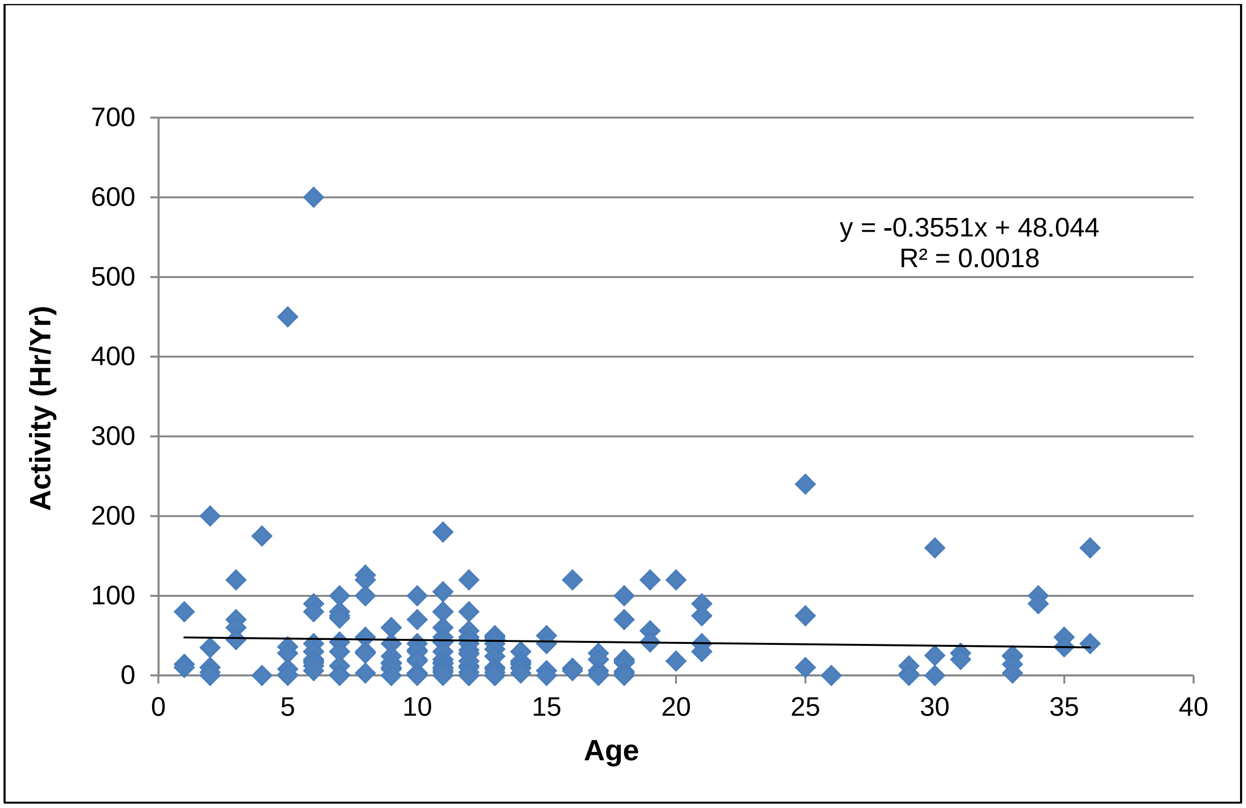


Figure VI-7: Annual Activity of PWC/Jet Drive SIMW by Age



E. TEMPERATURE/REID VAPOR PRESSURE CORRECTION

The following is an illustrative example of correcting the test data to different local temperature and fuel RVP conditions.

As indicated in the main report text, note that the vapor model was developed for vehicles without sealed tanks or pressure relief valves, but can be adapted for SIMW. The amount of vapor restricted from venting to the atmosphere will depend on the setting of the pressure relief valve.

Specifically, U.S. EPA estimates that the range of pressure relief valve installed on PWC varies from 0.5 to 4.0 psi. Reddy and U.S. EPA both assessed the impact of a 1.0 psi pressure relief valve on vapor generation, with both concluding that a 1.0 psi valve would reduce vapor generation by about 0.7 grams per gallon vapor space. This would apply to different temperature and RVP conditions, as the pressure relief valve operates at the same threshold regardless of the conditions under which vapor was generated (although the relative reduction may be quite different). Using the Reddy equation, staff assumes a 1.0 psi “trigger” for pressure relief valves and corrects the existence of a pressure relief valve by subtracting 0.7 grams/gallon off of the uncontrolled vapor generation rate.

Figure VI-7 provides the sample calculation used in developing the RVP/Temp correction applied to diurnal test data which were conducted over 24 hours from 65°F to 105°F and back to 65°F. As shown in the spreadsheet, vapor generation, hose permeation, and tank permeation were estimated by Reddy’s equations based on a typical fuel tank of 25 gallons. The diurnal emissions are the sum of vapor generation and half of the total permeation whereas the resting emissions are half of the total permeation.

Different local temperatures and RVPs were then used to calculate the diurnal and resting loss emissions. Finally, RVP/Temperature corrections were developed based on diurnal and resting loss emissions normalized using 65°F to 105°F data as a reference.

Figure VI-2: Sample Calculation of Temperature/RVP Correction

Typical Outboard fuel tank and hose

Vapor Generation

	Input	Units
Tmin	65	F
Tmax	105	F
RVP	7	psi
Tank Size	25	gallons
Fill (%)	0.50	
Vapor generation	2.07	g/gal
Vapor per day	25.85	g/day

Reddy Coefficients

A	B	C	
0.00875	0.2056	0.043	(10% ethanol, sea level)

Assume tank has pressure relief valve of 1 psi and need to subtract 0.7 g/gal

Vapor generated (g/gal vapor space) = A* exp $^{B*(RVP)}$ (exp^{C*T2} – exp^{C*T1}) - 0.7

Vapor generated (grams) = Vapor (g/gallon vapor space) * Fuel Capacity (gal) * (1- Fill %)

Tank Permeation

Base EF	10.70	g/m2/day
Temp Correction at Tmin	0.46	F
Temp Correction at Tmax	2.16	F
Ave Temp Correction	1.31	F
Adjusted EF	14.0	g/m2/day
Tank Surface Area (S.A.)	2.02	m2
Final Emissions	28.34	g/day

Temp Correction = 0.03788519*EXP(0.03850818*T) relative to 85 F

$$S.A. = \sqrt{\frac{(Tank\ \ Size + 2)^2}{4} - 1}$$

Hose Permeation

Base EF	222.00	g/m2/day
Temp Correction at Tmin	0.73	F
Temp Correction at Tmax	3.43	F
Ave Temp Correction	2.08	F
Adjusted EF	462.19	g/m2/day
Hose Surface Area	0.32	m2
Final Emissions	147.90	g/day

Temp Correction = 0.06013899*EXP(0.03850818*T) relative to 73 F

Typical hose surface area = 0.32 m^2 for outboard

Total Emission	202.09	g/day
"Diurnal"	113.97	g/day
"Resting"	88.12	g/day

Total Permeation = Tank Permeation + Hose Permeation

Diurnal = Vapor generation + 0.5*(Total Permeation)

Resting = 0.5*(Total Permeation)

Local Temp and Fuel RVP			Final Output (g/day)						Temp/RVP Correction	
RVP	T min	T max	Vapor Generation	Tank Permeation	Hose Permeation	Total	Diurnal	Resting Loss	Diurnal	Resting Loss
7	65	105	25.85	28.34	147.90	202.09	113.97	88.12	1.00	1.00
7.8	73.7	86.7	0.94	18.53	96.69	116.16	58.55	57.61	0.51	0.65
7.8	53.8	70.2	0.00	9.36	48.85	58.21	29.11	29.11	0.26	0.33
7.8	72.1	90.7	6.04	20.03	104.53	130.60	68.32	62.28	0.60	0.71
7.8	77	92.4	5.25	22.31	116.41	143.97	74.61	69.36	0.65	0.79
7.8	71.4	89.7	5.27	19.35	100.97	125.59	65.43	60.16	0.57	0.68
7.8	75.7	93.4	7.33	22.48	117.33	147.14	77.24	69.91	0.68	0.79

F. STORAGE EFFECT FOR ACTIVE SIMW

As described in earlier sections, diurnal and resting loss emissions are measured from a gasoline-powered SIMW stored inside a SHED over a specific 24-hour temperature profile. Processes such as fuel tank vapor displacement during diurnal heating, tank or hose permeation, and transient CB fuel bowl drying are all associated with emissions measured during diurnal and resting loss.

Historically, diurnal and resting loss emissions factors for SIMW were based on a 3-day average of diurnal and resting loss tests. However, from the diurnal and resting loss emissions results from 30 SIMW, staff noticed that the emissions rate followed a consistent trend where day 1 was higher than day 2, while day 2 was higher than day 3. The survey data from CSUS also indicated that the average time between SIMW usages is about 3 to 4 weeks. Generally speaking, SIMW are used much less frequently than commuter cars or commercial equipment and there are long periods between uses. Thus, the 3-day average emissions factors for diurnal and resting loss may overestimate the diurnal and resting loss emissions as the time between each usage is over 3 weeks (24 days) instead of 3 days.

Correction factors were developed to adjust 3-day data to the 24-day period representative of average SIMW usage. More specifically, a CB sterndrive, a FI outboard SIMW, and a CB PWC were tested over a prolonged period ranging from 11 days to 20 days (the duration was dependent upon the number of days the test SIMW was available). To estimate the diurnal resting loss effects with respect to time and temperature, staff tested the SIMW based on an average Los Angeles temperature profile that starts at 65°F peaks at 82°F, then returns to 65°F. Figures VI-8 to VI-10 show that over multi-day to multi-week periods daily diurnal and resting loss emissions all decline with respect to time and eventually reach a steady state after 2 or 3weeks. To create a profile dataset that matches the average 24 day period of inactivity indicated from the CSUS survey, staff extrapolated the measured evaporative emissions data as needed to create 24 day profiles.

Figure VI-9: Multi-Day Evaporative Emissions for Sterndrive

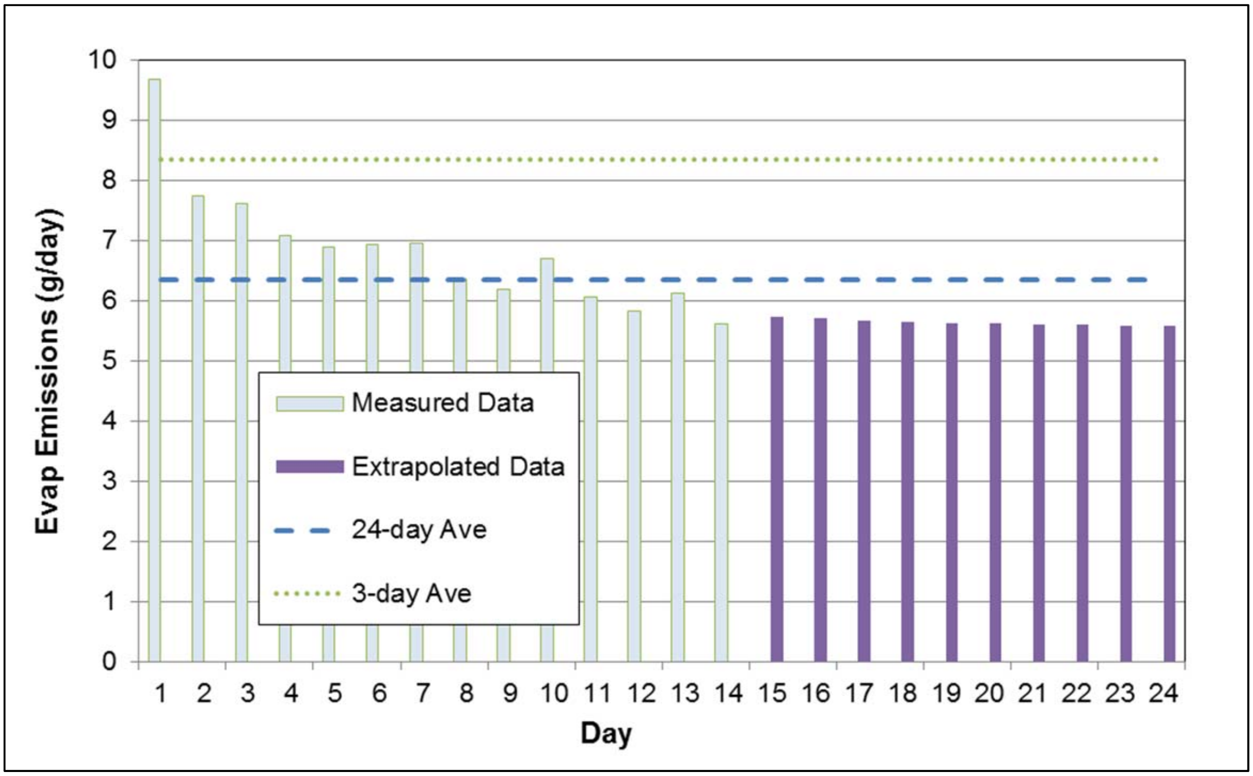


Figure VI-10: Multi-Day Evaporative Emissions for Outboard

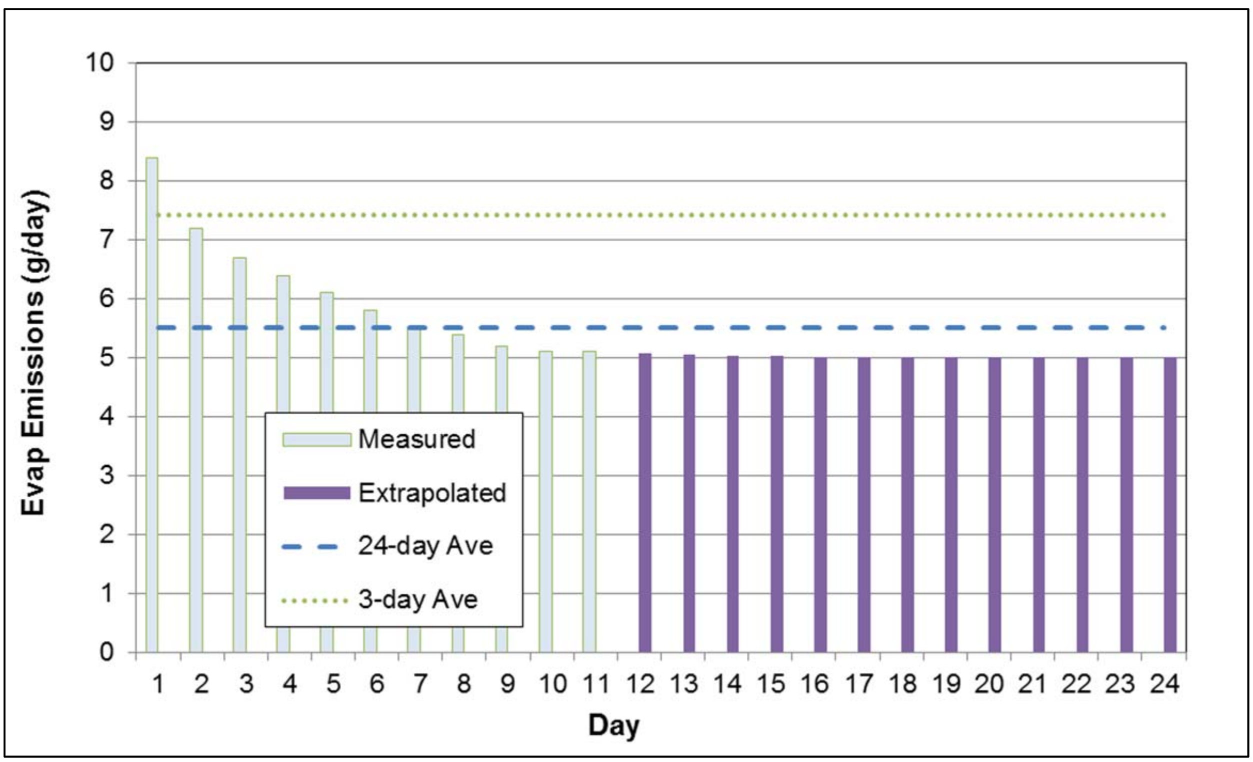
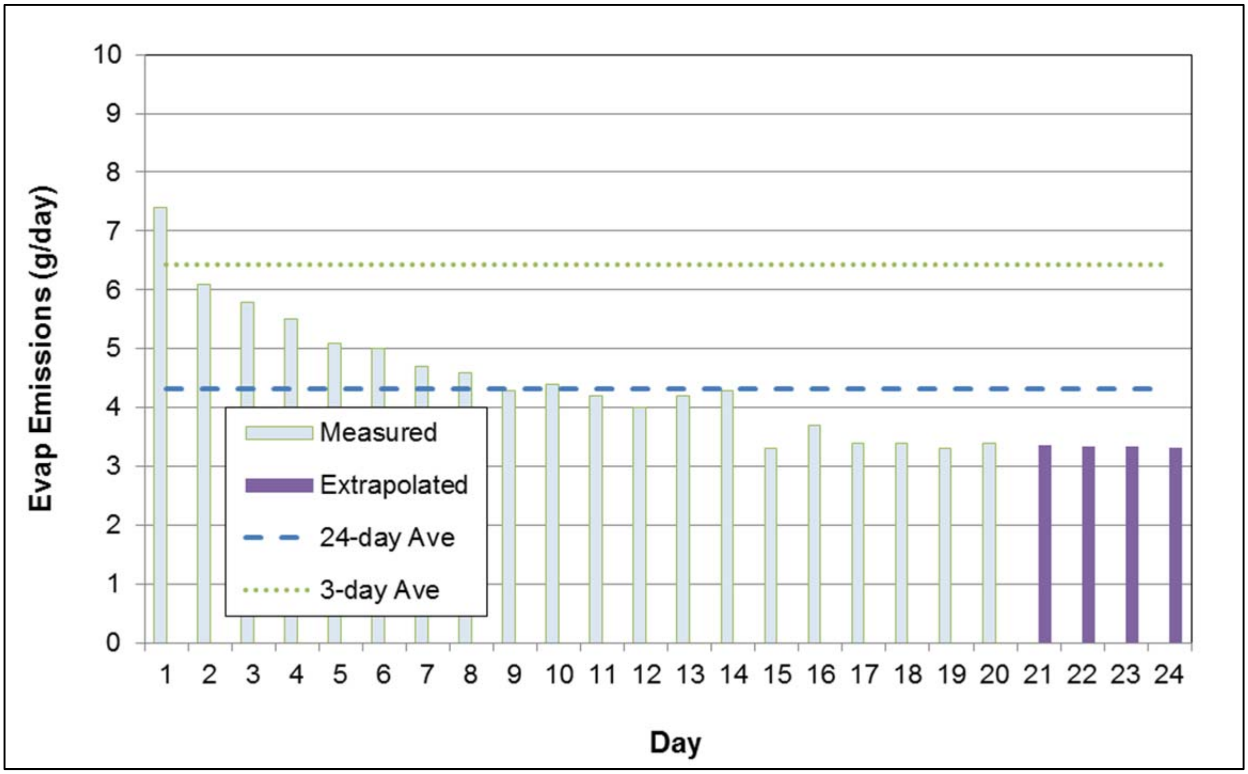


Figure VI-3: Multi-Day Evaporative Emissions for PWC



From the measured and extrapolated results from these 3 SIMW, staff determined the average emissions rate over 3 days and over 24 days. Staff then divided the 24-day average over the 3-day average to come up with the correction factor. The correction factor was then applied to the baseline emissions factor for diurnal and resting loss. As shown in Table VI-9, the average correction factors for sterndrive, outboard, and PWCs are 0.76, 0.67, and 0.74, respectively. Instead of applying the correction factor individually to each SIMW type, staff decided to take the average which is 0.72.

Table VI-9: Between-Use Storage Correction Factors for Active SIMW

Boat Type	Fuel System	Size of Fuel Tank (gal)	3-day Avg (g/day)	24-day Avg (g/day)	Correction Factor
Sterndrive	Carb	32	8.4	6.3	0.76
PWC	Carb	8	6.4	4.3	0.67
Outboard	FI	20	7.4	5.5	0.74
				Average	0.72

G. WEATHERING EFFECT FOR INACTIVE SIMW

In OFFROAD2007, evaporative emissions (diurnal and resting loss) were based on the assumption that the emissions rate remains constant throughout all 365 days of the year for inactive SIMW. This is tantamount to assuming that the ambient temperature extremes remain constant, and that the liquid-phase composition is constant (no depletion of volatile components or weathering). While such an assumption may be reasonable for active SIMW, which are refueled more frequently throughout the year, it may not be applicable for inactive SIMW, since they are more likely to be stored for many months without activity or refueling. Consequently, a different approach is needed to estimate the evaporative emissions (diurnal and resting loss) from inactive SIMW. Below, a simplified model which estimates evaporative emissions of hydrocarbons based on an uncontrolled, 50 percent filled 5-gallon fuel tank is described. Results from this analysis are used to create a weathering "adjustment factor" for inactive SIMW.

Mass Balance Calculation of Fuel Tank Based on Vapor Liquid Equilibrium (VLE)

Based on the principle of vapor-liquid equilibrium (VLE), staff estimated the daily loss of emissions in an uncontrolled fuel tank (i.e., where gasoline vapor is not restricted from leaving the fuel tank).

Instead of including all gasoline species in the vapor-liquid mass balance, staff simplified the mass balance calculation by selecting 12 major components in the gasoline. With this method, the vapors expelled from the tank are assumed to be saturated (in equilibrium with the liquid). The volatilized components are deducted from the liquid phase and a new vapor-liquid equilibrium is established the next day.

Two scenarios were used: 50 percent full with MTBE gasoline; or 50 percent full with 0 percent ethanol (E0) fuel. In both cases, the density of the gasoline is assumed to be 6.2 lbs/gallon with 7 psi RVP. Staff also used the minimum and maximum of average monthly temperature to reflect the change of average daily conditions in Los Angeles County (see Table VI-10).

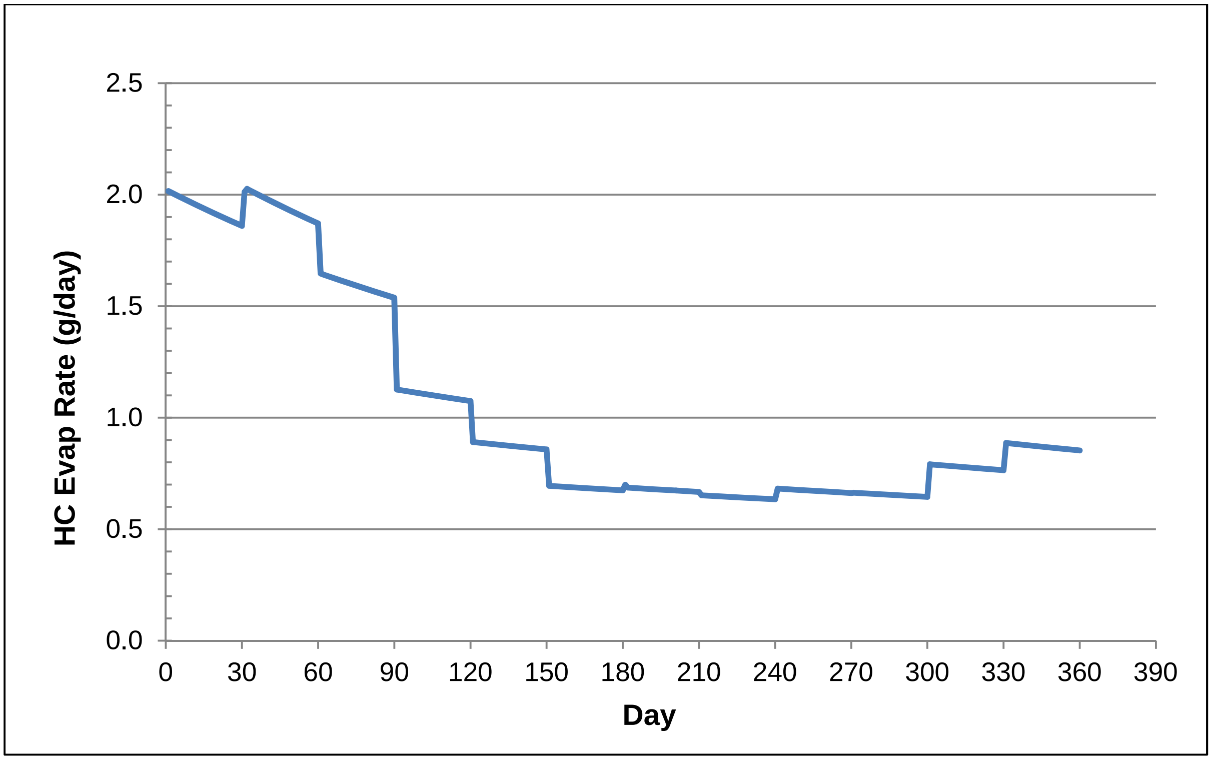
Table VI-10: Average Temperature Range in Los Angeles County

Month	Min. Temp (F)	Max. Temp (F)
Jan	49.1	65
Feb	49.6	65.1
Mar	51.2	66.9
Apr	52.4	67.7
May	57.1	72.8
Jun	60.7	76.6
Jul	64.8	82
Aug	64.6	82.9
Sep	63.2	80.8
Oct	58.6	74.8
Nov	53.6	69.8
Dec	48.8	64.6

To model the depletion of volatile species, staff applied the VLE mass balance on the 12 major component species of gasoline. As a result of daily rise of temperature, the light ends of the gasoline species (largely butane) that have lower boiling points are predicted to evaporate first. It was assumed that the vapor volume calculated beyond the tank capacity was emitted.

A constant temperature range is assumed for each month. It is also assumed that the decline in emissions during the month is due to evaporative “weathering” of the volatile species. The variation from month to month is due to the range of temperatures at different seasons. The VLE method estimated the average emissions per month starting from July and lasted for 12 months. As seen in Table VI-10, the average emissions rate is higher during summer, lower during winter, and it rises again during spring. The VLE method estimated the sequential day-by-day emissions and composition change for each month’s average temperature “swing” or range. As seen in Figure VI-11 the emissions rates versus time have a “U” shape which follows the seasonal temperatures. But each step of the “U” is slightly slanted downward. This is the slowing of the evaporative rate due to preferential vaporization of light components (weathering).

Figure VI-4: Estimated HC Emissions from VLE Method



To calculate a weathered versus unweathered adjustment factor, results were estimated based on 2 temperature profiles: LA County (also presented in Table VI-11), and the previous profile of 65°F to 105°F. The "weathered" (including VLE) and "unweathered" (not including VLE) results are provided below in Table VI-11. Based on the Los Angeles County temperature profile, the annual "weathered" emissions over 12 months are 385 g/year, which is 2.7 percent of the liquid gasoline in the fuel tank. The annual emissions from "unweathered" rate are 737 g/year (assuming 2.03 g/day x 365 day/year). Thus, the annual emissions calculated from VLE mass balance is about 53 percent of the "unweathered" calculation. The adjustment factor for this weathering and temperature profile is 0.53. Based on the VLE (weathered) mass balance over 365 days of temperature profile at 65°F to 105°F, the annual emissions are 1,870 g/year. However, the annual emissions from "unweathered" rate are 2,900 g/year (assuming 7.94 g/day x 365 days/year). The adjustment factor for this weathering and temperature profile is 0.64 (Table VI-11).

Table VI-11: Emissions Estimated from Weathered and Unweathered Conditions

Temp Profile	Method	g/yr	gal/yr	% of 5 gal tank	Adjustment Factor
LA County (12 months)	Weathered (VLE mass balance)	385	0.14	2.7%	0.53
	Unweathered	737	0.26	5.2%	
65 to 105°F	Weathered (VLE mass balance)	1,870	0.66	13.0%	0.64
	Unweathered	2,900	1.03	20.6%	

In conclusion, while not all fuel tanks for inactive SIMW are “open” systems, it is likely that a majority of such inactive SIMW contain fuel tanks that are not fully sealed due to deterioration. Thus, it is assumed the approach described in this attachment can be used to estimate the weathering effect on emissions rates for inactive SIMW. Staff recommends that an adjustment factor of 0.53 to be applied to correct statewide annual emissions, since it is based on month-to-month changes of ambient temperature in LA County over 12 months.

H. DETAILED BREAKDOWN OF EVAPORATIVE EMISSIONS BENEFITS

Table VI-12 presents the emissions benefits for state and local districts for 2020, 2023, and 2035. These specific years were chosen for SIP comparison purposes.

Table VI-12: ROG and NOx Emissions Benefits for State and Local Districts (TPD)

2020			
State	**Baseline**	**Proposed Rule**	**Benefit**
Hot Soak	1.90	1.88	0.02
Diurnal & Resting	15.03	14.90	0.13
Running Loss	6.02	6.02	0.00
Exhaust	106.54	106.54	0.00
ROG (total)	129.48	129.33	0.15
NOx	24.74	24.74	0.00
Bay Area AQMD	**Baseline**	**Proposed Rule**	**Benefit**
Hot Soak	0.34	0.34	0.00
Diurnal & Resting	2.92	2.90	0.03
Running Loss	1.09	1.09	0.00
Exhaust	19.22	19.22	0.00
ROG (total)	23.57	23.54	0.03
NOx	4.49	4.49	0.00
SJV APCD	**Baseline**	**Proposed Rule**	**Benefit**
Hot Soak	0.26	0.26	0.00
Diurnal & Resting	2.12	2.10	0.02
Running Loss	0.82	0.82	0.00
Exhaust	14.55	14.55	0.00
ROG (total)	17.74	17.72	0.02
NOx	3.32	3.32	0.00
SCAQMD	**Baseline**	**Proposed Rule**	**Benefit**
Hot Soak	0.30	0.30	0.00
Diurnal & Resting	3.15	3.12	0.03
Running Loss	0.96	0.96	0.00
Exhaust	16.92	16.92	0.00
ROG (total)	21.33	21.30	0.03
NOx	3.96	3.96	0.00

2023			
State	**Baseline**	**Proposed Rule**	**Benefit**
Hot Soak	1.75	1.71	0.04
Diurnal & Resting	13.96	13.66	0.30
Running Loss	5.75	5.75	0.00
Exhaust	92.42	92.42	0.00
ROG (total)	113.87	113.53	0.34
NOx	23.90	23.90	0.00
Bay Area AQMD	**Baseline**	**Proposed Rule**	**Benefit**
Hot Soak	0.32	0.31	0.01
Diurnal & Resting	2.71	2.66	0.06
Running Loss	1.04	1.04	0.00
Exhaust	16.69	16.69	0.00
ROG (total)	20.76	20.69	0.07
NOx	4.34	4.34	0.00
SJV APCD	**Baseline**	**Proposed Rule**	**Benefit**
Hot Soak	0.24	0.23	0.01
Diurnal & Resting	1.97	1.93	0.04
Running Loss	0.78	0.78	0.00
Exhaust	12.58	12.58	0.00
ROG (total)	15.57	15.52	0.05
NOx	3.21	3.21	0.00
SCAQMD	**Baseline**	**Proposed Rule**	**Benefit**
Hot Soak	0.28	0.27	0.01
Diurnal & Resting	2.92	2.86	0.06
Running Loss	0.91	0.91	0.00
Exhaust	14.70	14.70	0.00
ROG (total)	18.82	18.75	0.07
NOx	3.82	3.82	0.00

2035			
State	**Baseline**	**Proposed Rule**	**Benefit**
Hot Soak	1.36	1.23	0.13
Diurnal & Resting	10.88	9.95	0.93
Running Loss	4.79	4.79	0.00
Exhaust	55.90	55.90	0.00
ROG (total)	72.93	71.87	1.06
NOx	22.06	22.06	0.00
Bay Area AQMD	**Baseline**	**Proposed Rule**	**Benefit**
Hot Soak	0.25	0.22	0.02
Diurnal & Resting	2.12	1.93	0.18
Running Loss	0.87	0.87	0.00
Exhaust	10.14	10.14	0.00
ROG (total)	13.37	13.16	0.20
NOx	4.01	4.01	0.00
SJV APCD	**Baseline**	**Proposed Rule**	**Benefit**
Hot Soak	0.19	0.17	0.02
Diurnal & Resting	1.53	1.40	0.13
Running Loss	0.65	0.65	0.00
Exhaust	7.47	7.47	0.00
ROG (total)	9.85	9.70	0.15
NOx	2.96	2.96	0.00
SCAQMD	**Baseline**	**Proposed Rule**	**Benefit**
Hot Soak	0.22	0.20	0.02
Diurnal & Resting	2.28	2.08	0.20
Running Loss	0.76	0.76	0.00
Exhaust	8.96	8.96	0.00
ROG (total)	12.22	12.00	0.22
NOx	3.53	3.53	0.00

I. INSTALLATION AND USER GUIDE

- Download Instructions and Computer Specifications:
- Zip - Use any zipping utility to unzip the file. Most operating systems like Windows come with a utility like ‘WinZip’. Others can be downloaded off the internet along with their user guides.
- Computer Requirements: Your computer needs to have sufficient memory to store and run the model (these requirements are fairly small). Unzipped, the file will be about 1.2GB. When running the model it can grow up to 2.0GB. Model runtimes can vary depending on the processing power of the computer. Estimates are provided in the user interface.
- Microsoft Access: The RW emissions inventory model runs as an Microsoft Access database file. The model was developed in Microsoft Access 2010. Previous versions of Access may not support all the model functionality.
- **Download Warnings:** When the database is first loaded onto the computer, Microsoft Access will warn the user of possible unsafe code in the program. It is important to allow the program to open without any restrictions. **This means selecting options when Microsoft Access opens that ENABLE the program content** (if prompted with a warning such as ‘Do you want to allow Access to open with these unsafe expressions’ **CLICK YES, OPEN, or ENABLE**).
    - Microsoft Access allows a user to define security restrictions that will apply to every file on a user’s computer. If security restrictions have been set too restrictively, Access will not allow the Emissions Inventory model to open or run properly. The user might need to change the settings in the “Trust Center.” Information about having the proper settings for Microsoft Access are available on Microsoft’s website (1common setting is having the macro setting that does not inform the user when content has been blocked, in this case the question above will not come up).
- ***Note: allow a couple minutes for the model to compact itself when closing Access, this is an important step in managing space. If the model becomes unstable (errors or warnings), close the form then close Access and reopen. If problems persist, the model might be corrupt and a new version can be downloaded from the ARB website.**

Model Functionality (instructions also available within the model):

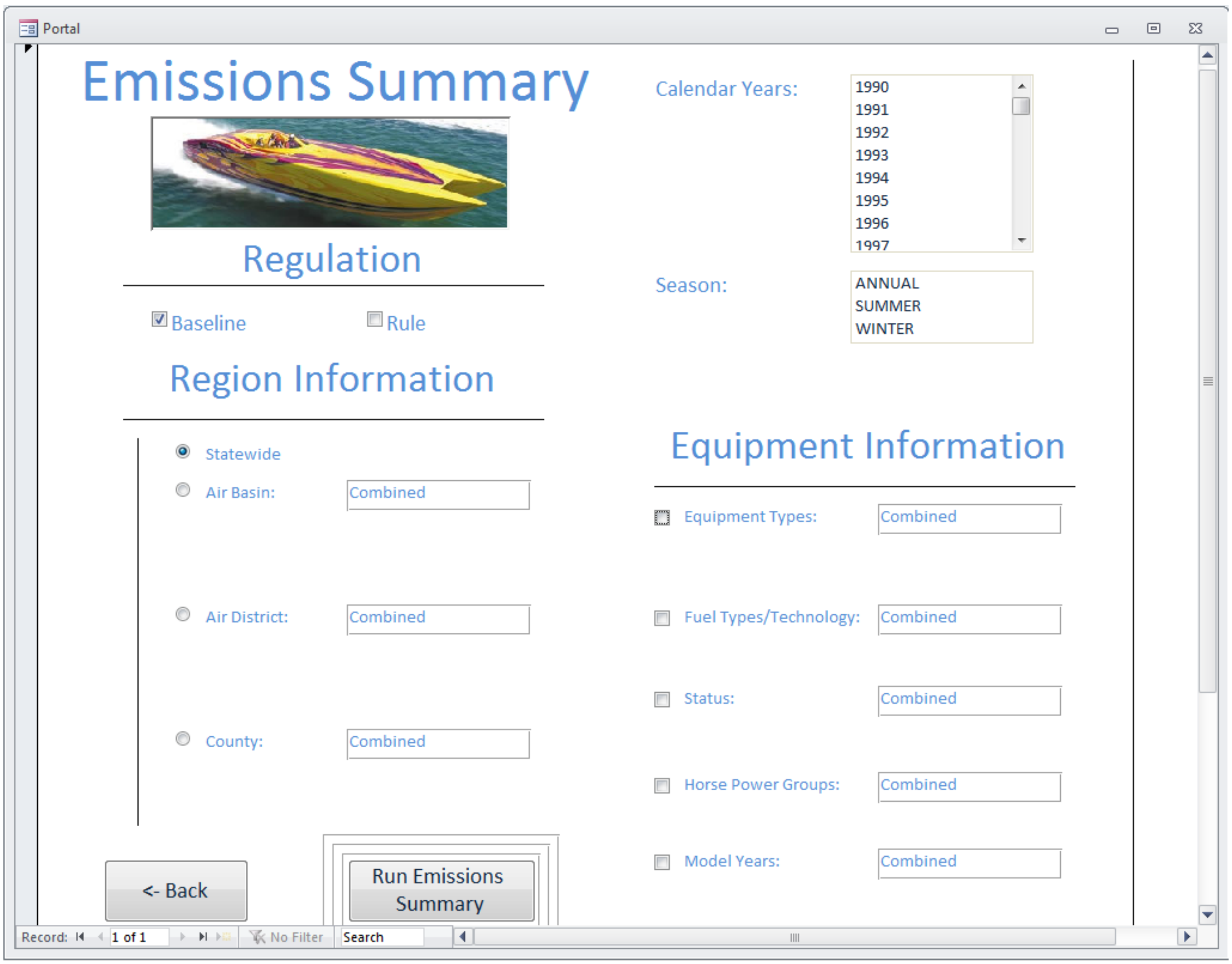
User Interface

When the model is opened, the main user interface opens (below). From here the user can choose to use 2 parts of the model: "Emissions Summary" or "Run Model."

Emissions Summary

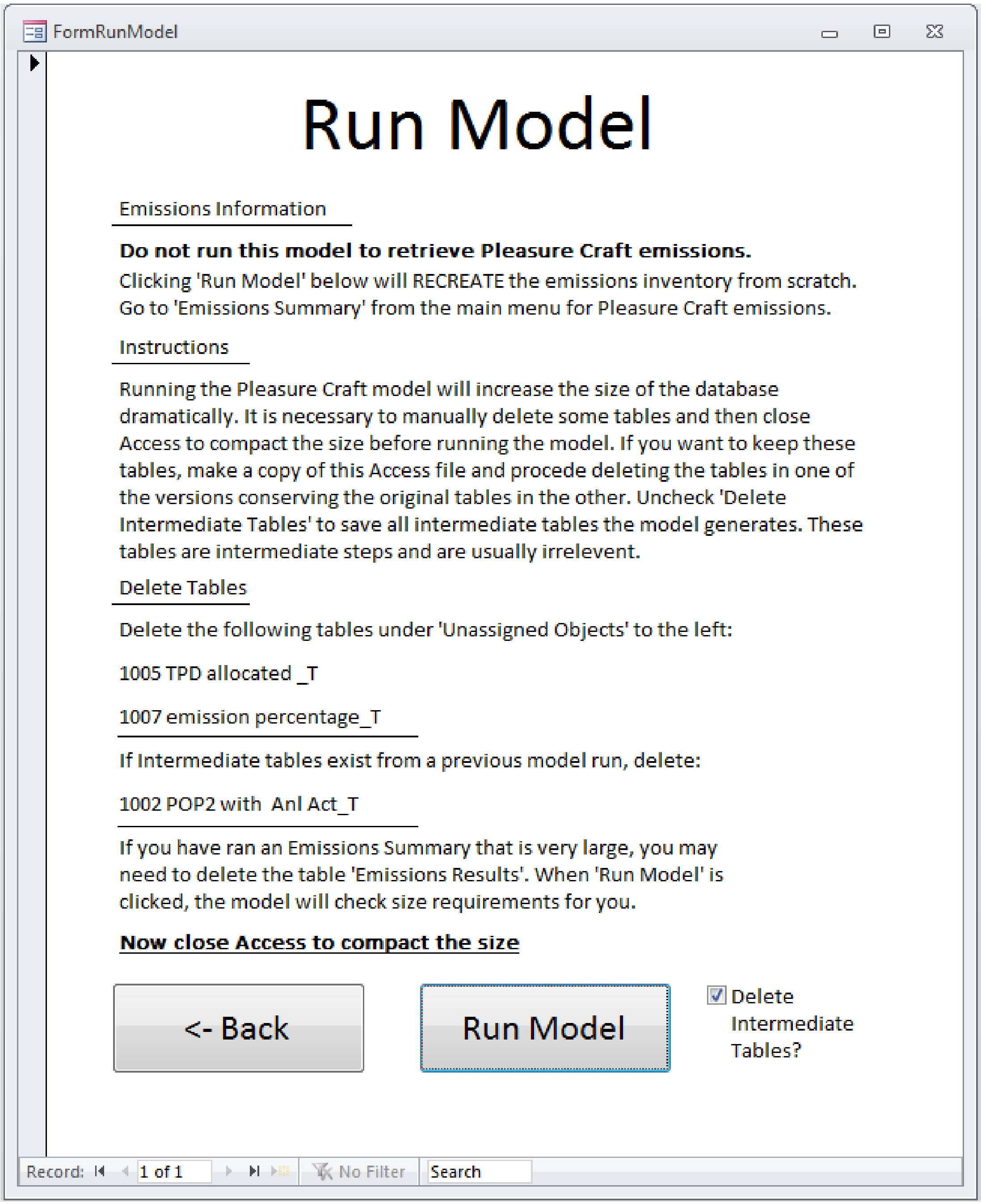
Clicking this button navigates to the “Emissions Summary” page (below) and estimates California RW emissions for any combination of equipment type, fuel type, status, horsepower, MY, CY, season, and/or region for baseline or regulation emissions.

Running the Emissions Summary by MY dramatically increases the runtime and restricts the user to selecting 1region at a time. Equipment and fuel types must be selected with MY requests.



Run Model

The ”Run Model” window is only used to run a simulation of the model (below). READ ALL THE INSTRUCTIONS ON THIS PAGE BEFORE USING THE RUN MODEL PROGRAM. This portion of the model is not for viewing the emissions inventory. Running the model recreates emissions from scratch. This is not necessary as the model comes with emissions already loaded and available through the Emissions Summary window.


FormRunModel
Run Model
Emissions Information
Do not run this model to retrieve Pleasure Craft emissions.
Clicking 'Run Model' below will RECREATE the emissions inventory from scratch.
Go to 'Emissions Summary' from the main menu for Pleasure Craft emissions.
Instructions
Running the Pleasure Craft model will increase the size of the database dramatically. It is necessary to manually delete some tables and then close Access to compact the size before running the model. If you want to keep these tables, make a copy of this Access file and procede deleting the tables in one of the versions conserving the original tables in the other. Uncheck 'Delete Intermediate Tables' to save all intermediate tables the model generates. These tables are intermediate steps and are usually irrelevent.
Delete Tables
Delete the following tables under 'Unassigned Objects' to the left:
1005 TPD allocated _T
1007 emission percentage_T
If Intermediate tables exist from a previous model run, delete:
1002 POP2 with Anl Act_T
If you have ran an Emissions Summary that is very large, you may need to delete the table 'Emissions Results'. When 'Run Model' is clicked, the model will check size requirements for you.
Now close Access to compact the size
<- Back
Run Model
Delete Intermediate Tables?
Record: 1 of 1
No Filter
Search

Model Code

The code of the model can be viewed at the following location:
Under main menu, click tab “Database Tools”, then click on the second selection “Visual Basic”, depends on viewer’s needs, double click on “Form_FormMain” or “Form_FormRunModel” or “Form_Portal” on the left side of the screen to see the code of the model.

Please read all instructions provided in the model including this user guide. If there is still any confusion, feel free to contact the Mobile Source Analysis Branch at msei@arb.ca.gov.

J. SOURCE CODE OF PC2014

```
Option Compare Database
'initialized global table names, column names, form names, etc.
'initialize for variable names (fuel comun name = "asdkjfhak")
'Put brackets around EVERYTHING
'Form Objects
Public glb_CheckBoxName, glb_ListBoxName, glb_otherList1, glb_otherList2, glb_LookupTable, glb_ColumnName As String
Public glb_OptionName As String
'Form Lookup Tables
Public glb_FrmTblEquipType, glb_FrmTblFuel, glb_FrmTblCalYr, glb_FrmTblMdlYr, glb_FrmTblSeason As String
Public glb_FrmTblAirBasin, glb_FrmTblDist, glb_FrmTblCounty, glb_FrmTblStatus, glb_FrmTblHP As String
'Access Tables
Public glb_EmissionsTable, glb_EmissionsResults As String
Public glb_FldEquipType, glb_FldFuel, glb_FldCalYr, glb_FldMdlYr, glb_FldSeason As String
Public glb_FldAirBasin, glb_FldDist, glb_FldCounty, glb_FldStatus, glb_FldHP As String
Public glb_Validation As Boolean
'Region limit
Public glb_RegionLimit As Integer
'SQL statement
Public SQLS, SelectS, SumS, IntoFromS, GroupByS, HavingS, InnerJoinS As String
Private Sub CommandMain_Click()
DoCmd.OpenForm "FormMain"
DoCmd.Close acForm, "Portal"
End Sub
Private Sub Form_Open(Cancel As Integer)
glb_ModelYearTable = "1007 emissions percentage_T"
'Region limit
glb_RegionLimit = DLookup("[Region Restriction]", "References", "ID = 1")
'Names of tables and columns
glb_EmissionsTable = DLookup("[Master Table (Yours)]", "References", "ID = 1")
glb_EmissionsResults = DLookup("[Results Table]", "References", "ID = 1")
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glb_FldMdlYr = DLookup("[Model Year Column]", "References", "ID = 1")
glb_FldSeason = DLookup("[SEASON Column]", "References", "ID = 1")
glb_FldAirBasin = DLookup("[Air Basin Column]", "References", "ID = 1")
glb_FldDist = DLookup("[Air District Column]", "References", "ID = 1")
glb_FldCounty = DLookup("[County Column]", "References", "ID = 1")
glb_FldStatus = DLookup("[Status Column]", "References", "ID = 1")
glb_FldHP = DLookup("[Horse Power Column]", "References", "ID = 1")
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glb_FrmTblEquipType = DLookup("[Equipment Type Table]", "References", "ID = 1")
glb_FrmTblFuel = DLookup("[Fuel / Tech  Table]", "References", "ID = 1")
glb_FrmTblCalYr = DLookup("[Calendar Year Table]", "References", "ID = 1")
glb_FrmTblMdlYr = DLookup("[Model Year  Table]", "References", "ID = 1")
glb_FrmTblSeason = DLookup("[Season  Table]", "References", "ID = 1")
glb_FrmTblAirBasin = DLookup("[Air Basin  Table]", "References", "ID = 1")
glb_FrmTblDist = DLookup("[Air District  Table]", "References", "ID = 1")
glb_FrmTblCounty = DLookup("[County  Table]", "References", "ID = 1")
glb_FrmTblStatus = DLookup("[Status  Table]", "References", "ID = 1")
glb_FrmTblHP = DLookup("[Horse Power  Table]", "References", "ID = 1")
'ListEquipmentType.RowSource = "SELECT [" & glb_FrmTblEquipType & "].[" & glb_FldEquipType & "] FROM [" & glb_FrmTblEquipType & "] WHERE [" & glb_FrmTblEquipType &
"].[" & glb_FldEquipType & "] = '*Combined' ORDER BY [" & glb_FldEquipType & "];"
'ListFuelType.RowSource = "SELECT [" & glb_FrmTblFuel & "].[" & glb_FldFuel & "] FROM [" & glb_FrmTblFuel & "] WHERE [" & glb_FrmTblFuel & "].[" & glb_FldFuel & "] =
'*Combined' ORDER BY [" & glb_FldFuel & "];"
'ListSeason.RowSource = "SELECT [" & glb_FrmTblSeason & "].[" & glb_FldSeason & "] FROM [" & glb_FrmTblSeason & "] ORDER BY [" & glb_FldSeason & "];"
'ListCalendarYear.RowSource = "SELECT [" & glb_FrmTblCalYr & "].[" & glb_FldCalYr & "] FROM [" & glb_FrmTblCalYr & "] ORDER BY [" & glb_FldCalYr & "];"
'ListAirBasin.RowSource = "SELECT [" & glb_FrmTblAirBasin & "].[" & glb_FldAirBasin & "] FROM [" & glb_FrmTblAirBasin & "] WHERE [" & glb_FrmTblAirBasin & "].[" &
glb_FldAirBasin & "] = '*Combined' ORDER BY [" & glb_FldAirBasin & "];"
'ListAirDistrict.RowSource = "SELECT [" & glb_FrmTblDist & "].[" & glb_FldDist & "] FROM [" & glb_FrmTblDist & "] WHERE [" & glb_FrmTblDist & "].[" & glb_FldDist & "] = '*Combined'
ORDER BY [" & glb_FldDist & "];"
'ListCounty.RowSource = "SELECT [" & glb_FrmTblCounty & "].[" & glb_FldCounty & "] FROM [" & glb_FrmTblCounty & "] WHERE [" & glb_FrmTblCounty & "].[" & glb_FldCounty & "]
= '*Combined' ORDER BY [" & glb_FldCounty & "];"
'ListHP.RowSource = "SELECT [" & glb_FrmTblHP & "].[" & glb_FldHP & "] FROM [" & glb_FrmTblHP & "] WHERE [" & glb_FrmTblHP & "].[" & glb_FldHP & "] = '*Combined' ORDER
BY [" & glb_FldHP & "];"
'ListModelYear.RowSource = "SELECT [" & glb_FrmTblMdlYr & "].[" & glb_FldMdlYr & "] FROM [" & glb_FrmTblMdlYr & "] WHERE [" & glb_FrmTblMdlYr & "].[" & glb_FldMdlYr & "] =
'*Combined' ORDER BY [" & glb_FldMdlYr & "];"
'ListStatus.RowSource = "SELECT [" & glb_FrmTblStatus & "].[" & glb_FldStatus & "] FROM [" & glb_FrmTblStatus & "] WHERE [" & glb_FrmTblStatus & "].[" & glb_FldStatus & "] =
'*Combined' ORDER BY [" & glb_FldStatus & "];"
End Sub
Function RunEmissions()
glb_ModelYearTable = "1007 emissions percentage_T"
'Region limit
glb_RegionLimit = DLookup("[Region Restriction]", "References", "ID = 1")
'Names of tables and columns
glb_EmissionsTable = DLookup("[Master Table (Yours)]", "References", "ID = 1")
glb_EmissionsResults = DLookup("[Results Table]", "References", "ID = 1")
glb_FldEquipType = DLookup("[Equipment Type Column]", "References", "ID = 1")
glb_FldFuel = DLookup("[Fuel / Tech Column]", "References", "ID = 1")
glb_FldCalYr = DLookup("[Calendar Year Column]", "References", "ID = 1")
glb_FldMdlYr = DLookup("[Model Year Column]", "References", "ID = 1")
glb_FldSeason = DLookup("[SEASON Column]", "References", "ID = 1")
glb_FldAirBasin = DLookup("[Air Basin Column]", "References", "ID = 1")
glb_FldDist = DLookup("[Air District Column]", "References", "ID = 1")
glb_FldCounty = DLookup("[County Column]", "References", "ID = 1")
glb_FldStatus = DLookup("[Status Column]", "References", "ID = 1")
glb_FldHP = DLookup("[Horse Power Column]", "References", "ID = 1")
'Names of Form Lookup Tables
glb_FrmTblEquipType = DLookup("[Equipment Type Table]", "References", "ID = 1")
```

```
glb_FrmTblFuel = DLookup("[Fuel / Tech  Table]", "References", "ID = 1")
glb_FrmTblCalYr = DLookup("[Calendar Year Table]", "References", "ID = 1")
glb_FrmTblMdlYr = DLookup("[Model Year  Table]", "References", "ID = 1")
glb_FrmTblSeason = DLookup("[Season  Table]", "References", "ID = 1")
glb_FrmTblAirBasin = DLookup("[Air Basin  Table]", "References", "ID = 1")
glb_FrmTblDist = DLookup("[Air District  Table]", "References", "ID = 1")
glb_FrmTblCounty = DLookup("[County  Table]", "References", "ID = 1")
glb_FrmTblStatus = DLookup("[Status  Table]", "References", "ID = 1")
glb_FrmTblHP = DLookup("[Horse Power  Table]", "References", "ID = 1")
glb_Validation = True
Dim rstSumFields As dao.Recordset
Dim dbs As dao.Database
Dim strSumField, strMYField, strFNameField As String
glb_ListBoxName = "ListCalendarYear"
glb_CheckBoxName = "NoOptionNoCheck"
FormValidation
'If glb_Validation = False Then
'    Exit Function
'End If
glb_ListBoxName = "ListSeason"
glb_CheckBoxName = "NoOptionNoCheck"
FormValidation
'If glb_Validation = False Then
'    Exit Function
'End If
SelectS = "SELECT "
                'SelectS = "SELECT [" & glb_EmissionsTable & "].[" & glb_FldCalYr & "], "
'Just precautious, these shouldn't be anything
Set rstSumFields = Nothing
Set dbs = Nothing
Set dbs = CurrentDb()
If Me.CheckBaseline = True Then
   'Summation1
   Set rstSumFields = dbs.OpenRecordset("Summation1")
     rstSumFields.MoveFirst
      While Not rstSumFields.EOF
strSumField = rstSumFields.Fields("[Fields to Sum]").Value
strMYField = rstSumFields.Fields("[ModelYearField]").Value
strFNameField = rstSumFields.Fields("[FinalName]").Value
            If Me.CheckModelYear = False Then

          SumS = SumS & " Sum([" & glb_EmissionsTable & "].[" & strSumField & "]) AS [SumOf_" & strFNameField & "], "
             ElseIf Me.CheckModelYear = True Then
               SumS = SumS & " Sum([" & glb_EmissionsTable & "].[" & strSumField & "]*[" & glb_ModelYearTable & "].[" & strMYField & "]) AS [SumOf_" & strFNameField & "], "
             End If
             rstSumFields.MoveNext
   Wend
   rstSumFields.Close
      Set rstSumFields = Nothing
   'additional pollutants
   Set rstSumFields = dbs.OpenRecordset("Summation3")
   rstSumFields.MoveFirst
      While Not rstSumFields.EOF
strSumField = rstSumFields.Fields("[Additional_Pollutants]").Value
             If Me.CheckModelYear = False Then
                SumS = SumS & " Sum([" & glb_EmissionsTable & "].[" & strSumField & "]) AS [SumOf_" & strSumField & "-Baseline], "
             ElseIf Me.CheckModelYear = True Then
          SumS = SumS &" CDbl(0) AS [SumOf_" & strSumField & "-Baseline], "
                End If
      rstSumFields.MoveNext
   Wend
   rstSumFields.Close
      Set rstSumFields = Nothing
End If
If Me.CheckRule = True Then
    'Summation2
   Set rstSumFields = dbs.OpenRecordset("Summation2")
      rstSumFields.MoveFirst
      While Not rstSumFields.EOF
strSumField = rstSumFields.Fields("[Fields to Sum]").Value
strMYField = rstSumFields.Fields("[ModelYearField]").Value
strFNameField = rstSumFields.Fields("[FinalName]").Value
             If Me.CheckModelYear = False Then

          SumS = SumS & " Sum([" & glb_EmissionsTable & "].[" & strSumField & "]) AS [SumOf_" & strFNameField & "], "
             ElseIf Me.CheckModelYear = True Then
                SumS = SumS & " Sum([" & glb_EmissionsTable & "].[" & strSumField & "]*[" & glb_ModelYearTable & "].[" & strMYField & "]) AS [SumOf_" & strFNameField & "], "
             End If
            rstSumFields.MoveNext
      Wend
      rstSumFields.Close
      Set rstSumFields = Nothing
''''''''''''''''''Similar to above but hard coding individual pollutants instead of using the recordset
   'additional pollutants
'    Set rstSumFields = dbs.OpenRecordset("Summation3")
'
'    rstSumFields.MoveFirst
''    While Not rstSumFields.EOF
''        strSumField = rstSumFields.Fields("[Additional_Pollutants]").Value
      If Me.CheckModelYear = False Then
           SumS = SumS & " Sum([" & glb_EmissionsTable & "].[THC-Total_Rule]) AS [SumOf_THC-Total-Rule], "
          SumS = SumS & " Sum([" & glb_EmissionsTable & "].[TOG_exhaust]) AS [SumOf_TOG_exhaust-Rule], "
          SumS = SumS & " Sum([" & glb_EmissionsTable & "].[TOG_evap_Rule]) AS [SumOf_TOG_evap-Rule], "
          SumS = SumS & " Sum([" & glb_EmissionsTable & "].[TOG_total_Rule]) AS [SumOf_TOG_total-Rule], "
          SumS = SumS & " Sum([" & glb_EmissionsTable & "].[ROG_exhaust]) AS [SumOf_ROG_exhaust-Rule], "
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```
        SumS = SumS & " Sum([" & glb_EmissionsTable & "].[ROG_evap_Rule]) AS [SumOf_ROG_evap-Rule], "
        SumS = SumS & " Sum([" & glb_EmissionsTable & "].[ROG_total_Rule]) AS [SumOf_ROG_total-Rule], "
        SumS = SumS & " Sum([" & glb_EmissionsTable & "].[PM10]) AS [SumOf_PM10-Rule], "
        SumS = SumS & " Sum([" & glb_EmissionsTable & "].[PM25]) AS [SumOf_PM25-Rule], "
        SumS = SumS & " Sum([" & glb_EmissionsTable & "].[Fuel_Consumption_Exhaust]) AS [SumOf_Fuel_Consumption_Exhaust-Rule], "
        SumS = SumS & " Sum([" & glb_EmissionsTable & "].[Fuel_Consumption_Evap_Rule]) AS [SumOf_Fuel_Consumption_Evap-Rule], "
        SumS = SumS & " Sum([" & glb_EmissionsTable & "].[Fuel_Consumption_Total_Rule]) AS [SumOf_Fuel_Consumption_Total-Rule], "
        SumS = SumS & " Sum([" & glb_EmissionsTable & "].[NH3_Rule]) AS [SumOf_NH3-Rule], "
        SumS = SumS & " Sum([" & glb_EmissionsTable & "].[SOx_Rule]) AS [SumOf_SOx-Rule], "

      ElseIf Me.CheckModelYear = True Then
        SumS = SumS &" CDbl(0) AS [SumOf_THC-Total-Rule], "
        SumS = SumS &" CDbl(0) AS [SumOf_TOG_exhaust-Rule], "
        SumS = SumS &" CDbl(0) AS [SumOf_TOG_evap-Rule], "
        SumS = SumS &" CDbl(0) AS [SumOf_TOG_total-Rule], "
        SumS = SumS &" CDbl(0) AS [SumOf_ROG_exhaust-Rule], "
        SumS = SumS &" CDbl(0) AS [SumOf_ROG_evap-Rule], "
        SumS = SumS &" CDbl(0) AS [SumOf_ROG_total-Rule], "
        SumS = SumS &" CDbl(0) AS [SumOf_PM10-Rule], "
        SumS = SumS &" CDbl(0) AS [SumOf_PM25-Rule], "
        SumS = SumS &" CDbl(0) AS [SumOf_Fuel_Consumption_Exhaust-Rule], "
        SumS = SumS &" CDbl(0) AS [SumOf_Fuel_Consumption_Evap-Rule], "
        SumS = SumS &" CDbl(0) AS [SumOf_Fuel_Consumption_Total-Rule], "
        SumS = SumS &" CDbl(0) AS [SumOf_SOx-Rule], "
        SumS = SumS &" CDbl(0) AS [SumOf_NH3-Rule], "
       End If
'       rstSumFields.MoveNext
'    Wend
'    rstSumFields.Close
'    Set rstSumFields = Nothing
End If

IntoFromS = " INTO [" & glb_EmissionsResults & "] "
If Me.CheckModelYear = False Then
   InnerJoinS = " FROM FormSeasons INNER JOIN (FormFuelTypes INNER JOIN (FormStatuses INNER JOIN (FormEquipmentTypes INNER JOIN (FormCounties INNER JOIN (FormAirDistricts INNER JOIN (FormAirBasins INNER JOIN [1005 TPD allocated _T] ON FormAirBasins.AirBasinID = [1005 TPD allocated _T].AirBasinID) ON FormAirDistricts.DistrictID = [1005 TPD allocated _T].DistrictID) ON FormCounties.CountyID = [1005 TPD allocated _T].CountyID) ON FormEquipmentTypes.ID = [1005 TPD allocated _T].CATEGORY) ON FormStatuses.ID = [1005 TPD allocated _T].STATUS) ON FormFuelTypes.ID = [1005 TPD allocated _T].[STRK-FUEL-TECH]) ON FormSeasons.ID = [1005 TPD allocated _T].SEASON "

ElseIf Me.CheckModelYear = True Then
   InnerJoinS = " FROM (FormSeasons INNER JOIN (FormFuelTypes INNER JOIN (FormStatuses INNER JOIN (FormEquipmentTypes INNER JOIN (FormCounties INNER JOIN (FormAirDistricts INNER JOIN (FormAirBasins INNER JOIN [1005 TPD allocated _T] ON FormAirBasins.AirBasinID = [1005 TPD allocated _T].AirBasinID) ON FormAirDistricts.DistrictID = [1005 TPD allocated _T].DistrictID) ON FormCounties.CountyID = [1005 TPD allocated _T].CountyID) ON FormEquipmentTypes.ID = [1005 TPD allocated _T].CATEGORY) ON FormStatuses.ID = [1005 TPD allocated _T].STATUS) ON " & _
   "FormFuelTypes.ID = [1005 TPD allocated _T].[STRK-FUEL-TECH]) ON FormSeasons.ID = [1005 TPD allocated _T].SEASON) INNER JOIN [1007 emissions percentage_T] ON ([1005 TPD allocated _T].CATEGORY = [1007 emissions percentage_T].CATEGORY) AND ([1005 TPD allocated _T].STATUS = [1007 emissions percentage_T].STATUS) AND ([1005 TPD allocated _T].CY = [1007 emissions percentage_T].CY) AND ([1005 TPD allocated _T].[STRK-FUEL-TECH] = [1007 emissions percentage_T].[STRK-FUEL-TECH]) AND ([1005 TPD allocated _T].HPGRP = [1007 emissions percentage_T].HPGRP) "
End If
GroupByS = " GROUP BY "
              'GroupByS = " GROUP BY [" & glb_EmissionsTable & "].[" & glb_FldCalYr & "], "
HavingS = " HAVING ( ( ([" & glb_EmissionsTable & "].[" & glb_FldCalYr & "]) >= 1990 ) "
''''''''''
'Season
glb_CheckBoxName = "NoOptionNoCheck"
glb_ListBoxName = "ListSeason"
glb_LookupTable = glb_FrmTblSeason
glb_ColumnName = glb_FldSeason
glb_EmissionsTable = glb_FrmTblSeason
VariableSelection
glb_EmissionsTable = DLookup("[Master Table (Yours)]", "References", "ID = 1")
'''end Season
'CY
glb_CheckBoxName = "NoOptionNoCheck"
glb_ListBoxName = "ListCalendarYear"
glb_LookupTable = glb_FrmTblCalYr
glb_ColumnName = glb_FldCalYr
VariableSelection
'''end CY
'
'AirBasin_
glb_OptionName = "OptionAirBasin"
glb_CheckBoxName = "OptionBox"
glb_ListBoxName = "ListAirBasin"
glb_LookupTable = glb_FrmTblAirBasin
glb_ColumnName = glb_FldAirBasin
glb_EmissionsTable = glb_FrmTblAirBasin

VariableSelection

glb_EmissionsTable = DLookup("[Master Table (Yours)]", "References", "ID = 1")
'End AB
'AirDistrict_
glb_OptionName = "OptionAirDistrict"
glb_CheckBoxName = "OptionBox"
glb_ListBoxName = "ListAirDistrict"
glb_LookupTable = glb_FrmTblDist
glb_ColumnName = glb_FldDist
glb_EmissionsTable = glb_FrmTblDist
VariableSelection
glb_EmissionsTable = DLookup("[Master Table (Yours)]", "References", "ID = 1")
'End DIS
```

```
'CheckCounty_
glb_OptionName = "OptionCounty"
glb_CheckBoxName = "OptionBox"
glb_ListBoxName = "ListCounty"
glb_LookupTable = glb_FrmTblCounty
glb_ColumnName = glb_FldCounty
glb_EmissionsTable = glb_FrmTblCounty
VariableSelection
glb_EmissionsTable = DLookup("[Master Table (Yours)]", "References", "ID = 1")
'End county
'Just easier to hardcode checkboxes at this point
RegionCheckBoxes
'Equipment Type
glb_CheckBoxName = "CheckEquipmentType"
glb_ListBoxName = "ListEquipmentType"
glb_LookupTable = glb_FrmTblEquipType
glb_ColumnName = glb_FldEquipType
glb_EmissionsTable = glb_FrmTblEquipType
VariableSelection

glb_EmissionsTable = DLookup("[Master Table (Yours)]", "References", "ID = 1")
'''end equipment type
'Fuel Type
glb_CheckBoxName = "CheckFuelType"
glb_ListBoxName = "ListFuelType"
glb_LookupTable = glb_FrmTblFuel
glb_ColumnName = glb_FldFuel
glb_EmissionsTable = glb_FrmTblFuel
VariableSelection
glb_EmissionsTable = DLookup("[Master Table (Yours)]", "References", "ID = 1")
'''end fuel
'Status_
glb_CheckBoxName = "CheckStatus"
glb_ListBoxName = "ListStatus"
glb_LookupTable = glb_FrmTblStatus
glb_ColumnName = glb_FldStatus
glb_EmissionsTable = glb_FrmTblStatus
VariableSelection
glb_EmissionsTable = DLookup("[Master Table (Yours)]", "References", "ID = 1")
'End status
'HP
glb_CheckBoxName = "CheckHP"
glb_ListBoxName = "ListHP"
glb_LookupTable = glb_FrmTblHP
glb_ColumnName = glb_FldHP
VariableSelection
'End HP
''ModelYear
glb_CheckBoxName = "CheckModelYear"
glb_ListBoxName = "ListModelYear"
glb_LookupTable = glb_FrmTblMdlYr
glb_ColumnName = glb_FldMdlYr
glb_EmissionsTable = glb_ModelYearTable
VariableSelection
glb_EmissionsTable = DLookup("[Master Table (Yours)]", "References", "ID = 1")
'End MY
'Additional_Pollutants
'Need placeholder in groupby statement-only for model year runs
If Me.CheckModelYear = True Then
   If Me.CheckBaseline = True Then
         Set rstSumFields = dbs.OpenRecordset("Summation3")
         rstSumFields.MoveFirst

      While Not rstSumFields.EOF
            GroupByS = GroupByS &" CDbl(0), "
            rstSumFields.MoveNext
         Wend
        rstSumFields.Close
         Set rstSumFields = Nothing
      End If
   If Me.CheckRule = True Then
        Set rstSumFields = dbs.OpenRecordset("Summation3")
         rstSumFields.MoveFirst
            While Not rstSumFields.EOF
            GroupByS = GroupByS &" CDbl(0), "
            rstSumFields.MoveNext
         Wend
         rstSumFields.Close
            Set rstSumFields = Nothing
      End If
End If
Set dbs = Nothing
'Finalize SQL statement
SumS = Left(SumS, Len(SumS) - 2) & " "
GroupByS = Left(GroupByS, Len(GroupByS) - 2) & " "
HavingS = HavingS & ") "
SQLS = SelectS & SumS & IntoFromS & InnerJoinS & GroupByS & HavingS & ";"
If glb_Validation = True Then
   DoCmd.SetWarnings False
   DoCmd.RunSQL SQLS
   SQLS = ""
   SelectS = ""
   SumS = ""
   IntoFromS = ""
   GroupByS = ""
```

```
    HavingS = ""
    InnerJoinS = ""
        If Me.CheckModelYear.Value = True Then
            AdditionalPollutants
            End If
        DoCmd.SetWarnings True
        DoCmd.OpenTable glb_EmissionsResults
ElseIf glb_Validation = False Then
    SQLS = ""
    SelectS = ""
    SumS = ""
    IntoFromS = ""
    GroupByS = ""
    HavingS = ""
    InnerJoinS = ""
End If
End Function
Public Sub AdditionalPollutants()
If Me.CheckBaseline.Value = True And Me.CheckRule.Value = True Then
DoCmd.RunSQL "UPDATE EmissionsResults INNER JOIN FRACTIONSx11 ON (EmissionsResults.CY = FRACTIONSx11.CY) AND (EmissionsResults.[STRK-FUEL-TECH] =
FRACTIONSx11.[STRK-FUEL-TECH_Name]) AND (EmissionsResults.CATEGORY = FRACTIONSx11.CATEGORY_Name) SET EmissionsResults.[SumOf_THC-Total-Baseline] =
[EmissionsResults]![SumOf_HC-Exhaust-Baseline]+[EmissionsResults]![SumOf_HC-HotSoak-Baseline]+[EmissionsResults]![SumOf_HC-Diurnal-
Baseline]+[EmissionsResults]![SumOf_HC-Resting-Baseline]+[EmissionsResults]![SumOf_HC-RunningLoss-Baseline], EmissionsResults.[SumOf_TOG_Exhaust-Baseline] =
[EmissionsResults]![SumOf_HC-Exhaust-Baseline]*[FRACTIONSx11]![FR-TOG], EmissionsResults.[SumOf_TOG_evap-Baseline] = ([EmissionsResults]![SumOf_HC-HotSoak-
Baseline]+[EmissionsResults]![SumOf_HC-Diurnal-Baseline]+[EmissionsResults]![SumOf_HC-Resting-Baseline]+[EmissionsResults]![SumOf_HC-RunningLoss-
Baseline])*[FRACTIONSx11]![FR-ROG-EVAP], " & _
"EmissionsResults.[SumOf_ROG_exhaust-Baseline] = [EmissionsResults]![SumOf_HC-Exhaust-Baseline]*[FRACTIONSx11]![FR-ROG], EmissionsResults.[SumOf_ROG_evap-
Baseline] = ([EmissionsResults]![SumOf_HC-HotSoak-Baseline]+[EmissionsResults]![SumOf_HC-Diurnal-Baseline]+[EmissionsResults]![SumOf_HC-Resting-
Baseline]+[EmissionsResults]![SumOf_HC-RunningLoss-Baseline])*[FRACTIONSx11]![FR-ROG-EVAP], EmissionsResults.[SumOf_PM10-Baseline] =
[EmissionsResults]![SUMOF_PM-BASELINE]*[FRACTIONSx11]![FR-PM10], EmissionsResults.[SUMOF_PM25-BASELINE] = [EmissionsResults]![SUMOF_PM-
BASELINE]*[FRACTIONSx11]![FR-PM25], EmissionsResults.[SumOf_Fuel_Consumption_Evap-Baseline] = ([EmissionsResults]![SumOf_HC-HotSoak-
Baseline]+[EmissionsResults]![SumOf_HC-Diurnal-Baseline]+[EmissionsResults]![SumOf_HC-Resting-Baseline]+[EmissionsResults]![SumOf_HC-RunningLoss-
Baseline])*[FRACTIONSx11]![FR-ROG-EVAP]*2000/6.17, " & _
"EmissionsResults.[SumOf_THC-Total-Rule] = [EmissionsResults]![SumOf_HC-Exhaust-Baseline]+[EmissionsResults]![SumOf_HC-HotSoak-Rule]+[EmissionsResults]![SumOf_HC-
Diurnal-Rule]+[EmissionsResults]![SumOf_HC-Resting-Rule]+[EmissionsResults]![SumOf_HC-RunningLoss-Rule], EmissionsResults.[SumOf_TOG_evap-Rule] =
([EmissionsResults]![SumOf_HC-HotSoak-Rule]+[EmissionsResults]![SumOf_HC-Diurnal-Rule]+[EmissionsResults]![SumOf_HC-Resting-Rule]+[EmissionsResults]![SumOf_HC-
RunningLoss-Rule])*[FRACTIONSx11]![FR-ROG-EVAP], " & _
"EmissionsResults.[SumOf_ROG_evap-Rule] = ([EmissionsResults]![SumOf_HC-HotSoak-Rule]+[EmissionsResults]![SumOf_HC-Diurnal-Rule]+[EmissionsResults]![SumOf_HC-
Resting-Rule]+[EmissionsResults]![SumOf_HC-RunningLoss-Rule])*[FRACTIONSx11]![FR-ROG-EVAP], EmissionsResults.[SumOf_Fuel_Consumption_Evap-Rule] =
([EmissionsResults]![SumOf_HC-HotSoak-Rule]+[EmissionsResults]![SumOf_HC-Diurnal-Rule]+[EmissionsResults]![SumOf_HC-Resting-Rule]+[EmissionsResults]![SumOf_HC-
RunningLoss-Rule])*[FRACTIONSx11]![FR-ROG-EVAP]*2000/6.17;"


DoCmd.RunSQL "UPDATE [EmissionsResults] SET [EmissionsResults].[SumOf_TOG_total-Baseline] = [EmissionsResults]![SumOf_TOG_Exhaust-
Baseline]+[EmissionsResults]![SumOf_TOG_evap-Baseline], [EmissionsResults].[SumOf_ROG_total-Baseline] = [EmissionsResults]![SumOf_ROG_exhaust-
Baseline]+[EmissionsResults]![SumOf_ROG_evap-Baseline], [EmissionsResults].[SumOf_Fuel_Consumption_Exhaust-Baseline] =
(12.011/(12.011+0.54*1.008)*[EmissionsResults]![SumOf_TOG_Exhaust-Baseline]+0.429*[EmissionsResults]![SumOf_CO-Baseline]+0.273*[EmissionsResults]![SUMOF_CO2-
BASELINE])*2000/(0.854*6.17), [EmissionsResults].[SumOf_TOG_total-Rule] = [EmissionsResults]![SumOf_ROG_exhaust-Baseline]+[EmissionsResults]![SumOf_ROG_evap-
Baseline], [EmissionsResults].[SumOf_ROG_total-Rule] = [EmissionsResults]![SumOf_ROG_exhaust-Baseline]+[EmissionsResults]![SumOf_ROG_evap-Rule];"
DoCmd.RunSQL "UPDATE FRACTIONSx11 INNER JOIN EmissionsResults ON (FRACTIONSx11.CY = EmissionsResults.CY) AND (FRACTIONSx11.[STRK-FUEL-TECH_Name] =
EmissionsResults.[STRK-FUEL-TECH]) AND (FRACTIONSx11.CATEGORY_Name = EmissionsResults.CATEGORY) SET EmissionsResults.[SumOf_Fuel_Consumption_Total-
Baseline] = [EmissionsResults]![SumOf_Fuel_Consumption_Exhaust-Baseline]+[EmissionsResults]![SumOf_Fuel_Consumption_Evap-Baseline], EmissionsResults.[SumOf_SOx-
Baseline] = ([EmissionsResults]![SumOf_Fuel_Consumption_Exhaust-Baseline]+[EmissionsResults]![SumOf_Fuel_Consumption_Evap-
Baseline])*[FRACTIONSx11]![SULFUR_CONTENT]*(IIf([FRACTIONSx11]![STRK-FUEL-TECH]=5,7.07,6.25)/(1000000000)), EmissionsResults.[SUMOF_NH3-BASELINE] =
([EmissionsResults]![SumOf_Fuel_Consumption_Exhaust-Baseline]+[EmissionsResults]![SumOf_Fuel_Consumption_Evap-Baseline])*IIf([EmissionsResults]![STRK-FUEL-
TECH]='Diesel',83.3,116)/1000/454/2000, " & _
"EmissionsResults.[SumOf_Fuel_Consumption_Total-Rule] = [EmissionsResults]![SumOf_Fuel_Consumption_Exhaust-
Baseline]+[EmissionsResults]![SumOf_Fuel_Consumption_Evap-Rule], EmissionsResults.[SumOf_SOx-Rule] = ([EmissionsResults]![SumOf_Fuel_Consumption_Exhaust-
Baseline]+[EmissionsResults]![SumOf_Fuel_Consumption_Evap-Rule])*[FRACTIONSx11]![SULFUR_CONTENT]*(IIf([FRACTIONSx11]![STRK-FUEL-
TECH]=5,7.07,6.25)/(1000000000)), EmissionsResults.[SumOf_NH3-Rule] = ([EmissionsResults]![SumOf_Fuel_Consumption_Exhaust-
Baseline]+[EmissionsResults]![SumOf_Fuel_Consumption_Evap-Rule])*IIf([EmissionsResults]![STRK-FUEL-TECH]='Diesel',83.3,116)/1000/454/2000;"
DoCmd.RunSQL "UPDATE EmissionsResults INNER JOIN FRACTIONSx11 ON (EmissionsResults.CY = FRACTIONSx11.CY) AND (FRACTIONSx11.[STRK-FUEL-TECH_Name] =
EmissionsResults.[STRK-FUEL-TECH]) AND (EmissionsResults.CATEGORY = FRACTIONSx11.CATEGORY_Name) SET EmissionsResults.[SumOf_TOG_exhaust-Rule] =
[EmissionsResults]![SumOf_HC-Exhaust-Baseline]*[FRACTIONSx11]![FR-TOG], EmissionsResults.[SumOf_ROG_exhaust-Rule] = [EmissionsResults]![SumOf_HC-Exhaust-
Baseline]*[FRACTIONSx11]![FR-ROG], EmissionsResults.[SumOf_PM10-Rule] = [EmissionsResults]![SUMOF_PM-BASELINE]*[FRACTIONSx11]![FR-PM10],
EmissionsResults.[SumOf_PM25-Rule] = [EmissionsResults]![SUMOF_PM-BASELINE]*[FRACTIONSx11]![FR-PM25], EmissionsResults.[SumOf_Fuel_Consumption_Exhaust-Rule] =
(12.011/(12.011+0.54*1.008)*[EmissionsResults]![SumOf_TOG_Exhaust-Baseline]+0.429*[EmissionsResults]![SumOf_CO-Baseline]+0.273*[EmissionsResults]![SUMOF_CO2-
BASELINE])*2000/(0.854*6.17);"
ElseIf Me.CheckBaseline = True And Me.CheckRule.Value = False Then
DoCmd.RunSQL "UPDATE EmissionsResults INNER JOIN FRACTIONSx11 ON (FRACTIONSx11.[STRK-FUEL-TECH_Name] = EmissionsResults.[STRK-FUEL-TECH]) AND
(FRACTIONSx11.CATEGORY_Name = EmissionsResults.CATEGORY) AND (EmissionsResults.CY = FRACTIONSx11.CY) SET EmissionsResults.[SumOf_THC-Total-Baseline] =
[EmissionsResults]![SumOf_HC-Exhaust-Baseline]+[EmissionsResults]![SumOf_HC-HotSoak-Baseline]+[EmissionsResults]![SumOf_HC-Diurnal-
Baseline]+[EmissionsResults]![SumOf_HC-Resting-Baseline]+[EmissionsResults]![SumOf_HC-RunningLoss-Baseline], EmissionsResults.[SumOf_TOG_Exhaust-Baseline] =
[EmissionsResults]![SumOf_HC-Exhaust-Baseline]*[FRACTIONSx11]![FR-TOG], EmissionsResults.[SumOf_TOG_evap-Baseline] = ([EmissionsResults]![SumOf_HC-HotSoak-
Baseline]+[EmissionsResults]![SumOf_HC-Diurnal-Baseline]+[EmissionsResults]![SumOf_HC-Resting-Baseline]+[EmissionsResults]![SumOf_HC-RunningLoss-
Baseline])*[FRACTIONSx11]![FR-ROG-EVAP], " & _
"EmissionsResults.[SumOf_ROG_exhaust-Baseline] = [EmissionsResults]![SumOf_HC-Exhaust-Baseline]*[FRACTIONSx11]![FR-ROG], EmissionsResults.[SumOf_ROG_evap-
Baseline] = ([EmissionsResults]![SumOf_HC-HotSoak-Baseline]+[EmissionsResults]![SumOf_HC-Diurnal-Baseline]+[EmissionsResults]![SumOf_HC-Resting-
Baseline]+[EmissionsResults]![SumOf_HC-RunningLoss-Baseline])*[FRACTIONSx11]![FR-ROG-EVAP], EmissionsResults.[SumOf_PM10-Baseline] =
[EmissionsResults]![SUMOF_PM-BASELINE]*[FRACTIONSx11]![FR-PM10], EmissionsResults.[SUMOF_PM25-BASELINE] = [EmissionsResults]![SUMOF_PM-
BASELINE]*[FRACTIONSx11]![FR-PM25], EmissionsResults.[SumOf_Fuel_Consumption_Evap-Baseline] = ([EmissionsResults]![SumOf_HC-HotSoak-
Baseline]+[EmissionsResults]![SumOf_HC-Diurnal-Baseline]+[EmissionsResults]![SumOf_HC-Resting-Baseline]+[EmissionsResults]![SumOf_HC-RunningLoss-
Baseline])*[FRACTIONSx11]![FR-ROG-EVAP]*2000/6.17;"
DoCmd.RunSQL "UPDATE EmissionsResults SET EmissionsResults.[SumOf_TOG_total-Baseline] = [EmissionsResults]![SumOf_TOG_Exhaust-
Baseline]+[EmissionsResults]![SumOf_TOG_evap-Baseline], EmissionsResults.[SumOf_ROG_total-Baseline] = [EmissionsResults]![SumOf_ROG_exhaust-
Baseline]+[EmissionsResults]![SumOf_ROG_evap-Baseline], EmissionsResults.[SumOf_Fuel_Consumption_Exhaust-Baseline] =
(12.011/(12.011+0.54*1.008)*[EmissionsResults]![SumOf_TOG_Exhaust-Baseline]+0.429*[EmissionsResults]![SumOf_CO-Baseline]+0.273*[EmissionsResults]![SUMOF_CO2-
BASELINE])*2000/(0.854*6.17);"


DoCmd.RunSQL "UPDATE FRACTIONSx11 INNER JOIN EmissionsResults ON (FRACTIONSx11.CATEGORY_Name = EmissionsResults.CATEGORY) AND
(FRACTIONSx11.[STRK-FUEL-TECH_Name] = EmissionsResults.[STRK-FUEL-TECH]) AND (FRACTIONSx11.CY = EmissionsResults.CY) SET
EmissionsResults.[SumOf_Fuel_Consumption_Total-Baseline] = [EmissionsResults]![SumOf_Fuel_Consumption_Exhaust-
Baseline]+[EmissionsResults]![SumOf_Fuel_Consumption_Evap-Baseline], EmissionsResults.[SumOf_SOx-Baseline] = ([EmissionsResults]![SumOf_Fuel_Consumption_Exhaust-
Baseline]+[EmissionsResults]![SumOf_Fuel_Consumption_Evap-Baseline])*[FRACTIONSx11]![SULFUR_CONTENT]*(IIf([FRACTIONSx11]![STRK-FUEL-
```

```
TECH]=5,7.07,6.25)/(1000000000)), EmissionsResults.[SUMOF_NH3-BASELINE] = ([EmissionsResults]![SumOf_Fuel_Consumption_Exhaust-
Baseline]+[EmissionsResults]![SumOf_Fuel_Consumption_Evap-Baseline])*IIf([EmissionsResults]![STRK-FUEL-TECH]='Diesel',83.3,116)/1000/454/2000;"
ElseIf Me.CheckBaseline = False And Me.CheckRule.Value = True Then
DoCmd.RunSQL "UPDATE EmissionsResults INNER JOIN FRACTIONSx11 ON (FRACTIONSx11.[STRK-FUEL-TECH_Name] = EmissionsResults.[STRK-FUEL-TECH]) AND
(FRACTIONSx11.CATEGORY_Name = EmissionsResults.CATEGORY) AND (EmissionsResults.CY = FRACTIONSx11.CY) SET EmissionsResults.[SumOf_TOG_Exhaust-Rule] =
[EmissionsResults]![SumOf_HC-Exhaust-Rule]*[FRACTIONSx11]![FR-TOG], EmissionsResults.[SumOf_ROG_exhaust-Rule] = [EmissionsResults]![SumOf_HC-Exhaust-
Rule]*[FRACTIONSx11]![FR-ROG], EmissionsResults.[SumOf_PM10-Rule] = [EmissionsResults]![SUMOF_PM-Rule]*[FRACTIONSx11]![FR-PM10],
EmissionsResults.[SUMOF_PM25-Rule] = [EmissionsResults]![SUMOF_PM-Rule]*[FRACTIONSx11]![FR-PM25], EmissionsResults.[SumOf_THC-Total-Rule] =
[EmissionsResults]![SumOf_HC-Exhaust-Rule]+[EmissionsResults]![SumOf_HC-HotSoak-Rule]+[EmissionsResults]![SumOf_HC-Diurnal-Rule]+[EmissionsResults]![SumOf_HC-
Resting-Rule]+[EmissionsResults]![SumOf_HC-RunningLoss-Rule], " & _
"EmissionsResults.[SumOf_TOG_evap-Rule] = ([EmissionsResults]![SumOf_HC-HotSoak-Rule]+[EmissionsResults]![SumOf_HC-Diurnal-Rule]+[EmissionsResults]![SumOf_HC-
Resting-Rule]+[EmissionsResults]![SumOf_HC-RunningLoss-Rule])*[FRACTIONSx11]![FR-ROG-EVAP], EmissionsResults.[SumOf_ROG_evap-Rule] =
([EmissionsResults]![SumOf_HC-HotSoak-Rule]+[EmissionsResults]![SumOf_HC-Diurnal-Rule]+[EmissionsResults]![SumOf_HC-Resting-Rule]+[EmissionsResults]![SumOf_HC-
RunningLoss-Rule])*[FRACTIONSx11]![FR-ROG-EVAP], EmissionsResults.[SumOf_Fuel_Consumption_Evap-Rule] = ([EmissionsResults]![SumOf_HC-HotSoak-
Rule]+[EmissionsResults]![SumOf_HC-Diurnal-Rule]+[EmissionsResults]![SumOf_HC-Resting-Rule]+[EmissionsResults]![SumOf_HC-RunningLoss-Rule])*[FRACTIONSx11]![FR-
ROG-EVAP]*2000/6.17;"
DoCmd.RunSQL "UPDATE EmissionsResults SET EmissionsResults.[SumOf_Fuel_Consumption_Exhaust-Rule] =
(12.011/(12.011+0.54*1.008)*[EmissionsResults]![SumOf_TOG_Exhaust-Rule]+0.429*[EmissionsResults]![SumOf_CO-Rule]+0.273*[EmissionsResults]![SUMOF_CO2-
Rule])*2000/(0.854*6.17), EmissionsResults.[SumOf_TOG_total-Rule] = [EmissionsResults]![SumOf_ROG_exhaust-Rule]+[EmissionsResults]![SumOf_ROG_evap-Rule],
EmissionsResults.[SumOf_ROG_total-Rule] = [EmissionsResults]![SumOf_ROG_exhaust-Rule]+[EmissionsResults]![SumOf_ROG_evap-Rule];"
DoCmd.RunSQL "UPDATE FRACTIONSx11 INNER JOIN EmissionsResults ON (FRACTIONSx11.CATEGORY_Name = EmissionsResults.CATEGORY) AND
(FRACTIONSx11.[STRK-FUEL-TECH_Name] = EmissionsResults.[STRK-FUEL-TECH]) AND (FRACTIONSx11.CY = EmissionsResults.CY) SET
EmissionsResults.[SumOf_Fuel_Consumption_Total-Rule] = [EmissionsResults]![SumOf_Fuel_Consumption_Exhaust-Rule]+[EmissionsResults]![SumOf_Fuel_Consumption_Evap-
Rule], EmissionsResults.[SumOf_SOx-Rule] = ([EmissionsResults]![SumOf_Fuel_Consumption_Exhaust-Rule]+[EmissionsResults]![SumOf_Fuel_Consumption_Evap-
Rule])*[FRACTIONSx11]![SULFUR_CONTENT]*(IIf([FRACTIONSx11]![STRK-FUEL-TECH]=5,7.07,6.25)/(1000000000)), EmissionsResults.[SumOf_NH3-Rule] =
([EmissionsResults]![SumOf_Fuel_Consumption_Exhaust-Rule]+[EmissionsResults]![SumOf_Fuel_Consumption_Evap-Rule])*IIf([EmissionsResults]![STRK-FUEL-
TECH]='Diesel',83.3,116)/1000/454/2000;"
DoCmd.RunSQL "UPDATE EmissionsResults INNER JOIN FRACTIONSx11 ON (EmissionsResults.CY = FRACTIONSx11.CY) AND (FRACTIONSx11.[STRK-FUEL-TECH_Name] =
EmissionsResults.[STRK-FUEL-TECH]) AND (EmissionsResults.CATEGORY = FRACTIONSx11.CATEGORY_Name) SET EmissionsResults.[SumOf_TOG_exhaust-Rule] =
[EmissionsResults]![SumOf_HC-Exhaust-Rule]*[FRACTIONSx11]![FR-TOG], EmissionsResults.[SumOf_ROG_exhaust-Rule] = [EmissionsResults]![SumOf_HC-Exhaust-
Rule]*[FRACTIONSx11]![FR-ROG], EmissionsResults.[SumOf_PM10-Rule] = [EmissionsResults]![SUMOF_PM-Rule]*[FRACTIONSx11]![FR-PM10], EmissionsResults.[SumOf_PM25-
Rule] = [EmissionsResults]![SUMOF_PM-Rule]*[FRACTIONSx11]![FR-PM25], EmissionsResults.[SumOf_Fuel_Consumption_Exhaust-Rule] =
(12.011/(12.011+0.54*1.008)*[EmissionsResults]![SumOf_TOG_Exhaust-Rule]+0.429*[EmissionsResults]![SumOf_CO-Rule]+0.273*[EmissionsResults]![SUMOF_CO2-
Rule])*2000/(0.854*6.17);"
End If
End Sub

Private Sub FormValidation()
Dim lstGUI As ListBox
Dim chkGUI As CheckBox
Dim optGUI As OptionButton
If Me.CheckBaseline = False And Me.CheckRule = False Then
   MsgBox "You need to select Baseline or Rule emissions."
      glb_Validation = False
End If
If glb_Validation = True Then
   Set lstGUI = Me(glb_ListBoxName)
      If glb_CheckBoxName = "NoOptionNoCheck" Then
         If lstGUI.ItemsSelected.Count = 0 Then
               MsgBox "You need to select one or more "& Right(glb_ListBoxName, Len(glb_ListBoxName) - 4) & "(s) from the " & Right(glb_ListBoxName, Len(glb_ListBoxName) - 4) &
" selection box."
            glb_Validation = False
               End If
         ElseIf glb_CheckBoxName = "OptionBox" Then
         Set optGUI = Me(glb_OptionName)
            If Me.FrameRegions.Value <> 1 And Me.FrameRegions.Value = optGUI.OptionValue And lstGUI.ItemsSelected.Count = 0 Then

         MsgBox "You need to select one or more "& Right(glb_ListBoxName, Len(glb_ListBoxName) - 4) & "(s) from the " & Right(glb_ListBoxName, Len(glb_ListBoxName) - 4) & "
selection box."

         glb_Validation = False
      End If
            Set optGUI = Nothing
         Else

      Set chkGUI = Me(glb_CheckBoxName)
       If chkGUI.Value = True And lstGUI.ItemsSelected.Count = 0 Then
                  MsgBox "You need to select one or more "& Right(glb_ListBoxName, Len(glb_ListBoxName) - 4) & "(s) from the " & Right(glb_ListBoxName, Len(glb_ListBoxName) -
4) & " selection box."
               glb_Validation = False
      End If
            Set chkGUI = Nothing
      End If
      Set lstGUI = Nothing
End If
End Sub

Public Sub VariableSelection()
'Updates the SQL language for the final query
'Variables might be passed implicitly which makes these alterations inneffective
FormValidation
Dim chkGUI As CheckBox
Dim optGUI As OptionButton
Dim lstGUI As ListBox
Dim VarItem As Variant
If glb_Validation = True Then
     If glb_CheckBoxName = "OptionBox" Then
            Set optGUI = Me(glb_OptionName)
      Set lstGUI = Me(glb_ListBoxName)
            If Me.FrameRegions.Value <> 1 And Me.FrameRegions.Value = optGUI.OptionValue Then
               'If lstGUI.ItemsSelected.Item(0) <> 1 Then
                  SelectS = SelectS & "[" & glb_EmissionsTable & "].[" & glb_ColumnName & "], "
         GroupByS = GroupByS & "[" & glb_EmissionsTable & "].[" & glb_ColumnName & "], "
               'test if *All has been selected
         If lstGUI.ItemsSelected.Item(0) <> 0 Then
```

```
                HavingS = HavingS & " AND ("

            For Each VarItem In lstGUI.ItemsSelected
               If IsNumeric(lstGUI.ItemData(VarItem)) = True Then
                  HavingS = HavingS & " ([" & glb_EmissionsTable & "].[" & glb_ColumnName & "])= " & lstGUI.ItemData(VarItem) & " OR "
               Else
                  HavingS = HavingS & " ([" & glb_EmissionsTable & "].[" & glb_ColumnName & "])= '" & lstGUI.ItemData(VarItem) & "' OR "
               End If
            Next VarItem

            'Not sure if these should go inside the 'If' statement above
                    HavingS = Left(HavingS, Len(HavingS) - 3) & " "

            HavingS = HavingS & ") "

            'End If

         End If

      End If

      Set optGUI = Nothing
      Set lstGUI = Nothing

      ElseIf glb_CheckBoxName = "NoOptionNoCheck" Then

      Set lstGUI = Me(glb_ListBoxName)
         SelectS = SelectS & "[" & glb_EmissionsTable & "].[" & glb_ColumnName & "], "
      GroupByS = GroupByS & "[" & glb_EmissionsTable & "].[" & glb_ColumnName & "], "

      HavingS = HavingS & " AND ("
         For Each VarItem In lstGUI.ItemsSelected
         If IsNumeric(lstGUI.ItemData(VarItem)) = True Then
            HavingS = HavingS & " ([" & glb_EmissionsTable & "].[" & glb_ColumnName & "])= " & lstGUI.ItemData(VarItem) & " OR "
         Else
            HavingS = HavingS & " ([" & glb_EmissionsTable & "].[" & glb_ColumnName & "])= '" & lstGUI.ItemData(VarItem) & "' OR "
         End If
      Next VarItem

      'Not sure if these should go inside the 'If' statement above
            HavingS = Left(HavingS, Len(HavingS) - 3) & " "
            HavingS = HavingS & ") "
            Set lstGUI = Nothing
      Else
            Set chkGUI = Me(glb_CheckBoxName)
      Set lstGUI = Me(glb_ListBoxName)
            'test if checkbox is selected
      If chkGUI.Value = True Then
               'If lstGUI.ItemsSelected.Item(0) <> 1 Then
                  SelectS = SelectS & "[" & glb_EmissionsTable & "].[" & glb_ColumnName & "], "
         GroupByS = GroupByS & "[" & glb_EmissionsTable & "].[" & glb_ColumnName & "], "
                  'test if *All has been selected
         If lstGUI.ItemsSelected.Item(0) <> 0 Then
                     HavingS = HavingS & " AND ("
                     For Each VarItem In lstGUI.ItemsSelected
               If IsNumeric(lstGUI.ItemData(VarItem)) = True Then
                  HavingS = HavingS & " ([" & glb_EmissionsTable & "].[" & glb_ColumnName & "])= " & lstGUI.ItemData(VarItem) & " OR "
               Else
                  HavingS = HavingS & " ([" & glb_EmissionsTable & "].[" & glb_ColumnName & "])= '" & lstGUI.ItemData(VarItem) & "' OR "
               End If
            Next VarItem
                    'Not sure if these should go inside the 'If' statement above

            HavingS = Left(HavingS, Len(HavingS) - 3) & " "

            HavingS = HavingS & ") "

         End If

         'End If

      End If

      Set chkGUI = Nothing
      Set lstGUI = Nothing

   End If

End If

End Sub
Public Sub RegionCheckBoxes()

If Me.CheckABDIS.Value = True Or Me.CheckCODIS.Value = True Then
      SelectS = SelectS & "[" & glb_FrmTblDist & "].[" & glb_FldDist & "], "
   GroupByS = GroupByS & "[" & glb_FrmTblDist & "].[" & glb_FldDist & "], "

End If
If Me.CheckABCO.Value = True Or Me.CheckDISCO.Value = True Then

   SelectS = SelectS & "[" & glb_FrmTblCounty & "].[" & glb_FldCounty & "], "
   GroupByS = GroupByS & "[" & glb_FrmTblCounty & "].[" & glb_FldCounty & "], "
End If

If Me.CheckDISAB.Value = True Or Me.CheckCOAB.Value = True Then
```

```
   SelectS = SelectS & "[" & glb_FrmTblAirBasin & "].[" & glb_FldAirBasin & "], "
   GroupByS = GroupByS & "[" & glb_FrmTblAirBasin & "].[" & glb_FldAirBasin & "], "
End If

End Sub
Public Sub CheckUpdate()
'Updates the list box after you check the checkbox
Dim chkGUI As CheckBox
Dim lstGUI As ListBox
Set chkGUI = Me(glb_CheckBoxName)
Set lstGUI = Me(glb_ListBoxName)



If chkGUI.Value = True Then
   lstGUI.Visible = True
   lstGUI.Enabled = True
   lstGUI.FontWeight = 400
   lstGUI.Height = 930
   lstGUI.RowSource = "SELECT [" & glb_LookupTable & "].[" & glb_ColumnName & "] FROM [" & glb_LookupTable & "] ORDER BY [" & glb_ColumnName & "];"
Else
   lstGUI.Visible = False
   lstGUI.Enabled = False
   lstGUI.FontWeight = 100
   lstGUI.Height = 330
   lstGUI.RowSource = "SELECT [" & glb_LookupTable & "].[" & glb_ColumnName & "] FROM [" & glb_LookupTable & "] WHERE [" & glb_LookupTable & "].[" & glb_ColumnName & "]
= '*Combined' ORDER BY [" & glb_ColumnName & "];"
End If
Set chkGUI = Nothing
Set lstGUI = Nothing
End Sub
Public Sub OptionUpdate()
'Updates the list box after you check the option
'Very similar to CheckUpdate, some names are still from 'checkbox' code
Dim chkGUI As OptionButton
Dim lstGUI, otherList1, otherList2 As ListBox
Set chkGUI = Me(glb_CheckBoxName)
Set lstGUI = Me(glb_ListBoxName)
Set otherList1 = Me(glb_otherList1)
Set otherList2 = Me(glb_otherList2)
If glb_CheckBoxName = "OptionStatewide" Then
   lstGUI.Visible = False
'   lstGUI.Enabled = False
'   lstGUI.FontWeight = 100
'   lstGUI.Height = 330
'   lstGUI.RowSource = "SELECT [" & glb_LookupTable & "].[" & glb_ColumnName & "] FROM [" & glb_LookupTable & "] WHERE [" & glb_LookupTable & "].[" & glb_ColumnName &
"] = '*Combined' ORDER BY [" & glb_ColumnName & "];"
Else

   lstGUI.Visible = True
   'list with focus
   lstGUI.Enabled = True
   lstGUI.FontWeight = 400
   lstGUI.Height = 1450
   lstGUI.RowSource = "SELECT [" & glb_LookupTable & "].[" & glb_ColumnName & "] FROM [" & glb_LookupTable & "] ORDER BY [" & glb_ColumnName & "];"
End If
otherList1.Visible = False
otherList2.Visible = False
''other list 1
'otherList1.Enabled = False
'otherList1.FontWeight = 100
'otherList1.Height = 330
'otherList1.RowSource = "SELECT [" & glb_LookupTable & "].[" & glb_ColumnName & "] FROM [" & glb_LookupTable & "] WHERE [" & glb_LookupTable & "].[" & glb_ColumnName &
"] = '*Combined' ORDER BY [" & glb_ColumnName & "];"
'
''other list 2
'otherList2.Enabled = False
'otherList2.FontWeight = 100
'otherList2.Height = 330
'otherList2.RowSource = "SELECT [" & glb_LookupTable & "].[" & glb_ColumnName & "] FROM [" & glb_LookupTable & "] WHERE [" & glb_LookupTable & "].[" & glb_ColumnName &
"] = '*Combined' ORDER BY [" & glb_ColumnName & "];"
Set chkGUI = Nothing
Set lstGUI = Nothing
Set otherList1 = Nothing
Set otherList2 = Nothing
End Sub
Public Sub ListAllCombined()
'Validates the listbox selection
Dim lstGUI As ListBox
Dim chkGUI As CheckBox
Dim VarItem As Variant
If glb_Validation = True Then

   Set lstGUI = Me(glb_ListBoxName)

   If lstGUI.ItemsSelected.Count > 0 Then

   '   If lstGUI.ItemsSelected.Item(0) = 1 Then
   '      For Each VarItem In lstGUI.ItemsSelected
   '         lstGUI.Selected(VarItem) = False
   '      Next VarItem
   '      lstGUI.Selected(1) = True

      If lstGUI.ItemsSelected.Item(0) = 0 Then
```

```
            For Each VarItem In lstGUI.ItemsSelected

lstGUI.Selected(VarItem) = False

            Next VarItem

lstGUI.Selected(0) = True

        End If

    End If

    Set chkGUI = Nothing
    Set lstGUI = Nothing

    Set lstGUI = Nothing

End If

glb_Validation = True

End Sub

Public Sub ListSelectLimit()
'Validates the listbox selection


'Dim chkGUI As CheckBox
Dim lstGUI As ListBox


Set lstGUI = Me(glb_ListBoxName)

If lstGUI.ItemsSelected.Count > 0 Then

    If Me.CheckModelYear.Value = True Then

        'Set chkGUI = Me(glb_CheckBoxName)

        If lstGUI.ItemsSelected.Count > glb_RegionLimit Or lstGUI.ItemsSelected.Item(0) = 0 Then
            MsgBox "You have selected Model Year output. You can only view " & glb_RegionLimit & " region(s) at a time. Choose a specific County, District, Air Basin, or Statewide (no regional selection)."
lstGUI.Selected(lstGUI.ListIndex) = False
        End If

        glb_Validation = False


        'Set chkGUI = Nothing

    End If

End If

Set lstGUI = Nothing


End Sub



Private Sub OptionStatewide_GotFocus()


Me.CheckABDIS.Visible = False
Me.CheckABCO.Visible = False
Me.CheckDISAB.Visible = False
Me.CheckDISCO.Visible = False
Me.CheckCOAB.Visible = False
Me.CheckCODIS.Visible = False

Me.CheckABDIS.Value = False
Me.CheckABCO.Value = False
Me.CheckDISAB.Value = False
Me.CheckDISCO.Value = False
Me.CheckCOAB.Value = False
Me.CheckCODIS.Value = False

Me.LabelABDIS.Visible = False
Me.LabelABCO.Visible = False
Me.LabelDISAB.Visible = False
Me.LabelDISCO.Visible = False
Me.LabelCOAB.Visible = False
Me.LabelCODIS.Visible = False


glb_CheckBoxName = "OptionStatewide"
glb_ListBoxName = "ListAirBasin"
glb_otherList1 = "ListAirDistrict"
glb_otherList2 = "ListCounty"
glb_LookupTable = glb_FrmTblAirBasin
glb_ColumnName = glb_FldAirBasin
```

```
OptionUpdate

End Sub

Private Sub OptionAirBasin_GotFocus()


If Me.CheckModelYear.Value = False Then

    Me.CheckABDIS.Visible = True
    Me.CheckABCO.Visible = True
    Me.CheckDISAB.Visible = False
    Me.CheckDISCO.Visible = False
    Me.CheckCOAB.Visible = False
    Me.CheckCODIS.Visible = False

    Me.CheckDISAB.Value = False
    Me.CheckDISCO.Value = False
    Me.CheckCOAB.Value = False
    Me.CheckCODIS.Value = False

    Me.LabelABDIS.Visible = True
    Me.LabelABCO.Visible = True
    Me.LabelDISAB.Visible = False
    Me.LabelDISCO.Visible = False
    Me.LabelCOAB.Visible = False
    Me.LabelCODIS.Visible = False


End If


glb_CheckBoxName = "OptionAirBasin"
glb_ListBoxName = "ListAirBasin"
glb_otherList1 = "ListAirDistrict"
glb_otherList2 = "ListCounty"
glb_LookupTable = glb_FrmTblAirBasin
glb_ColumnName = glb_FldAirBasin


OptionUpdate

End Sub

Private Sub OptionAirDistrict_GotFocus()


If Me.CheckModelYear.Value = False Then

    Me.CheckABDIS.Visible = False
    Me.CheckABCO.Visible = False
    Me.CheckDISAB.Visible = True
    Me.CheckDISCO.Visible = True
    Me.CheckCOAB.Visible = False
    Me.CheckCODIS.Visible = False

    Me.CheckABDIS.Value = False
    Me.CheckABCO.Value = False
    Me.CheckCOAB.Value = False
    Me.CheckCODIS.Value = False

    Me.LabelABDIS.Visible = False
    Me.LabelABCO.Visible = False
    Me.LabelDISAB.Visible = True
    Me.LabelDISCO.Visible = True
    Me.LabelCOAB.Visible = False
    Me.LabelCODIS.Visible = False

End If
glb_CheckBoxName = "OptionAirDistrict"
glb_ListBoxName = "ListAirDistrict"
glb_otherList1 = "ListAirBasin"
glb_otherList2 = "ListCounty"
glb_LookupTable = glb_FrmTblDist
glb_ColumnName = glb_FldDist
OptionUpdate
End Sub

Private Sub OptionCounty_GotFocus()
Me.CheckABDIS.Visible = False
Me.CheckABCO.Visible = False
Me.CheckDISAB.Visible = False
Me.CheckDISCO.Visible = False
Me.CheckCOAB.Visible = True
Me.CheckCODIS.Visible = True
Me.CheckABDIS.Value = False
Me.CheckABCO.Value = False
Me.CheckDISAB.Value = False
Me.CheckDISCO.Value = False
Me.LabelABDIS.Visible = False
Me.LabelABCO.Visible = False
Me.LabelDISAB.Visible = False
Me.LabelDISCO.Visible = False
Me.LabelCOAB.Visible = True
```

```
Me.LabelCODIS.Visible = True
glb_CheckBoxName = "OptionCounty"
glb_ListBoxName = "ListCounty"
glb_otherList1 = "ListAirDistrict"
glb_otherList2 = "ListAirBasin"
glb_LookupTable = glb_FrmTblCounty
glb_ColumnName = glb_FldCounty

OptionUpdate

End Sub

Private Sub CheckHP_Click()

glb_CheckBoxName = "CheckHP"
glb_ListBoxName = "ListHP"
glb_LookupTable = glb_FrmTblHP
glb_ColumnName = glb_FldHP

CheckUpdate

End Sub

Private Sub CheckModelYear_Click()

glb_CheckBoxName = "CheckModelYear"
glb_ListBoxName = "ListModelYear"
glb_LookupTable = glb_FrmTblMdlYr
glb_ColumnName = glb_FldMdlYr

CheckUpdate

If Me.CheckModelYear.Value = True Then
    MsgBox "You have selected Model Year output.  You can only view " & glb_RegionLimit & " region(s) at a time. Choose an individual County, District, Air Basin, or Statewide (no regional selection)."

    'Region deselction on form
    Me.ListAirBasin.Enabled = False
    Me.ListAirBasin.FontWeight = 100
    Me.ListAirBasin.Height = 330
    Me.ListAirBasin.RowSource = "SELECT [" & glb_LookupTable & "].[" & glb_ColumnName & "] FROM [" & glb_LookupTable & "] WHERE [" & glb_LookupTable & "].[" & glb_ColumnName & "] = '*Combined' ORDER BY [" & glb_ColumnName & "];"

    Me.ListAirDistrict.Enabled = False
    Me.ListAirDistrict.FontWeight = 100
    Me.ListAirDistrict.Height = 330
    Me.ListAirDistrict.RowSource = "SELECT [" & glb_LookupTable & "].[" & glb_ColumnName & "] FROM [" & glb_LookupTable & "] WHERE [" & glb_LookupTable & "].[" & glb_ColumnName & "] = '*Combined' ORDER BY [" & glb_ColumnName & "];"

    Me.ListCounty.Enabled = False
    Me.ListCounty.FontWeight = 100
    Me.ListCounty.Height = 330
    Me.ListCounty.RowSource = "SELECT [" & glb_LookupTable & "].[" & glb_ColumnName & "] FROM [" & glb_LookupTable & "] WHERE [" & glb_LookupTable & "].[" & glb_ColumnName & "] = '*Combined' ORDER BY [" & glb_ColumnName & "];"

    Me.FrameRegions.Value = 1

    Me.CheckABDIS.Visible = False
    Me.CheckABCO.Visible = False
    Me.CheckDISAB.Visible = False
    Me.CheckDISCO.Visible = False
    Me.CheckCOAB.Visible = False
    Me.CheckCODIS.Visible = False

    Me.CheckABDIS.Value = False
    Me.CheckABCO.Value = False
    Me.CheckDISAB.Value = False
    Me.CheckDISCO.Value = False
    Me.CheckCOAB.Value = False
    Me.CheckCODIS.Value = False

    Me.LabelABDIS.Visible = False
    Me.LabelABCO.Visible = False
    Me.LabelDISAB.Visible = False
    Me.LabelDISCO.Visible = False
    Me.LabelCOAB.Visible = False
    Me.LabelCODIS.Visible = False


    'equipment type and fuel type requirement
    Me.CheckEquipmentType.Value = True
    Me.CheckEquipmentType.Visible = False
    Me.ListEquipmentType.Visible = True
    Me.ListEquipmentType.Enabled = True
    Me.ListEquipmentType.FontWeight = 400
    Me.ListEquipmentType.Height = 930
    Me.ListEquipmentType.RowSource = "SELECT [FormEquipmentTypes].[CATEGORY] FROM FormEquipmentTypes ORDER BY [CATEGORY]; "
    Me.CheckFuelType.Value = True
    Me.CheckFuelType.Visible = False
    Me.ListFuelType.Visible = True
    Me.ListFuelType.Enabled = True
    Me.ListFuelType.FontWeight = 400
    Me.ListFuelType.Height = 930
    Me.ListFuelType.RowSource = "SELECT [FormFuelTypes].[STRK-FUEL-TECH] FROM FormFuelTypes ORDER BY [STRK-FUEL-TECH]; "
```

```
ElseIf Me.CheckModelYear = False Then

   Me.CheckEquipmentType.Visible = True

   Me.CheckFuelType.Visible = True

End If
End Sub
Private Sub CheckStatus_Click()

glb_CheckBoxName = "CheckStatus"
glb_ListBoxName = "ListStatus"
glb_LookupTable = glb_FrmTblStatus
glb_ColumnName = glb_FldStatus

CheckUpdate

End Sub

Private Sub CheckEquipmentType_Click()
glb_CheckBoxName = "CheckEquipmentType"
glb_ListBoxName = "ListEquipmentType"
glb_LookupTable = glb_FrmTblEquipType
glb_ColumnName = glb_FldEquipType
CheckUpdate

End Sub


Private Sub CheckFuelType_Click()

glb_CheckBoxName = "CheckFuelType"
glb_ListBoxName = "ListFuelType"
glb_LookupTable = glb_FrmTblFuel
glb_ColumnName = glb_FldFuel


CheckUpdate

End Sub

Private Sub ListAirBasin_BeforeUpdate(Cancel As Integer)
glb_CheckBoxName = "CheckAirBasin"
glb_ListBoxName = "ListAirBasin"
glb_LookupTable = glb_FrmTblAirBasin
glb_ColumnName = glb_FldAirBasin
ListSelectLimit
ListAllCombined
End Sub
Private Sub ListAirDistrict_BeforeUpdate(Cancel As Integer)
glb_CheckBoxName = "CheckAirDistrict"
glb_ListBoxName = "ListAirDistrict"
glb_LookupTable = glb_FrmTblDist
glb_ColumnName = glb_FldDist
ListSelectLimit
ListAllCombined
End Sub

Private Sub ListCounty_BeforeUpdate(Cancel As Integer)
glb_CheckBoxName = "CheckCounty"
glb_ListBoxName = "ListCounty"
glb_LookupTable = glb_FrmTblCounty
glb_ColumnName = glb_FldCounty
ListSelectLimit
ListAllCombined
End Sub
Private Sub ListEquipmentType_BeforeUpdate(Cancel As Integer)
glb_CheckBoxName = "CheckEquipmentType"
glb_ListBoxName = "ListEquipmentType"
glb_LookupTable = glb_FrmTblEquipType
glb_ColumnName = glb_FldEquipType
ListAllCombined
End Sub

Private Sub ListFuelType_BeforeUpdate(Cancel As Integer)
glb_CheckBoxName = "CheckFuelType"
glb_ListBoxName = "ListFuelType"
glb_LookupTable = glb_FrmTblFuel
glb_ColumnName = glb_FldFuel

ListAllCombined
End Sub
Private Sub ListHP_BeforeUpdate(Cancel As Integer)
glb_CheckBoxName = "CheckHP"
glb_ListBoxName = "ListHP"
glb_LookupTable = glb_FrmTblHP
glb_ColumnName = glb_FldHP

ListAllCombined
End Sub
Private Sub ListModelYear_BeforeUpdate(Cancel As Integer)
glb_CheckBoxName = "CheckModelYear"
glb_ListBoxName = "ListModelYear"
glb_LookupTable = glb_FrmTblMdlYr
glb_ColumnName = glb_FldMdlYr
```

```
ListAllCombined
End Sub
Private Sub ListStatus_BeforeUpdate(Cancel As Integer)
glb_CheckBoxName = "CheckStatus"
glb_ListBoxName = "ListStatus"
glb_LookupTable = glb_FrmTblStatus
glb_ColumnName = glb_FldStatus

ListAllCombined

End Sub
```