Updated Oakridge-Westfir $PM_{2.5}$ Attainment Plan

LRAPA
Lane Regional Air Protection Agency

1010 Main Street
Springfield, Oregon 97477

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Note: This 2016 Updated Oakridge-Westfir $PM_{2.5}$ Attainment Plan occasionally refers to appendices of the original 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan, essentially sub-appendices of Appendix 3 above. It has been our intent to make this clear in the text, but if there is any question to the reader: All of the alphabetical appendices (e.g., A through K) are from the 2012 Plan; and all of the numeric appendices (e.g., 1 through 4) are specific to the appendices above in this 2016 Plan.

EXECUTIVE SUMMARY

The Oakridge community in Lane County, Oregon, has steadily improved air quality over the past 25 years. This Updated Oakridge-Westfir $PM_{2.5}$ Attainment Plan outlines the work by the community from 2014-2016 to complete the attainment of current national health standards adopted in 2006 (24-hour) and 2012 (annual), and to ensure continued attainment of those standards in future years.

Oakridge is a forest-oriented community (population 3,240 as of July 2015) in a valley of the Middle Fork Willamette River in the foothills of the Cascade Mountains about 45 miles southeast of Eugene-Springfield. Many of the homes are heated by wood as the primary or secondary heat source, or even sole source in some cases. As a result, the major contributor to the historical particulate air pollution has been home wood heating, especially on stagnant winter days when temperature inversions form over the small valley.

The Lane Regional Air Protection Agency (LRAPA) has been monitoring in Oakridge for inhalable particulate matter (PM_{10} – particles 10 microns and smaller) since 1988 and for respirable particulate matter ($PM_{2.5}$ – particles 2.5 microns and smaller) since 1999.

The U.S. Environmental Protection Agency (EPA) designated Oakridge as a moderate PM_{10} nonattainment area in 1994. The Oakridge PM_{10} attainment strategy was adopted by the City of Oakridge, LRAPA, and the Oregon Environmental Quality Commission (EQC) in 1996 and submitted to EPA as part of the State Implementation Plan (SIP). EPA approved the plan in 1999. The Oakridge PM_{10} strategy focused primarily on control of residential wood combustion. The attainment strategy was successful in achieving the PM_{10} standards in Oakridge on schedule. In 2001, EPA published a finding of attainment for the Oakridge PM_{10} area.

The 1996 Oakridge PM_{10} attainment plan was successful in not only meeting the PM_{10} standards on schedule, but also meeting the initial national $PM_{2.5}$ standard of 65 micrograms per cubic meter ($\mu g/m^3$) adopted by EPA in 1997. In 1997, EPA adopted an annual average $PM_{2.5}$ standard of 15 $\mu g/m^3$, and tightened that annual standard to 12 $\mu g/m^3$ in 2012. The Oakridge area has met the 12 $\mu g/m^3$ annual average PM_{10} standard since 2006 as a by-product of the strategies to meet the 24-hour PM_{10} and $PM_{2.5}$ standards.

However, subsequent national health studies supported a more protective 24-hour national $PM_{2.5}$ health standard, and EPA adopted the 35 $\mu g/m^3$ standard in 2006. Between 2006 and 2011, $PM_{2.5}$ concentrations in Oakridge on worst winter days continually violated the new 24-hour national health standard.

In 2012, the City of Oakridge, LRAPA, and Oregon EQC developed and submitted to the EPA the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan. The 2012 plan confirmed the dominant source of $PM_{2.5}$ in Oakridge on the problem winter days as residential wood combustion (RWC) in woodstoves and fireplaces. This was determined by $PM_{2.5}$ emission inventories, chemical speciation of particulate filter samples, and diurnal $PM_{2.5}$ concentration fluctuations. Therefore,

the strategies in the 2012 $PM_{2.5}$ SIP submittal focused primarily on RWC emission reductions, as did the previous PM_{10} strategy.

The above-mentioned control measures in the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan included: woodstove change outs; a mandatory curtailment program; removal of uncertified woodstoves at the time of home sale; and a 40% opacity limit on residential chimneys. However, these strategies proved to be inadequate to fully reach attainment status. Adverse meteorological and winter weather conditions proved to be a real challenge to fully achieve the wood heating emission reductions in Oakridge. Limitations on woodstove change out requirements prevented many rentals from benefiting from the program. A lack of dedicated code enforcement officer and not enough police officers trained in EPA Method 9 smoke-reading led to limited enforcement and education of the curtailment program. Furthermore, the absence of an ongoing stakeholder workgroup also made communication between LRAPA and the City more challenging.

Air quality conditions were gradually improving, but in 2014 it became clear that the standards would likely not be met by the Clean Air Act deadline. The particulate concentrations measured in Oakridge for the calendar year 2015 and the three-year period 2013-2015 were the lowest measured in the 25 years of monitoring in Oakridge, but the 3-year 98th percentile value of 37 $\mu g/m^3$ did not meet the 35 $\mu g/m^3$ national $PM_{2.5}$ standard by December 31, 2015 as required by the federal Clean Air Act. Therefore, in 2014 the City of Oakridge and LRAPA triggered the contingency plan portion of the 2012 $PM_{2.5}$ SIP submittal and initiated monthly meetings with the other Oakridge stakeholders. These meetings sought to revisit the past plan's strategies and implement the triggered contingency measures to ensure attainment of standards as soon as possible.

The federal Clean Air Act gives the EPA Administrator discretionary authority to grant a 1-year extension to the attainment date for moderate nonattainment areas such as Oakridge. Two criteria are required to be met: first, the community must have implemented all of the control strategies promised in the previous attainment plan; second, the 98th percentile $PM_{2.5}$ concentration in the community in the extension year has to be less than or equal to the 35 $\mu g/m^3$ standard. In Oakridge, the community implemented all of the control strategies promised in the 2012 attainment plan. In addition, the 98th percentile $PM_{2.5}$ concentration in 2015 was 28.9 $\mu g/m^3$, which is less than the 35 $\mu g/m^3$ standard. Therefore, on December 14, 2015, the City of Oakridge, LRAPA, and the Oregon Department of Environmental Quality (ODEQ) jointly requested and was granted a 1-year attainment date extension to December 31, 2016. This extension allowed the City of Oakridge and LRAPA to determine the adequacy of the more aggressive control measures implemented in 2014.

Oakridge and LRAPA are confident that the strategies currently being implemented will be adequate to fully meet the national 24-hour $PM_{2.5}$ health standards by December 31, 2016, and in subsequent years. To illustrate, the 1999-2015 $PM_{2.5}$ trends indicate:

- Worst-day $PM_{2.5}$ concentrations (i.e., the 98th percentile design values) in Oakridge improved an average 1.5 $\mu g/m^3$ per year compared to an average annual improvement

of 0.8 µg/m^3 at the non-Oakridge monitoring sites (i.e., areas not affected by the Oakridge-specific strategies) in Lane County.

- Using the worst-day $PM_{2.5}$ concentrations at the non-Oakridge sites as a reference, it appears that meteorological conditions in 2012-2014 and 2013-2015 were more adverse than average (and similarly, the conditions in 2009-2011 and 2010-2012 were better than average).
- Annual average $PM_{2.5}$ concentrations in Oakridge improved an average 0.4 µg/m^3 per year compared to an average annual improvement of 0.2 µg/m^3 at the non-Oakridge monitoring sites in Lane County.
- In Oakridge, most of the improvement in the $PM_{2.5}$ annual average was in November-February (0.6 µg/m^3 per year improvement in the seasonal average) when the RWC strategies were most effective, compared to 0.2 µg/m^3 per year improvement the rest of the year (March-October) when the RWC strategies were less applicable.

The Air Pollution Control Ordinances adopted by the City of Oakridge are a critical part of the Updated Oakridge-Westfir $PM_{2.5}$ Attainment Plan. The $PM_{2.5}$ emission reductions and air quality improvements are summarized in the following table, including the implementation timeframes, the corresponding emission inventory, and the Oakridge Air Pollution Control Ordinance that was in effect.

	Reductions on Worst Winter Days		**Time**	**Emission**	**Oakridge**	**Ordinance**
RWC Strategy Category	**lb/day**	**ug/m3**	**Period**	**Inventory**	**Ordinance**	**Date**
Long-Term RWC Strategies	38	2.6	2009-2014	2015	#903	Oct-2012
Short-Term Curtailment	107	7.1	2009-2014	2015	#903	Oct-2012
Supplemental Underway	25	1.7	2015	2016	#914	Oct-2015
Conditional Contingency	42	2.8	Future	Future	#920	Oct-2016

This Updated Oakridge-Westfir $PM_{2.5}$ Attainment Plan includes contingency control measures to be implemented if standards are not achieved on schedule, quantitative milestones to be achieved during implementation of the attainment plan, and the process for determining reasonable further progress in future years. The Oakridge $PM_{2.5}$ concentrations measured thus far in 2016 are similar to the record low Oakridge $PM_{2.5}$ concentrations measured in 2015, further strengthening our confidence that the 24-hour $PM_{2.5}$ health standards will be fully achieved by December 31, 2016. During 2016, the City of Oakridge and LRAPA intend to document the adequacy of the new aggressive control measures implemented since October 2014 and to record the additional air quality data needed to demonstrate full attainment of $PM_{2.5}$ standards.

INTRODUCTION

Background

This plan addresses the 24-hour and the annual ambient air quality standards for $PM_{2.5}$ as adopted by the EPA after consultation with the Clean Air Scientific Advisory Committee (CASAC), a group of non-EPA scientists and medical professionals established by Congress.

In 1997, EPA adopted a daily (24-hr) $PM_{2.5}$ standard of 65 $\mu g/m^3$ and an annual $PM_{2.5}$ standard of 15 $\mu g/m^3$. However, subsequent national health studies supported more protective $PM_{2.5}$ health standards, and EPA adopted a 35 $\mu g/m^3$ 24-hour $PM_{2.5}$ standard in 2006 and a 12 $\mu g/m^3$annual $PM_{2.5}$ standard in 2012.

Areas in violation of either of the $PM_{2.5}$ standards (based on the most recent three years of federal reference monitoring data) are designated as a "nonattainment area" by the EPA. Oakridge, Oregon, has been designated as nonattainment for the daily $PM_{2.5}$ standard. The Lane Regional Air Protection Agency (LRAPA) and the City of Oakridge must develop an attainment plan that will bring air quality in Oakridge into compliance with the standard for approval by the Oregon Environmental Quality Commission (EQC) and EPA. The initial attainment plan was prepared and submitted to EPA in December 2012 but the 24-hour $PM_{2.5}$ standard was not achieved by December 31, 2015 as required by the federal Clean Air Act, so a 1-year extension request was submitted to EPA on December 14, 2015 and approved by EPA effective August 17, 2016.

What is $PM_{2.5}$?

Particulate matter (PM) is the general term used for a mixture of solid particles or liquid droplets found in the air. Some particles are large or dark enough to be seen as soot or smoke. Others are so small they can be detected only with an electron microscope. These particles come in a wide range of sizes ("fine" or "respirable" particles are less than 2.5 micrometers in diameter and coarser-sized particles are larger than 2.5 micrometers), and originate from many different sources. Fine particles ($PM_{2.5}$) generally result from fuel combustion from residential fireplaces and woodstoves, pile and forest burning, industrial facilities, and motor vehicles. Coarse particles (PM_{10} and larger) are generally emitted from sources such as vehicles traveling on paved and unpaved roads, materials handling, and wood products operations, as well as wind-blown dust.

These particles can accumulate in the respiratory system and are associated with numerous negative health effects. Fine particles are most closely associated with such health effects as increased hospital admissions and emergency room visits for heart and lung disease, increased respiratory symptoms and disease, decreased lung function and premature death. Sensitive groups that are at greatest risk include the elderly, pregnant women, individuals with cardiopulmonary disease such as asthma, and children.

National Ambient Air Quality Standards for $PM_{2.5}$

EPA has established National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ at 35 micrograms per cubic meter ($\mu g/m^3$) for a daily (24-hour) standard and 12 $\mu g/m^3$ as an annual

standard. Any value monitored above these levels, as defined by federal rules and guidance, is considered an exceedance. EPA uses the 98th percentile of the 24-hr $PM_{2.5}$ within any given year and averages it over three calendar years. An exceedance of the average 98th percentile over three years greater than 35 $\mu g/m^3$ is considered a violation. An exceedance of the annual standard averaged over three years becomes a violation of the annual standard. If an area violates either standard, EPA designates it as a nonattainment area. This plan includes a demonstration of continuing attainment with both standards in Oakridge.

Purpose of Attainment Plan

This document provides a pathway for continued improvement to reduce particulate emissions and to return the Oakridge Nonattainment Area to attainment for $PM_{2.5}$ (state classification will be “maintenance”) by achieving the more protective national health standards adopted in 2006 and 2012. It is a plan to ensure Oakridge meets the 24-hour and annual National Ambient Air Quality Standards for $PM_{2.5}$ and maintains the annual standard for $PM_{2.5}$. This document complies with the applicable 1990 Federal Clean Air Act requirements and EPA guidance and policies. The attainment plan provides strategies to meet the $PM_{2.5}$ standards by 2016 and provides contingency measures should Oakridge not meet the deadline. To demonstrate "attainment" requires the collection of representative monitoring data using approved measuring instruments and procedures, with adequate quality assurance. EPA will review the plan to determine if it is approvable and publish its findings in the Federal Register. Redesignation back to attainment is possible only after Oakridge meets the standards for three consecutive years and a maintenance plan is drafted, adopted by the LRAPA Board of Directors, the EQC and approved by EPA.

Oakridge Area Description

Oakridge lies in an alluvial plain in the foothills at the southern end of the Willamette River valley. The city is in Lane County, Oregon, approximately 45 miles east-southeast of Eugene, and 28 miles west of Willamette Pass, a summit of the Cascade Mountain Range. The city limits of present-day Oakridge include the historic City of Oakridge and, directly west, the area formerly known as Willamette City. Figure 1 shows the location of Oakridge in Lane County.

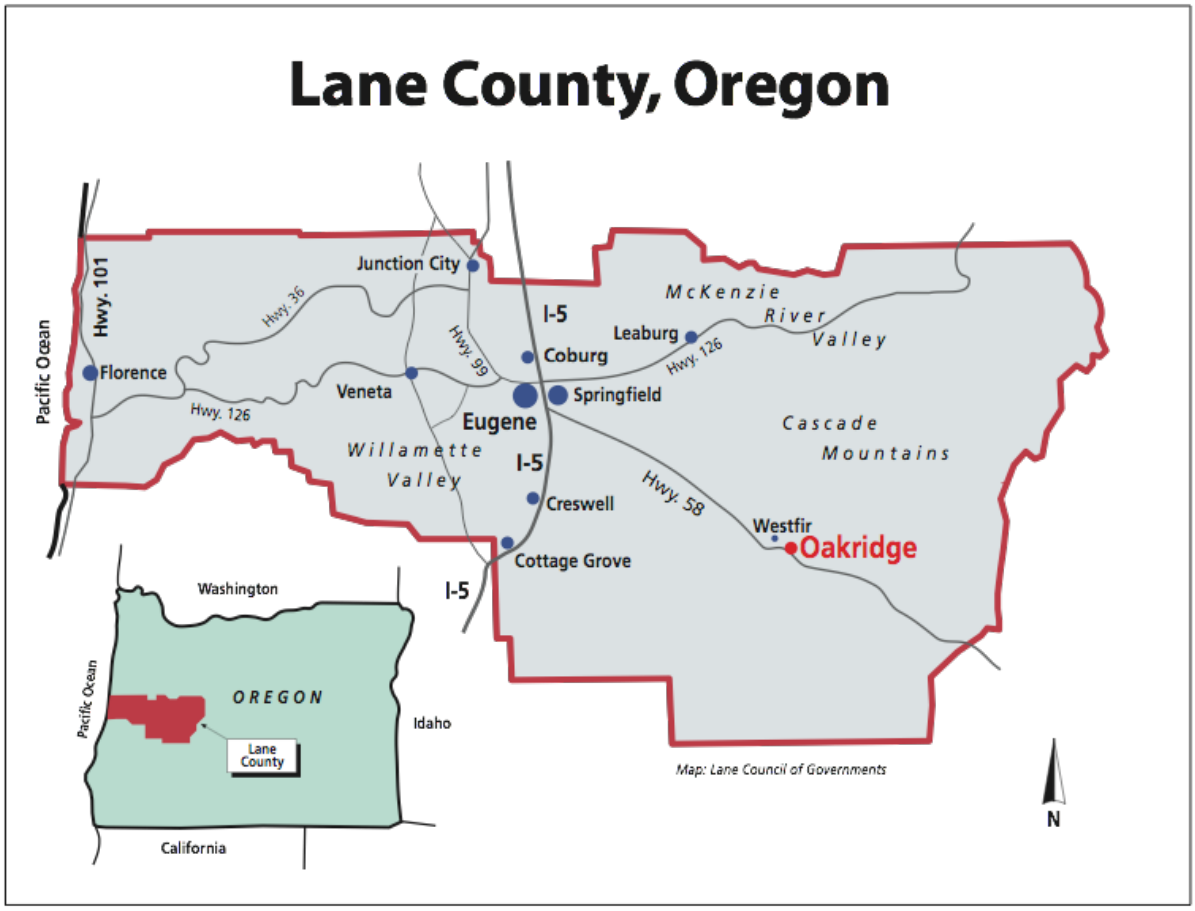


Figure 1: Oakridge Location in Lane County and Oregon.

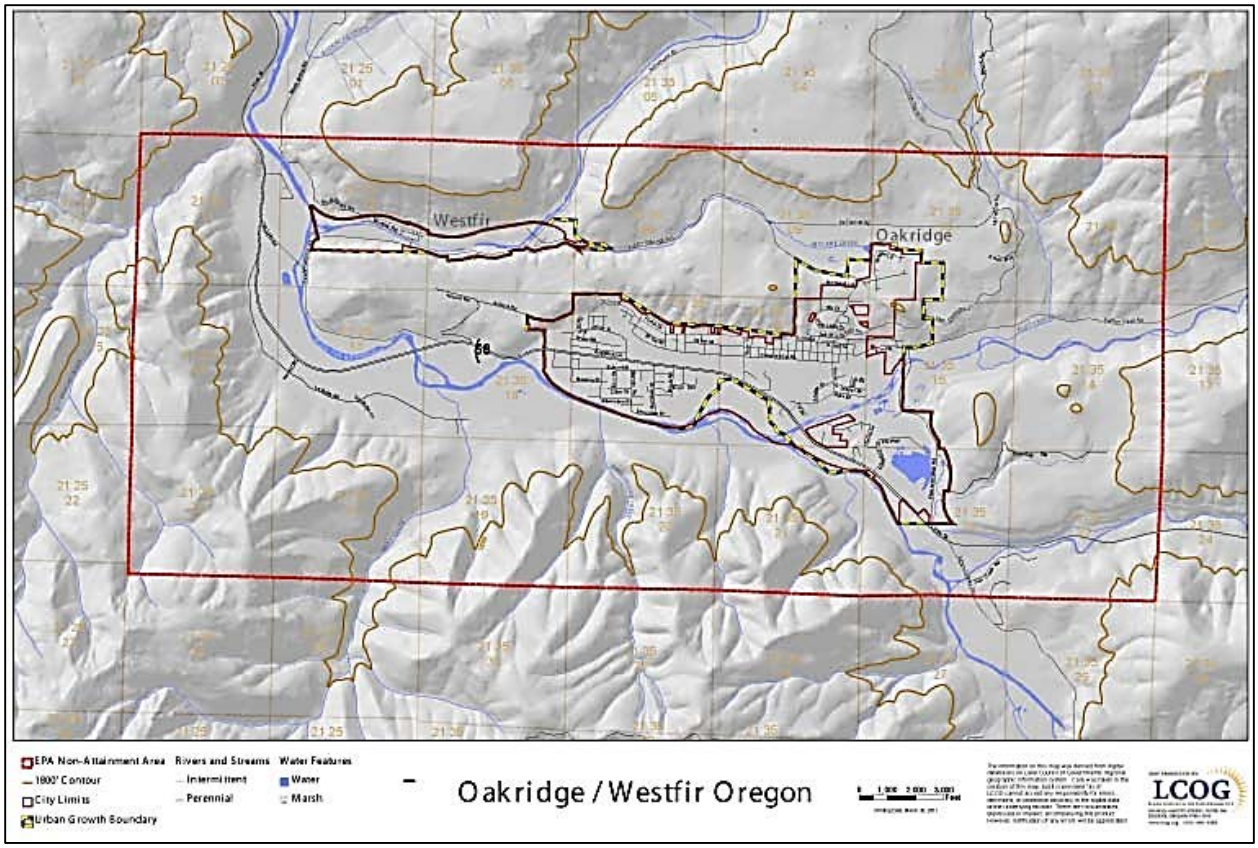


Figure 2: Nonattainment Area Boundary map.

The area of applicability for this attainment plan includes an area that contains the City of Oakridge and the small town of Westfir. Figure 2 shows the Oakridge non-attainment area.

The City of Oakridge is situated in a valley oriented east to west, where the middle fork of the Willamette River flows. Elevation of the area ranges from 1100 feet at the lower (west) end to 1600 feet with areas of densest population situated between 1100 feet and 1200 feet. Mountains rise on the north and south sides to 1700 feet and 1600 feet, respectively.

Westfir is a very small (population 255 as of July 2015) isolated rural mountain community that is located along the north fork of the Willamette River about 1 mile NW of Oakridge. Its elevation is about the same as Oakridge and it is surrounded by the same high mountains. Westfir and Oakridge are in opposite steep sided river valleys separated by a 400-foot ridge. The Westfir valley is very narrow, only about 1/4 mile across at its widest point, while the Oakridge valley is about 1 mile across at its widest point.

Air Quality Monitoring

The Oakridge air monitoring station (Site Code WAC, AQS #410392013) has been located at the Willamette Activity Center (WAC) in the southwest portion of the city of Oakridge since 1989. Saturation monitoring studies in 1991 and 1994 (PM_{10}) and 2002-2003 ($PM_{2.5}$) demonstrated the monitor is located in the area of maximum emissions and PM concentrations. The WAC station is part of the SLAMS (State and Local Air Monitoring Stations) network and meets all siting requirements and criteria for the monitoring objective of maximum population exposure at the neighborhood spatial scale.

The WAC sampling method for $PM_{2.5}$ is the filter-based Federal Reference Method (FRM) operating on an every-3rd-day schedule. Other parameters measured at the WAC station include:

- PM_{10} (filter-based FRM on an every-6th-day operating schedule),
- $PM_{2.5}$ with Federal Equivalent Method (continuous beta attenuation),
- Nephelometer (continuous optical backscatter),
- Wind Speed and Direction (continuous propeller/vane),
- Temperature (continuous thermistor at 2 meters and 10 meters height),
- Barometric Pressure (continuous electronic barometer), and
- Solar Radiation (continuous pyranometer).

Additional details, photos, and maps are included in the annual LRAPA Ambient Air Monitoring Network Plan; Figures 3a and 3b are taken from that Network Plan.

Figure 3a: Oakridge WAC Air Monitoring Station.

Figure 3b: WAC Station Location.

Quality-assured data is submitted quarterly by LRAPA to ODEQ and EPA within 60 days of the end of each calendar quarter.

History of Efforts to Address Particulate Matter in Oakridge

The air quality in Oakridge has steadily improved over the past 25 years with comprehensive strategies to reduce the measured concentrations of particulate matter and to address the adoption of progressively more protective national air quality health standards.

The Oakridge Urban Growth Boundary (UGB) was designated nonattainment for PM_{10} and classified as moderate by EPA on January 20, 1994. LRAPA submitted a draft Oakridge PM_{10} attainment plan to EPA Region 10 for stringency review during early 1996. The Oakridge PM_{10} attainment plan was adopted by the LRAPA Board of Directors at a hearing on August 13, 1996. The Oakridge PM_{10} attainment plan was subsequently adopted by the EQC on December 9, 1996, and submitted to EPA. EPA approved the plan on March 15, 1999 (64 FR 12751). The plan relied on control strategies needed to assure attainment of the PM_{10} National Ambient Air Quality Standards (NAAQS). The strategy focused on control of RWC and road dust. Additional reductions were provided by statewide efforts to reduce slash burning smoke.

These control measures were approved by EPA, effective May 14, 1999:

- Accelerated Woodstove Replacement Program through grants and loans (1993-1994); Aggressive Voluntary Residential Wood Burning Curtailment (1996);
- Letter of Agreement from ODOT , July 29, 1996, Use of Anti-icing Chemicals in the City of Oakridge; and
- Road Paving Program (1991-1995).

EPA also approved these contingency measures on March 15, 1999 (64 FR 12751), but the Oakridge area achieved the PM_{10} standards on schedule without triggering the contingency measures:

- City Ordinance 815, Mandatory Wood Heating Curtailment Program, adopted August 15, 1996; and
- OAR 340-262-0310 Removal and Destruction of Uncertified stove upon Sale of Home.

The Oakridge PM_{10} strategies were successful in achieving the PM_{10} standards on schedule. On July 26, 2001, EPA published a finding of attainment for the Oakridge PM_{10} area (66 FR 38947). The Oakridge PM_{10} data for 1988-2014 is outlined in Figure 4.

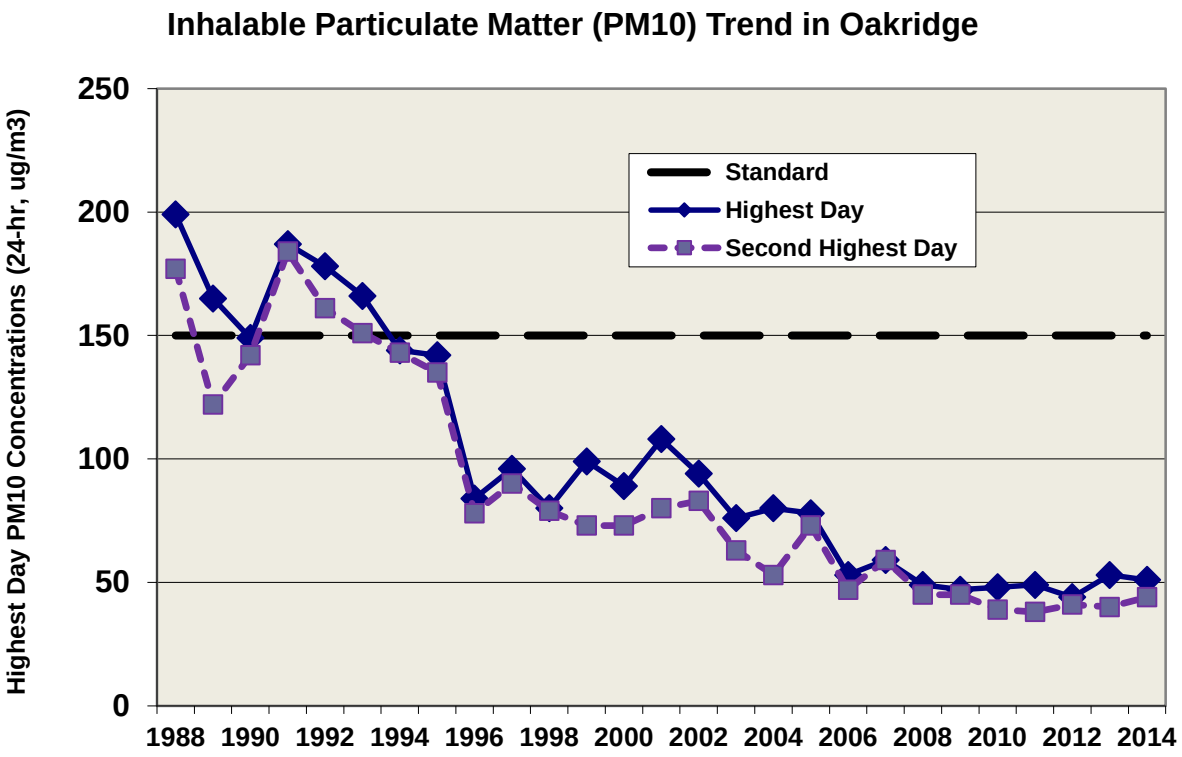


Figure 4: PM_{10} Trend at the Oakridge WAC Monitoring Station.

The 1996 Oakridge PM_{10} attainment plan was successful in not only meeting the PM_{10} standards on schedule, but also meeting the initial national $PM_{2.5}$ standards (65 µg/m^3) adopted by EPA in 1997 as shown in Figure 5.

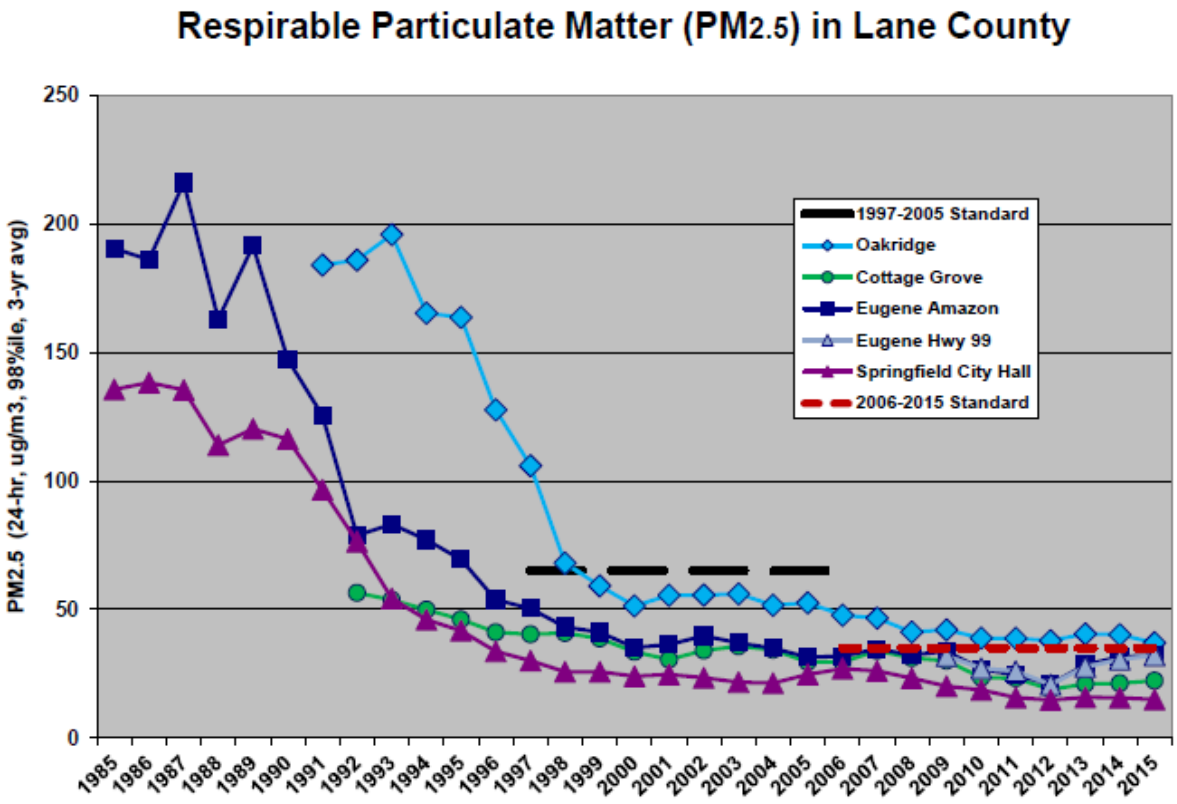


Figure 5: Long-Term $PM_{2.5}$ Trends at the Oakridge and other Lane County Monitoring Stations.

Subsequent national health studies supported a more protective 24-hour national $PM_{2.5}$ health standard, and EPA adopted the 35 µg/m^3 standard in December 2006. Between 2006 and 2011, $PM_{2.5}$ concentrations in Oakridge on worst winter days violated the new 24-hour national health standard. The city of Oakridge, LRAPA, and EQC developed and submitted to the EPA a 2012 $PM_{2.5}$ SIP submittal. The dominant source of $PM_{2.5}$ in Oakridge on the problem winter days was clearly RWC in woodstoves and fireplaces (about 80-88% in the 2008 base year). This is based on $PM_{2.5}$ emission inventories, chemical speciation of particulate filter samples, and diurnal $PM_{2.5}$ concentration fluctuations. Therefore, the new strategies in the 2012 $PM_{2.5}$ SIP submittal focused primarily on RWC emission reductions:

- Woodstove change-out programs;
- Woodstove removal upon sale of home;
- Expanded public education programs;
- Mandatory curtailment program for residential wood burning during periods of air stagnation;
- Enhanced training of police officers on smoke reading for opacity enforcement; and
- Transportation and fuel-related emission reduction programs.

All of these programs are all currently being implemented as committed in the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan. In some cases, the programs are being further strengthened, as discussed under supplemental strategies in the Attainment Plan and Demonstration.

Progress to Meet National Ambient Air Quality Standards (NAAQS)

As mentioned previously, in 2006 and 2012 the EPA revised the $PM_{2.5}$ standards to more accurately reflect the latest health information. EPA revised the 24-hour standard from 65 µg/m^3 to 35 µg/m^3 in 2006, and revised the annual standard from 15.0 µg/m^3 to 12.0 µg/m^3 in 2012. EPA determines compliance with the $PM_{2.5}$ standards based on averaging air quality measurements both annually and on a 24-hour basis.

Annual $PM_{2.5}$ Standard

The annual standard for $PM_{2.5}$ is met whenever the three-year average of the annual mean $PM_{2.5}$ concentrations for a designated monitor is less than or equal to the standard. Oakridge has met the 1997-2011 annual 15.0 µg/m^3 standard since $PM_{2.5}$ monitoring started at Willamette Activity Center in 1998, and has met the 2012 annual 12.0 µg/m^3 standard since 2006. Figure 6 compares the annual average $PM_{2.5}$ in Oakridge to the 1997-2011 and 2012-2016 annual $PM_{2.5}$ standards and to the composite average of the other two long-term monitoring sites (Eugene-Amazon and Springfield-City Hall) in Lane County.

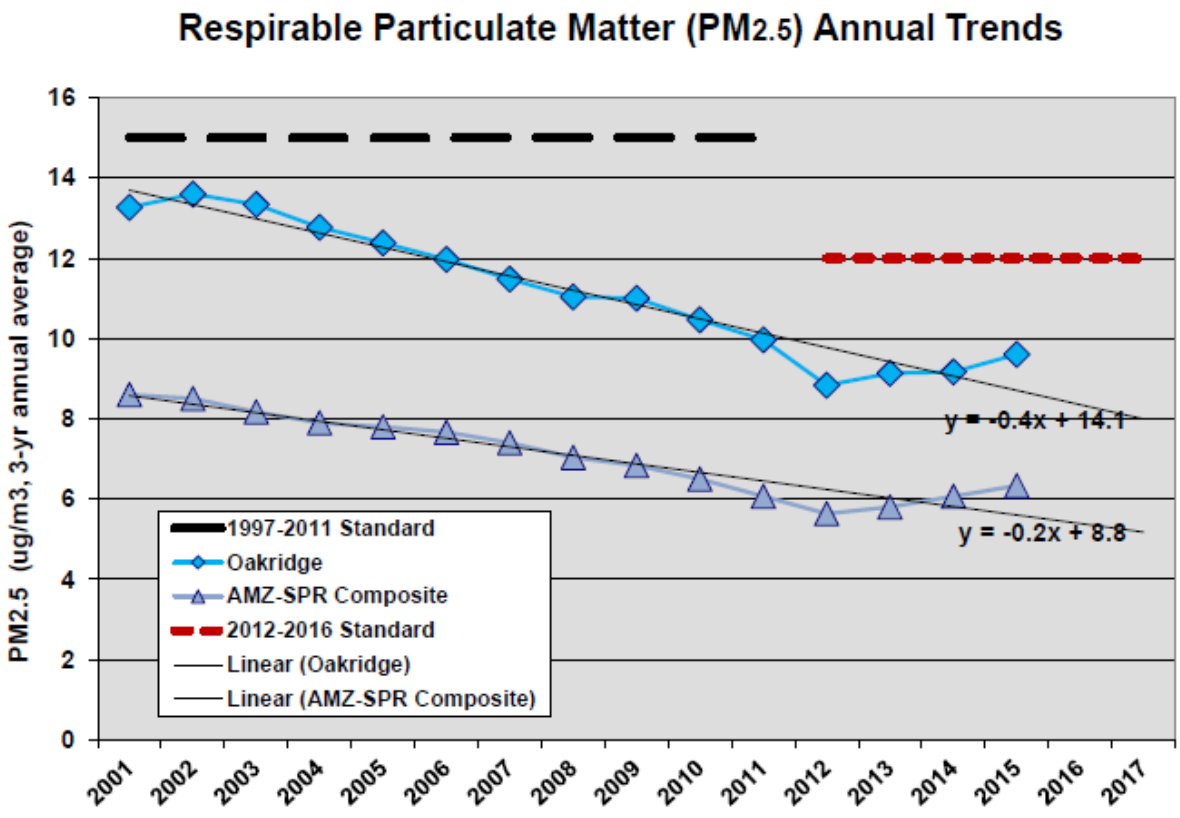


Figure 6: $PM_{2.5}$ Annual Average Trends for Oakridge and Eugene-Springfield.

The trend lines illustrate that the annual average in Oakridge is improving by about 0.4 µg/m^3 per year compared to 0.2 µg/m^3 per year at the composite of the other two long-term Lane County sites. Using the annual $PM_{2.5}$ concentrations at the non-Oakridge sites as a reference, it appears that overall annual average meteorological conditions in 2013-2015 were more adverse than average (and similarly, the conditions in 2010-2012 were better than average). Since all of these monitoring sites are within 40 miles of each other, they would frequently be impacted by the same wildfire events or air stagnation episodes.

24-Hour $PM_{2.5}$ Standard

The 24-hour standard for $PM_{2.5}$ is met whenever the three year average of the annual 98th percentile of values at a monitoring site is less than or equal to 35 µg/m^3. The 98th percentile is a concentration below which 98% of observations fall. This value is used for the 24-hour standard instead of the maximum observation for any given year. By doing so, EPA ensures infrequent peaks are ignored and a more robust value is used for comparison.

From 2001 through 2005, Oakridge was in compliance with the $PM_{2.5}$ standard of 65 µg/m^3. However in 2006, when EPA revised the standard to 35 µg/m^3, Oakridge violated the 24-hour standard. The three year average 98th percentile for the Oakridge monitoring site has continued to violate the 24-hour standard each year since the standard tightened in 2006, but has decreased significantly over the period 2006 - 2015. Figure 7 compares the 98th percentile 24-hour $PM_{2.5}$ in Oakridge to the 1997-2005 and 2006-2016 $PM_{2.5}$ standards and to the composite average of the other two long-term monitoring sites (Eugene-Amazon and Springfield-City Hall) in Lane County.

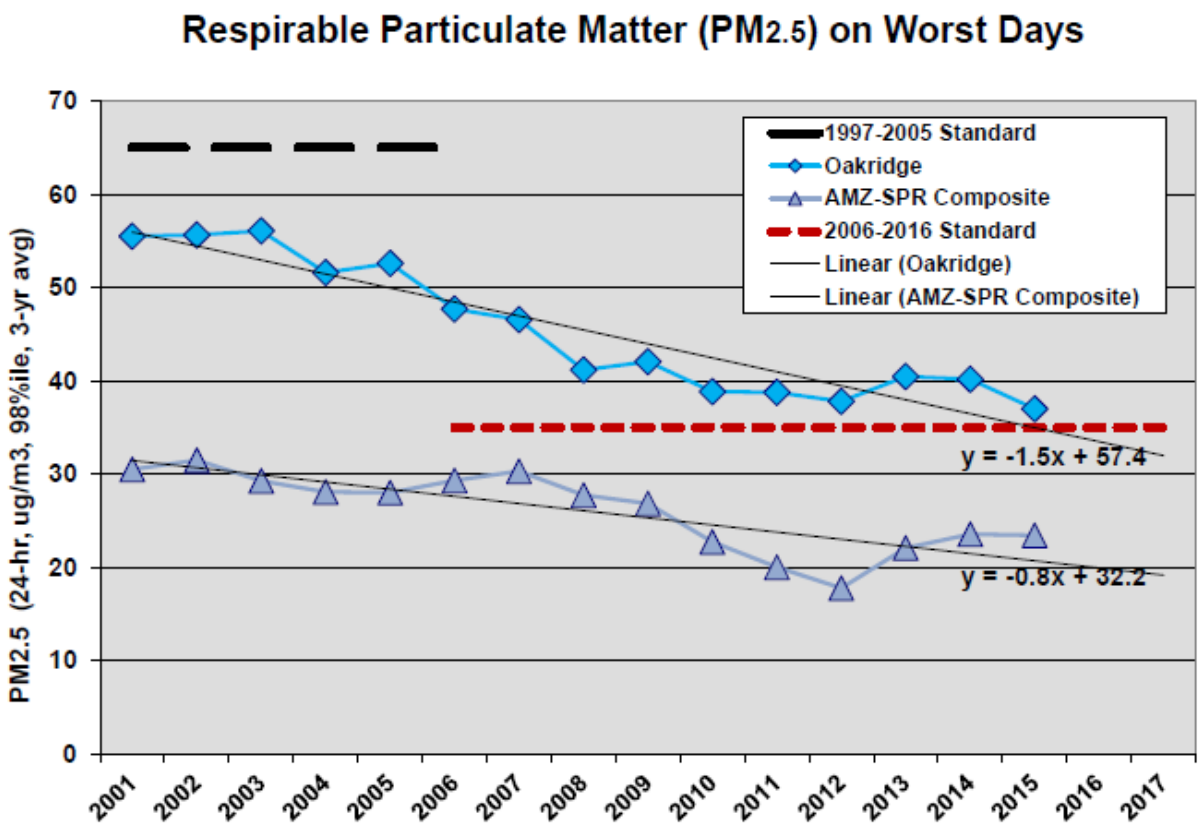


Figure 7: $PM_{2.5}$ Daily 98th Percentile Trends for Oakridge and Eugene-Springfield.

The trend lines illustrate that the 98th percentile in Oakridge is improving by about 1.5 µg/m^3 per year compared to 0.8 µg/m^3 per year at the composite of the other two long-term Lane County sites. Using the worst-day $PM_{2.5}$ concentrations at the non-Oakridge sites as a reference, it appears that meteorological conditions in 2012-2014 and 2013-2015 were more adverse than average (and similarly, the conditions in 2009-2011 and 2010-2012 were better than average). Since all of these monitoring sites are within 40 miles of each other, they would frequently be impacted by the same air stagnation episodes. Wildfire impacts would not be a factor during November-February when the worst-day $PM_{2.5}$ concentrations are measured.

The $PM_{2.5}$ concentrations measured in Oakridge for the calendar year 2015 (28.9 µg/m^3) and the three-year period 2013-2015 (37 µg/m^3) were the lowest measured since $PM_{2.5}$ monitoring began in Oakridge, but the 3-year 98th percentile value of 37 µg/m^3 did not meet the 35 µg/m^3 national $PM_{2.5}$ standard by December 31, 2015 as required by the federal Clean Air Act.

Image 1: EPA and LRAPA Staff at the monitoring station.

Additional Monitoring

In addition to the Oakridge monitoring, investigative monitoring was done during 2009-2010 in the Westfir area to determine $PM_{2.5}$ concentrations there in comparison to the Willamette Activity Center monitor. The results of that investigation were reported in the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan. Westfir $PM_{2.5}$ concentrations were consistently and substantially lower than in Oakridge, supporting the revision of the nonattainment area to the Oakridge Urban Growth Boundary, as was done in the successful 1996 PM_{10} Oakridge Attainment Plan, in order to most effectively focus the limited financial, monitoring and staff resources. This Westfir investigation was augmented by separate LRAPA and ODEQ documentation and analysis to EPA.

ATTAINMENT PLAN AND DEMONSTRATION

Emission Inventory

An emission inventory consists of emission estimates from sources that emit $PM_{2.5}$ within the Oakridge nonattainment area boundary. The emissions inventory data is essential in developing the attainment demonstration, as it helps identify the sources contributing to the air quality problem and the emission reduction strategies, once implemented, that reduce pollution levels below the standard. Sources of $PM_{2.5}$ in Oakridge include minor industry, on-road mobile sources (e.g., car and truck exhaust, road dust), railroads, and area sources (e.g., outdoor burning, woodstoves, and fireplaces).

Base Year Emission Inventory (2008)

The base year emission inventory is used as the starting point for the attainment demonstration. This inventory includes sources in the nonattainment area during the 2008 baseline year.

The 2008 emission inventory is summarized in Table 1 and Figure 8. The calculation procedures are included in Appendix D of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan, except for the on-road emissions which were updated during 2016 using the MOVES 2014a model. See Appendix 1 for details of the MOVES 2014a modeling results. The MOVES 2014a results were very similar to the previous MOVES 2010 modeling results for the 2008 base year.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources(1)				
Oakridge Sand & Gravel: Rock crushing operation	0.4	0.8	0.1%	0.1%
Oakridge Sand & Gravel: Cement plant	0.1	0.1	0.0%	0.0%
Stationary Area Sources				
Residential Wood Combustion: Fireplace(2)	38.5	42.3	7%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert(2)	158.9	174.8	30%	32%
Residential Wood Combustion: Certified Woodstove/Insert(2)	228.0	250.8	43%	45%
Pellet Stoves	6.7	7.4	1%	1%
All Other Stationary Area Sources	47.4	4.7	9%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	29.3	36.9	5%	7%
Re-Entrained Road Dust	12.1	27.8	2%	5%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
Total, All Sources, lbs/day	**527**	**552**		

(1) Worst-case day = Peak month production/20 workdays.
(2) Worst-case day = Peak Heating Degree Day

Table 1: 2008 Estimated Typical Season Day and Worst-Case Design-Day $PM_{2.5}$ Emissions.

The emissions inventory on worst winter days is of most interest since the $PM_{2.5}$ concentrations measured in Oakridge do not meet the current 24-hour $PM_{2.5}$ standard and the peak $PM_{2.5}$ concentrations occur on cold, stagnant days during the November-February wood-heating season. RWC emissions (from certified and non-certified woodstoves, fireplaces, and pellet stoves) account for about 86% of the emissions on worst winter days, as illustrated in Figure 8.

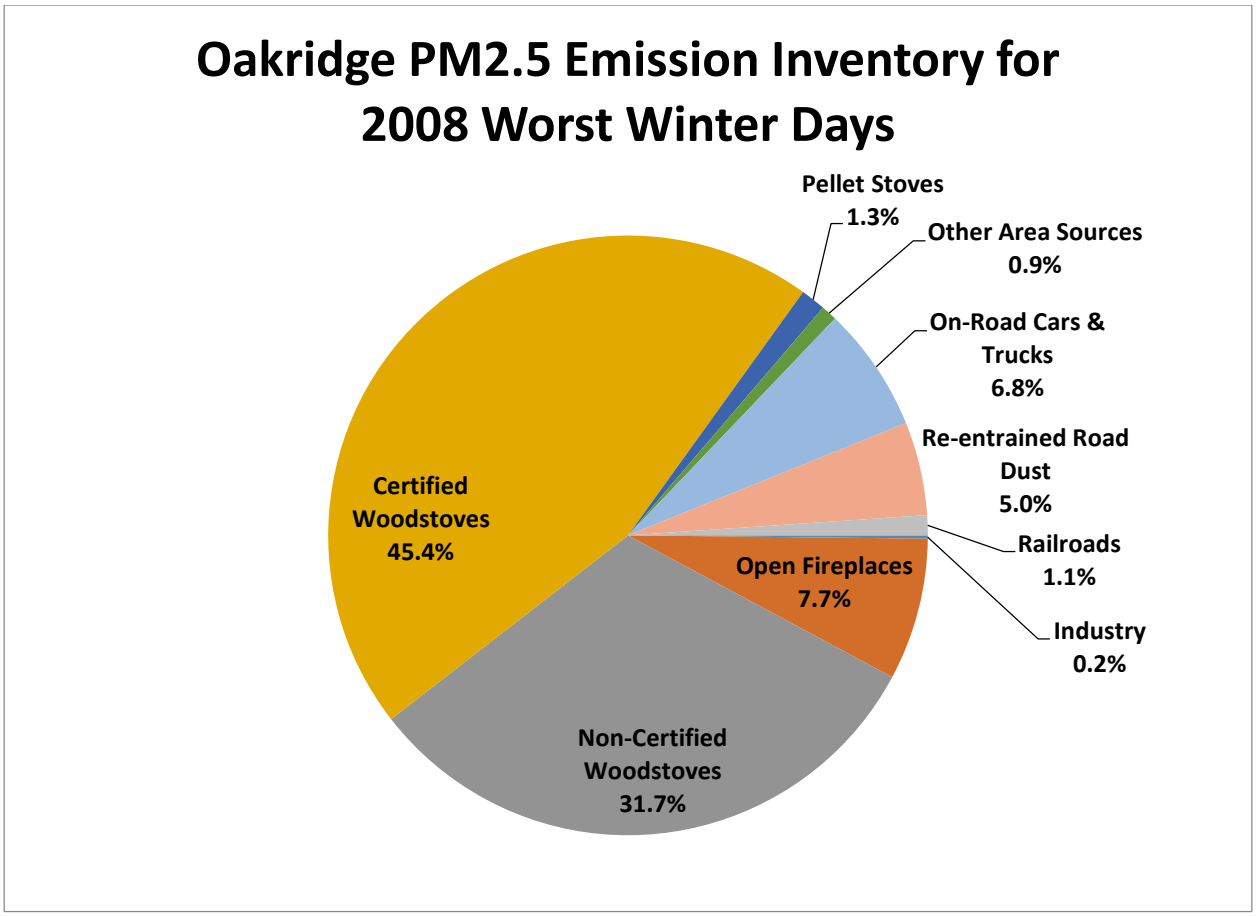


Figure 8: Oakridge $PM_{2.5}$ Emission Inventory for 2008 Worst Winter Days.

Residential Wood Combustion

RWC is a common way to heat homes in Oregon. To estimate emissions from wood burning, LRAPA conducted a survey for the 2009-2010 heating season in Oakridge-Westfir. The survey provided LRAPA with information on how many homes use various types of wood-heating devices, the amount of wood burned, and other information on wood-heating practices.

Mobile and Non-road Sources

Road dust and tailpipe emissions of $PM_{2.5}$ from motor vehicles were calculated by Lane Council of Governments (LCOG) transportation staff by applying emission factors from the EPA MOVES computer program to total vehicle miles traveled in the nonattainment area. Motor vehicle emissions were updated by ODEQ technical services staff in 2016 using the EPA MOVES2014 program. Estimated vehicle miles traveled are from previous transportation modeling by LCOG for the Oregon Department of Transportation. Emissions from railroads were provided by Union Pacific Railroad staff using the EPA NONROAD2008a emissions protocol.

Industrial Point Sources

LRAPA maintains data on industrial point source emissions in Lane County. The only operating industrial point sources within Oakridge-Westfir area are two minor aggregate industry sources operated by Oakridge Sand & Gravel.

Attainment Year Emission Inventory (2015)

The attainment year inventory is an estimation of emissions for the year that the area is expected to have attained the $PM_{2.5}$ standard. It includes projected emissions for the attainment year based on a number of different factors. Growth rates for population, employment, and vehicle miles traveled through 2015 were used to estimate 2014-2016 emissions. LRAPA took credit for emissions reductions as a result of the woodstove replacement project implemented during 2009-2012 that reduced the number of non-certified woodstoves accounted for in the 2008 emission inventory.

The attainment year emission inventory is projected from: the 2008 base-year emissions inventory; estimated growth rates between the 2008 base year and the 2015 attainment year; and the emission reduction strategies that have been implemented during 2009-2014.

Since RWC emissions are the majority of Oakridge $PM_{2.5}$ emissions during the problem winter months, the RWC control measures are the most important part of the Oakridge solution. RWC control measures are closely inter-related and involve changing the woodburning culture and increasing the level of community cooperation over time, so it is somewhat difficult to separate the benefits of the individual control measures due to overlapping effects (for example, improved seasoning of firewood in a cleaner-burning certified woodstove that is curtailed during stagnant air episodes). The emission inventories reflect the overall change in RWC emissions and are based on progressive implementation of the RWC control measures over time. The emission reduction strategies include:

- the continued implementation of control measures that were effective in achieving the PM_{10} standards and the initial (1997) $PM_{2.5}$ standards on schedule (reflected in the 2008 base year emission inventory);
- additional and strengthened control measures developed during 2009-2012, most notably the RWC requirements in Oakridge City Ordinance #903 adopted on November 15, 2012 and including the contingency plan triggered in October 2014 (reflected in the 2015 future year emission inventory); and
- new control measures developed in 2015, including Oakridge City Ordinance #914 adopted on October 15, 2015 (reflected in the 2016 emission inventory for supplemental contingency plan purposes).

The critical air pollution control strategies in Oakridge have been of three types: Ongoing, Long-Term, and Short-Term. Ongoing strategies have included education on cleaner-burning practices such as improved firewood seasoning, use of smaller-hotter fires, avoiding the excessive dampering of the woodstove, etc. Long-term strategies have included replacement of older woodstoves with cleaner burning units (newer certified woodstove, pellet stoves, ductless heat pumps, etc.) and overall housing upgrades including weatherization. The key short-term strategy is the green-yellow-red home wood heating advisory program with mandatory curtailment of wood burning during stagnant air episodes.

The dominant source of $PM_{2.5}$ in Oakridge on the problem winter days was clearly RWC in woodstoves and fireplaces, based on $PM_{2.5}$ emission inventories, chemical speciation of

particulate filter samples, and diurnal $PM_{2.5}$ concentration fluctuations. Therefore, the new strategies in the 2012 $PM_{2.5}$ SIP submittal focused primarily on RWC emission reductions:

- Woodstove change-out programs;
- Woodstove removal upon sale of home;
- Expanded public education programs;
- Mandatory curtailment program for residential wood burning during periods of air stagnation;
- Enhanced training of police officers on smoke reading for opacity enforcement; and
- Transportation and fuel-related emission reduction programs.

These programs are all currently being implemented and further strengthened as outlined below under the Extension Request and Supplemental Strategies section. Control measures implemented before December 31, 2014 are reflected in the 2015 future year emission inventory; control measures implemented during 2015 are reflected in the 2016 emission inventory.

Wood Stove Change-out Program: The Warm Homes wood stove change-out program continued into 2009. Funding from EPA helped replace 11 uncertified wood stoves with new heating devices. In October 2010, LRAPA received funds from the American Recovery and Reinvestment Act. LRAPA used the funding to conduct another round of wood stove change-outs in Oakridge and Westfir. The program offered two-tier funding for qualified residents within the non-attainment boundary designated by EPA. Residents who qualified as low income based on Housing and Urban Development's (HUD) income guidelines received a full rebate of up to $5,000 to pay for a ductless heat pump, certified wood stove, or pellet stove. All other qualified applicants received a rebate of up to $2,000 based on emission reductions. The program ended in December 2011. LRAPA provided rebates to replace 79 stoves. Wood heat was most popular; 56 new wood stoves were installed, 10 pellet stoves, and 13 electric ductless systems.

Oakridge Wood Stove Change-out Programs		
Years	2009	2010-11
# of Stoves	11	79

Table 2: Oakridge Wood Change-out Programs (2009/2010-11)

Due to the effectiveness of this strategy in the past, LRAPA will continue pursuing funds for more woodstove change-outs within the nonattainment area. Implementation of this strategy may provide substantial reductions in $PM_{2.5}$ in the future. LRAPA did not apply any emission credit for this strategy to the 2015 inventory since no additional funding was secured during 2012-2014. In the most recent round of wood stove change-outs during 2010-2011, 75% of the participants qualified as low-income. The poor economy in Oakridge makes it essential any

future change-out incentives include grants to cover the full cost of replacement for low income individuals and substantial incentives to residents who are not "low income".

Heat Smart: Stove Removal upon Sale of Home: In 2010, a statewide requirement mandating the removal of an uncertified stove at the time of home sale went into effect. This statewide rule closely mirrored the existing requirement in the Oakridge ordinance. Under the rule, all uncertified devices that are on the property being sold (including residences, shops, garages, and outbuildings) must be removed at the time of home sale. The Oregon Heat Smart law requires DEQ to confirm residences where owners removed or changed-out uncertified woodstoves upon home sale. DEQ currently administers the Heat Smart program and tracks submittals of all uncertified removals at the time of home sale. Three Heat Smart removals were recorded in Oakridge before December 31, 2014 and are reflected in the 2015 emission inventory. These submittals can be used to estimate the level of compliance in Oakridge and identify any need for additional education or follow-up. DEQ has established in rules, penalties for noncompliance and hopes to conduct periodic enforcement sweeps throughout the state. LRAPA is responsible for Heat Smart implementation in Lane County.

Public Education: LRAPA has maintained a vigorous public education program in Oakridge. In 2009 -2011, the program expanded to reach a wider audience. In 2010, LRAPA produced a television commercial to promote compliance with home wood heating advisories and clean burning practices. The commercial has run every fall on three major television networks; all are available to Oakridge viewers. Radio ads targeting open burning and home wood heating have aired on a network of radio stations in Lane County since 2009. Almost all stations are available in Oakridge.

Articles in the weekly newspaper, the Dead Mountain Echo, serving the Oakridge area have been submitted by LRAPA staff periodically to keep the public informed about poor air quality, LRAPA programs, and other topics related to wood smoke. Display advertisements and fliers inserted into the paper are also used to promote high profile projects, the Warm Homes program being an example. People have also received fliers and articles from LRAPA through the city's water bill mailing list and Lane Electric Co-op's Ruralite magazine.

Every spring, the US Forest Service hosts outdoor school in Oakridge for middle school students. LRAPA attends annually with educational material, presentations, and experiments centered on air quality problems specific to Oakridge.

LRAPA's Public Affairs department has also done several targeted presentations in Oakridge in recent years to publicize the Warm Home Program, elaborate on attainment goals at town hall meetings, and information sessions at the Oakridge Public Library.

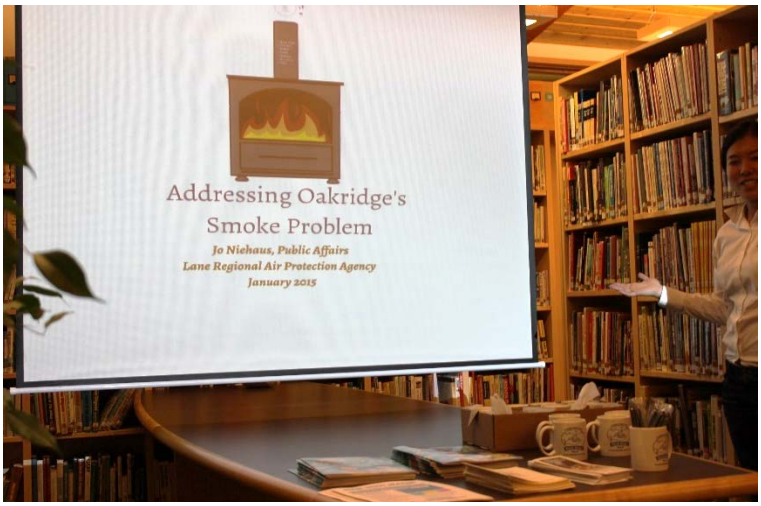


Image 2: Informational session at Oakridge Public Library.

In addition, LRAPA's Public Affairs department has increased access to information about the daily home wood heating advisories and information about burn bans. Residents can find out the daily advisory through an automated phone line, 541-736-HEAT, or go online to the LRAPA website, www.lrapa.org. In 2015, LRAPA activated direct text message and e-mail alerts for burn bans. If people choose to receive messages directly, they can opt in to the LRAPA alert program.

Transportation and Fuel-Related Emissions: Federal, state, and local transportation regulations and programs recently implemented will reduce mobile and non-road emissions. These include:

- Federal regulations requiring:
  - Reduced sulfur content of gasoline and diesel
  - Increased fuel economy
- Oregon regulations requiring:
  - Low emissions vehicles beginning with model year 2009 and newer
  - Renewable fuel standard for biodiesel – 5%
- Local programs:
  - Implementing diesel retrofits of school buses

No specific credit was taken for these mobile source programs in the 2015 attainment year emission inventory other than the normal reductions over time included in the MOVES2014a modeling.

Oakridge is considered an isolated rural nonattainment area, so transportation conformity under 40 CFR 93.109(g) is only needed when a non-exempt federally-funded project is funded or approved. An updated motor vehicle emissions budget (MVEB) of direct $PM_{2.5}$ and precursors based on the updated 2015 emission inventory using MOVES2014a is included in Appendix 4.

Enforcement of Oakridge Ordinance: Oakridge Ordinance #889 (subsequently updated and expanded with Oakridge Air Pollution Control Ordinance #903 and #914) allowed the City to impose a penalty not greater than $500 upon anyone who violates City Code related to the use of a solid fuel heating device. Each day's violation will incur additional fines. The City of Oakridge has enforcement authority of the ordinance. LRAPA has worked with the Oakridge Police Department to train and strengthen enforcement on yellow and red advisory days. LRAPA has provided a series of door hangers that can be left at a residence with an excessively smoky chimney if personal contact is unable to be made. The door hangers include language from the City Ordinance, including potential fines for a violation.

Previous (2012 Plan) Contingency Strategies: The following contingency strategies were adopted to fully meet the air quality standards, when it became clear that the strengthened ongoing strategies described above would not be sufficient to attain the $PM_{2.5}$ standards by 2014:

- Stricter opacity limit on all green or yellow advisory days, revising the previous 40% opacity limit in the city ordinance to a more restrictive 20% limit, as has been done in some other northwest communities. A 20% opacity limit on green and yellow advisory days to help reduce emissions with the goal of avoiding red advisories when no visible emissions are allowed.
- Stricter green-yellow-red advisory program, with more yellow and red advisory days each winter.
- Further restrictions on city woodstove curtailment exemptions (for sole source, economic hardship).

Triggering of Contingency Plan: The particulate concentrations measured in Oakridge for the calendar year 2015 and the three-year period 2013-2015 were the lowest measured in the 25 years of monitoring in Oakridge. However, the 3-year 98th percentile value of 37 $\mu g/m^3$ did not meet the 35 $\mu g/m^3$ national $PM_{2.5}$ standard by December 31, 2015 as required by the federal Clean Air Act. In October 2014, when it became clear that the standards would likely not be met by the Clean Air Act deadline, the City of Oakridge and LRAPA immediately triggered the contingency strategies portion of the 2012 $PM_{2.5}$ SIP submittal to ensure attainment of standards as soon as possible.

Extension Request and Supplemental Strategies: The federal Clean Air Act gives the EPA Administrator discretionary authority to grant a 1-year extension to the attainment date for moderate nonattainment areas such as Oakridge. Two criteria are required to be met: first, the community must have implemented all of the control strategies promised in the 2012 attainment plan; and second, the 98th percentile $PM_{2.5}$ concentration in the community in 2015 had to be less than or equal to the 35 $\mu g/m^3$ standard. In Oakridge, the community has implemented all of the control strategies promised in the 2012 attainment plan, and the 98th

percentile $PM_{2.5}$ concentration in 2015 was 28.9 µg/m^3 which is less than the 35 µg/m^3 standard. Therefore, on December 14, 2015, the City of Oakridge, LRAPA, and the Oregon Department of Environmental Quality (ODEQ) jointly requested that the EPA Administrator grant a 1-year attainment date extension to December 31, 2016.

On May 18, 2016, EPA proposed approval of the 1-year extension of the Oakridge attainment date to meet the 24-hour $PM_{2.5}$ standard from December 31, 2015 to December 31, 2016 (81 FR 31202) on the basis that the CAA criteria for such an extension had been met. On July 18, 2016, EPA finalized its extension decision (81 FR 46612) effective August 17, 2016.

The extension will allow the City of Oakridge and LRAPA to determine the adequacy of the new aggressive control measures implemented since October 2014 to achieve attainment of standards. The supplemental strategies currently being implemented, in addition to those in the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan, include:

1. The City of Oakridge adopted an expanded Air Pollution Control Ordinance (#914) on October 15, 2015, which tightens the exemption process, reaffirms the 20% opacity limits on woodstove emissions, prohibits unseasoned (>20% moisture) firewood, and clarifies other requirements.
2. The City of Oakridge, with LRAPA financial assistance, hired a code enforcement officer effective November 2015, to focus on air pollution control under Ordinance #914 during the winter months. The code enforcement officer has been trained and is currently implementing Oakridge air pollution control ordinances with the assistance of LRAPA field compliance officers. The code enforcement officer and LRAPA field compliance officers have teamed up for over 40 visitations per month to residences with visible smoke during the peak RWC season (November 2015 – February 2016).
3. The City of Oakridge, with LRAPA financial assistance, sponsored a smoke school in November 2015 in Oakridge for police, fire, and public works staff to get certified to document stack opacity readings.
4. LRAPA extended the daily home wood heating advisory from four months (November-February) to eight months (October-May), effective October 1, 2015.
5. Lane Electric Cooperative (LEC) has continued to provide financial assistance for heat pump installations in the Oakridge area since the submittal of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan: 15 installations in 2012, 15 in 2013, 22 in 2014, and 36 in 2015. LEC enhanced its financial assistance and incentives for ductless heat pumps effective October 20, 2015. The number of heat pump installations in 2016 is expected to exceed the record number in 2015. The November 2015 Lane Electric Ruralite Magazine included a Winter Wood Heating article for Oakridge prepared by LRAPA.
6. Firewood seasoning programs and other strategies continue to be pursued under the stakeholder collaborative. The Community Firewood Program was developed by the Southern Willamette Forest Collaborative to provide affordable seasoned firewood (consistent with the requirements of Oakridge City Ordinance #914 described above) to Oakridge and Westfir residents. The seasoned firewood was sold at discounted prices for elderly, disabled, and low-income participants in the Oakridge home wood heating exemption program. The initial 60 cords of firewood were delivered to a covered storage

area, split, moisture tested, and made available for sale on December 11, 2015, by the Collaborative with the assistance of Inbound LLC. Details and updates on this program and the Collaborative are available from: http://southwillamette.wix.com/swfc , and https://www.facebook.com/swfcollaborative.

Image 3: Oakridge Community Firewood Program.

Economic Factors

The economy in Oakridge has shifted from logging-based industries to a more recreation-oriented model. The decline in the harvesting and processing of timber has left Oakridge with no industrial employer or businesses that support the lumber industry. In the 1990s, the population in Oakridge declined sharply as jobs disappeared. Current census figures in Table 3 show only minimal growth between 2000 and 2015, with Oakridge increasing from 3,172 to 3,240, and Westfir decreasing from 280 to 255, over the 15-year period (for a combined 0.1% per year growth rate). Within the civilian labor force, 16% were unemployed in 2010 and 21.7% of all families had incomes below the poverty level. The low cost of living has attracted low-income and unemployed people to Oakridge.

2015 PSU Certified Population Estimates for Lane County and Its Cities

	2000	2014	2015	2014-2015 Numerical Change	2014-2015 Percent Change	2000 - 2015 Annual Average Growth Rate
Oregon	3,421,399	3,962,710	4,013,845	51,135	1.3%	1.1%
Lane County	322,959	358,805	362,150	3,345	0.9%	0.8%
Eugene	137,893	160,775	163,400	2,625	1.6%	1.1%
Springfield	52,864	60,065	60,135	70	0.1%	0.9%
Cottage Grove	8,445	9,840	9,875	35	0.4%	1.0%
Florence	7,263	8,565	8,620	55	0.6%	1.1%
Junction City	4,721	5,620	5,870	250	4.4%	1.5%
Creswell	3,579	5,075	5,125	50	1.0%	2.4%
Veneta	2,762	4,690	4,700	10	0.2%	3.6%
Oakridge	3,172	3,220	3,240	20	0.6%	0.1%
Dunes City	1,241	1,315	1,315	0	0.0%	0.4%
Lowell	880	1,060	1,065	5	0.5%	1.3%
Coburg	969	1,045	1,055	10	1.0%	0.6%
Westfir	280	255	255	0	0.0%	-0.6%
Incorporated (within city limits)	224,069	261,525	264,655	3,130	1.2%	1.1%
Unincorporated	98,890	97,280	97,495	215	0.2%	-0.1%

Data for 2000 are from the decennial Census, and are as of April 1st.
Other annual estimates are from the Population Research Center at Portland State University, and are as of July 1 each year.

Table 3: Population Estimates for Oakridge, Westfir and other cities in Lane County in 2000-2015.

The recreation industry has picked up in Oakridge, with mountain biking being very popular. A hostel, brew pub, and other small businesses have opened to support the visitors attracted to the area. Despite the recent business growth, few jobs have been created. Population and employment in Oakridge are expected to increase only modestly over the next 20 years. The population estimate for the year 2025 is 4,000. Any new employment has been assigned to the potential development of the Oakridge Industrial Park.

Growth Rates

Growth is expected to be low in the Oakridge-Westfir area through 2016. Population, housing, and employment forecasts are expected to increase gradually. VMT growth is based on the previous transportation modeling by LCOG in the Highway 58 corridor.

The 2015 emission inventory is summarized in Table 4. The calculation procedures are included in Appendix D of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan, except for minor updates to the on-road emissions using MOVES 2014a and to the residential wood combustion emissions due to 2012-2014 heat pump installations by Lane Electric Cooperative and non-certified woodstove removals under the HeatSmart requirements (see Appendix 1).

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.1%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	3.5%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	31.7	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	108.4	89.4	23%	23%
Residential Wood Combustion: Certified Woodstove/Insert[2]	243.2	200.7	51%	51%
Pellet Stoves	7.3	8.0	2%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	17.6	22.2	4%	6%
Re-Entrained Road Dust	7.1	16.3	1%	4%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
Total, All Sources, lbs/day	**481**	**397**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table 4: 2015 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.

Comparison of 2008 to 2015 Emissions

The emission inventory shows an overall decrease in emissions for the attainment year (2015) based on the effectiveness of the emission control strategies.

The differences in the 2008 and 2015 emission inventories are the combination of increases due to growth factors and decreases due to emission control measures implemented by December 31, 2014. For example, motor vehicle emissions decreased overall due to progressively cleaner gasoline and diesel fuels and motor vehicles, but part of the emissions decrease was offset by gradual growth in traffic volumes. Industry emissions were conservatively increased to reflect operation at maximum capacity in 2015, but both industrial sources are minor so this did not have a major effect on the 2015 inventory. The most significant category is residential wood-heating; emissions were increased to reflect population growth during 2008-2015, decreased due to non-certified woodstove replacements with cleaner burning units during 2009-2014, and decreased due to improvements in the programs for mandatory curtailment during stagnant air episodes.

Attainment Strategies – Emission Reduction Analysis

This section describes strategies currently in place or those to be implemented to achieve compliance with the 24-hour $PM_{2.5}$ standard. These strategies are expected to improve air quality and meet the $PM_{2.5}$ standard by the required 2015 attainment date.

RACT and RACM. The attainment strategies are required to meet Reasonably Available Control Technologies (RACT) for significant industrial sources and Reasonably Available Control Measures (RACM) for significant area source categories such as residential wood combustion.

The two existing industrial sources in the Oakridge-Westfir area are minor industrial sources of $PM_{2.5}$ emissions. The facilities are a portable rock crusher and a ready-mix concrete plant owned and operated by Oakridge Sand & Gravel.

These two minor sources together emit less than one ton per year of $PM_{2.5}$ emissions and contribute less than 1% to the base year emission inventory. These two minor sources are well below the LRAPA significant emission rate (SER) for $PM_{2.5}$ of 10 tons per year.

The air pollution control technology installed on these sources are the standard for the industry and meet RACT requirements. The rock crusher has water-spray controls and the concrete plant has baghouse controls.

Even the elimination of the emissions from these two sources would not significantly affect progress to meet the $PM_{2.5}$ standard. For example, the worst-day $PM_{2.5}$ concentrations need to be reduced by about one microgram per cubic meter ($\mu g/m^3$) per year in order to meet the $PM_{2.5}$ standard by 2015 (i.e., reduced from 39.5 $\mu g/m^3$ in the 2006-2010 baseline period to 35 $\mu g/m^3$ by the 2015 attainment date). The modeled impact of these two sources if operated at maximum permitted production rates in 2015 is much less than one $\mu g/m^3$, or much less than the annual progress required by 2015. Further, both of these sources consistently operate well below maximum production rates, especially during the winter months when $PM_{2.5}$ concentrations are a problem.

For the Oakridge nonattainment area, the main source of emissions is wood smoke from residential wood combustion, and RACM is applicable to this emission category. The RWC emission control strategies were determined by LRAPA in the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan to be consistent with the RACM requirements for residential wood combustion (EPA-450/2-89-015), and with the triggering of the Oakridge Air Pollution Control Ordinance #903 in October 2014, including a 20% opacity limit, the RWC emission control strategies significantly exceed the RACM requirements.

The RACT / RACM analysis took into account direct $PM_{2.5}$ and the precursors NO_x and SO_2 as required by the 2007 implementation rule. Preliminary analysis of the airshed found very little contribution of local sources to secondary sulfate and nitrate relative to direct $PM_{2.5}$. Since the total local emissions of NO_x and SO_2 are not a major factor in ambient $PM_{2.5}$ at the violating monitor, it was a reasonable hypothesis that small changes in that total NO_x and SO_2 emission budget would be a very minor factor in $PM_{2.5}$ in Oakridge relative to primary $PM_{2.5}$ emissions. Thus the attainment model was simplified to not take attainment credit for emission changes in $PM_{2.5}$ nitrate and sulfate precursors. LRAPA is confident that direct $PM_{2.5}$ is the cause of (and solution to) $PM_{2.5}$ nonattainment and that there is little opportunity for reducing $PM_{2.5}$ through emission reductions of NO_x and SO_2.

Estimated Reductions and Credits for Future Strategies

The emission changes between 2008 and 2015 are due to the combination of increases due to growth factors and decreases due to emission control measures through December 31, 2014.

The most significant category is residential wood-heating; emissions were increased in the 2015 inventory to reflect population growth during 2008-2015, decreased due to non-certified woodstove replacements with cleaner burning units during 2010-2012, and decreased due to 2012-2014 improvements in the programs for curtailment during stagnant air episodes. The emission decrease due to woodstove replacements was based on the actual number of woodstove replacements documented after the 2008 baseline year.

Most of the improvement in the $PM_{2.5}$ annual average in Oakridge was in November-February (0.6 µg/m^3 per year improvement in the seasonal average) when the RWC strategies were most effective, compared to 0.2 µg/m^3 per year improvement the rest of the year (March-October) when the RWC strategies were less applicable. This is illustrated in Figure 9.

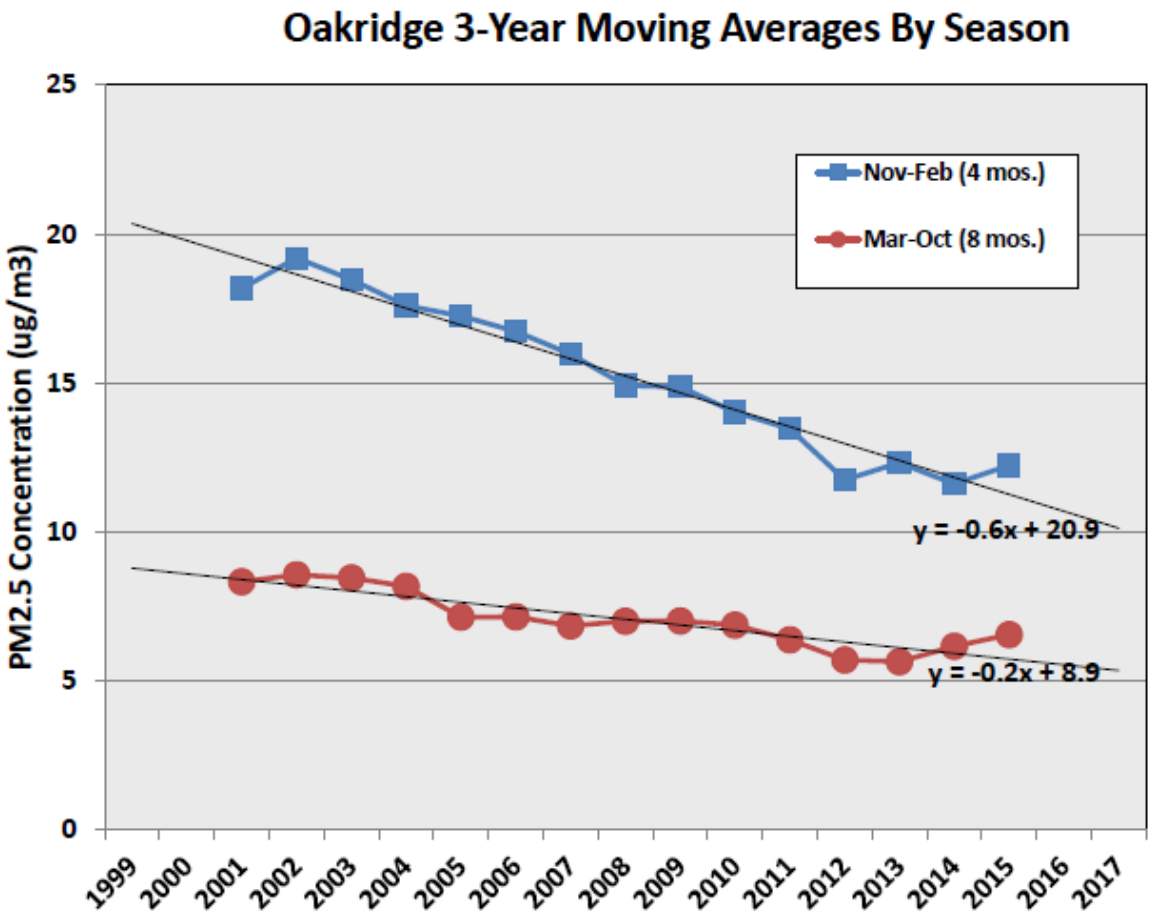


Figure 9: $PM_{2.5}$ Seasonal Trends for Oakridge.

The emission decrease for the more effective woodstove curtailment program is conservatively estimated at a 30% emission reduction on worst winter days as a result of enforcement of the existing city ordinances during stagnant air episodes subsequent to the 2006-2010 baseline

period; mandatory curtailment programs in Oregon have historically documented reductions of 50% or more.

Traffic volumes are projected to gradually increase in future years but motor vehicle emissions are calculated to decrease overall due to progressively cleaner gasoline and diesel fuels and motor vehicles. Industry emissions were conservatively increased in the inventory to reflect operation at maximum capacity in 2015, but both industrial sources are minor so this did not have a major effect on the 2015 emission inventory.

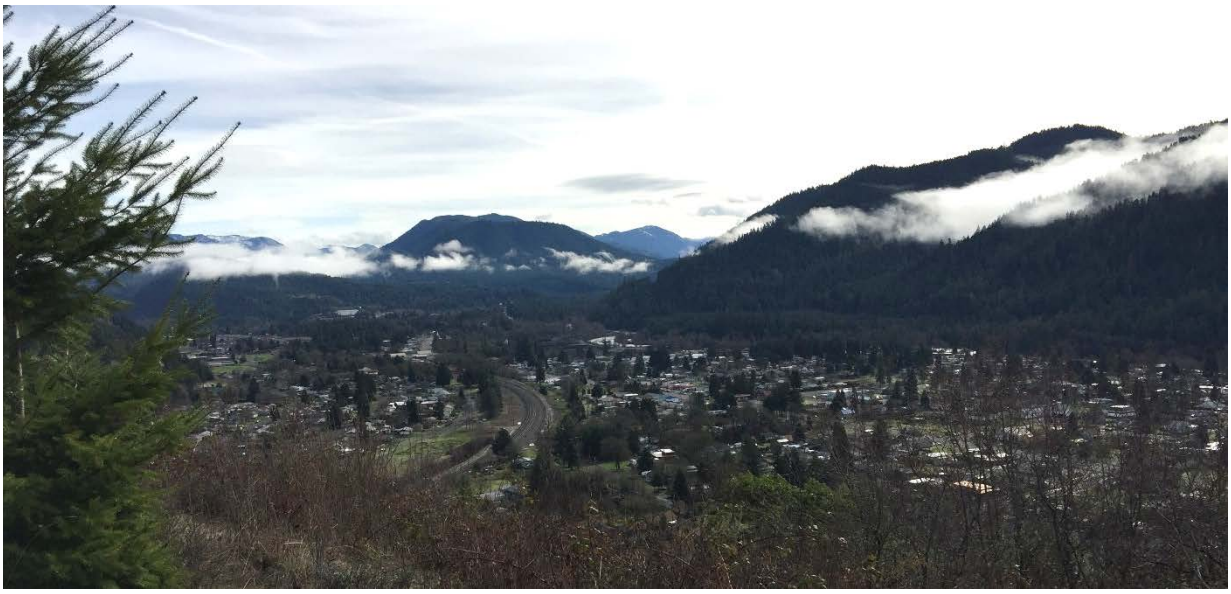


Image 4: Oakridge showing Highway 58 running through the middle.

Attainment Demonstration

The attainment demonstration shows how Oakridge will meet the $PM_{2.5}$ standard by 2015 through the implementation of control measures listed above. LRAPA used a "proportional rollback/rollforward analysis" or rollback model to conduct the analysis. The goal of this section is to demonstrate that future concentrations are less than the NAAQS at the Willamette Activity Center monitor and other unmonitored parts of the designated nonattainment area.

Baseline Design Value

The demonstration starts with estimating the baseline design value, or baseline concentration, for $PM_{2.5}$. The baseline design value is a statistic, expressed as a concentration that describes the $PM_{2.5}$ levels at the Willamette Activity Center monitor relative to the NAAQS. The procedure for its calculation is presented in Appendix N to 40 CFR 50, "Interpretation of the National Ambient Air Quality Standards for Particulate Matter" and "EPA Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for O_3, $PM_{2.5}$, and Regional Haze". $PM_{2.5}$ measurements from 2006 to 2010 are used to calculate the design value of 39.5 $\mu g/m^3$ (see Table 5). Detailed methods on the baseline design value calculation are in Appendix G of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

Year	$PM_{2.5}$ ($\mu g/m^3$)
2006	38.6
2007	42.7
2008	38.7
2009	41.3
2010	33.0
Baseline DV	**39.5**

Table 5: Annual $PM_{2.5}$ values used to calculate baseline design value.

Background on Precursors

Speciated $PM_{2.5}$ samples were collected at Willamette Activity Center for the period July 2009-2011. The samples showed the dominance of organic and elemental carbon, with secondary inorganic aerosol nitrate and sulfate comprising relatively minor concentrations of total $PM_{2.5}$. Concern had been expressed about the role of secondary organic aerosols (SOAs) as components of total organic carbon, and an additional analysis was conducted by a research scientist at Portland State University (PSU) in collaboration with ODEQ to better understand the magnitude of these aerosols in the Klamath Falls, Oregon air shed. The results of this analysis showed that the contributions from both biogenic and anthropogenic sources to be minor, less than 1% and 3%, respectively, of total design value $PM_{2.5}$. In consultation with EPA, LRAPA chose to adopt these percent contributions as a conservative assumption for the Oakridge NAA demonstration. Because all secondary aerosols were determined to be minor contributors to total $PM_{2.5}$, these components and their concentrations are held constant in the rollback model and assigned a Relative Response Factor (RRF) of 1.0, assuming future year precursor concentrations are constant or declining. The precursor emissions to secondary aerosols, including NO_X, SO_2, ammonia, and biogenic and anthropogenic VOCs, are not used in the attainment demonstration (LRAPA is utilizing a rollback analysis for the attainment demonstration).

In addition to the study of secondary aerosols, a positive matrix factorization (PMF) study based on the speciated data from Willamette Activity Center was conducted by EPA Region 10 to identify likely sources of speciated $PM_{2.5}$. The study showed the importance of residential woodsmoke to the high levels of organic carbon, an estimated 70-75% of total PM concentrations.

The Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbonaceous Material Balance Approach (SANDWICH) speciation formulation, based on adjusted and corrected Willamette Activity Center speciation data, is used to speciate the FRM measured design value (DV) for use in the rollback model. The SANDWICH is a profile of the DV with which to describe the components that contribute to $PM_{2.5}$ exceedances. This profile is shown in Figure 10, and shows that over 95% of total PM is from organic and elemental carbon with smaller amounts of secondary inorganic aerosols, such as sulfate (1%) and nitrate (0.4%). The SANDWICH analysis,

and the PMF study are described in more detail in Appendix E.1 and Appendix E.2 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan. Based on the evidence cited above, the major sources contributing to nonattainment in Oakridge are considered to be those that emit direct emissions of $PM_{2.5}$. As a result, LRAPA has focused its strategies for the attainment demonstration on these sources.

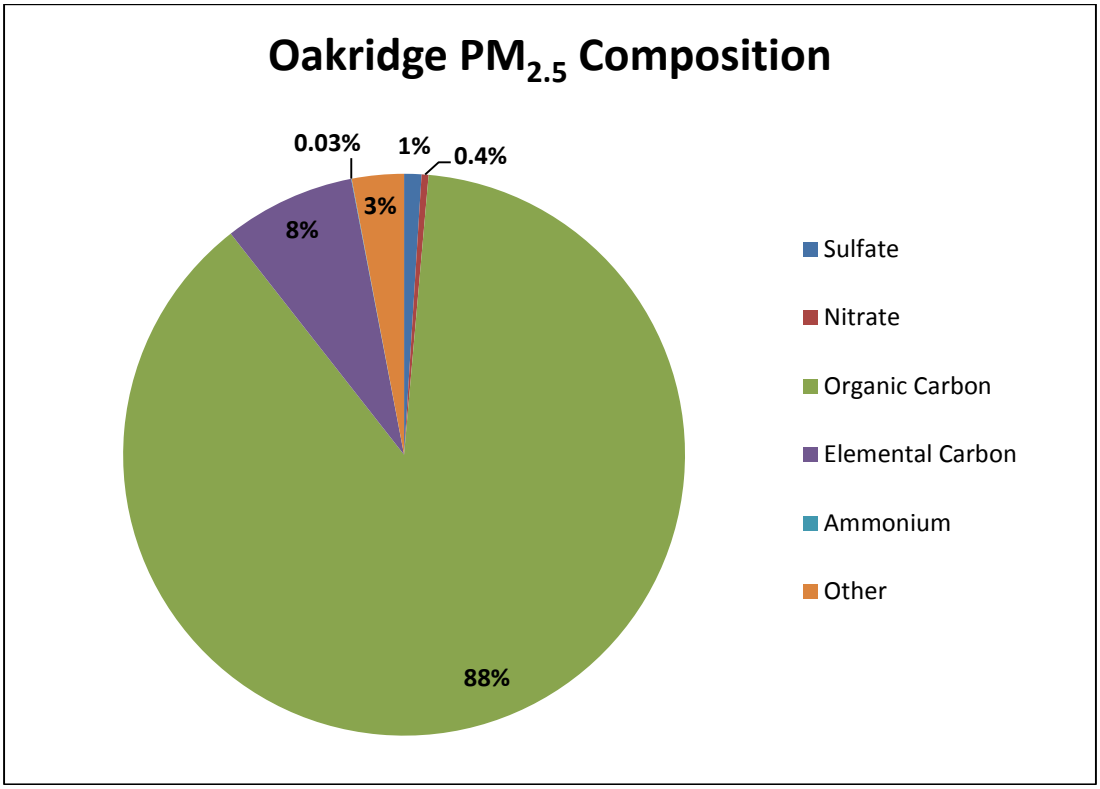


Figure 10: Speciated Components of $PM_{2.5}$ (using SANDWICH analysis).

Speciated Filter Sample Analysis

$PM_{2.5}$ is a mixture and can be divided into major components: mass associated with sulfates, nitrates, ammonium, organic carbon, elemental carbon, particle bound water, and other primary inorganic particulate matter. Percent contribution to the total mass by each of these major components is used to estimate relative contribution by different emission sources.

From July 2009 to 2011, LRAPA conducted $PM_{2.5}$ speciation monitoring at the Willamette Activity Center location. Total $PM_{2.5}$ mass measurements using the FRM are used mainly to determine attainment or nonattainment of the standard. However, to provide information about particular source contribution to that total mass it was necessary to co-locate a speciation sampler that allows the breakdown of the total mass into different chemical species.

The total mass of $PM_{2.5}$ using the FRM sampler is not equal to the simple sum of the measured components from the speciation filter, therefore it is necessary to make adjustments to

represent FRM mass. In order to apply the results of the speciated filter analysis to the aerosol mass measurements, EPA Region 10 conducted the Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbonaceous Material Balance Approach (SANDWICH) which is the default method in EPA modeling guidance to define baseline $PM_{2.5}$. The SANDWICH approach uses a combination of speciation measurements and modeled estimates to represent FRM $PM_{2.5}$ measurements. The goal is to reconstruct the measured speciated components so that they add up to the measured FRM $PM_{2.5}$ mass. Table 6 shows the results as percent contribution by a speciated component (sulfates, nitrates, organic carbon (OC), elemental carbon (EC), ammonia (NH_3), and other primary particulate (OPP)). Detailed methods of the SANDWICH analysis are included in Appendix E.1 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

Parameter	Sulfate	Nitrate	OC	EC	Water	NH3	OPP
Percent	1.1	0.4	88.4	7.6	1.4	0.03	1.1
ug/m3	0.43	0.16	34.46	2.95	0.54	0.01	0.44

Table 6: Contribution by speciated components, based on results of SANDWICH analysis for the top 25% high concentration winter (October-March) days.

LRAPA consulted with EPA Region 10 to ensure that the SANDWICH analysis satisfied the requirements for a comprehensive precursor analysis. Each of the precursor groups in Table 6 was determined to be below the Region 10 insignificance threshold of 1.3 ug/m3:

- Nitrate + ammonia = 0.16 ug/m3 + 0.01 ug/m3 = 0.17 ug/m3 < 1.3 ug/m3.
- Sulfate = 0.43 ug/m3 < 1.3 ug/m3.

Minor $PM_{2.5}$ Components

In addition to the speciated components in Table 6, ODEQ, in partnership with Portland State University, examined contribution by secondary organic aerosols in Klamath Falls, Oregon and found it to be relatively low. Anthropogenic secondary organic aerosols (SOA) contribute 3% (1.17 ug/m3) and biogenic 1% to the total measured $PM_{2.5}$ mass. LRAPA chose to adopt these percent contributions as a conservative assumption for the Oakridge NAA demonstration. Even the conservatively-estimated anthropogenic SOA of 1.17 ug/m3 was less than the EPA Region 10 insignificance threshold of 1.3 ug/m3.

Secondary organic aerosols and the other minor components sulfate, nitrate, and background EC and OC are assumed to be constant in rollback modeling. More details about this analysis are included in Appendix E.1 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

Each source emits a different proportion of OC, EC, and OPP, the three components used to develop a speciated emissions inventory. This proportion, or the speciation profiles, for each source category are taken primarily from EPA SPECIATE 4.2 and 4.3 databases. The following source categories are included in the analysis:

1	Cement Production
2	Sand and gravel mining
3	Fireplace
4	Woodstove Insert Non-Cert
5	Woodstove Insert Cert (Non-Cat)
6	Pellet / Woodstove Cert
7	Ag and open burn
8	Rail
9	Passenger Vehicles - light diesel
10	Trucks - Heavy diesel
11	Passenger Vehicles - gas
12	Vehicle Road Dust

Table 7: Source categories with speciation profiles.

Rollback Model

In evaluating the appropriate modeling analysis of $PM_{2.5}$ for Oakridge, LRAPA considered many different modeling approaches, including rollback and more sophisticated methods such as dispersion modeling. However, both dispersion and receptor are more resource intensive and do not offer substantial improvements in demonstrating attainment under conditions that exist in Oakridge. A rollback model can simulate worst case day conditions when stagnant conditions and slow emissions movement within the nonattainment area occur.

Oakridge is particularly well suited for a rollback demonstration because of a) the relatively small area of the NAA, b) the bowl shape of the local airshed and the presence of inversions and low mixing heights during evening hours when measured particulates are highest, c) the very few types of emissions sources in the NAA, with home wood heating devices dominating the emissions. Based on these considerations, LRAPA has chosen a rollback model for the area.

The rollback model is based on the assumption that there is a direct correlation between emissions of a pollutant and measured concentrations of that pollutant in the same airshed, and that changes in emissions will result in corresponding changes in concentration. This correlation is used to predict future concentrations based on future emissions. The change in concentrations caused by changes in emissions is represented by the Relative Response Factor (RRF). An RRF less than one indicates a reduction in future concentrations, RRF equal to one indicates no change, and RRF larger than one indicates an increase. RRFs are calculated for each speciated component (EC, OC, and OPP) used in the rollback model. Details of the analysis are presented in Appendix H of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan. The results show a cumulative RRF = 0.696, which indicates a decrease in future concentrations. After the cumulative RRF is applied to the input data for the baseline design value, the results are used to calculate a future 2015 design value of 29.3 $\mu g/m^3$.

Year	Baseline DV $PM_{2.5}$ (µg/m^3)	Future DV $PM_{2.5}$ (µg/m^3)
2006	38.6	28.6
2007	42.7	31.6
2008	38.7	28.7
2009	41.3	30.8
2010	33.0	24.5
Design Value	**39.5**	**29.3**

Table 8: Baseline and Future projected design values.

The future ambient concentration levels are below the NAAQS (35 µg/m^3) for a 24-hour average and the attainment of the standard is demonstrated with the application of the current strategies in place. The current reduction strategies implemented through December 31, 2014 and described earlier in this section lower the emissions enough to meet the NAAQS at the Willamette Activity Center monitor.

Modeled Air Quality Improvements of the Key RWC Strategies

The key long-term permanent residential wood combustion (RWC) strategies have been:

- the woodstove change-out programs replacing uncertified woodstoves with cleaner burning and more efficient home heating units;
- the Oregon and EPA woodstove certification programs requiring any new woodstoves installed since 1986 to be certified woodstoves; and
- the Oakridge ordinance and Oregon Heat Smart law requiring removal of uncertified woodstoves upon home sale.

These programs have been critical to the significant improvement in Oakridge $PM_{2.5}$ concentrations during 2001-2015 as outlined in Figures 6 and 7. In addition, the combined emission reduction of these programs will more than offset the growth in population and housing between 2008 and 2015, with a net RWC emission reduction of about 35 lb/day on typical season days and 38 lb/day on worst-case days and reduce future $PM_{2.5}$ concentrations by 2.6 µg/m^3 on worst-case days.

The key short-term RWC strategy is a strengthened mandatory curtailment program to reduce fireplace and woodstove emissions by 25% on an average of 20 red days per year (based on the number of days above 30 µg/m^3 $PM_{2.5}$ during 2005-2011). This will reduce RWC emissions by 107 lb/day and reduce future $PM_{2.5}$ concentrations by 7.1 µg/m^3 on worst-case days.

Additional details on the modeled air quality improvements due to these emission reductions are included in Appendix H (Rollback Analysis) and Appendix J (Residential Wood Combustion RACM) of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan and the air quality impact results are updated in Appendix 1 of this Updated Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

Unmonitored Area Analysis

The previous section describes the demonstration of attainment at the Willamette Activity Center monitor. In addition, a supplemental analysis was conducted to examine future design values away from the Willamette Activity Center, both within Oakridge and in the neighboring city of Westfir. The unmonitored area analysis is based on a 2002–2003 saturation survey of Oakridge, and the 2009-2010 monitoring of Westfir. These monitoring efforts are described in greater detail in Appendix A of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

The ratio of average concentration at each of these monitors to the average concentration at Willamette Activity Center is applied to the baseline design value at Willamette Activity Center to establish a "baseline" design value for each monitor. The same ratio is then applied to the Willamette Activity Center future design value to estimate a future design value for each site. Since there is currently only one small point source in the emissions inventory for Oakridge, a dispersion modeling exercise to estimate source impacts was deemed unnecessary.

In both monitoring efforts referenced here, the Willamette Activity Center was the location of the highest observed concentration. Base and future design values for all monitored locations were below the NAAQS, indicating that the Willamette Activity Center concentration is the highest in the area. More detail of the unmonitored area analysis is available in Appendix A.

Application of Future Strategies

Including continuing and strengthening current strategies, the rollback model shows that the Oakridge non-attainment area will achieve the standard of 35 $\mu g/m^3$ by 2015. At 29.3 $\mu g/m^3$, the future design value includes a buffer for potential variation while still meeting the standard. The actual 24-hour 98th percentile $PM_{2.5}$ concentration recorded during calendar year 2015 was 28.9 $\mu g/m^3$. The results of the rollback at Willamette Activity Center show a cumulative RRF of 0.70 with current strategies and future strengthening of these strategies recommended by the committee. Table 9 shows the estimated emissions, and proportional concentrations, based on all current attainment strategies implemented prior to 2015:

Source Category	Base Year 2008		Future Year 2015	
	Emissions %	$PM_{2.5}$ µg/m3	Emissions %	$PM_{2.5}$ µg/m3
Residential Wood Combustion	79.6%	31.4	75.6%	22.2
Industry	0.0%	0.0	1.2%	0.3
On-Road Vehicles	8.4%	3.3	6.8%	2.0
Other	2.1%	0.8	2.8%	0.8
Background & Secondary Aerosols	9.9%	3.9	13.6%	4.0
Total	100.0%	**39.5**	100.0%	**29.3**

Table 9: Allocation of emissions and modeled concentrations for base and future year.

Contingency Plan

The attainment plan must contain contingency measures that would be implemented in the event that the Oakridge nonattainment area fails to meet the standard by the Clean Air Act deadline, or measures beyond those necessary to meet standards by the CAA deadline. The contingency measures are designed to correct the violation of the $PM_{2.5}$ standards and be implemented immediately. EPA requires that any contingency measures must equal one-year equivalent of reasonable further progress (RFP).

In Oakridge, the worst-day $PM_{2.5}$ concentrations need to be reduced by about one microgram per cubic meter (µg/m^3) per year in order to meet the $PM_{2.5}$ standard by 2015 (i.e., reduced from 39.5 µg/m^3 in the 2006-2010 baseline period to 35 µg/m^3 by the 2015 attainment date). Therefore, the RFP requirement in Oakridge is slightly less than one µg/m^3 of further reduction.

Supplemental Strategies Already Underway to Further Insure Attainment on Schedule

This Updated Oakridge-Westfir $PM_{2.5}$ Attainment Plan includes the following contingency strategies implemented during 2015 to further insure full attainment of the $PM_{2.5}$ air quality health standards by the one-year extension date of December 31, 2016 (based on 2014-2016 data) and to maintain compliance with the standards through 2025 and beyond:

- Stricter green-yellow-red advisory program, with more yellow and red advisory days each winter, by reducing the advisory thresholds by 5 µg/m^3 in the Oakridge Air Pollution Control Ordinance #914; this is projected to increase the average number of potential red advisory days by five days per year.
- Expanded field compliance with a dedicated Oakridge Police Department compliance officer effective November 2015 with assistance of LRAPA field compliance officer.
- Stricter opacity limit, revising the historical 40% opacity limit to the more restrictive 20% limit in the Oakridge Air Pollution Control Ordinance #914.
- Further restrictions on city woodstove curtailment exemptions (for sole source, economic hardship), including inspections of all exempt households to verify whether sole source and to evaluate eligibility for weatherization and ductless heat pump programs beginning in July 2016.

The field compliance improvements in the contingency plan were not made until the second half of 2015, so the curtailment effectiveness during 2015 was estimated at 25% rather than the expected future target of at least 30% effectiveness. As outlined in the earlier section on Attainment Demonstration, a 25% RWC mandatory curtailment program is projected to reduce RWC emissions by 107 lb/day and reduce concentrations on worst-case days by 7.1 $\mu g/m^3$ in 2015. With the more restrictive red advisory criteria and the increased frequency of curtailment enforcement (warnings and citations) during the latter part of 2015 and in 2016, 30% RWC curtailment is projected on worst days in 2016; this will reduce RWC emissions by 132 lb/day (an additional reduction of 25 lb/day from 2015) and concentrations on worst case days by 8.7 $\mu g/m^3$ (an additional reduction of 1.7 $\mu g/m^3$). The 2016 emission inventory is included in Appendix 1.

In summary, the contingency measures for stronger enforcement on more red advisory days are expected to increase the curtailment effectiveness from 25% to 30%, reduce RWC emissions by an additional 25 lb/day, and reduce concentrations on worst case days by an additional 1.7 $\mu g/m^3$; this would more than achieve the one $\mu g/m^3$ target needed to meet the EPA RFP test for contingency plans. The 2016 emission inventory and 2016 impacts are outlined in Table 10 and Table 11.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.1%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	3.8%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	29.6	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	109.1	84	23%	23%
Residential Wood Combustion: Certified Woodstove/Insert[2]	237.4	182.8	50%	49%
Pellet Stoves	7.3	8.0	2%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	16.3	20.5	3%	6%
Re-Entrained Road Dust	7.1	16.3	1%	4%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
Total, All Sources, lbs/day	**475**	**370**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table 10: 2016 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.

Source Category	Base Year 2008		Future Year 2016	
	Emissions %	$PM_{2.5}$ µg/m3	Emissions %	$PM_{2.5}$ µg/m3
Residential Wood Combustion	79.6%	31.4	74.1%	20.5
Industry	0.0%	0.0	1.2%	0.3
On-Road Vehicles	8.4%	3.3	7.3%	1.9
Other	2.1%	0.8	3.0%	0.8
Background & Secondary Aerosols	9.9%	3.9	14.5%	4.0
Total	100.0%	**39.5**	100.0%	**27.5**

Table 11: Allocation of emissions and modeled concentrations for base and future year 2016.

The highest $PM_{2.5}$ day recorded during the first ten months of 2016 (January-October) was 26.8 µg/m^3 on February 9, 2016. The running 12-month 98th percentile $PM_{2.5}$ concentration for Q3-2015 through Q2-2016 (i.e., July 2015 through June 2016) was 21.7 µg/m^3. This data supports the expectation that the calendar year 2016 $PM_{2.5}$ concentrations will be lower than the 28.9 µg/m^3 98th percentile $PM_{2.5}$ concentration recorded during calendar year 2015, consistent with the modeled 2016 98th percentile $PM_{2.5}$ concentration of 27.5 µg/m^3 in Table 11.

Supplemental Contingency Plan – Conditional Strategies If Needed

The Updated Oakridge-Westfir $PM_{2.5}$ Attainment Plan includes the following strategies as contingency strategies to automatically go into effect upon notice by EPA that standards were not fully achieved by December 31, 2016:

- Stricter green-yellow-red advisory program, with more red advisory days each winter, by reducing the red advisory thresholds by 3 µg/m^3 in the Oakridge Air Pollution Control Ordinance; this is projected to increase the average number of potential red advisory days by three to five additional days per year.

- Prohibition of fireplace use on yellow advisory days (in addition to the existing prohibition on red advisory days).

These conditional provisions are being included in the Oakridge City Ordinance in parallel with the development of this Updated Oakridge-Westfir $PM_{2.5}$ Attainment Plan. If the standards are not met by December 31, 2016, the number of red curtailment days would be increased and the frequency of curtailment enforcement (warnings and citations) would be increased accordingly in order to increase the effectiveness of the curtailment to 40% on worst case days. Using these contingency strategies to increase curtailment effectiveness to 40% is expected to reduce RWC emissions by 42 lb/day and reduce $PM_{2.5}$ concentrations by an additional 2.8 $\mu g/m^3$ on worst case days. These contingency measures would more than achieve the one $\mu g/m^3$ target needed to meet the EPA RFP test.

Overview Summary of RWC Strategies

The $PM_{2.5}$ emission reductions and air quality improvements discussed in the previous sections are summarized in Table 12. Table 12 also indicates the implementation timeframes, the corresponding emission inventory, and the Oakridge Air Pollution Control Ordinance that was in effect.

	Reductions on Worst Winter Days		Time	Emission	Oakridge	Ordinance
RWC Strategy Category	**lb/day**	**ug/m3**	**Period**	**Inventory**	**Ordinance**	**Date**
Long-Term RWC Strategies	38	2.6	2009-2014	2015	#903	Oct-2012
Short-Term Curtailment	107	7.1	2009-2014	2015	#903	Oct-2012
Supplemental Underway	25	1.7	2015	2016	#914	Oct-2015
Conditional Contingency	42	2.8	Future	Future	#920	Oct-2016

Table 12: Summary of $PM_{2.5}$ emission reductions and air quality improvements from RWC strategies.

Quantitative Milestones (QM)

Section 189c of the federal Clean Air Act requires quantitative milestones which demonstrate that continued progress is being made until attainment of standards. The quantitative milestones for Oakridge include:

- Quality-assured air quality data for the previous calendar year, including upload to the EPA Air Quality System (AQS), will be provided within 60 days of the end of each quarter to confirm attainment of health standards in 2014-2016 and future time periods.
- Oakridge air quality data will be compared to other air monitoring stations in Lane County, as illustrated in Figures 6 and 7, by June 30th of each year to evaluate the relative severity of meteorology during each 1-year and 3-year period.
- In addition to the usual comparison of calendar year air quality to the health standards, the most recent 12-months of air quality data will be compared to standards at the end of each winter (i.e., at the end of Q1) by June 30th of each year, since the highest concentrations occur on stagnant winter days.

- The effectiveness of the mandatory curtailment program and other elements of the Oakridge Air Pollution Control Ordinance #914 (in Appendix 2) will be reevaluated by June 30th of each year, including the number of homeowner contacts made by the Oakridge Police Department and LRAPA field compliance staff, and the number of warnings and citations issued under Oakridge Ordinance #914.

This Oakridge attainment plan is projecting attainment by December 31, 2016; therefore, the Quantitative Milestones for 2017 are not expected to apply. If standards are attained in Oakridge by December 31, 2016 as expected, no Quantitative Milestone report is required; if for any reason standards are not attained in Oakridge by December 31, 2016, a Quantitative Milestone report will be submitted to EPA by June 30, 2017 as an initial step toward reassessment of the Oakridge strategies.

Reasonable Further Progress (RFP)

Progress to attain the national $PM_{2.5}$ health standards will be demonstrated by June 30th of each year for the previous calendar year and the previous 3-year period. The determination of Reasonable Further Progress will be based on the evaluation of:

- Review of progress to meet the Quantitative Milestones in the previous section.
- Updated emission inventory by June 30th of each year for comparison to the attainment year emission inventory, including review of updated population figures as of July 1st of the previous calendar year, number of ductless heat pumps installed annually in the Oakridge area, number of reported uncertified woodstoves removed annually under the HeatSmart program, and reported industrial production rates and emissions.
- Comparison of the updated emission inventory to the updated seasonal trends of ambient $PM_{2.5}$ air quality data in Figure 9 to ensure consistency with the air monitoring record.

Reasonable Further Progress will be satisfied if the $PM_{2.5}$ health standards are achieved by the EPA Clean Air Act deadline. If standards are attained in Oakridge by December 31, 2016 as expected, no RFP or QM reports are required.

Image 5: Sunny afternoon in Oakridge.

MLH/JN:mlh:rcl (11/10/2016)

Appendix 1: Emission Inventory

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area Emission Inventory and Forecast for 2008 Base Year and 2015 Attainment Year

(including updated on-road emissions using MOVES2014a)

November 2016

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477

Background

The 1990 Clean Air Act contains provisions on the required development of emission inventories for designated areas that failed or have failed in the past to meet the National Ambient Air Quality Standards (NAAQS). The Oakridge-Westfir Nonattainment Area (NAA) is a designated NAAQS $PM_{2.5}$ nonattainment area. This emission inventory is provided as a part of the State of Oregon revisions to its State Implementation Plan (SIP) to formulate a strategy to maintain the NAAQS.

The principal components for development and documentation for the 2014 Attainment Plan emission inventories have been addressed in this document, which includes stationary permitted point sources, stationary area (non-permitted) sources, non-road mobile sources (railroads), on-road mobile sources, and emissions summaries. Inventory years include a base year of 2008 and the 2015 attainment deadline year. The geographic boundary for each inventory is the Oakridge-Westfir NAA, as defined by the NAA boundary.

In this document the terms *annual*, *typical season day*, and *worst-case day* emissions are used to categorize the estimated emissions for a particular time period. The annual emissions are a total amount of emissions for the source category that occurred throughout the year, represented in tons per year (tpy). The typical season day emissions represent an average daily emission value occurring from November 1st through the end of February. This four-month time period is considered to be the PM season, and is when the PM standard is usually violated. The worst-case day emissions are the highest daily emissions estimated for the PM season, and represent a day during the PM season when emissions generating activity is at its highest. For emission inventory purposes, the worst-case day is equivalent to the 98th-percentile design value (DV) day. Typical season day and worst-case day emissions are represented in pounds per day (lbs/day).

The 2008 National Emission Inventory (NEI) for Lane County was used as the starting point for calculating both $PM_{2.5}$ emissions and $PM_{2.5}$ precursor emissions for the Oakridge-Westfir $PM_{2.5}$ nonattainment area. The Lane County portion of the 2008 NEI was summarized in Appendix D-5 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan, including emissions of $PM_{2.5}$, NOx, SO2, VOC and NH3. The initial Oakridge-Westfir emissions were estimated by applying appropriate emission allocation factors (e.g., relative population, housing, vehicle miles of travel, land area, etc.) to the Lane County $PM_{2.5}$ and precursor emission categories. The significant (and insignificant) source categories during the winter $PM_{2.5}$ problem season were identified in Appendix D-5 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

The 2011 and 2014 NEIs were released subsequent to the submittal of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan. LRAPA has summarized and compared the Lane County and Oakridge portions of the 2008 NEI, the 2011 NEI and the 2014 NEI. The comparison of the 2008-2011-2014 NEIs indicates that the anthropogenic precursor emissions are decreasing significantly over time. The next NEI (2017) will probably not be available until late 2018, but based on the 2008-2014 trends, LRAPA expects the 2015-2017 precursor emissions to be even lower than the 2014 precursor emissions.

Secondary particulate is an overall very minor contributor to the Oakridge $PM_{2.5}$ air pollution concentrations on worst winter days as summarized in both the 2012 and 2016 Oakridge-Westfir Attainment Plans. For example, as outlined in Table 6 of the 2016 Plan, sulfates contribute only 1.1% and nitrates contribute only 0.4% on the top 25% high $PM_{2.5}$ concentration days. Rather, the major $PM_{2.5}$ contributor is organic carbon (88%), primarily from residential wood combustion.

Parameter	Sulfate	Nitrate	OC	EC	Water	NH3	OPP
Percent	1.1	0.4	88.4	7.6	1.4	0.03	1.1
ug/m3	0.43	0.16	34.46	2.95	0.54	0.01	0.44

Table 1 (from 2016 Plan): Contribution by speciated components, based on results of SANDWICH analysis for the top 25% high concentration winter (October-March) days.

Each of the precursor groups in Table 6 was determined to be below the EPA Region 10 insignificance threshold of 1.3 ug/m3:

- Nitrate + ammonia = 0.16 ug/m3 + 0.01 ug/m3 = 0.17 ug/m3 < 1.3 ug/m3.
- Sulfate = 0.43 ug/m3 < 1.3 ug/m3.

Therefore, the LRAPA emission inventory analysis focused in most detail on the significant $PM_{2.5}$ particulate sources during the winter season in Oakridge-Westfir, notably residential woodburning emissions from woodstoves, fireplaces and pellet stoves.

Executive Summary

This emission inventory consists of emission estimates from sources that emit $PM_{2.5}$ within the Oakridge-Westfir nonattainment area boundary. The emissions inventory data is essential in developing the attainment demonstration, as it helps identify the sources contributing to the air quality problem and the emission reduction strategies, once implemented, that reduce pollution levels below the standard. Sources of $PM_{2.5}$ in Oakridge include minor industry, on-road mobile sources (e.g., car and truck exhaust, road dust), railroads, and area sources (e.g., outdoor burning, woodstoves, and fireplaces).

Base Year Emission Inventory (2008)

The base year emission inventory is used as the starting point for the attainment demonstration. This inventory includes sources in the nonattainment area during the 2008 baseline year. The 2008 emission inventory is summarized in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources(1)				
Oakridge Sand & Gravel: Rock crushing operation	0.4	0.8	0.1%	0.1%
Oakridge Sand & Gravel: Cement plant	0.1	0.1	0.0%	0.0%
Stationary Area Sources				
Residential Wood Combustion: Fireplace(2)	38.5	42.3	7%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert(2)	158.9	174.8	30%	32%
Residential Wood Combustion: Certified Woodstove/Insert(2)	228.0	250.8	43%	45%
Pellet Stoves	6.7	7.4	1%	1%
All Other Stationary Area Sources	47.4	4.7	9%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	29.3	36.9	5%	7%
Re-Entrained Road Dust	12.1	27.8	2%	5%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
Total, All Sources, lbs/day	**527**	**552**		

(1) Worst-case day = Peak month production/20 workdays.
(2) Worst-case day = Peak Heating Degree Day

Table 1: 2008 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.

The emissions inventory on worst winter days is of most interest since the $PM_{2.5}$ concentrations measured in Oakridge do not meet the current 24-hour $PM_{2.5}$ standard and the peak $PM_{2.5}$ concentrations occur on cold, stagnant days during the November-February wood-heating season. Residential wood-heating emissions (from certified and non-certified woodstoves, fireplaces, and pellet stoves) account for about 86% of the emissions on worst winter days, as illustrated in the following figure.

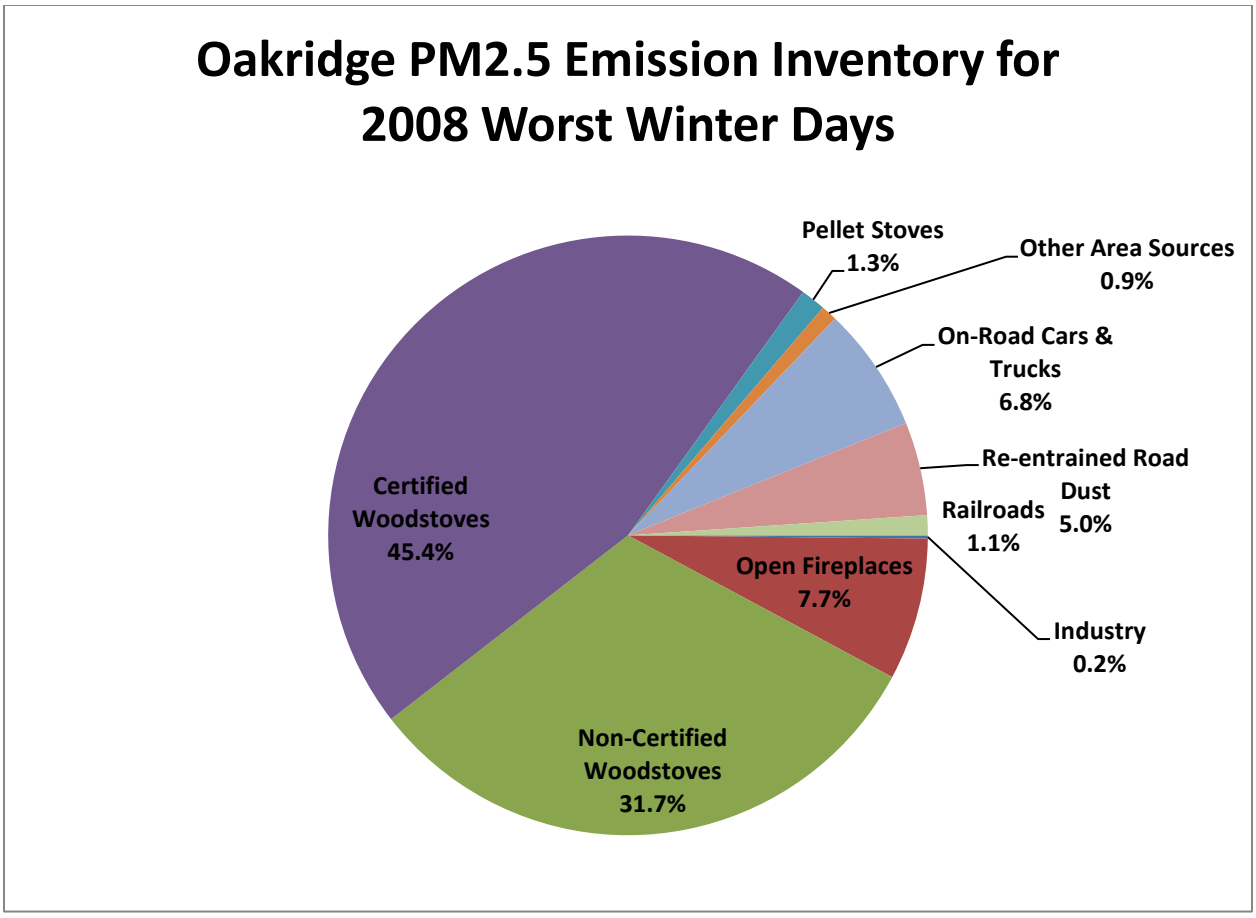


Figure 1: **Oakridge $PM_{2.5}$ Emission Inventory for 2008 Worst Winter Days**

Residential Wood Combustion

Residential wood combustion (RWC) is a common way to heat homes in Oregon. To estimate emissions from wood burning, LRAPA conducted a survey for the 2009-2010 heating season in Oakridge-Westfir. The survey provided LRAPA with information on how many homes use various types of wood-heating devices, the amount of wood burned, and other information on wood-heating practices.

Mobile and Nonroad Sources

Road dust and tailpipe emissions of $PM_{2.5}$ from motor vehicles were initially calculated by Lane Council of Governments (LCOG) transportation staff by applying emission factors from the EPA MOVES 2010b computer program to total vehicle miles traveled in the nonattainment area. Estimated vehicle miles traveled are from previous transportation modeling by LCOG for the Oregon Department of Transportation. The on-road mobile source emissions were updated by the Oregon Department of Environmental Quality (DEQ) in 2016 using MOVES 2014a. Emissions from railroads were provided by Union Pacific Railroad staff using the EPA NONROAD2008a emissions protocol.

Industrial Point Sources

LRAPA maintains data on industrial point source emissions in Lane County. The only operating industrial point sources within the Oakridge-Westfir area are two minor aggregate industry sources (rock crusher and concrete batch plant) operated by Oakridge Sand & Gravel.

Attainment Year Emission Inventory (2015)

The attainment year inventory is an estimation of emissions for the year that the area is expected to have attained the $PM_{2.5}$ standard. It includes projected emissions for the attainment year based on a number of different factors. Growth rates for population, employment, and VMT through 2015 were used to estimate 2015 emissions. LRAPA took credit for RWC emissions reductions as a result of the woodstove replacement and heat pump installation projects implemented during 2009-2014 that reduced the number of non-certified woodstoves accounted for in the 2008 emission inventory.

The attainment year emission inventory is based on the 2008 emissions inventory, estimated growth rates and the emission reduction strategies that have recently been put into effect. The emission reduction strategies primarily include the continued implementation (with specific strengthening revisions in some cases) of the existing control measures that have been effective in achieving the PM_{10} standards and the initial (1997) $PM_{2.5}$ standards on schedule. The key ongoing control strategies, which were in place prior to 2008, include:

- City ordinance to curtail burning during stagnant weather periods;
- City ordinance requiring the removal of a non-certified wood stoves upon sale of a home;
- City ordinance prohibiting the use of a non-certified wood stove in a residence; and
- Partnering in additional change-out programs to encourage removal of non-certified woodstoves.

The RWC emission reduction credits in the proposed $PM_{2.5}$ Attainment Plan are conservative. The calculated credits are based on:

- New woodstoves installed after 2008 are EPA certified Phase II equivalent, based on the Oakridge ordinances and the Oregon HeatSmart law;
- Existing uncertified woodstove replacements since 2008 are based on the 79 units documented by LRAPA-administered financial incentive programs;
- Lane Electric Cooperative installed additional heat pumps in the Oakridge area during 2012-2015: 15 in 2012, 15 in 2013, 22 in 2014 (and an additional 36 in 2015 considered in the calculation of 2016 emissions); and
- The strengthened mandatory curtailment program during air pollution episodes forecasts a 25% reduction in wood burning on red advisory days by December 31, 2014 and a 30% reduction by December 31, 2015.

There are several other RWC strategies in the proposed $PM_{2.5}$ Attainment Plan but no specific credits were taken for those strategies.

The 2015 emission inventory is summarized in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources(1)				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.1%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	3.7%
Stationary Area Sources				
Residential Wood Combustion: Fireplace(2)	38.5	31.7	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert(2)	108.4	89.4	22%	21%
Residential Wood Combustion: Certified Woodstove/Insert(2)	243.2	200.7	52%	51%
Pellet Stoves	7.3	8.0	1%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	17.6	22.2	3%	6%
Re-Entrained Road Dust	7.1	16.3	1%	4%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
Total, All Sources, lbs/day	**481**	**397**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table 2: **2015 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.**

Comparison of 2008 to 2015 Emissions

The emission inventory shows an overall decrease in emissions for the attainment year (2015) based on the effectiveness of the emission control strategies.

The differences in the 2008 and 2015 emission inventories are the combination of increases due to growth factors and decreases due to emission control strategies. For example, motor vehicle emissions decreased overall due to progressively cleaner gasoline and diesel fuels and motor vehicles, but part of the emissions decrease was offset by gradual growth in traffic volumes. Industry emissions were conservatively increased to reflect operation at maximum capacity in 2015, but both industrial sources are minor so this did not have a major effect on the 2015 inventory. The most significant category is residential wood-heating; emissions were increased to reflect population growth during 2008-2015, decreased due to non-certified woodstove replacements with cleaner burning units during 2009-2014, and decreased due to improvements in the programs for curtailment during stagnant air episodes.

To review, the key long-term permanent RWC strategies have been:

- the woodstove change-out programs replacing uncertified woodstoves with cleaner burning and more efficient home heating units;
- the Oregon and EPA woodstove certification programs requiring any new woodstoves installed since 1986 to be certified woodstoves; and
- the Oakridge ordinance and Oregon Heat Smart law requiring removal of uncertified woodstoves upon home sale.

These programs have been critical to the significant improvement in Oakridge $PM_{2.5}$ concentrations during 2005-2011. In addition, the combined emission reduction of these programs will more than offset the growth in population and housing between 2008 and 2015, with a net RWC emission reduction of about 35 lb/day on typical season days and 38 lb/day on worst-case days.

The key short-term RWC strategy is a strengthened mandatory curtailment program to reduce fireplace and woodstove emissions by 25% on an average of 20 red days per year (based on the number of days above 30 $\mu g/m^3$ $PM_{2.5}$ during 2005-2011). This will reduce RWC emissions by 107 lb/day and reduce future $PM_{2.5}$ concentrations below the 35 $\mu g/m^3$ $PM_{2.5}$ standard on worst-case days.

Contingency Planning

The attainment plan must contain contingency measures that would be implemented in the event that the Oakridge nonattainment area fails to meet the standard by the Clean Air Act deadline, or measures beyond those necessary to meet standards by the CAA deadline. The contingency measures are designed to correct the violation of the $PM_{2.5}$ standards and be implemented immediately. EPA requires that any contingency measures must equal one-year equivalent of reasonable further progress (RFP).

In Oakridge, the worst-day $PM_{2.5}$ concentrations need to be reduced by about one microgram per cubic meter ($\mu g/m^3$) per year in order to meet the $PM_{2.5}$ standard by 2014-2016 (i.e., reduced from 39.5 $\mu g/m^3$ in the 2006-2010 baseline period to 35 $\mu g/m^3$ by the 2014-2016 attainment date). Therefore, the RFP requirement in Oakridge would equal about one $\mu g/m^3$ of further reduction.

The contingency measures for stronger enforcement on more red advisory days beginning in 2015 (and reflected in the 2016 emission inventory) are expected to increase the curtailment effectiveness from 25% to 30%, reduce RWC emissions by an additional 25 lb/day, and reduce concentrations on worst case days by an additional 1.7 $\mu g/m^3$; this would more than achieve the one $\mu g/m^3$ target needed to meet the EPA RFP test for contingency plans.

Introduction

Purpose of the Report

The $PM_{2.5}$ Nonattainment Area State Implementation Plan (SIP) emissions inventory for Oakridge-Westfir has been developed in response to requirements specified in the Clean Air Act Amendments of 1990 and in conformance to 40 CFR §51.1002(c).

The 1990 Clean Air Act contains provisions on the required development of emission inventories for designated areas that failed or have failed in the past to meet the National Ambient Air Quality Standards (NAAQS). The Oakridge-Westfir Nonattainment Area (NAA) is a designated NAAQS $PM_{2.5}$ nonattainment area. This emission inventory is provided as a part of the State of Oregon revisions to its State Implementation Plan (SIP) to formulate a strategy to maintain the NAAQS.

The U.S. Environmental Protection Agency (EPA) adopted revisions to the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ in September 2006. $PM_{2.5}$ is fine particulate matter two and a half microns and less in diameter.

On October 8, 2009, the Environmental Protection Agency (EPA) issued final area non-attainment designations for the 24-hour national air quality standards for fine particulate matter ($PM_{2.5}$). Oakridge was designated a non-attainment area in Oregon. Under the Clean Air Act, an area that violates the federal standards is designated as "nonattainment" and must adopt a plan with emission reduction measures to bring the area back into compliance. The area designated as non-attainment for $PM_{2.5}$ contains Oakridge, the small town of Westfir and surrounding area.

This document fulfills the EPA requirements for preparing the 2008 Base Year and 2014 Attainment Year emission inventories, as specified in the provisions of the 1990 CAAA, and EPA guidance documents. The purpose of this report is to establish baseline emissions for the Oakridge-Westfir NAA in 2008 and project emissions to 2014. These emissions are then used to determine whether the area will reach attainment by 2014. This determination is documented in the Oakridge $PM_{2.5}$ Attainment Plan, of which this is an appendix.

The principal components for development and documentation for the 2014 Attainment Plan emission inventories have been addressed in this document, which includes stationary permitted point sources, stationary area (non-permitted) sources, non-road mobile sources (railroads), on-road mobile sources, and emissions summaries. Inventory years include a base year of 2008 and the 2014 attainment deadline year. The geographic boundary for each inventory is the Oakridge-Westfir NAA, as defined by the NAA boundary.

Description of Inventory and Area Covered

The 2008 Base Year emission inventory and 2014 Attainment Year emission forecast cover $PM_{2.5}$ emissions for the Oakridge-Westfir NAA. Emissions are reported as annual, typical season day, and worst-case day. Typical season day emissions are the daily rate of emissions for the four-month PM season, defined as the period from the beginning of January through the end of February and beginning of November through the end of December. Worst-case day emissions represent the highest ambient $PM_{2.5}$ accumulations on a single day during the four-month PM season. Annual emissions are reported as tons per year (tpy), whereas typical season and worst-case day emissions are reported as lbs per day.

Oakridge, Oregon lies in an alluvial plain in the foothills at the southern end of the Willamette River valley. The city is in Lane County, Oregon, approximately 45 miles east-southeast of Eugene, and 28 miles west of Willamette Pass, the summit of the Cascade Mountain Range. The city limits of present-day Oakridge includes the historic City of Oakridge and, directly west, the area formerly known as Willamette City. Figure 2 shows the location of Oakridge in Lane County.

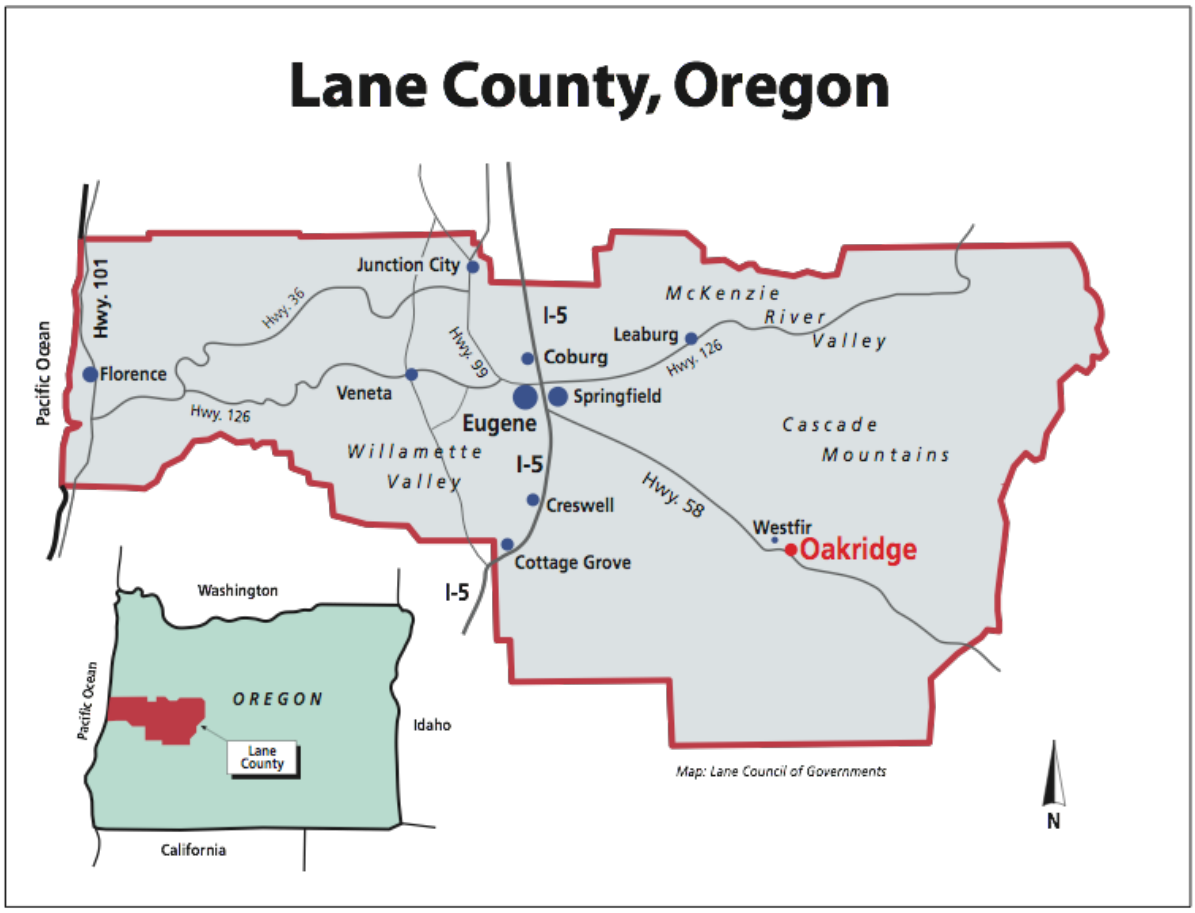


Figure 2: Oakridge Location

The area of applicability for this attainment plan includes an area that contains the City of Oakridge and the small town of Westfir. Figure 3 shows the Oakridge-Westfir non-attainment area.

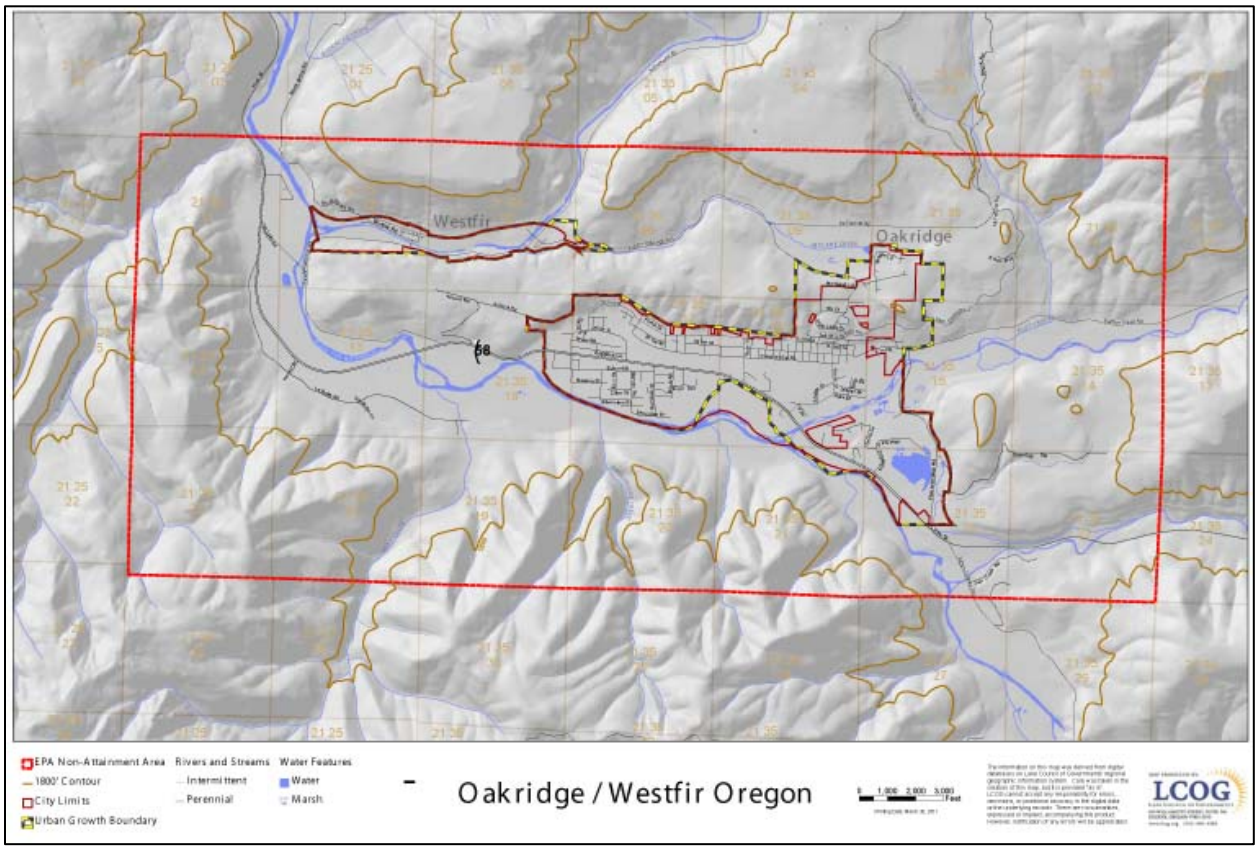


Figure 3: Nonattainment Area

The City of Oakridge is situated in a valley oriented east-west, through which flows the middle fork of the Willamette River. Elevation of the area ranges from 1100 feet at the lower (west) end to 1600 feet with areas of densest population situated between 1100 feet and 1200 feet. Mountains rise on the north and south sides to 1700 feet and 1600 feet, respectively.

Westfir is a very small (population 335) isolated rural mountain community that is located along the north fork of the Willamette River about 1 mile NW of Oakridge. Its elevation is about the same as Oakridge and it is surrounded by the same high mountains. Westfir and Oakridge are in separate steep sided river valleys separated by a 400-foot ridge. The Westfir valley is very narrow, only about 1/4 mile across at its widest point, while the Oakridge valley is about 1 mile across at its widest point.

Description of Emission Inventory Information Systems

The inventory has been assembled by the staff of the Lane Regional Air Protection Agency (LRAPA) with support from the staffs of the Lane Council of Governments (LCOG) and the Oregon Department of Environmental Quality ODEQ). Permitted point source emissions were drawn from the LRAPA permit source files and ODEQ emission factors. Residential wood combustion (RWC) emissions were calculated from LRAPA wood use surveys and EPA emission factors. Onroad emissions were calculated by LCOG using previous traffic modeling studies and the EPA MOVES emissions model. Railroad emissions were calculated by staff of the Union Pacific Railroad (UPRR) using UPRR data and EPA emissions factors. All other emissions were either modeled or inventoried by LRAPA staff specifically for this project.

Sources Not Inventoried

All significant sources of $PM_{2.5}$ in the Oakridge-Westfir NAA were considered for inclusion in the emission inventory. Sources were omitted for one of the following reasons: (1) point, area, non-road or mobile sources did not emit significant amounts of $PM_{2.5}$ annually or during the winter months; or (2) the activity did not occur within the Oakridge-Westfir NAA. The Lane County portion of the 2008 National Emission Inventory (NEI) was used as the initial base for the initial screening to identify significant source categories of PM, NOx, SO2, VOC and NH3 emissions in the Oakridge-Westfir area. The initial screening of estimated emissions in the Oakridge-Westfir area used relative population, housing, traffic volumes, acreage, industry locations, and other parameters. The Lane County and Oakridge-Westfir emissions of PM, NOx, SO2, VOC and NH3 are summarized in a series of tables by pollutant in Appendix D-5.

Guidance Documents

The inventory was conducted using applicable EPA procedure and guidance documents. Emission factors were taken from the EPA Procedures Document, the *Compilation of Air Pollutant Emission Factors*, hereinafter referred to as AP-42. Localized emission factors were used when documentation existed to support their accuracy. These and other information sources are cited in the text, as appropriate.

Contact Personnel for the Inventory

Merlyn Hough and Max Hueftle of LRAPA performed most of the required source calculations. Josh Roll of the LCOG staff provided the vehicle miles travelled (VMT) and initial onroad emissions calculations using MOVES 2010b; Wes Risher and Gary Beyer of DEQ updated the on-road emissions calculation in 2016 using MOVES 2014a.

Quality Assurance and Quality Control of the Inventory

LRAPA staff consulted with DEQ staff throughout the preparation of these emission inventories. Emissions from each of the categories (e.g., mobile source emission rates per mile) were compared to similar inventories for the Klamath Falls and Tacoma areas. PM emissions were compared to historical emission inventories and trends for the successful 1988-2010 Oakridge and Eugene-Springfield PM_{10} attainment planning and control strategies implementation. The Oakridge emission inventories were consistent with independent chemical speciation work on Oakridge PM filters and Positive Matrix Factorization (PMF) results by EPA Region 10 staff.

Summary of Emissions Data

Base Year Emission Inventory (2008)

The base year emission inventory is used as the starting point for the attainment demonstration. This inventory includes sources in the nonattainment area during the 2008 baseline year. The 2008 emission inventory is summarized in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	0.4	0.8	0.1%	0.1%
Oakridge Sand & Gravel: Concrete plant	0.1	0.1	0.0%	0.0%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	42.3	7%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	158.9	174.8	30%	32%
Residential Wood Combustion: Certified Woodstove/Insert[2]	228.0	250.8	43%	45%
Pellet Stoves	6.7	7.4	1%	1%
All Other Stationary Area Sources	47.4	4.7	9%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	29.3	36.9	5%	7%
Re-Entrained Road Dust	12.1	27.8	2%	5%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
Total, All Sources, lbs/day	**527**	**552**		

(1) Worst-case day = Peak month production/20 workdays.
(2) Worst-case day = Peak Heating Degree Day

Table 1: **2008 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.**

The emissions inventory on worst winter days is of most interest since the $PM_{2.5}$ concentrations measured in Oakridge do not meet the current 24-hour $PM_{2.5}$ standard and the peak $PM_{2.5}$ concentrations occur on cold, stagnant days during the November-February wood-heating season. Residential wood-heating emissions (from certified and non-certified woodstoves, fireplaces, and pellet stoves) account for about 86% of the emissions on worst winter days, as illustrated in the following figure.

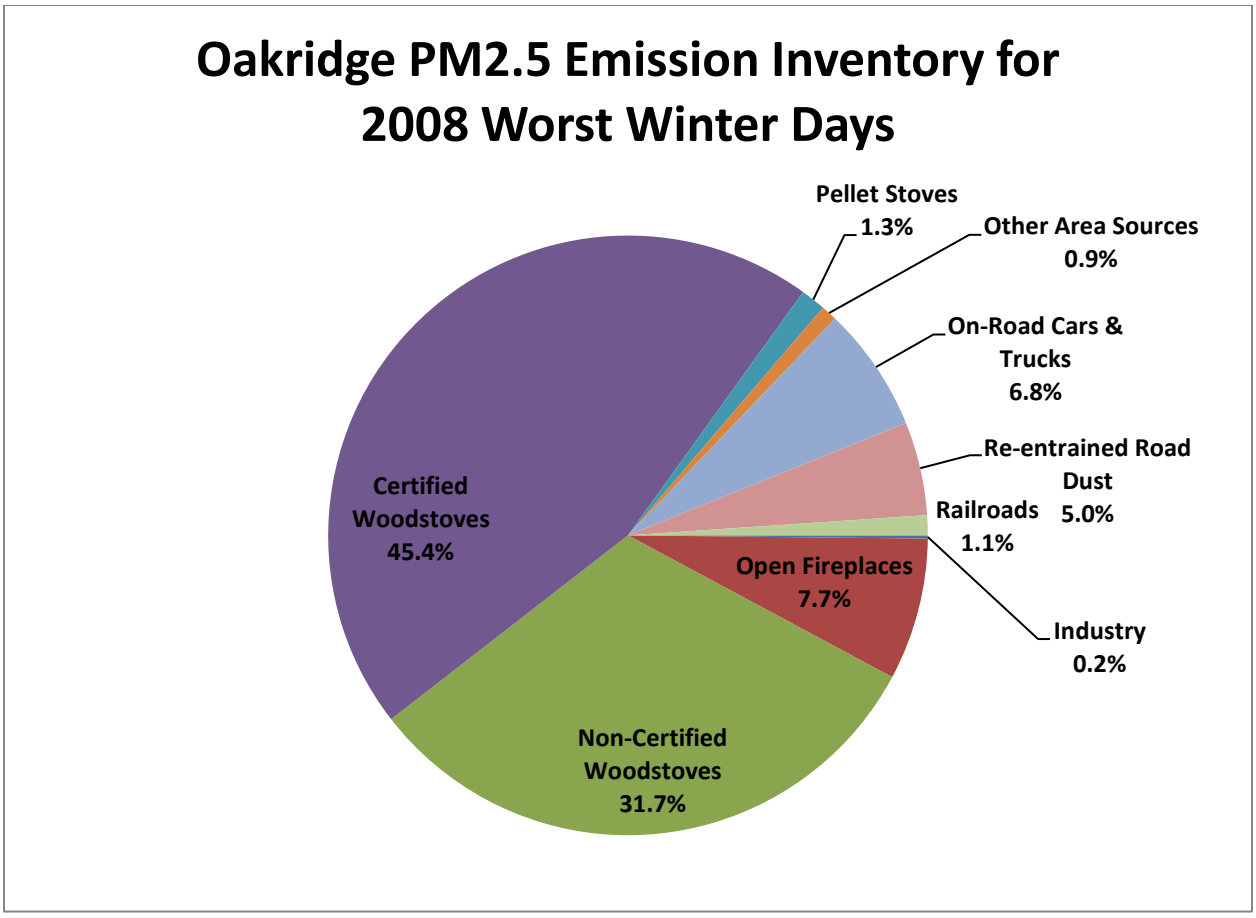


Figure 1: **Oakridge $PM_{2.5}$ Emission Inventory for 2008 Worst Winter Days**

Industrial Point Sources

LRAPA maintains data on industrial point source emissions in Lane County. The two existing industrial sources in the Oakridge-Westfir area are minor industrial sources of $PM_{2.5}$ emissions. The facilities are a portable rock crusher and a ready-mix concrete plant owned and operated by Oakridge Sand & Gravel.

These two minor sources together emit less than one ton per year of $PM_{2.5}$ emissions and contribute less than 1% to the base year and future year emission inventories. These two minor sources are well below the LRAPA significant emission rate (SER) for $PM_{2.5}$ of 10 tons per year.

The air pollution control technologies installed on these sources are the standards for the industry and meet RACT requirements. The rock crusher has water-spray controls and the concrete plant has baghouse controls. Actual production rates, maximum production capacities, actual emissions, and maximum potential emissions are summarized in Appendix D-1. Emission factors are based on the ODEQ Emission Factors for Asphalt and Aggregate

Industries (AQ-EF06) which are derived from EPA AP-42. A copy of AQ-EF06 was included in Appendix D-1 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

The typical season day emissions for these two facilities during the base year were based on average actual production rates and calculated emissions during the months of November-February in recent years (2008-2011). The worst-case day emissions for these two facilities during the base year on based on actual production rates and calculated emissions during the highest production month during November-February in recent years (2008-2011); for the rock crusher, the peak winter month was January 2011; for the ready-mix concrete plant, the peak winter month was November 2009.

[The future year (2015) emissions for these two facilities are based on the maximum allowable production rates identified in the facility permit applications and the LRAPA-issued permits. The typical season day emissions are based on the annual maximum production capacity and the worst-day emissions are based on the daily maximum production capacity. The rock crusher has a production capacity of 3,600 tons per day (potential $PM_{2.5}$ emissions of 4 lb/day) and 300,000 tons per year (potential $PM_{2.5}$ emissions of 360 lb/year). The ready-mix concrete plant has a production capacity of 480 cubic yards per day (potential $PM_{2.5}$ emissions of 14 lb/day) and 30,000 cubic yards per year (potential $PM_{2.5}$ emissions of 90 lb/year).]

Residential Wood Combustion

Residential wood combustion (RWC) is a common way to heat homes in Oregon. To estimate emissions from wood burning, LRAPA conducted a survey for the 2009-2010 heating season in Oakridge-Westfir. The survey provided LRAPA with information on how many homes use various types of wood-heating devices, the amount of wood burned, and other information on wood-heating practices. The Oakridge wood use is summarized in the following table.

Woodburning Device	Base Year Wood Fuel Use Survey (Households)	Base Year Wood Fuel Use (tons/HH)	Base Year Wood Fuel Use (tons/year)
Oakridge NAA			
21-04-008-100 Fireplace without Insert	123	1.6	195.6
21-04-008-320 Certified Non-Cat Wood-Stove	256	3.0	770.6
21-04-008-330 Certified Cat Wood-Stove	64	3.0	192.6
21-04-008-310 Conv Wood Stove	111	3.0	334.1
21-04-008-230 Fireplace Insert Cert Catalyst	28	3.0	84.3
21-04-008-220 Fireplace Insert Cert Non-Cat	112	3.0	337.1
21-04-008-210 Fireplace Insert Conv.	96	3.0	289.0
21-04-008-400 Exempt Pellet Stove	228	1.2	264.5
21-04-008-510 Central Furnace	0	0.0	0.0
Total	1,018		2,468

Table 1a: **Oakridge Base Year Residential Wood Use Survey Results.**

The survey report, data, and additional RWC emission calculation details are included at the end of Appendix D-2 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan in a series of tables of RWC 2008 emissions of $PM_{2.5}$ (and NOx, SO2, VOC and NH3).

Other Area Sources

The only other area source category with potential significant emissions is backyard burning. Backyard burning is banned in Lane County for fire safety reasons during the June-September fire season and is banned in Oakridge for air quality reasons during November-February. There are 1,756 households in the Oakridge-Westfir nonattainment area. The LRAPA survey indicates that 28% of the households (about 492 households) burn yard debris (weighted average of 3 cubic yards per household) during the Fall and Spring months. The yard debris is a mix of leaves and brush with an estimated average density of 312.5 pounds per cubic yard using conversion factors (250-375 lb/yard) from OAR 340-097-0110. AP-42 emission factors are 17-38 lb/ton, or an average of 27.5 lb/ton. The total amount of yard debris burned is calculated to be 230.6 tons per year with $PM_{2.5}$ emissions of 3.2 tons per year. Typical season days emissions

are estimated to be 47.4 lb/day on the approximately 135 days per year during the Spring and Fall burning seasons . Although backyard burning is banned during November-February, LRAPA and Oakridge occasionally receive complaints of backyard burning on banned days, so backyard burning emissions are conservatively estimated at 10% (4.7 lb/day) on worst-case days during November-February.

Mobile and Nonroad Sources

Road dust and tailpipe emissions of $PM_{2.5}$ from motor vehicles were calculated by Lane Council of Governments (LCOG) transportation staff by applying emission factors from the EPA MOVES 2010b computer program to total vehicle miles traveled in the nonattainment area. Estimated vehicle miles traveled are from previous transportation modeling by LCOG for the Oregon Department of Transportation. A copy of the LCOG report was included as Appendix D-3 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

Since the 2012 on-road modeling was completed, EPA developed MOVES2014 as a major revision of the mobile source emission model to replace MOVES2010 and its minor revisions (MOVES2010a and MOVES2010b). MOVES2014 incorporates the effects of three new emission control programs associated with regulations promulgated since the release of MOVES2010b:

- Tier 3 emission standards that phase in beginning in 2017 for cars, light-duty trucks, medium-duty passenger vehicles, and some heavy-duty trucks, and Tier 3 fuel standards that require lower sulfur gasoline beginning in 2017
- Heavy-duty engine and vehicle greenhouse gas (GHG) regulations that phase in during model years 2014-2018.
- The second phase of light-duty vehicle GHG regulations that phase in for model years 2017-2025 cars and light trucks.

MOVES2014 also includes new and updated emissions data from a wide range of test programs and other sources. The most significant changes in MOVES2014 include new effects of fuel properties such as gasoline sulfur and ethanol, new data on evaporative emissions from fuel leaks and from vehicles parked for multiple days, new analyses of particulate matter (PM) data related to PM speciation and temperature effects on running PM emissions, and new real world in-use emissions for heavy-duty vehicles using data from portable emission monitoring systems. In addition to these and many other updates for emission rates, MOVES2014 also includes substantial new data and updates for default population and activity. These include new vehicle population estimates and sales projections, new vehicle miles travelled (VMT) estimates based on the updated methodology for the Federal Highway Administration's Highway Performance Monitoring System, new national average speed distributions based on global positioning system (GPS) data, new state supplied data from the 2011 National Emission Inventory, and many other population and/or activity related updates.

In general, VOC, NOx, PM, and CO emissions show greater decreases over time compared to MOVES2010b. Differences in total emissions vary by calendar year and location, but in general, VOC and NOx emissions are lower in MOVES2014. PM emissions may be higher in some areas and lower in others.

EPA strongly encouraged LRAPA to use MOVES2014a for the 2015-2016 Supplemental Oakridge Attainment Plan. Oregon DEQ staff agreed to model on-road emissions using MOVES2014a for LRAPA using the inputs and VMT compiled by LCOG in 2012. Wes Risher and Gary Beyer completed this work in July 2016.

Additional details are included in Appendix 1-A, but the key differences between MOVES2010b and MOVES2014a are summarized here. Primary $PM_{2.5}$ Exhaust + Tirewear + Brakewear were modeled for years 2008, 2015 and 2025. Weekdays are labeled 5, and weekend days are labeled 2. Four seasons were modeled separately and labeled 4 (April), 7 (July), 9 (September), and 12 (December).

MOVES 2014a Results by DEQ

Year	Day	4	7	9	12	
2008	5	25.58	28.36	28.16	27.56	
	2	32.57	37.80	34.50	36.87	
2015	5	15.37	17.02	16.92	16.59	
	2	19.61	22.77	20.78	22.23	
2025	5	5.34	6.09	6.04	5.56	
	2	6.72	8.03	7.32	7.34	

MOVES 2010b Results by LCOG

Year	Day	4	7	9	12	
2008	5	22.40	22.70	23.30	27.20	
	2	29.90	32.00	30.00	37.30	
2014	5	13.20	12.80	13.30	16.70	
	2	17.30	17.90	16.90	22.20	
2025	5	6.90	6.00	6.40	9.30	
	2	8.60	7.90	7.80	11.80	

DELTA

Year	Day	4	7	9	12	
2008	5	14.21%	24.94%	20.87%	1.32%	
	2	8.92%	18.12%	15.00%	-1.15%	
2015	5	16.42%	32.98%	27.21%	-0.64%	
	2	13.37%	27.21%	22.99%	0.13%	
2025	5	-22.61%	1.48%	-5.69%	-40.18%	
	2	-21.91%	1.58%	-6.16%	-37.82%	

Emissions from railroads were provided by Union Pacific Railroad staff using the EPA NONROAD2008a emissions protocol. The UPRR report was included as Appendix D-4 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan. Fuel consumption information was submitted by UPRR to LRAPA as Confidential Business Information so some of the report is not included in the appendix. Contact LRAPA or UPRR if additional details or calculations are needed for verification.

Other non-road mobile sources were categorized by LRAPA as insignificant in Oakridge-Westfir during the $PM_{2.5}$ winter season as summarized in Appendix D-5 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

Attainment Year Emission Inventory (2015)

The attainment year inventory is an estimation of emissions for the year that the area is expected to have attained the $PM_{2.5}$ standard. It includes projected emissions for the attainment year based on a number of different factors. Growth rates for population, employment, and VMT through 2014 were used to estimate 2014 emissions. LRAPA took credit for RWC emissions reductions as a result of the woodstove replacement project implemented during 2009-2012 that reduced the number of non-certified woodstoves accounted for in the 2008 emission inventory.

The attainment year emission inventory is based on 2008 emissions inventory, estimated growth rates and the emission reduction strategies that have recently been put into effect. The emission reduction strategies primarily include the continued implementation (with specific strengthening revisions in some cases) of the existing control measures that have been effective in achieving the PM_{10} standards and the initial (1997) $PM_{2.5}$ standards on schedule. The key ongoing control strategies, which were in place prior to 2008, include:

- City ordinance to curtail burning during stagnant weather periods;
- City ordinance requiring the removal of a non-certified wood stoves upon sale of a home;
- City ordinance prohibiting the use of a non-certified wood stove in a residence; and
- Partnering in additional change-out programs to encourage removal of non-certified woodstoves.

The RWC emission reduction credits in the proposed $PM_{2.5}$ Attainment Plan are conservative. The calculated credits are based on:

- New woodstoves installed after 2008 are EPA certified Phase II equivalent, based on the Oakridge ordinances and the Oregon HeatSmart law;
- Existing uncertified woodstove replacements since 2008 are based on the 79 units documented by LRAPA-administered financial incentive programs;
- Lane Electric Cooperative installed additional heat pumps in the Oakridge area during 2012-2015: 15 in 2012, 15 in 2013, 22 in 2014 (and an additional 36 in 2015 considered in the calculation of 2016 emissions); and
- The strengthened mandatory curtailment program during air pollution episodes forecasts a 25% reduction in wood burning on red advisory days by December 31, 2014 and a 30% reduction by December 31, 2015.

There are several other RWC strategies in the proposed $PM_{2.5}$ Attainment Plan but no specific credits were taken for those strategies.

Economic Factors

The economy in Oakridge has shifted from logging-based industries to a more recreation-oriented model. The decline in the harvesting and processing of timber has left Oakridge with

no industrial employer or businesses that support the lumber industry. In the 1990's, the population in Oakridge declined sharply as jobs disappeared. Current census figures show only modest growth of 1.8% between 2000 and 2010, with the 2015 population at 3,240. Within the civilian labor force, 16% were unemployed in 2010 and 21.7% of all families had incomes below the poverty level. The low cost of living has attracted low-income and unemployed people to Oakridge.

The recreation industry has picked up in Oakridge, with mountain biking being very popular. A hostel, brew pub, and other small businesses have opened to support the visitors attracted to the area. Despite the recent business growth, few jobs have been created. Population and employment in Oakridge are expected to increase only modestly over the next 20 years. The population estimate for the year 2025 is 4,000. Any new employment has been assigned to the potential development of the Oakridge Industrial Park.

Growth Rates

Growth is expected to be low to moderate in the Oakridge-Westfir area through 2016. Population, housing, and employment forecasts are expected to increase gradually. VMT growth is based on the previous transportation modeling by LCOG in the Highway 58 corridor. The 2015 emission inventory is summarized in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources(1)				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.1%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	3.7%
Stationary Area Sources				
Residential Wood Combustion: Fireplace(2)	38.5	31.7	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert(2)	108.4	89.4	22%	21%
Residential Wood Combustion: Certified Woodstove/Insert(2)	243.2	200.7	52%	51%
Pellet Stoves	7.3	8.0	1%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	17.6	22.2	3%	6%
Re-Entrained Road Dust	7.1	16.3	1%	4%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
Total, All Sources, lbs/day	**481**	**397**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table 2: **2015 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.**

Residential wood combustion continues to be the major emission source category in 2015. The Oakridge 2015 wood use, after applying growth factors and woodstove replacements, is summarized in the following table.

Woodburning Device	2015 Wood Fuel Use (Households)	2015 Wood Fuel Use (tons/HH)	2015 Wood Fuel Use (tons/year)
Oakridge NAA			
21-04-008-100 Fireplace without Insert	123	1.6	195.6
21-04-008-320 Certified Non-Cat Wood-Stove	287	3.0	846.9
21-04-008-330 Certified Cat Wood-Stove	62	3.0	183.0
21-04-008-310 Conv Wood Stove	66	3.0	194.8
21-04-008-230 Fireplace Insert Cert Catalyst	27	3.0	79.7
21-04-008-220 Fireplace Insert Cert Non-Cat	125	3.0	368.9
21-04-008-210 Fireplace Insert Conv.	78	3.0	230.2
21-04-008-400 Exempt Pellet Stove	238	1.2	276.1
21-04-008-510 Central Furnace	0	0.0	0.0
Total	1,006		2,375

Table 2a: **Oakridge 2015 Projected Residential Wood Use.**

For example, comparing Tables 1a and 2a, the number of wood burning households and amount of wood burned did not change significantly during 2008-2015, but the number of conventional (uncertified) woodstoves and fireplace inserts decreased due to units replaced with woodstove replacement incentives during 2009-2012 as verified by LRAPA. Additional RWC emission calculation details are included at the end of Appendix D-2 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan in a series of tables (Tables 3 through 12) of RWC 2014 emissions of $PM_{2.5}$ (and NOx, SO2, VOC and NH3).

Comparison of 2008 to 2015 Emissions

The emission inventory shows an overall decrease in emissions for the attainment year (2015) based on the effectiveness of the emission control strategies.

The differences in the 2008 and 2015 emission inventories are the combination of increases due to growth factors and decreases due to emission control strategies. For example, motor

vehicle emissions decreased overall due to progressively cleaner gasoline and diesel fuels and motor vehicles, but part of the emissions decrease was offset by gradual growth in traffic volumes.

Industry emissions were conservatively increased to reflect operation at maximum capacity in 2015, but both industrial sources are minor so this did not have a major effect on the 2014 inventory. The future year (2015) emissions for these two facilities are based on the maximum allowable production rates identified in the facility permit applications and the LRAPA-issued permits. The typical season day emissions are based on the annual maximum production capacity and the worst-day emissions are based on the daily maximum production capacity. The rock crusher has a production capacity of 3,600 tons per day (potential $PM_{2.5}$ emissions of 4 lb/day) and 300,000 tons per year (potential $PM_{2.5}$ emissions of 360 lb/year). The ready-mix concrete plant has a production capacity of 480 cubic yards per day (potential $PM_{2.5}$ emissions of 14 lb/day) and 30,000 cubic yards per year (potential $PM_{2.5}$ emissions of 90 lb/year).

The most significant category is residential wood-heating; emissions were increased to reflect population growth during 2008-2015, decreased due to non-certified woodstove replacements with cleaner burning units during 2009-2012, and decreased due to improvements in the programs for curtailment during stagnant air episodes.

In order to illustrate the RWC emission reductions from the key strategies, it is helpful to compare the 2014 emission inventories with (Table 2 above) and without (Table 5 below) the strengthened mandatory curtailment program on worst-case days, and to compare both of these tables to the 2008 emission inventory in Table 1.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources(1)				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	0.8%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	2.8%
Stationary Area Sources				
Residential Wood Combustion: Fireplace(2)	38.5	42.3	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert(2)	108.4	119.2	23%	24%
Residential Wood Combustion: Certified Woodstove/Insert(2)	243.2	267.6	51%	53%
Pellet Stoves	7.3	8.0	2%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	17.6	22.2	4%	4%
Re-Entrained Road Dust	7.1	16.3	1%	3%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
Total, All Sources, lbs/day	**481**	**504**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table 5: 2015 Estimated Worst-Case Day $PM_{2.5}$ Emissions without Mandatory Curtailment.

To review, the key long-term permanent RWC strategies have been:

- the woodstove change-out programs replacing uncertified woodstoves with cleaner burning and more efficient home heating units;
- the Oregon and EPA woodstove certification programs requiring any new woodstoves installed since 1986 to be certified woodstoves; and
- the Oakridge ordinance and Oregon Heat Smart law requiring removal of uncertified woodstoves upon home sale.

These programs have been critical to the significant improvement in Oakridge $PM_{2.5}$ concentrations during 2005-2011. In addition, the combined emission reduction of these programs will more than offset the growth in population and housing between 2008 and 2015, with a net RWC emission reduction of about 35 lb/day on typical season days and 38 lb/day on worst-case days (comparing the fireplace, woodstove and pellet stove emissions in Tables 1 and 3).

The key short-term RWC strategy is a strengthened mandatory curtailment program to reduce fireplace and woodstove emissions by 25% on an average of 20 red days per year (based on the number of days above 30 $\mu g/m^3$ $PM_{2.5}$ during 2005-2011). This will reduce RWC emissions by 107 lb/day (comparing the fireplace and woodstove emissions in Tables 2 and 3) and reduce future $PM_{2.5}$ concentrations below the 35 $\mu g/m^3$ $PM_{2.5}$ standard on worst-case days.

Contingency Planning

The attainment plan must contain contingency measures that would be implemented in the event that the Oakridge nonattainment area fails to meet the standard by the Clean Air Act deadline, or measures beyond those necessary to meet standards by the CAA deadline. The contingency measures are designed to correct the violation of the $PM_{2.5}$ standards and be implemented immediately. EPA requires that any contingency measures must equal one-year equivalent of reasonable further progress (RFP).

In Oakridge, the worst-day $PM_{2.5}$ concentrations need to be reduced by about one microgram per cubic meter ($\mu g/m^3$) per year in order to meet the $PM_{2.5}$ standard by 2014-2016 (i.e., reduced from 39.5 $\mu g/m^3$ in the 2006-2010 baseline period to 35 $\mu g/m^3$ by the 2014-2016 attainment date). Therefore the RFP requirement in Oakridge would equal about one $\mu g/m^3$ of further reduction.

The Oakridge $PM_{2.5}$ attainment plan includes the following contingency strategies implemented during 2015 to insure full attainment of the $PM_{2.5}$ air quality health standards by 2014-2016 and to maintain compliance with the standards through 2025 and beyond:

- Stricter green-yellow-red advisory program, with more yellow and red advisory days each winter, by reducing the advisory thresholds by 5 $\mu g/m^3$ in the Oakridge Air Pollution Control Ordinance #914; this is projected to increase the average number of potential red advisory days by five days per year.

- Expanded field compliance with a dedicated Oakridge Police Department compliance officer effective November 2015 with assistance of LRAPA field compliance officer.
- Stricter opacity limit, revising the historical 40% opacity limit to the more restrictive 20% limit in the Oakridge Air Pollution Control Ordinance #914.
- Further restrictions on city woodstove curtailment exemptions (for sole source, economic hardship), including inspections of all exempt households to verify whether sole source and to evaluate eligibility for weatherization and ductless heat pump programs beginning in July 2016.

The field compliance improvements in the contingency plan were not made until the second half of 2015, so the curtailment effectiveness during 2015 was estimated at 25% rather than the expected future target of at least 30% effectiveness. A 25% RWC mandatory curtailment program is projected to reduce RWC emissions by 107 lb/day and reduce concentrations on worst-case days by 7.1 $\mu g/m^3$ in 2015. With the more restrictive red advisory criteria and the increased frequency of curtailment enforcement (warnings and citations) during the latter part of 2015 and in 2016, 30% RWC curtailment is projected on worst days in 2016; this will reduce RWC emissions by an additional reduction of 25 lb/day from 2015 and concentrations on worst case days by an additional reduction of 1.7 $\mu g/m^3$. In addition, RWC emissions in 2016 will be lower due to continued installation of heat pumps by Lane Electric Cooperative (36 in 2015) and continued removal of non-certified woodstoves upon home sale under the Oregon HeatSmart law.

In summary, the contingency measures for stronger enforcement on more red advisory days are expected to increase the curtailment effectiveness from 25% to 30%, reduce RWC emissions by an additional 25 lb/day, and reduce concentrations on worst case days by an additional 1.7 $\mu g/m^3$; this would more than achieve the one $\mu g/m^3$ target needed to meet the EPA RFP test for contingency plans. The 2016 emission inventory and 2016 impacts are outlined in Table 3 and Table 4.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.1%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	3.8%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	29.6	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	109.1	84	23%	23%
Residential Wood Combustion: Certified Woodstove/Insert[2]	237.4	182.8	50%	49%
Pellet Stoves	7.3	8.0	2%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	16.3	20.5	3%	6%
Re-Entrained Road Dust	7.1	16.3	1%	4%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
Total, All Sources, lbs/day	**475**	**370**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table 3: 2016 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.

Source Category	Base Year 2008		Future Year 2016	
	Emissions %	$PM_{2.5}$ µg/m3	Emissions %	$PM_{2.5}$ µg/m3
Residential Wood Combustion	79.6%	31.4	74.1%	20.5
Industry	0.0%	0.0	1.2%	0.3
On-Road Vehicles	8.4%	3.3	7.3%	1.9
Other	2.1%	0.8	3.0%	0.8
Background & Secondary Aerosols	9.9%	3.9	14.5%	4.0
Total	100.0%	**39.5**	100.0%	**27.5**

Table 4: Allocation of emissions and modeled concentrations for base and future year 2016.

Appendix 1-A
On-Road Emission Inventory Update

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477

LRAPA evaluated mobile source emissions of $PM_{2.5}$ and precursors (NOx, SO2, VOC and NH3) for the years 2008, 2015 and 2025 with the assistance of the Oregon Department of Environmental Quality (DEQ). The results of the MOVES2014a model runs are included in the links of the following DEQ-LRAPA transmittal email:

> **From:** RISHER Wes [mailto:wes.risher@state.or.us]
> **Sent:** Thursday, November 03, 2016 11:49 AM
> **To:** Merlyn Hough <merlyn@lrapa.org>; Robbye Lanier <robbye@lrapa.org>
> **Cc:** SWAB Christopher <christopher.swab@state.or.us>; BEYER Gary <gary.beyer@state.or.us>; STOCUM Jeffrey <jeffrey.g.stocum@state.or.us>; LAZAREV Svetlana <svetlana.lazarev@state.or.us>
> **Subject:** Rerun of MOVES modeling for Oakridge-Westfir PM2.5 and additional pollutants (NOx, SO2, VOC and NH3), 2008, 2015 and 2025
>
> Merlyn and Robbye,
> We have completed the **rerun** of MOVES2014a onroad modeling and emission estimation for Oakridge-Westfir PM2.5 with the additional pollutants needed (NOx, SO2, VOC and NH3), for the years 2008, 2015 and 2025.
>
> At the links below is an ftp site where you can pull the Excel spreadsheets (Pivot tables), with and without link level data, and the Access databases that has the daily lbs. per day emissions; sizeable files hence the ftp site to provide you a copy. Day 5 is the Weekday and Day 2 is the Weekend. You will likely just need to work with the ResultsWithoutLink but I wanted you to have both sets of results.
>
> ftp://deqftp2.deq.state.or.us\wrisher\Oakridge_rerun_ResultByLink_PIVOT.xlsx
> ftp://deqftp2.deq.state.or.us\wrisher\Oakridge_rerun_ResultsByLinkFinalOutput.mdb
> ftp://deqftp2.deq.state.or.us\wrisher\Oakridge_rerun_ResultsWithoutLink.accdb
> ftp://deqftp2.deq.state.or.us\wrisher\Oakridge_rerun_ResultWithoutLink_PIVOT.xlsx
>
> Regards,
> Wes Risher

Wesley Risher
Air Technical Services
Environmental Solutions Division
Oregon Dept. of Environmental Quality
Phone: 503-229-5092
email: risher.wes@state.or.us

LRAPA greatly appreciates the assistance of Wesley Risher, Gary Beyer, Jeffrey Stocum and Christopher Swab of the DEQ staff in running of the MOVES2014a model and the compilation of the results.

DEQ ran MOVES2014a for:

1. Four seasons (April, July, September and December);
2. Weekdays and weekend days;
3. Three years: 2008 base year, 2015 attainment year, and 2025 future year;
4. $PM_{2.5}$ (exhaust, brakewear and tirewear); and
5. $PM_{2.5}$ precursors (NOx, SO2, VOC and NH3).

Mobile source emissions are projected to steadily decrease between 2008 and 2015 as a result of cleaner vehicles and cleaner fuels. EPA has adopted national requirements for progressively more effective pollution control equipment on new cars and trucks and for cleaner gasoline and diesel fuels.

The overall summary table of the results in pounds per day (lb/day) is as follows:

Year	Pollutant Name	April Weekday	April Weekend	July Weekday	July Weekend	September Weekday	September Weekend	December Weekday	December Weekend
2008	Ammonia (NH3)	8.2	11.8	10.9	15.7	10.5	13.8	7.7	12.2
2008	Oxides of Nitrogen (NOx)	722.2	918.3	905.3	1,184.4	866.9	1,049.6	713.0	970.7
2008	Primary Exhaust PM2.5 - Total	24.1	30.7	26.6	35.5	26.5	32.4	26.2	34.9
2008	Primary PM2.5 - Brakewear Particulate	1.0	1.3	1.2	1.6	1.2	1.4	1.0	1.3
2008	Primary PM2.5 - Tirewear Particulate	0.4	0.6	0.5	0.8	0.5	0.7	0.4	0.6
2008	Sulfur Dioxide (SO2)	2.7	3.6	3.7	5.2	3.5	4.5	2.6	3.8
2008	Volatile Organic Compounds	732.2	739.0	756.7	804.8	750.3	759.7	772.7	794.1
	2008 Total	1490.9	1705.3	1704.9	2047.9	1659.4	1862.2	1523.6	1817.7
2015	Ammonia (NH3)	8.0	11.6	10.7	15.5	10.3	13.6	7.6	12.0
2015	Oxides of Nitrogen (NOx)	539.7	671.8	669.7	861.0	642.4	765.6	535.5	711.3
2015	Primary Exhaust PM2.5 - Total	13.8	17.6	15.2	20.3	15.1	18.5	15.1	20.1
2015	Primary PM2.5 - Brakewear Particulate	1.1	1.4	1.3	1.7	1.3	1.5	1.1	1.4
2015	Primary PM2.5 - Tirewear Particulate	0.5	0.6	0.6	0.8	0.6	0.7	0.4	0.7
2015	Sulfur Dioxide (SO2)	2.0	2.8	2.6	3.7	2.5	3.2	2.0	2.9
2015	Volatile Organic Compounds	507.5	508.0	530.7	558.9	523.5	526.4	533.3	543.2
	2015 Total	1072.5	1213.8	1230.7	1461.9	1195.6	1329.6	1094.9	1291.6
2025	Ammonia (NH3)	6.1	8.8	8.1	11.8	7.8	10.3	5.7	9.1
2025	Oxides of Nitrogen (NOx)	154.8	182.6	183.3	225.6	177.8	203.5	155.0	193.1
2025	Primary Exhaust PM2.5 - Total	3.6	4.5	4.0	5.3	4.0	4.8	3.9	5.0
2025	Primary PM2.5 - Brakewear Particulate	1.2	1.5	1.4	1.8	1.4	1.7	1.2	1.6
2025	Primary PM2.5 - Tirewear Particulate	0.5	0.7	0.7	0.9	0.6	0.8	0.5	0.7
2025	Sulfur Dioxide (SO2)	1.0	1.3	1.2	1.7	1.2	1.5	0.9	1.3
2025	Volatile Organic Compounds	170.6	169.5	167.6	175.2	168.2	168.4	182.3	183.2
	2025 Total	337.8	368.9	366.3	422.3	361.0	391.1	349.5	394.0

These results were used to update the 2008 and 2015 emission inventories in the 2016 Updated Oakridge-Westfir $PM_{2.5}$ Attainment Plan as well as the Motor Vehicle Emission Budget in Appendix 4.

Earlier MOVES2014a runs specific to $PM_{2.5}$ (not including precursors) are reviewed in the following correspondence.

From: RISHER Wes [mailto:wes.risher@state.or.us]
Sent: Friday, July 15, 2016 2:41 PM
To: Merlyn Hough <merlyn@lrapa.org>; Robbye Lanier <robbye@lrapa.org>
Subject: Completed MOVES modeling for Oakridge-Westfir PM2.5, 2008, 2015 and 2025

Merlyn and Robbye,
We have completed the MOVES2014a onroad modeling and emission estimation for Oakridge-Westfir PM2.5 for the years 2008, 2015 and 2025. At the link below is an ftp site where you can pull the Excel spreadsheet (Pivot table) that has the daily lbs. per day emissions; sizeable file hence the ftp site to provide you a copy. Please confirm that you are able to retrieve the file. Day 5 is the Weekday and Day 2 is the Weekend. Below in Gary's email there is a good comparison of the daily lbs./day values from our modeling analysis and the previous MOVES2010b work that LCOG prepared.

ftp://deqftp2.deq.state.or.us\wrisher\Oakridge_ResultByLink_PIVOT.xlsx

Regards,
Wes Risher

Wesley Risher
Air Technical Services
Environmental Solutions Division
Oregon Dept. of Environmental Quality
Phone: 503-229-5092
email: risher.wes@deq.state.or.us

MOVES 2014a Results by DEQ

Year	Day	4	7	9	12	
2008	5	25.58	28.36	28.16	27.56	
	2	32.57	37.80	34.50	36.87	
2015	5	15.37	17.02	16.92	16.59	
	2	19.61	22.77	20.78	22.23	
2025	5	5.34	6.09	6.04	5.56	
	2	6.72	8.03	7.32	7.34	

MOVES 2010b Results by LCOG

Year	Day	4	7	9	12	
2008	5	22.40	22.70	23.30	27.20	
	2	29.90	32.00	30.00	37.30	
2014	5	13.20	12.80	13.30	16.70	
	2	17.30	17.90	16.90	22.20	
2025	5	6.90	6.00	6.40	9.30	
	2	8.60	7.90	7.80	11.80	

DELTA

Year	Day	4	7	9	12	
2008	5	14.21%	24.94%	20.87%	1.32%	
	2	8.92%	18.12%	15.00%	-1.15%	
2015	5	16.42%	32.98%	27.21%	-0.64%	
	2	13.37%	27.21%	22.99%	0.13%	
2025	5	-22.61%	1.48%	-5.69%	-40.18%	
	2	-21.91%	1.58%	-6.16%	-37.82%	

Gary Beyer
Environmental Engineer
Oregon Department of Environmental Quality
Vehicle Inspection Program
1240 SE12th Avenue
Portland, Oregon 97214
☎: *971-673-1641*
📱: *503-863-9659*

From: BEYER Gary [mailto:gary.beyer@state.or.us]
Sent: Thursday, September 08, 2016 9:46 AM
To: Merlyn Hough <merlyn@lrapa.org>
Subject: FW: MOST Package has Completed
Importance: High

Hi Merlyn,

The email below is a user notification and a MOVES-MOST run summary.

This should give you an idea of what data is available in the run output database (ResultsByLinkFinalOutput.mdb).

Gary Beyer
Environmental Engineer
Oregon Department of Environmental Quality
Vehicle Inspection Program
1240 SE12th Avenue
Portland, Oregon 97214
☎: *971-673-1641*
📱: *503-863-9659*
-----Original Message-----
From: BEYER Gary
Sent: Thursday, September 08, 2016 9:43 AM
To: BEYER Gary
Subject: MOST Package has Completed
Importance: High

MOVES - MOST HAS COMPLETED SUCCESSFULLY
Run Time = 2 Hours 37 Secs

Year	Mth	Day	VMT
Base	4	2	91,392 miles
Base	7	2	121,731 miles
Base	9	2	107,160 miles
Base	12	2	94,676 miles
Base	4	5	63,463 miles
Base	7	5	84,189 miles
Base	9	5	81,047 miles
Base	12	5	59,856 miles
Conformity	4	2	107,931 miles
Conformity	7	2	144,041 miles
Conformity	9	2	126,729 miles
Conformity	12	2	111,797 miles
Conformity	4	5	74,889 miles

Conformity	7	5	99,553 miles
Conformity	9	5	95,794 miles
Conformity	12	5	70,612 miles
Future	4	2	97,999 miles
Future	7	2	130,696 miles
Future	9	2	114,999 miles
Future	12	2	101,555 miles
Future	4	5	67,928 miles
Future	7	5	90,259 miles
Future	9	5	86,864 miles
Future	12	5	64,056 miles

==========

User: DEQ\gbeyer
Email: BEYER.Gary@deq.state.or.us
Date: 9/8/2016 7:41:45 AM

SCENARIOS:

Run	Year	Scenario	Mth	Day	Moves Scenario
1	Base	TSD	4	2	2008DEQ_Oakridge_PM25
2	Base	TSD	7	2	2008DEQ_Oakridge_PM25
3	Base	TSD	9	2	2008DEQ_Oakridge_PM25
4	Base	TSD	12	2	2008DEQ_Oakridge_PM25
5	Base	TSD	4	5	2008DEQ_Oakridge_PM25
6	Base	TSD	7	5	2008DEQ_Oakridge_PM25
7	Base	TSD	9	5	2008DEQ_Oakridge_PM25
8	Base	TSD	12	5	2008DEQ_Oakridge_PM25
9	Conform	TSD	4	2	2025DEQ_Oakridge_PM25
10	Conform	TSD	7	2	2025DEQ_Oakridge_PM25
11	Conform	TSD	9	2	2025DEQ_Oakridge_PM25
12	Conform	TSD	12	2	2025DEQ_Oakridge_PM25
13	Conform	TSD	4	5	2025DEQ_Oakridge_PM25
14	Conform	TSD	7	5	2025DEQ_Oakridge_PM25
15	Conform	TSD	9	5	2025DEQ_Oakridge_PM25
16	Conform	TSD	12	5	2025DEQ_Oakridge_PM25
17	Future	TSD	4	2	2015DEQ_Oakridge_PM25
18	Future	TSD	7	2	2015DEQ_Oakridge_PM25
19	Future	TSD	9	2	2015DEQ_Oakridge_PM25
20	Future	TSD	12	2	2015DEQ_Oakridge_PM25
21	Future	TSD	4	5	2015DEQ_Oakridge_PM25
22	Future	TSD	7	5	2015DEQ_Oakridge_PM25
23	Future	TSD	9	5	2015DEQ_Oakridge_PM25
24	Future	TSD	12	5	2015DEQ_Oakridge_PM25

POLLUTANTS:

#	ID	Pollutant Name
1	1	Total Gaseous Hydrocarbons
2	35	Nitrate (NO3)
3	36	Ammonium (NH4)
4	51	Chloride
5	52	Sodium
6	53	Potassium
7	54	Magnesium
8	55	Calcium
9	56	Titanium
10	57	Silicon
11	58	Aluminum
12	59	Iron
13	66	Manganese Compounds
14	91	Total Energy Consumption
15	110	Primary Exhaust PM2.5 - Total
16	111	Organic Carbon
17	112	Elemental Carbon
18	115	Sulfate Particulate
19	116	Primary PM2.5 - Brakewear Particulate
20	117	Primary PM2.5 - Tirewear Particulate
21	118	Composite - NonECPM
22	119	H2O (aerosol)
23	121	CMAQ5.0 Unspeciated (PMOTHR)
24	122	Non-carbon Organic Matter (NCOM)

From: BEYER Gary [mailto:gary.beyer@state.or.us]
Sent: Thursday, September 08, 2016 10:31 AM
To: MATHEWS John <john.mathews@state.or.us>
Cc: FIELDS Brian <brian.fields@state.or.us>; SWAB Christopher <christopher.swab@state.or.us>; STOCUM Jeffrey <jeffrey.g.stocum@state.or.us>; Merlyn Hough <merlyn@lrapa.org>; RISHER Wes <wes.risher@state.or.us>
Subject: MOVES – MOST Process Diagram Ver 16.02

I have attached an updated process diagram for MOVES – MOST.

There are a few minor changes:

- Added contributors to title block
- Added empty table check to fail more gracefully
- Added Canceled by user message to reduce confusion

Let me know if you think I should add any other clarifications.

Regards,

Gary Beyer
Environmental Engineer
Oregon Department of Environmental Quality
Vehicle Inspection Program
1240 SE12th Avenue
Portland, Oregon 97214
☎: *971-673-1641*
📱: *503-863-9659*

MOVES – MOST
Process Diagram Ver

From: RISHER Wes [mailto:wes.risher@state.or.us]
Sent: Wednesday, July 13, 2016 11:00 AM
To: BEYER Gary <gary.beyer@state.or.us>
Cc: SWAB Christopher <christopher.swab@state.or.us>; Merlyn Hough <merlyn@lrapa.org>
Subject: MOVES2014 and MOVES2014a changes since the version of MOVES2010b

Gary,
Below is a write up I sent to the Portland Medford Multipollutant Analysis Project (PMMAP) team last winter regarding the changes to the MOVES model between the version MOVES2010b and MOVES2014 and MOVES2014a. The onroad mobile estimates for Oakridge that we have been comparing are estimates using the MOVES2010b version of the model. EPA (specifically OTAQ) would not approve the Oakridge-Westfir PM2.5 Attainment Year SIP as the work was not using the most recent version of the MOVES model (MOVES2014a). Outlined below are the three new emission control programs that are now being reflected in the emission rate output from the model beginning in 2017. It appears we are seeing these emission reductions in our future year emission estimates you have prepared. I thought this information would help explain the reductions we are seeing.
Regards,
Wes

From: RISHER Wes
Sent: Friday, February 12, 2016 11:46 AM
To: SWAB Christopher
Cc: DOWNING Kevin; ARMITAGE Sarah; ALLEN Philip; LAZAREV Svetlana; STOCUM Jeffrey
Subject: RE: PMMAP: SMOKE-MOVES

Chris,
Here is what I have found about the MOVES2014 and MOVES2014a changes since the version of MOVES2010b:

MOVES2014 - is a **major new revision** to EPA's mobile source emission model and it replaces MOVES2010 and its minor revisions (MOVES2010a and MOVES2010b).

- MOVES2014 incorporates the effects of three new emission control programs associated with regulations promulgated since the release of MOVES2010b:
    - Tier 3 emission standards that phase in beginning in 2017 for cars, light-duty trucks, medium-duty passenger vehicles, and some heavy-duty trucks, and Tier 3 fuel standards that require lower sulfur gasoline beginning in 2017
    - Heavy-duty engine and vehicle greenhouse gas (GHG) regulations that phase in during model years 2014-2018.
    - The second phase of light-duty vehicle GHG regulations that phase in for model years 2017-2025 cars and light trucks.
- MOVES2014 also includes new and updated emissions data from a wide range of test programs and other sources. The most significant changes in MOVES2014 include new effects of fuel properties such as gasoline sulfur and ethanol, new data on evaporative emissions from fuel leaks and from vehicles parked for multiple days, new analyses of particulate matter (PM) data related to PM speciation and temperature effects on running PM emissions, and new real world in-use emissions for heavy-duty vehicles using data from portable emission monitoring systems. In addition to these and many other updates for emission rates, MOVES2014 also includes substantial new data and updates for default population and activity. These include new vehicle population estimates and sales projections, new vehicle miles travelled (VMT) estimates based on the updated methodology for the Federal Highway Administration's Highway Performance Monitoring System, new national average speed distributions based on global positioning system (GPS) data, new state supplied data from the 2011 National Emission Inventory, and many other population and/or activity related updates.
- Option to map total organic gas (TOG) emissions to chemical species used in air quality transport models.
- MOVES2014 is currently the best tool EPA has for GHG emissions from the transportation sector, and it is a significant improvement over previous versions of MOVES. State and local agencies estimating GHG emissions in the transportation planning process should consider using MOVES2014 for GHG emissions analyses in the future.
- MOVES2014 estimates emissions for mobile source air toxics (MSATs) such as benzene, 1,3-butadiene, formaldehyde, acetaldehyde, acrolein, naphthalene, and ethanol. It is EPA's best available tool for quantifying emissions of these MSATs and is based on data that have been updated since MOVES2010b. State and local agencies, academic institutions, and other interested parties who are interested in analyzing MSAT emissions from transportation projects should consider using MOVES2014 in the future.
- In general, VOC, NOx, PM, and CO emissions show greater decreases over time compared to MOVES2010b. Differences in total emissions vary by calendar year and location, but in general, VOC and NOx emissions are lower in MOVES2014. PM emissions may be higher in some areas and lower in others.

MOVES2014a – **minor update**

- Correct an error in the CB05 and CB6 outputs for CY 2013-2030 (all new work with these outputs should be done with MOVES2014a). Error magnitude varies by chemical species, county and year. All new work with these outputs should be done with MOVES2014a.
- no changes to SMOKE MOVES
- NOx, VOC and CO emissions decrease 0-0.1%
- Total PM2.5 emissions decrease (2-7%) primarily due to correction to brake wear fix

EPA – We encourage state to use MOVES2014a for new onroad SIP and Conformity work, but can complete existing work with MOVES2014.

Based upon my review I strongly feel we need to transition to MOVES2014a from MOVES2010b due to the significant updates for the PMMAP work.
Regards,
Wes

From: SWAB Christopher
Sent: Thursday, February 11, 2016 8:55 AM
To: RISHER Wes
Subject: PMMAP: SMOKE-MOVES

Wes –

The AIRPACT-5 SMOKE-MOVES framework is using MOVES2010b; can you let me know the difference between MOVES2010b and MOVES2014?

Thanks,
Chris

Appendix 1-B

Comparison of 2008-2011-2014 National Emission Inventories for $PM_{2.5}$ Precursors in Lane County and Oakridge Areas

October 2016

Lane Regional Air Protection Agency

The 2008 National Emission Inventory (NEI) for Lane County was used as the starting point for calculating both $PM_{2.5}$ emissions and $PM_{2.5}$ precursor emissions for the Oakridge-Westfir $PM_{2.5}$ nonattainment area. The Lane County portion of the 2008 NEI was summarized in Appendix D-5 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan, including emissions of $PM_{2.5}$, NOx, SO2, VOC and NH3. The initial Oakridge-Westfir emissions were estimated by applying appropriate emission allocation factors (e.g., relative population, housing, vehicle miles of travel, land area, etc.) to the Lane County $PM_{2.5}$ and precursor emission cateogries. The significant (and insignificant) source categories during the winter $PM_{2.5}$ problem season were identified in Appendix D-5 of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan.

The 2011 and 2014 NEIs were released subsequent to the submittal of the 2012 Oakridge-Westfir $PM_{2.5}$ Attainment Plan. LRAPA has summarized and compared the Lane County and Oakridge portions of the 2008 NEI, the 2011 NEI and the 2014 NEI. The comparison of the 2008-2011-2014 NEIs indicates that the anthropogenic precursor emissions are decreasing significantly over time. The next NEI (2017) will probably not be available until late 2018, but based on the 2008-2014 trends, LRAPA expects the 2015-2017 precursor emissions to be even lower than the 2014 precursor emissions.

Secondary particulate is an overall very minor contributor to the Oakridge $PM_{2.5}$ air pollution concentrations on worst winter days as summarized in both the 2012 and 2016 Oakridge-Westfir Attainment Plans. For example, as outlined in Table 6 of the 2016 Plan, sulfates contribute only 1.1% and nitrates contribute only 0.4% on the top 25% high $PM_{2.5}$ concentration days. Rather, the major $PM_{2.5}$ contributor is organic carbon (88%), primarily from residential wood combustion.

Parameter	Sulfate	Nitrate	OC	EC	Water	NH3	OPP
Percent	1.1	0.4	88.4	7.6	1.4	0.03	1.1
ug/m3	0.43	0.16	34.46	2.95	0.54	0.01	0.44

Table 2 (from 2016 Plan): Contribution by speciated components, based on results of SANDWICH analysis for the top 25% high concentration winter (October-March) days.

Each of the precursor groups in Table 6 was determined to be below the EPA Region 10 insignificance threshold of 1.3 ug/m3:

- Nitrate + ammonia = 0.16 ug/m3 + 0.01 ug/m3 = 0.17 ug/m3 < 1.3 ug/m3.
- Sulfate = 0.43 ug/m3 < 1.3 ug/m3.

Therefore, the LRAPA emission inventory analysis focused in most detail on the significant $PM_{2.5}$ particulate sources during the winter season in Oakridge-Westfir, notably residential woodburning emissions from woodstoves, fireplaces and pellet stoves.

Details on the Lane County and Oakridge portions of the 2008, 2011 and 2014 NEIs, as well as graphic comparisons of trends by each precursor category, are included in the attached spreadsheet:

Comparison of 2008 and 2011 and 2014 NEIs for Lane County and Oakridge.xls

Appendix D: Emission Inventory

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area Emission Inventory and Forecast for 2008 Base Year and 2014 Attainment Year

October 2012

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477

Background

The 1990 Clean Air Act contains provisions on the required development of emission inventories for designated areas that failed or have failed in the past to meet the National Ambient Air Quality Standards (NAAQS). The Oakridge-Westfir Nonattainment Area (NAA) is a designated NAAQS $PM_{2.5}$ nonattainment area. This emission inventory is provided as a part of the State of Oregon revisions to its State Implementation Plan (SIP) to formulate a strategy to maintain the NAAQS.

The principal components for development and documentation for the 2014 Attainment Plan emission inventories have been addressed in this document, which includes stationary permitted point sources, stationary area (non-permitted) sources, non-road mobile sources (railroads), on-road mobile sources, and emissions summaries. Inventory years include a base year of 2008 and the 2014 attainment deadline year. The geographic boundary for each inventory is the Oakridge-Westfir NAA, as defined by the NAA boundary.

In this document the terms *annual*, *typical season day*, and *worst-case day* emissions are used to categorize the estimated emissions for a particular time period. The annual emissions are a total amount of emissions for the source category that occurred throughout the year, represented in tons per year (tpy). The typical season day emissions represent an average daily emission value occurring from November 1st through the end of February. This four month time period is considered to be the PM season, and is when the PM standard is usually violated. The worst-case day emissions are the highest daily emissions estimated for the PM season, and represent a day during the PM season when emissions generating activity is at its highest. For emission inventory purposes, the worst-case day is equivalent to the 98th-percentile design value (DV) day. Typical season day and worst-case day emissions are represented in pounds per day (lbs/day).

The 2008 National Emission Inventory (NEI) for Lane County was used as the starting point for calculating both $PM_{2.5}$ emissions and $PM_{2.5}$ precursor emissions for the Oakridge-Westfir $PM_{2.5}$ nonattainment area. The Lane County portion of the 2008 NEI is summarized in Appendix D-5, including emissions of $PM_{2.5}$, NOx, SO2, VOC and NH3. The initial Oakridge-Westfir emissions were estimated by applying appropriate emission allocation factors (e.g., relative population, housing, vehicle miles of travel, land area, etc.) to the Lane County $PM_{2.5}$ and precursor emission cateogries. The significant (and insignificant) source categories during the winter $PM_{2.5}$ problem season were identified in Appendix D-5.

Secondary particulate is an overall very minor contributor to the Oakridge $PM_{2.5}$ air pollution concentrations on worst winter days as described in the Speciation Studies in Appendix E and summarized in Table 8 of the Attainment Plan. For example, sulfates contribute only 1.1% and nitrates contribute only 0.4% on the top 25% high $PM_{2.5}$ concentration days. Rather, the major $PM_{2.5}$ contributor is organic carbon (88%), primarily from residential wood combustion.

Therefore, the emission inventory analysis focused in most detail on the significant $PM_{2.5}$ particulate sources during the winter season in Oakridge-Westfir, notably residential woodburning emissions from woodstoves, fireplaces and pellet stoves.

Executive Summary

This emission inventory consists of emission estimates from sources that emit $PM_{2.5}$ within the Oakridge-Westfir nonattainment area boundary. The emissions inventory data is essential in developing the attainment demonstration, as it helps identify the sources contributing to the air quality problem and the emission reduction strategies, once implemented, that reduce pollution levels below the standard. Sources of $PM_{2.5}$ in Oakridge include minor industry, on-road mobile sources (e.g., car and truck exhaust, road dust), railroads, and area sources (e.g., outdoor burning, woodstoves, and fireplaces).

Base Year Emission Inventory (2008)

The base year emission inventory is used as the starting point for the attainment demonstration. This inventory includes sources in the nonattainment area during the 2008 baseline year. The 2008 emission inventory is summarized in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	0.4	0.8	0.1%	0.1%
Oakridge Sand & Gravel: Cement plant	0.1	0.1	0.0%	0.0%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	42.3	7%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	158.9	174.8	30%	32%
Residential Wood Combustion: Certified Woodstove/Insert[2]	228.0	250.8	43%	45%
Pellet Stoves	6.7	7.4	1%	1%
All Other Stationary Area Sources	47.4	4.7	9%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	26.6	37.3	5%	7%
Re-Entrained Road Dust	12.1	27.8	2%	5%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
Total, All Sources, lbs/day	**525**	**552**		

(1) Worst-case day = Peak month production/20 workdays.
(2) Worst-case day = Peak Heating Degree Day

Table D-1: 2008 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.

The emissions inventory on worst winter days is of most interest since the $PM_{2.5}$ concentrations measured in Oakridge do not meet the current 24-hour $PM_{2.5}$ standard and the peak $PM_{2.5}$ concentrations occur on cold, stagnant days during the November-February wood-heating season. Residential wood-heating emissions (from certified and non-certified woodstoves, fireplaces, and pellet stoves) account for about 86% of the emissions on worst winter days, as illustrated in the following figure.

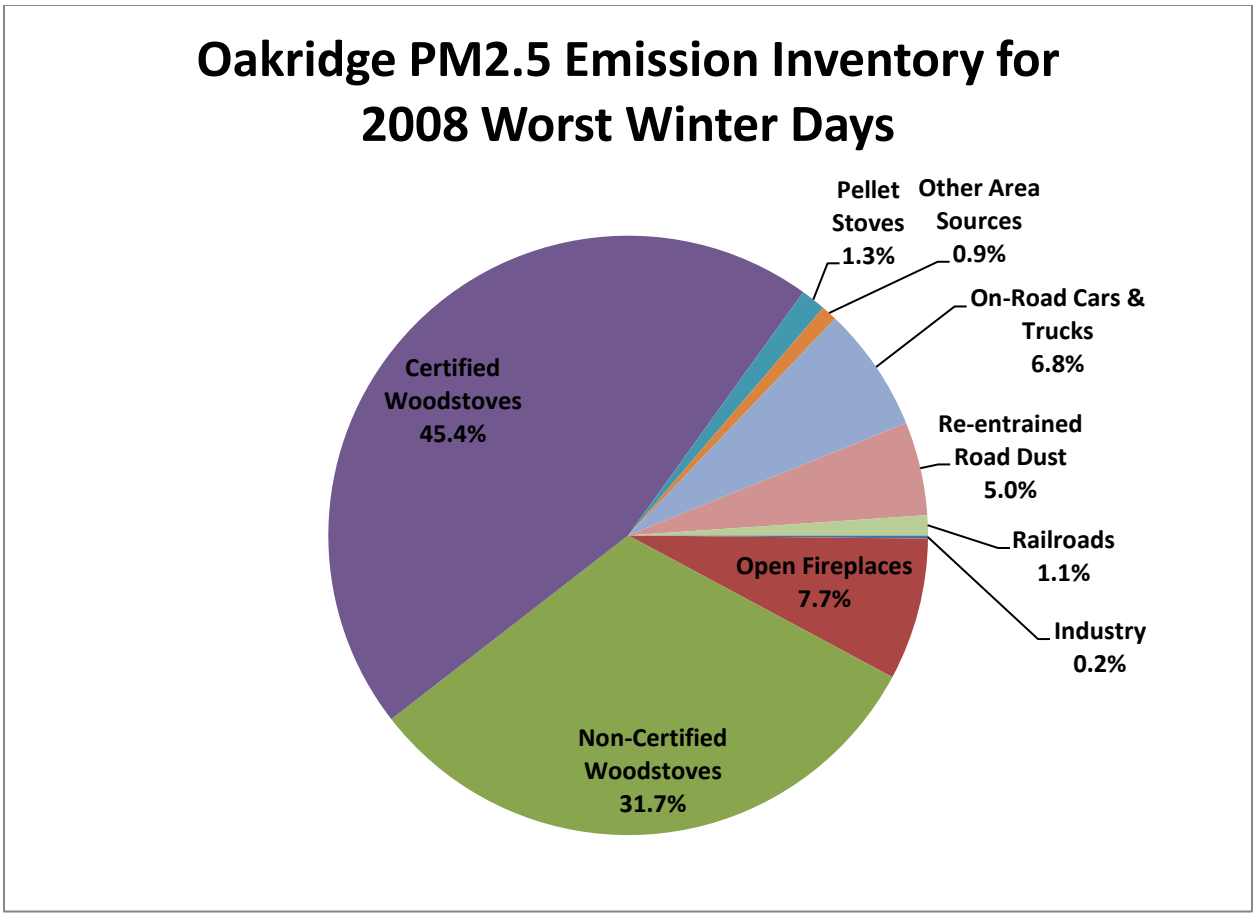


Figure D-1: **Oakridge $PM_{2.5}$ Emission Inventory for 2008 Worst Winter Days**

Residential Wood Combustion

Residential wood combustion (RWC) is a common way to heat homes in Oregon. To estimate emissions from wood burning, LRAPA conducted a survey for the 2009-2010 heating season in Oakridge-Westfir. The survey provided LRAPA with information on how many homes use various types of wood-heating devices, the amount of wood burned, and other information on wood-heating practices.

Mobile and Nonroad Sources

Road dust and tailpipe emissions of $PM_{2.5}$ from motor vehicles were calculated by Lane Council of Governments (LCOG) transportation staff by applying emission factors from the EPA MOVES computer program to total vehicle miles traveled in the nonattainment area. Estimated vehicle miles traveled are from previous transportation modeling by LCOG for the Oregon Department of Transportation. Emissions from railroads were provided by Union Pacific Railroad staff using the EPA NONROAD2008a emissions protocol.

Industrial Point Sources

LRAPA maintains data on industrial point source emissions in Lane County. The only operating industrial point sources within the Oakridge-Westfir area are two minor aggregate industry sources (rock crusher and concrete batch plant) operated by Oakridge Sand & Gravel.

Attainment Year Emission Inventory (2014)

The attainment year inventory is an estimation of emissions for the year that the area is expected to have attained the $PM_{2.5}$ standard. It includes projected emissions for the attainment year based on a number of different factors. Growth rates for population, employment, and VMT through 2014 were used to estimate 2014 emissions. LRAPA took credit for RWC emissions reductions as a result of the woodstove replacement project implemented during 2009-2012 that reduced the number of non-certified woodstoves accounted for in the 2008 emission inventory.

The attainment year emission inventory is based on the 2008 emissions inventory, estimated growth rates and the emission reduction strategies that have recently been put into effect. The emission reduction strategies primarily include the continued implementation (with specific strengthening revisions in some cases) of the existing control measures that have been effective in achieving the PM_{10} standards and the initial (1997) $PM_{2.5}$ standards on schedule. The key ongoing control strategies, which were in place prior to 2008, include:

- City ordinance to curtail burning during stagnant weather periods;
- City ordinance requiring the removal of a non-certified wood stoves upon sale of a home;
- City ordinance prohibiting the use of a non-certified wood stove in a residence; and
- Partnering in additional change-out programs to encourage removal of non-certified woodstoves.

The RWC emission reduction credits in the proposed $PM_{2.5}$ Attainment Plan are conservative. The calculated credits are based on:

- New woodstoves installed after 2008 are EPA certified Phase II equivalent, based on the Oakridge ordinances and the Oregon Heat Smart law;
- Existing uncertified woodstove replacements since 2008 are based on the 79 units documented by LRAPA-administered financial incentive programs; and
- The strengthened mandatory curtailment program during air pollution episodes forecasts a 30% reduction in wood burning on red advisory days.

There are several other RWC strategies in the proposed $PM_{2.5}$ Attainment Plan but no specific credits were taken for those strategies.

The 2014 emission inventory is summarized in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.1%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	3.7%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	29.6	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	106.1	81.7	22%	21%
Residential Wood Combustion: Certified Woodstove/Insert[2]	252.4	194.4	52%	51%
Pellet Stoves	7.3	8.0	1%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	15.7	22.2	3%	6%
Re-Entrained Road Dust	7.1	16.3	1%	4%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
Total, All Sources, lbs/day	**486**	**381**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table D-2: **2014 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.**

Comparison of 2008 to 2014 Emissions

The emission inventory shows an overall decrease in emissions for the attainment year (2014) based on the effectiveness of the emission control strategies.

The differences in the 2008 and 2014 emission inventories are the combination of increases due to growth factors and decreases due to emission control strategies. For example, motor vehicle emissions decreased overall due to progressively cleaner gasoline and diesel fuels and motor vehicles, but part of the emissions decrease was offset by gradual growth in traffic volumes. Industry emissions were conservatively increased to reflect operation at maximum capacity in 2014, but both industrial sources are minor so this did not have a major effect on the 2014 inventory. The most significant category is residential wood-heating; emissions were increased to reflect population growth during 2008-2014, decreased due to non-certified woodstove replacements with cleaner burning units during 2009-2012, and decreased due to improvements in the programs for curtailment during stagnant air episodes.

To review, the key long-term permanent RWC strategies have been:

- the woodstove change-out programs replacing uncertified woodstoves with cleaner burning and more efficient home heating units;
- the Oregon and EPA woodstove certification programs requiring any new woodstoves installed since 1986 to be certified woodstoves; and
- the Oakridge ordinance and Oregon Heat Smart law requiring removal of uncertified woodstoves upon home sale.

These programs have been critical to the significant improvement in Oakridge $PM_{2.5}$ concentrations during 2005-2011. In addition, the combined emission reduction of these programs will more than offset the growth in population and housing between 2008 and 2014, with a net RWC emission reduction of about 28 lb/day on typical season days and 31 lb/day on worst-case days.

The key short-term RWC strategy is a strengthened mandatory curtailment program to reduce fireplace and woodstove emissions by 30% on an average of 20 red days per year (based on the number of days above 30 $\mu g/m^3$ $PM_{2.5}$ during 2005-2011). This will reduce RWC emissions by 131 lb/day and reduce future $PM_{2.5}$ concentrations below the 35 $\mu g/m^3$ $PM_{2.5}$ standard on worst-case days.

Contingency Planning

The Oakridge $PM_{2.5}$ attainment plan must contain contingency measures that would be implemented in the event that the Oakridge nonattainment area fails to meet the standard on or after December 2014. The contingency measures are designed to correct the violation of the $PM_{2.5}$ standards and be implemented immediately. EPA requires that any contingency measures must equal one year equivalent of reasonable further progress (RFP). The RFP requirement in Oakridge would equal about one $\mu g/m^3$ of further reduction.

The Oakridge $PM_{2.5}$ attainment plan includes the following strategies as contingency strategies to fully meet the air quality standards, if it becomes clear that the strengthened ongoing strategies described above will not be sufficient to attain the $PM_{2.5}$ standards by 2014 and or to maintain compliance with the standards through 2024 and beyond:

- Stricter opacity limit, revising the current 40% opacity limit in the city ordinance to a more restrictive 20% limit, as has been done in some other northwest communities.
- Stricter green-yellow-red advisory program, with more yellow and red advisory days each winter.
- Further restrictions on city woodstove curtailment exemptions (for sole source, economic hardship).

The most quantifiable and most quickly implemented of these contingency measures would be further strengthening of the mandatory curtailment program by more consistent enforcement of the city curtailment ordinance and stricter criteria for expanding the number of yellow and red advisory days. If the standard is not met by 2014, the number of red curtailment days would be increased to an average of 30 days per year (based on the number of days above 25 $\mu g/m^3$ $PM_{2.5}$ during 2005-2011) and the frequency of curtailment enforcement (warnings and citations) would be increased accordingly in order to increase the effectiveness of the curtailment to 40% (or to 50% if necessary) on worst case days.

If the contingency plan is implemented, the mandatory curtailment program will be increased from an average of 20 days per year (based on 30 $\mu g/m^3$ $PM_{2.5}$ in the pre-2012 Oakridge

ordinance) to 30 days per year (based on 25 µg/m^3 $PM_{2.5}$ in the contingency plan). The contingency measures for stronger enforcement on more red advisory days is expected to increase the curtailment effectiveness.

- Using these contingency strategies to increase curtailment effectiveness to 40% is expected to reduce RWC emissions by 44 lb/day and further reduce $PM_{2.5}$ concentrations on worst case days.
- Using these contingency strategies to increase curtailment effectiveness to 50% is expected to reduce RWC emissions by 87 lb/day and further reduce $PM_{2.5}$ concentrations on worst case days.

Either of these contingency measures would more than achieve the one µg/m^3 target needed to meet the EPA RFP test.

If Oakridge meets the $PM_{2.5}$ standard by the EPA Clean Air Act 2014 deadline, the contingency plan will not need to be enacted. If Oakridge does not meet the $PM_{2.5}$ standard by the EPA Clean Air Act 2014 deadline, the contingency plan will be enacted by the beginning of the immediate next wood-heating season, November 15, 2015.

Introduction

Purpose of the Report

The $PM_{2.5}$ Nonattainment Area State Implementation Plan (SIP) emissions inventory for Oakridge-Westfir has been developed in response to requirements specified in the Clean Air Act Amendments of 1990 and in conformance to 40 CFR §51.1002(c).

The 1990 Clean Air Act contains provisions on the required development of emission inventories for designated areas that failed or have failed in the past to meet the National Ambient Air Quality Standards (NAAQS). The Oakridge-Westfir Nonattainment Area (NAA) is a designated NAAQS $PM_{2.5}$ nonattainment area. This emission inventory is provided as a part of the State of Oregon revisions to its State Implementation Plan (SIP) to formulate a strategy to maintain the NAAQS.

The U.S. Environmental Protection Agency (EPA) adopted revisions to the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ in September 2006. $PM_{2.5}$ is fine particulate matter two and a half microns and less in diameter.

On October 8, 2009, the Environmental Protection Agency (EPA) issued final area non-attainment designations for the 24-hour national air quality standards for fine particulate matter ($PM_{2.5}$). Oakridge was designated a non-attainment area in Oregon. Under the Clean Air Act, an area that violates the federal standards is designated as "nonattainment" and must adopt a plan with emission reduction measures to bring the area back into compliance. The area designated as non-attainment for $PM_{2.5}$ contains Oakridge, the small town of Westfir and surrounding area.

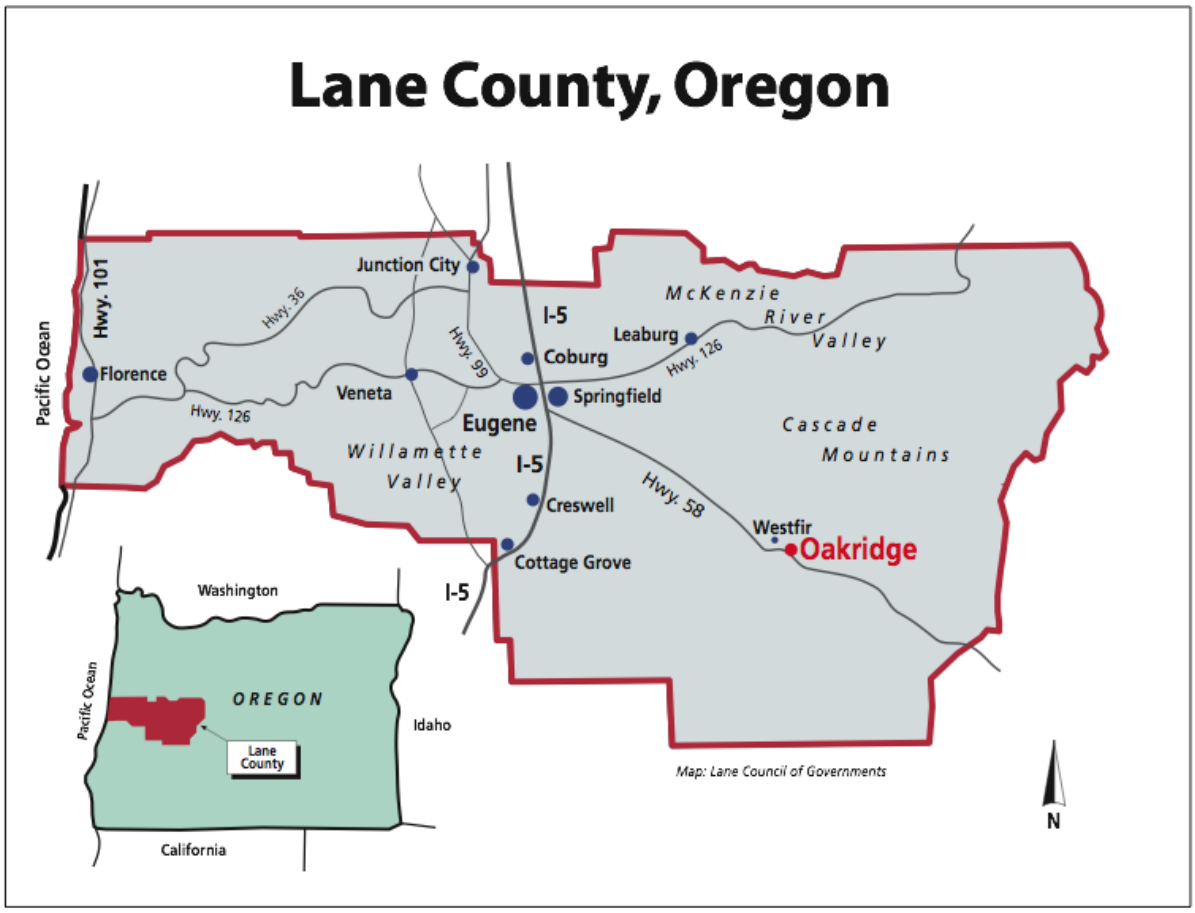
This document fulfills the EPA requirements for preparing the 2008 Base Year and 2014 Attainment Year emission inventories, as specified in the provisions of the 1990 CAAA, and EPA guidance documents. The purpose of this report is to establish baseline emissions for the Oakridge-Westfir NAA in 2008 and project emissions to 2014. These emissions are then used to determine whether the area will reach attainment by 2014. This determination is documented in the Oakridge $PM_{2.5}$ Attainment Plan, of which this is an appendix.

The principal components for development and documentation for the 2014 Attainment Plan emission inventories have been addressed in this document, which includes stationary permitted point sources, stationary area (non-permitted) sources, non-road mobile sources (railroads), on-road mobile sources, and emissions summaries. Inventory years include a base year of 2008 and the 2014 attainment deadline year. The geographic boundary for each inventory is the Oakridge-Westfir NAA, as defined by the NAA boundary.

Description of Inventory and Area Covered

The 2008 Base Year emission inventory and 2014 Attainment Year emission forecast cover $PM_{2.5}$ emissions for the Oakridge-Westfir NAA. Emissions are reported as annual, typical season day, and worst-case day. Typical season day emissions are the daily rate of emissions for the four-month PM season, defined as the period from the beginning of January through the end of February and beginning of November through the end of December. Worst-case day emissions represent the highest ambient $PM_{2.5}$ accumulations on a single day during the four-month PM season. Annual emissions are reported as tons per year (tpy), whereas typical season and worst-case day emissions are reported as lbs per day.

Oakridge, Oregon lies in an alluvial plain in the foothills at the southern end of the Willamette River valley. The city is in Lane County, Oregon, approximately 45 miles east-southeast of Eugene, and 28 miles west of Willamette Pass, the summit of the Cascade Mountain Range. The city limits of present-day Oakridge includes the historic City of Oakridge and, directly west, the area formerly known as Willamette City. Figure 2 shows the location of Oakridge in Lane



County.

Figure 2: Oakridge Location

The area of applicability for this attainment plan includes an area that contains the City of Oakridge and the small town of Westfir. Figure 3 shows the Oakridge-Westfir non-attainment area.

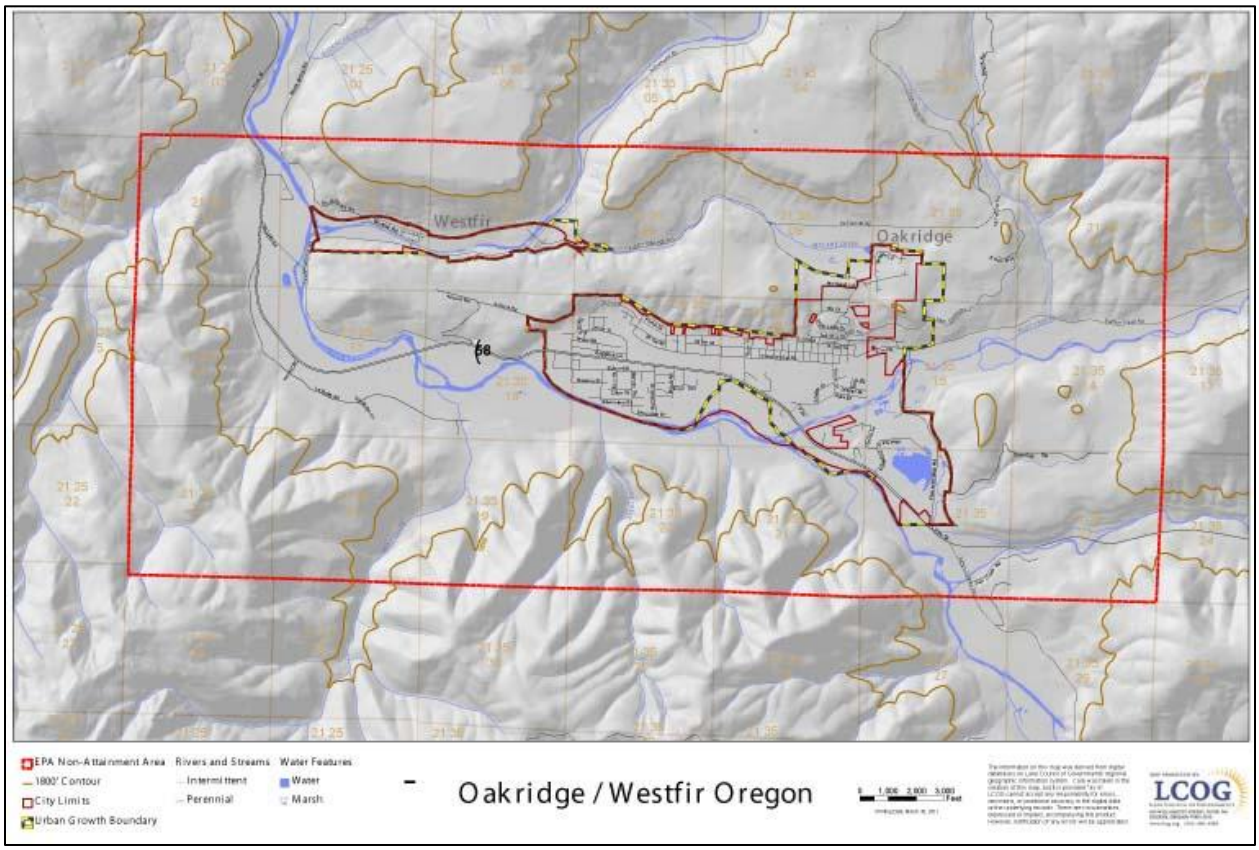


Figure 3: Nonattainment Area

The City of Oakridge is situated in a valley oriented east-west, through which flows the middle fork of the Willamette River. Elevation of the area ranges from 1100 feet at the lower (west) end to 1600 feet with areas of densest population situated between 1100 feet and 1200 feet. Mountains rise on the north and south sides to 1700 feet and 1600 feet, respectively.

Westfir is a very small (population 335) isolated rural mountain community that is located along the north fork of the Willamette River about 1 mile NW of Oakridge. Its elevation is about the same as Oakridge and it is surrounded by the same high mountains. Westfir and Oakridge are in separate steep sided river valleys separated by a 400-foot ridge. The Westfir valley is very narrow, only about 1/4 mile across at its widest point, while the Oakridge valley is about 1 mile across at its widest point.

Description of Emission Inventory Information Systems

The inventory has been assembled by the staff of the Lane Regional Air Protection Agency (LRAPA) with support from the staffs of the Lane Council of Governments (LCOG) and the Oregon Department of Environmental Quality ODEQ). Permitted point source emissions were drawn from the LRAPA permit source files and ODEQ emission factors. Residential wood combustion (RWC) emissions were calculated from LRAPA wood use surveys and EPA emission factors. Onroad emissions were calculated by LCOG using previous traffic modeling studies and the EPA MOVES emissions model. Railroad emissions were calculated by staff of the Union Pacific Railroad (UPRR) using UPRR data and EPA emissions factors. All other emissions were either modeled or inventoried by LRAPA staff specifically for this project.

Sources Not Inventoried

All significant sources of $PM_{2.5}$ in the Oakridge-Westfir NAA were considered for inclusion in the emission inventory. Sources were omitted for one of the following reasons: (1) point, area, non-road or mobile sources did not emit significant amounts of $PM_{2.5}$ annually or during the winter months; or (2) the activity did not occur within the Oakridge-Westfir NAA. The Lane County portion of the 2008 National Emission Inventory (NEI) was used as the initial base for the initial screening to identify significant source categories of PM, NOx, SO2, VOC and NH3 emissions in the Oakridge-Westfir area. The initial screening of estimated emissions in the Oakridge-Westfir area used relative population, housing, traffic volumes, acreage, industry locations, and other parameters. The Lane County and Oakridge-Westfir emissions of PM, NOx, SO2, VOC and NH3 are summarized in a series of tables by pollutant in Appendix D-5.

Guidance Documents

The inventory was conducted using applicable EPA procedure and guidance documents. Emission factors were taken from the EPA Procedures Document, the *Compilation of Air Pollutant Emission Factors*, hereinafter referred to as AP-42. Localized emission factors were used when documentation existed to support their accuracy. These and other information sources are cited in the text, as appropriate.

Contact Personnel for the Inventory

LRAPA staff, Merlyn Hough and Max Hueftle, performed most of the required source calculations. Josh Roll of the LCOG staff provided the vehicle miles travelled (VMT) and onroad emissions calculations.

Quality Assurance and Quality Control of the Inventory

LRAPA staff consulted with DEQ staff throughout the preparation of these emission inventories. Emissions from each of the categories (e.g., mobile source emission rates per mile) were compared to similar inventories for the Klamath Falls and Tacoma areas. PM emissions were compared to historical emission inventories and trends for the successful 1988-2010 Oakridge and Eugene-Springfield PM_{10} attainment planning and control strategies implementation. The Oakridge emission inventories were consistent with independent chemical speciation work on Oakridge PM filters and Positive Matrix Factorization (PMF) results by EPA Region 10 staff.

Summary of Emissions Data

Base Year Emission Inventory (2008)

The base year emission inventory is used as the starting point for the attainment demonstration. This inventory includes sources in the nonattainment area during the 2008 baseline year. The 2008 emission inventory is summarized in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	0.4	0.8	0.1%	0.1%
Oakridge Sand & Gravel: Concrete plant	0.1	0.1	0.0%	0.0%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	42.3	7%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	158.9	174.8	30%	32%
Residential Wood Combustion: Certified Woodstove/Insert[2]	228.0	250.8	43%	45%
Pellet Stoves	6.7	7.4	1%	1%
All Other Stationary Area Sources	47.4	4.7	9%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	26.6	37.3	5%	7%
Re-Entrained Road Dust	12.1	27.8	2%	5%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
Total, All Sources, lbs/day	**525**	**552**		

(1) Worst-case day = Peak month production/20 workdays.
(2) Worst-case day = Peak Heating Degree Day

Table D-1: 2008 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.

The emissions inventory on worst winter days is of most interest since the $PM_{2.5}$ concentrations measured in Oakridge do not meet the current 24-hour $PM_{2.5}$ standard and the peak $PM_{2.5}$ concentrations occur on cold, stagnant days during the November-February wood-heating season. Residential wood-heating emissions (from certified and non-certified woodstoves, fireplaces, and pellet stoves) account for about 86% of the emissions on worst winter days, as illustrated in the following figure.

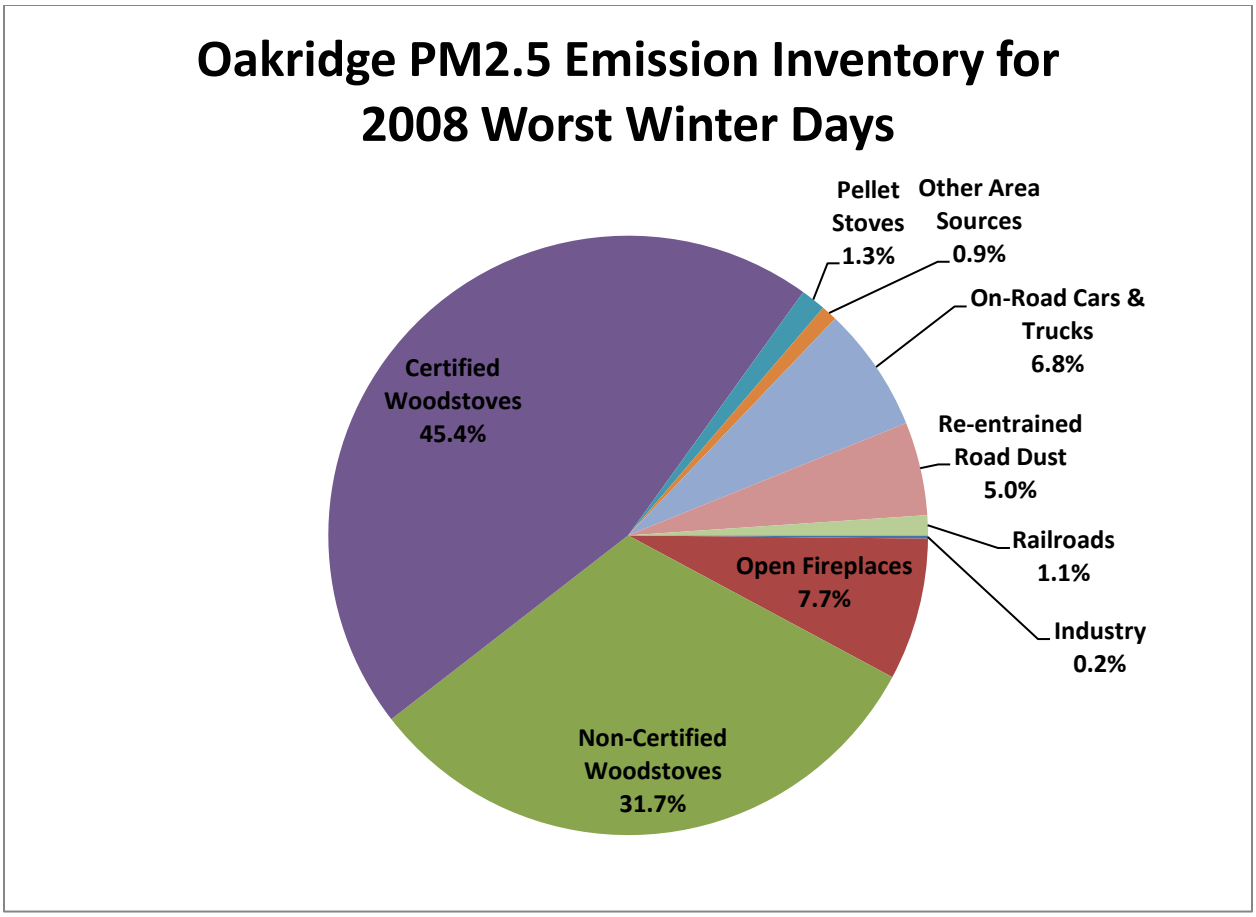


Figure D-1: **Oakridge $PM_{2.5}$ Emission Inventory for 2008 Worst Winter Days**

Industrial Point Sources

LRAPA maintains data on industrial point source emissions in Lane County. The two existing industrial sources in the Oakridge-Westfir area are minor industrial sources of $PM_{2.5}$ emissions. The facilities are a portable rock crusher and a ready-mix concrete plant owned and operated by Oakridge Sand & Gravel.

These two minor sources together emit less than one ton per year of $PM_{2.5}$ emissions and contribute less than 1% to the base year and future year emission inventories. These two minor sources are well below the LRAPA significant emission rate (SER) for $PM_{2.5}$ of 10 tons per year.

The air pollution control technologies installed on these sources are the standards for the industry and meet RACT requirements. The rock crusher has water-spray controls and the concrete plant has baghouse controls. Actual production rates, maximum production capacities, actual emissions, and maximum potential emissions are summarized in Appendix D-1. Emission factors are based on the ODEQ Emission Factors for Asphalt and Aggregate

Industries (AQ-EF06) which are derived from EPA AP-42. A copy of AQ-EF06 is included in Appendix D-1.

The typical season day emissions for these two facilities during the base year were based on average actual production rates and calculated emissions during the months of November-February in recent years (2008-2011). The worst-case day emissions for these two facilities during the base year on based on actual production rates and calculated emissions during the highest production month during November-February in recent years (2008-2011); for the rock crusher, the peak winter month was January 2011; for the ready-mix concrete plant, the peak winter month was November 2009.

[The future year (2014) emissions for these two facilities are based on the maximum allowable production rates identified in the facility permit applications and the LRAPA-issued permits. The typical season day emissions are based on the annual maximum production capacity and the worst-day emissions are based on the daily maximum production capacity. The rock crusher has a production capacity of 3,600 tons per day (potential $PM_{2.5}$ emissions of 4 lb/day) and 300,000 tons per year (potential $PM_{2.5}$ emissions of 360 lb/year). The ready-mix concrete plant has a production capacity of 480 cubic yards per day (potential $PM_{2.5}$ emissions of 14 lb/day) and 30,000 cubic yards per year (potential $PM_{2.5}$ emissions of 90 lb/year).]

Residential Wood Combustion

Residential wood combustion (RWC) is a common way to heat homes in Oregon. To estimate emissions from wood burning, LRAPA conducted a survey for the 2009-2010 heating season in Oakridge-Westfir. The survey provided LRAPA with information on how many homes use various types of wood-heating devices, the amount of wood burned, and other information on wood-heating practices. The Oakridge wood use is summarized in the following table.

Woodburning Device	Base Year Wood Fuel Use Survey (Households)	Base Year Wood Fuel Use (tons/HH)	Base Year Wood Fuel Use (tons/year)
Oakridge NAA			
21-04-008-100 Fireplace without Insert	123	1.6	195.6
21-04-008-320 Certified Non-Cat Wood-Stove	256	3.0	770.6
21-04-008-330 Certified Cat Wood-Stove	64	3.0	192.6
21-04-008-310 Conv Wood Stove	111	3.0	334.1
21-04-008-230 Fireplace Insert Cert Catalyst	28	3.0	84.3
21-04-008-220 Fireplace Insert Cert Non-Cat	112	3.0	337.1
21-04-008-210 Fireplace Insert Conv.	96	3.0	289.0
21-04-008-400 Exempt Pellet Stove	228	1.2	264.5
21-04-008-510 Central Furnace	0	0.0	0.0
Total	1,018		2,468

Table D-1a: **Oakridge Base Year Residential Wood Use Survey Results.**

The survey report, data, and additional RWC emission calculation details are included at the end of Appendix D-2 in a series of tables of RWC 2008 emissions of $PM_{2.5}$ (and NOx, SO2, VOC and NH3).

Other Area Sources

The only other area source category with potential significant emissions is backyard burning. Backyard burning is banned in Lane County for fire safety reasons during the June-September fire season and is banned in Oakridge for air quality reasons during November-February. There are 1,756 households in the Oakridge-Westfir nonattainment area. The LRAPA survey indicates that 28% of the households (about 492 households) burn yard debris (weighted average of 3 cubic yards per household) during the Fall and Spring months. The yard debris is a mix of leaves and brush with an estimated average density of 312.5 pounds per cubic yard using conversion factors (250-375 lb/yard) from OAR 340-097-0110. AP-42 emission factors are 17-38 lb/ton, or an average of 27.5 lb/ton. The total amount of yard debris burned is calculated to be 230.6 tons per year with $PM_{2.5}$ emissions of 3.2 tons per year. Typical season days emissions

are estimated to be 47.4 lb/day on the approximately 135 days per year during the Spring and Fall burning seasons . Although backyard burning is banned during November-February, LRAPA and Oakridge occasionally receive complaints of backyard burning on banned days, so backyard burning emissions are conservatively estimated at 10% (4.7 lb/day) on worst-case days during November-February.

Mobile and Nonroad Sources

Road dust and tailpipe emissions of $PM_{2.5}$ from motor vehicles were calculated by Lane Council of Governments (LCOG) transportation staff by applying emission factors from the EPA MOVES computer program to total vehicle miles traveled in the nonattainment area. Estimated vehicle miles traveled are from previous transportation modeling by LCOG for the Oregon Department of Transportation. A copy of the LCOG report is included as Appendix D-3.

Emissions from railroads were provided by Union Pacific Railroad staff using the EPA NONROAD2008a emissions protocol. The UPRR report is included as Appendix D-4. Fuel consumption information was submitted by UPRR to LRAPA as Confidential Business Information so some of the report is not included in the appendix. Contact LRAPA or UPRR if additional details or calculations are needed for verification.

Other non-road mobile sources were categorized by LRAPA as insignificant in Oakridge-Westfir during the $PM_{2.5}$ winter season as summarized in Appendix D-5.

Attainment Year Emission Inventory (2014)

The attainment year inventory is an estimation of emissions for the year that the area is expected to have attained the $PM_{2.5}$ standard. It includes projected emissions for the attainment year based on a number of different factors. Growth rates for population, employment, and VMT through 2014 were used to estimate 2014 emissions. LRAPA took credit for RWC emissions reductions as a result of the woodstove replacement project implemented during 2009-2012 that reduced the number of non-certified woodstoves accounted for in the 2008 emission inventory.

The attainment year emission inventory is based on 2008 emissions inventory, estimated growth rates and the emission reduction strategies that have recently been put into effect. The emission reduction strategies primarily include the continued implementation (with specific strengthening revisions in some cases) of the existing control measures that have been effective in achieving the PM_{10} standards and the initial (1997) $PM_{2.5}$ standards on schedule. The key ongoing control strategies, which were in place prior to 2008, include:

- City ordinance to curtail burning during stagnant weather periods;
- City ordinance requiring the removal of a non-certified wood stoves upon sale of a home;
- City ordinance prohibiting the use of a non-certified wood stove in a residence; and
- Partnering in additional change-out programs to encourage removal of non-certified woodstoves.

The RWC emission reduction credits in the proposed $PM_{2.5}$ Attainment Plan are conservative. The calculated credits are based on:

- New woodstoves installed after 2008 are EPA certified Phase II equivalent, based on the Oakridge ordinances and the Oregon Heat Smart law;
- Existing uncertified woodstove replacements since 2008 are based on the 79 units documented by LRAPA-administered financial incentive programs; and
- The strengthened mandatory curtailment program during air pollution episodes forecasts a 30% reduction in wood burning on red advisory days.

There are several other RWC strategies in the proposed $PM_{2.5}$ Attainment Plan but no specific credits were taken for those strategies.

Economic Factors

The economy in Oakridge has shifted from logging-based industries to a more recreation-oriented model. The decline in the harvesting and processing of timber has left Oakridge with no industrial employer or businesses that support the lumber industry. In the 1990's, the population in Oakridge declined sharply as jobs disappeared. Current census figures show only modest growth of 1.8% between 2000 and 2010, with the current population at 3,205. Within the civilian labor force, 16% were unemployed in 2010 and 21.7% of all families had incomes below the poverty level. The low cost of living has attracted low-income and unemployed people to Oakridge.

The recreation industry has picked up in Oakridge, with mountain biking being very popular. A hostel, brew pub, and other small businesses have opened to support the visitors attracted to the area. Despite the recent business growth, few jobs have been created. Population and employment in Oakridge are expected to increase only modestly over the next 20 years. The population estimate for the year 2025 is 4,000. Any new employment has been assigned to the potential development of the Oakridge Industrial Park.

Growth Rates

Growth is expected to be low to moderate in the Oakridge-Westfir area through 2014. Population, housing, and employment forecasts are expected to increase gradually. VMT growth is based on the previous transportation modeling by LCOG in the Highway 58 corridor.

The 2014 emission inventory is summarized in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.1%
Oakridge Sand & Gravel: Concrete plant	4.3	14.0	0.9%	3.7%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	29.6	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	106.1	81.7	22%	21%
Residential Wood Combustion: Certified Woodstove/Insert[2]	252.4	194.4	52%	51%
Pellet Stoves	7.3	8.0	1%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	15.7	22.2	3%	6%
Re-Entrained Road Dust	7.1	16.3	1%	4%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
Total, All Sources, lbs/day	**486**	**381**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table D-2: **2014 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.**

Residential wood combustion continues to be the major emission source category in 2014. The Oakridge 2014 wood use, after applying growth factors and woodstove replacements, is summarized in the following table.

Woodburning Device	2014 Wood Fuel Use (Households)	2014 Wood Fuel Use (tons/HH)	2014 Wood Fuel Use (tons/year)
Oakridge NAA			
21-04-008-100 Fireplace without Insert	123	1.6	195.6
21-04-008-320 Certified Non-Cat Wood-Stove	298	3.0	879.4
21-04-008-330 Certified Cat Wood-Stove	64	3.0	188.9
21-04-008-310 Conv Wood Stove	65	3.0	191.8
21-04-008-230 Fireplace Insert Cert Catalyst	28	3.0	82.6
21-04-008-220 Fireplace Insert Cert Non-Cat	130	3.0	383.6
21-04-008-210 Fireplace Insert Conv.	76	3.0	224.3
21-04-008-400 Exempt Pellet Stove	247	1.2	286.5
21-04-008-510 Central Furnace	0	0.0	0.0
Total	1,031		2,433

Table D-2a: **Oakridge 2014 Projected Residential Wood Use.**

For example, comparing Tables D-1a and D-2a, the number of wood burning households and amount of wood burned increased in 2008-2014 due to population and housing growth, but the number of conventional (uncertified) woodstoves and fireplace inserts decreased due to units replaced with woodstove replacement incentives during 2009-2012 as verified by LRAPA. Additional RWC emission calculation details are included at the end of Appendix D-2 in a series of tables (Tables 3 through 12) of RWC 2014 emissions of $PM_{2.5}$ (and NOx, SO2, VOC and NH3).

Comparison of 2008 to 2014 Emissions

The emission inventory shows an overall decrease in emissions for the attainment year (2014) based on the effectiveness of the emission control strategies.

The differences in the 2008 and 2014 emission inventories are the combination of increases due to growth factors and decreases due to emission control strategies. For example, motor vehicle emissions decreased overall due to progressively cleaner gasoline and diesel fuels and

motor vehicles, but part of the emissions decrease was offset by gradual growth in traffic volumes.

Industry emissions were conservatively increased to reflect operation at maximum capacity in 2014, but both industrial sources are minor so this did not have a major effect on the 2014 inventory. The future year (2014) emissions for these two facilities are based on the maximum allowable production rates identified in the facility permit applications and the LRAPA-issued permits. The typical season day emissions are based on the annual maximum production capacity and the worst-day emissions are based on the daily maximum production capacity. The rock crusher has a production capacity of 3,600 tons per day (potential $PM_{2.5}$ emissions of 4 lb/day) and 300,000 tons per year (potential $PM_{2.5}$ emissions of 360 lb/year). The ready-mix concrete plant has a production capacity of 480 cubic yards per day (potential $PM_{2.5}$ emissions of 14 lb/day) and 30,000 cubic yards per year (potential $PM_{2.5}$ emissions of 90 lb/year).

The most significant category is residential wood-heating; emissions were increased to reflect population growth during 2008-2014, decreased due to non-certified woodstove replacements with cleaner burning units during 2009-2012, and decreased due to improvements in the programs for curtailment during stagnant air episodes.

In order to illustrate the RWC emission reductions from the key strategies, it is helpful to compare the 2014 emission inventories with (Table D-2 above) and without (Table D-3 below) the strengthened mandatory curtailment program on worst-case days, and to compare both of these tables to the 2008 emission inventory in Table D-1.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	0.7%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	2.5%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	42.3	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	106.1	116.7	22%	21%
Residential Wood Combustion: Certified Woodstove/Insert[2]	252.4	277.7	52%	50%
Pellet Stoves	7.3	8.0	1%	1%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	15.7	22.2	3%	4%
Re-Entrained Road Dust	7.1	16.3	1%	3%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
Total, All Sources, lbs/day	**486**	**512**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table D-3: **2014 Estimated Worst-Case Day $PM_{2.5}$ Emissions without Mandatory Curtailment.**

To review, the key long-term permanent RWC strategies have been:

- the woodstove change-out programs replacing uncertified woodstoves with cleaner burning and more efficient home heating units;
- the Oregon and EPA woodstove certification programs requiring any new woodstoves installed since 1986 to be certified woodstoves; and
- the Oakridge ordinance and Oregon Heat Smart law requiring removal of uncertified woodstoves upon home sale.

These programs have been critical to the significant improvement in Oakridge $PM_{2.5}$ concentrations during 2005-2011. In addition, the combined emission reduction of these programs will more than offset the growth in population and housing between 2008 and 2014, with a net RWC emission reduction of about 28 lb/day on typical season days and 31 lb/day on worst-case days (comparing the fireplace, woodstove and pellet stove emissions in Tables D-1 and D-3).

The key short-term RWC strategy is a strengthened mandatory curtailment program to reduce fireplace and woodstove emissions by 30% on an average of 20 red days per year (based on the number of days above 30 $\mu g/m^3$ $PM_{2.5}$ during 2005-2011). This will reduce RWC emissions by 131 lb/day (comparing the fireplace and woodstove emissions in Tables D-2 and D-3) and reduce future $PM_{2.5}$ concentrations below the 35 $\mu g/m^3$ $PM_{2.5}$ standard on worst-case days as outlined in Appendix H.

Contingency Planning

The Oakridge $PM_{2.5}$ attainment plan must contain contingency measures that would be implemented in the event that the Oakridge nonattainment area fails to meet the standard on or after December 2014. The contingency measures are designed to correct the violation of the $PM_{2.5}$ standards and be implemented immediately. EPA requires that any contingency measures must equal one year equivalent of reasonable further progress (RFP).

In Oakridge, the worst-day $PM_{2.5}$ concentrations need to be reduced by about one microgram per cubic meter ($\mu g/m^3$) per year in order to meet the $PM_{2.5}$ standard by 2014 (i.e., reduced from 39.5 $\mu g/m^3$ in the 2006-2010 baseline period to 35 $\mu g/m^3$ by the 2014 attainment date). Therefore the RFP requirement in Oakridge would equal about one $\mu g/m^3$ of further reduction.

The Oakridge $PM_{2.5}$ attainment plan includes the following strategies as contingency strategies to fully meet the air quality standards, if it becomes clear that the strengthened ongoing strategies described above will not be sufficient to attain the $PM_{2.5}$ standards by 2014 and or to maintain compliance with the standards through 2024 and beyond:

- Stricter opacity limit, revising the current 40% opacity limit in the city ordinance to a more restrictive 20% limit, as has been done in some other northwest communities.
- Stricter green-yellow-red advisory program, with more yellow and red advisory days each winter.

- Further restrictions on city woodstove curtailment exemptions (for sole source, economic hardship).

The most quantifiable and most quickly implemented of these contingency measures would be further strengthening of the mandatory curtailment program by more consistent enforcement of the city curtailment ordinance and stricter criteria for expanding the number of yellow and red advisory days. If the standard is not met by 2014, the number of red curtailment days would be increased to an average of 30 days per year (based on the number of days above 25 $\mu g/m^3$ $PM_{2.5}$ during 2005-2011) and the frequency of curtailment enforcement (warnings and citations) would be increased accordingly in order to increase the effectiveness of the curtailment to 40% (or to 50% if necessary) on worst case days.

If curtailment was increased to 40% on 30 days per year, the 2014 RWC emissions would be reduced as outlined in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.2%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	4.2%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	25.4	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	106.1	70.0	22%	21%
Residential Wood Combustion: Certified Woodstove/Insert[2]	252.4	166.6	52%	49%
Pellet Stoves	7.3	8.0	1%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	15.7	22.2	3%	7%
Re-Entrained Road Dust	7.1	16.3	1%	5%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
Total, All Sources, lbs/day	**486**	**337**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table D-5: 2014 Estimated Worst-Case Day $PM_{2.5}$ Emissions with 40% Curtailment.

If curtailment was increased to 50% on 30 days per year, the 2014 RWC emissions would be reduced as outlined in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.4%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	4.8%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	21.2	8%	7%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	106.1	58.4	22%	20%
Residential Wood Combustion: Certified Woodstove/Insert[2]	252.4	138.8	52%	47%
Pellet Stoves	7.3	8.0	1%	3%
All Other Stationary Area Sources	47.4	4.7	10%	2%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	15.7	22.2	3%	8%
Re-Entrained Road Dust	7.1	16.3	1%	6%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
Total, All Sources, lbs/day	**486**	**294**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table D-6: 2014 Estimated Worst-Case Day $PM_{2.5}$ Emissions with 50% Curtailment.

If the contingency plan is implemented, the mandatory curtailment program will be increased from an average of 20 days per year (based on 30 µg/m^3 $PM_{2.5}$ in the pre-2012 Oakridge ordinance) to 30 days per year (based on 25 µg/m^3 $PM_{2.5}$ in the contingency plan). The contingency measures for stronger enforcement on more red advisory days is expected to increase the curtailment effectiveness.

- Using these contingency strategies to increase curtailment effectiveness to 40% is expected to reduce RWC emissions by 44 lb/day and further reduce $PM_{2.5}$ concentrations on worst case days.
- Using these contingency strategies to increase curtailment effectiveness to 50% is expected to reduce RWC emissions by 87 lb/day and further reduce $PM_{2.5}$ concentrations on worst case days.

Either of these contingency measures would more than achieve the one µg/m^3 target needed to meet the EPA RFP test.

If Oakridge meets the $PM_{2.5}$ standard by the EPA Clean Air Act 2014 deadline, the contingency plan will not need to be enacted. If Oakridge does not meet the $PM_{2.5}$ standard by the EPA Clean Air Act 2014 deadline, the contingency plan will be enacted by the beginning of the immediate next wood-heating season, November 15, 2015.

Appendix D-1
Industrial Point Sources Emission Inventory

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477

Hot Mix Asphalt Plants – Particulate Matter:

Type	Particulate Matter Controls	Pounds of pollutant per ton of product[1]		
		PM	PM_{10}	$PM_{2.5}$
Batch Mix	Uncontrolled	32	4.5	0.29
	Venturi or wet scrubber	0.14	0.034	0.018
	Baghouse	0.042	0.027	0.025
Drum Mix	Uncontrolled	28	6.5	1.6
	Venturi or wet scrubber	0.045	0.025	0.021
	Baghouse	0.033	0.023	0.022

Hot Mix Asphalt Plants – Gaseous Pollutants:

Type	Fuel	Pounds of pollutant per ton of product[2]			
		SO_2	NO_x	CO	VOC
Batch Mix	Natural Gas	0.0046	0.025	0.40/0.1[3]	0.0082
	No. 2 fuel oil	0.088	0.12/0.08[3]	0.40/0.1[3]	0.0082
	No. 6 fuel oil	0.088	0.12	0.40	0.036
Drum Mix	Natural Gas	0.0034	0.026	0.13/0.1[3]	0.032
	No. 2 fuel oil	0.011	0.055	0.13/0.1[3]	0.032
	Waste oil	0.058	0.055	0.13/0.1[3]	0.032

Rock crushers

Type of control	Pounds of pollutant per ton of rock crushed[4]		
	PM	PM_{10}	$PM_{2.5}$
Uncontrolled	0.25	0.0125	0.00075
Water Spray	0.04	0.02	0.0012[5]

Ready-mix concrete plants

Type of control	Pounds of pollutant per cubic yard of concrete[5]		
	PM	PM_{10}	$PM_{2.5}$
Uncontrolled	0.2	0.102	0.03
Baghouse	0.02	0.02	0.0059[5]

[1] These factors are from AP-42 Tables 11.1-1 and 11.1-2. These factors should not be used if there is source specific emissions data available.
[2] These factors are from AP-42 Tables 11.1-3 through 11.1-4. These factors should not be used if there is source specific emissions data available.
[3] The first value represents emissions from sources without routine tuning of the burner. The second value can be used for sources that have a routine burner tuning schedule.
[4] These are DEQ factors.
[5] EPA PM calculator applying percentage of $PM_{2.5}$ to PM_{10} emission factor
[6] The uncontrolled emission factor is from AP-42 Table 11.12-2. The controlled factors are DEQ factors.

Oakridge Sand and Gravel
Permit No. 202814

Rock Crushing

Year: 2008	Rock Crushed	PM	PM10	PM2.5
Month	(Tons)	(pounds)	(pounds)	(pounds)
January	-	-	-	-
February	-	-	-	-
March	40,028	1,601	801	48.0
April	28,787	1,151	576	34.5
May	-	-	-	-
June	-	-	-	-
July	-	-	-	-
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-
November	-	-	-	-
December	-	-	-	-
TOTAL	68,815	2,753	1,376	83

Year: 2009
Zero (0) tons

Year: 2010
Zero (0) tons

Year: 2011	Rock Crushed	PM	PM10	PM2.5
Month	(Tons)	(pounds)	(pounds)	(pounds)
January	13,600	544	272	16.3
February	10,200	408	204	12.2
March	-	-	-	-
April	-	-	-	-
May	-	-	-	-
June	-	-	-	-
July	-	-	-	-
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-
November	-	-	-	-
December		-	-	-
TOTAL	23,800	952	476	29

	Production	PM	PM10	PM2.5
Maximum	Tons	(pounds)	(pounds)	(pounds)
Hourly*	150	6	3	0
Daily	3,600	144	72	4
Annual	300,000	12,000	6,000	360

*Hourly production capacity of 150 tons/hr is from ACDP application

Emission Factors (rock crushers, waterspray control)**

PM	0.04	lb/ton
PM10	0.02	lb/ton
PM2.5	0.0012	lb/ton

**Reference = ODEQ AQ-EF06, Emission Factors Asphalt and Aggregate Industries

Oakridge Sand and Gravel
Permit No. 206125

Ready-Mix Concrete

Year: 2009	Concrete	PM	PM10	PM2.5
Month	(Cubic Yards)	(pounds)	(pounds)	(pounds)
January	92	1.84	1.8	0.5
February	31	0.62	0.6	0.2
March	113	2.26	2.3	0.7
April	69	1.38	1.4	0.4
May	23	0.46	0.5	0.1
June	369	7.38	7.4	2.2
July	95	1.9	1.9	0.6
August	139	2.78	2.8	0.8
September	77	1.54	1.5	0.5
October	50	1	1.0	0.3
November	95	1.9	1.9	0.6
December	6	0.12	0.1	0.0
TOTAL	1,159	23	23	7

Year: 2010	Concrete	PM	PM10	PM2.5
Month	(Cubic Yards)	(pounds)	(pounds)	(pounds)
January	28	0.56	0.6	0.2
February	25	0.5	0.5	0.1
March	42	0.84	0.8	0.2
April	31	0.62	0.6	0.2
May	19	0.38	0.4	0.1
June	27	0.54	0.5	0.2
July	27	0.54	0.5	0.2
August	52	1.04	1.0	0.3
September	14	0.27	0.3	0.1
October	17	0.34	0.3	0.1
November	26	0.52	0.5	0.2
December	-	0	0.0	-
TOTAL	307.5	6.2	6.2	1.8

Year: 2011	Concrete	PM	PM10	PM2.5
Month	(Cubic Yards)	(pounds)	(pounds)	(pounds)
January	7	0.14	0.1	0.0
February	17	0.34	0.3	0.1
March	21	0.42	0.4	0.1
April	15	0.3	0.3	0.1
May	38	0.76	0.8	0.2
June	83	1.66	1.7	0.5
July	26	0.52	0.5	0.2
August	8	0.16	0.2	0.0
September	7	0.14	0.1	0.0
October	-	0	0.0	-
November	-	0	0.0	-
December	-	0	0.0	-
TOTAL	222	4	4	1

	Production	PM	PM10	PM2.5
Maximum	Cubic Yards	(pounds)	(pounds)	(pounds)
Hourly*	20	0.4	0.4	0.1
Daily	480	10	10	2.8
Annual	30,000	600	600	177

*Hourly production capacity of 20 cubic yards/hr is from ACDP application

Emission Factors (ready-mix concrete, controlled by baghouse)**

PM	0.02	lb/cu yd
PM10	0.02	lb/cu yd
PM2.5	0.0059	lb/cu yd

**Reference = ODEQ AQ-EF06, Emission Factors Asphalt and Aggregate Industries (AP-42 derived)

Oakridge Sand and Gravel
Permit No. 206125

Combined Emissions from Rock Crushing and Ready-Mix Concrete Production

Year: 2008	PM	PM10	PM2.5	
Month	(pounds)	(pounds)	(pounds)	
January	92.0	1.8	1.8	
February	31.0	0.6	0.6	
March	1,714.1	802.8	50.3	includes rock production
April	1,220.5	577.1	35.9	includes rock production
May	23.0	0.5	0.5	
June	369.0	7.4	7.4	
July	95.0	1.9	1.9	
August	139.0	2.8	2.8	
September	77.0	1.5	1.5	
October	50.0	1.0	1.0	
November	95.0	1.9	1.9	
December	6.0	0.1	0.1	
TOTAL	3,911.6	1,399.5	105.8	

Facility does not have 2008 Ready Mix production so assume 2008 is equal to 2009 for Ready Mix

Year: 2009	PM	PM10	PM2.5
Month	(pounds)	(pounds)	(pounds)
January	92	1.84	1.8
February	31	0.62	0.6
March	113	2.26	2.3
April	69	1.38	1.4
May	23	0.46	0.5
June	369	7.38	7.4
July	95	1.9	1.9
August	139	2.78	2.8
September	77	1.54	1.5
October	50	1	1.0
November	95	1.9	1.9
December	6	0.12	0.1
TOTAL	1159	23.18	23.2

Year: 2010	PM	PM10	PM2.5
Month	(pounds)	(pounds)	(pounds)
January	28	0.56	0.6
February	25	0.5	0.5
March	42	0.84	0.8
April	31	0.62	0.6
May	19	0.38	0.4
June	27	0.54	0.5
July	27	0.54	0.5
August	52	1.04	1.0
September	13.5	0.27	0.3
October	17	0.34	0.3
November	26	0.52	0.5
December	0	0	0.0
TOTAL	307.5	6.15	6.2

Year: 2011	PM	PM10	PM2.5	
Month	(pounds)	(pounds)	(pounds)	
January	551	272.14	16.5	includes rock production
February	425	204.34	12.6	includes rock production
March	21	0.42	0.4	
April	15	0.3	0.3	
May	38	0.76	0.8	
June	83	1.66	1.7	
July	26	0.52	0.5	
August	8	0.16	0.2	
September	7	0.14	0.1	
October	0	0	0.0	
November	0	0	0.0	
December	0	0	0.0	
TOTAL	222	4.44	4.4	

	PM	PM10	PM2.5
Maximum	(pounds)	(pounds)	(pounds)
Hourly*	6	3	0.3
Daily	154	82	7.2
Annual	12,600	6,600	537

*Hourly production capacities are from ACDP application

Appendix D-2
Residential Wood Combustion Survey

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477

SURVEY OF OAKRIDGE AND WESTFIR RESIDENTS CONDUCTED FOR LANE REGIONAL AIR PROTECTION AGENCY

August, 2010

ADVANCED MARKETING
RESEARCH INC.

P.O. Box 5244 · Eugene, OR 97405 · Phone/Fax 541-345-6600 · www.advancedmarketingresearch.com

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QUESTIONNAIRE INSTRUMENT

EXECUTIVE SUMMARY

RESIDENCE (Q2)
87% of respondents live in Oakridge, 13% in Westfir.

LIVE INSIDE OR OUTSIDE OAKRIDGE CITY LIMITS (Q3)
77% of the Oakridge residents surveyed live inside city limits, down from 85% in 2005. 23% live outside city limits.

WOOD-BURNING DEVICES (Q4)
38% of respondents have a wood stove or fireplace with insert. 13% have a pellet stove. 7% have an open fireplace. 46% have no wood-burning devices. There have been no significant changes since 2005.

PELLET CONSUMPTION (Q5)
Although statistically there are not more people with pellet stoves than there were in 2005 (39 currently compared with 26 in 2005), those with pellet stoves are burning more bags of pellets per burning season than they were in 2005. Currently 17% burn one to twenty-nine bags, compared with 34% in 2005. And currently 44% burn over sixty bags, compared with 23% in 2005.

EPA CERTIFIED STOVES (Q6)
69% believe that their wood stove or fireplace with insert is EPA certified as "clean burning" (less than twenty-five years old). 15% say their stove in *not* EPA certified. 16% are unsure if their stove is certified. There have been no significant changes since 2005.

FREQUENCY OF BURNING WOOD (Q7)
Of those with a wood stove, fireplace with insert, or open fireplace (n=135), 48% burn wood daily in the winter months (down from 61% in 2005). 19% burn several times a week, 10% burn several times a month, and 10% burn less often than once a month. 13% never burn wood in these devices.

CONSUMPTION OF WOOD: OPEN FIREPLACE (Q8)
Of those with an open fireplace (n=22), 50% do not burn wood in their open fireplace, 32% burn one to two cords, and 19% burn three to five cords of wood per winter.

CONSUMPTION OF WOOD: WOOD STOVE (Q9)
Of those with a wood stove or fireplace with insert (n=117), 13% do not burn wood in it, 2% burn less than one cord, 43% burn one to two cords, and 43% burn over two cords of wood per winter. There have been no significant changes since 2005.

HOW IS WOOD STORED? (Q10)
The vast majority of wood (92%) is stored covered and dry. There have been no significant changes since 2005.

AGING OF WOOD (Q11)
66% of those burning wood (n=135) use wood that has aged for a year or more (down from 79% in 2005). 17% use wood that has aged for seven to eleven months. 7% use wood that has aged for six months or less. 12% are unsure how long their wood has aged when they burn it.

SOURCES OF HEAT (Q12)
For 33% of those who burn wood (not including pellets), their wood-burning device is the only heat source for their residence. 67% have an alternate source of heat. There have been no significant changes since 2005.

HOME HEATING EXEMPTION (Q13)
21% of Oakridge residents who burn wood (n=116) currently have a home wood heating exemption from the City of Oakridge, while 72% do not. 8% are unsure.

AWARENESS OF WOOD HEATING ADVISORY PROGRAM (Q14)
84% of respondents (down from 95% in 2005) are aware of the Home Wood Heating Advisory Program with its red, yellow, and green advisory system. 16% are unaware of the program.

ADVISORY PHONE CALLS (Q15-Q17)
47% of respondents receive occasional phone calls notifying them of whether or not they should burn wood based on air quality in their community (down from 80% in 2005). 51% do not receive such phone calls (up from 20% in 2005).

Of those not receiving calls (n=160), 81% don't know why; they have never been called (up from 63% in 2005). 7% say they don't know why; the calls just stopped. 7% don't burn wood. 4% asked to be removed from the list (down from 22% in 2005).

SHOULD THE CALL PROGRAM CONTINUE? (Q18-Q19)
56% of respondents feel that the notification call program is a useful program that should continue. 21% do not feel it should continue (down from 34% in 2005). 23% are unsure (up from 12% in 2005).

Those who do not feel the program is useful or are unsure (n=138) gave the following reasons: "We don't burn wood" (20%), "the calls are ineffective; some have to burn to keep warm" (20%), "it is unnecessary" (9%), and "unfamiliar with the program" (9%).

FOLLOWING THE ADVISORY (Q20)
Of those who receive advisory calls (n=146), 19% said that in general, the notification call program causes them to follow the wood burning advisory more often than they would without it. 2% said they follow the advisory less often than they would without the notification system. 39% report no change in following the advisory. 39% said "not applicable," they don't burn wood (down from 51% in 2005).

It should be noted that the wording of this question changed from 2005: "This year, did you follow the wood burning advisory more often, less often, or the same as in past years?" to the current wording: "In general, does the notification call program cause you to follow the wood burning advisory more often, less often, or the same as you would without it?"

AWARENESS OF AIR QUALITY (Q21)
Of those who receive advisory calls (n=146), 53% feel that the telephone advisory program has made them more aware of air quality in their community (up from 38% in 2005). 1% feel that they are less aware of air quality. 45% feel there is no difference in their awareness (down from 59% in 2005).

BACKYARD BURNING (Q22-Q24)
28% of respondents conduct backyard burning of yard trimmings at their residence; 72% do not.

Of those who do backyard burning (n=88), 82% do it once per backyard burning season. 14% burn once a month and 3% burn once a week.

Of those who do backyard burning (n=88), the majority (58%) burn one to five cubic yards per burning season. 19% burn less than one cubic yard, and 18% burn more than five cubic yards. 5% are unsure of how much they burn.

INTERNET ACCESS AT HOME (Q25)
69% of respondents have internet access at home (up from 36% in 2005); 30% do not.

SURVEY OF OAKRIDGE AND WESTFIR RESIDENTS FOR L.R.A.P.A.

August, 2010

PURPOSE OF THE STUDY

The purpose of this study is to assist LRAPA in measuring awareness and effectiveness of the Oakridge Home Wood Heating Telephone Advisory Program.

METHODOLOGY

Advanced Marketing Research was hired to conduct the research project in order to obtain unbiased and statistically valid results.

Using questions proposed by LRAPA, Advanced Marketing Research designed a questionnaire instrument to be administered by telephone. Using a random list of residents living in Oakridge and Westfir as a sampling frame, 312 interviews were completed. Telephone interviews were conducted between August 13 and August 22, 2010.

Proper data analysis techniques were employed by Advanced Marketing Research to avoid introducing unnecessary error and bias into the study.

QUOTAS OBSERVED

The gender and age quotas below were targeted in the data collection process.

Males	48% to 52%
Females	48% to 52%
Age 65+	28% Maximum

RESPONSE RATE

Of the 397 qualified respondents reached by telephone, 312 interviews were completed, for a response rate of 79%. The overall breakdown of numbers dialed is as follows:

Refusals	85
Disconnects	124
Wrong Numbers	22
Language Barrier	0
Spanish Language Barrier	0
Business Numbers	4
Fax	1
No Answer	98
Answering Machine	223
Busy Signal	3
Call Backs	18
No Qualified Respondent	6
Completed Interviews	312
Total Numbers Dialed	896

TESTS FOR DIFFERENCES BETWEEN PROPORTIONS

When looking at the data tables, differences between percentage amounts can be misleading, and statistical tests must be conducted to determine if the differences are statistically significant. The computer makes these calculations for us, and the results are occasional plus or minus signs at the bottom of certain cells. These indicate that those answers are more different from everybody else's answers than could be expected due to chance, given the sample sizes involved. Plus signs are used if the group picks that answer *more* often than everyone else; minus signs if it is *less* than everyone else. The number of plus or minus signs indicates the level of statistical significance. One means the 90% level, two the 95% level, and three the 99% level. For example, two plus signs would mean that you can be 95% sure that the people represented by that group really would pick that answer more often than the people represented by the rest of the sample. It should be noted that this test can only be done for banner columns that contain at least 30 people. Because of this requirement, it is possible that the test will be done for some banner columns on a table and not for others.

NOTES ON CHI SQUARE

The chi square value and its associated probability are printed beneath the first column in each banner heading. The probability (p=.xxx) indicates the probability that the heading and row variables are *not* related is .xxx. For example, a .05 probability of not being related means a 95 percent chance of being related.

BOUND ON ERROR

	SAMPLE SIZE		Bound on Error at
SEX	Frequency	Percent	95% Confidence Level
Male	154	49%	7.2%
Female	158	51%	7.1%
AGE			
18-34	30	10%	16.4%
35-44	27	9%	--
45-54	66	21%	11.1%
55-64	103	33%	8.9%
65+	86	28%	9.7%
INCOME			
Under $15,000	49	16%	12.8%
$15,000-$24,999	55	18%	12.1%
$25,000-$34,999	51	16%	12.6%
$35,000-$49,999	52	17%	12.5%
$50,000 and Up	50	16%	12.7%
TOTAL	312	100%	5.0%*

* What this means is that we are 95% certain that the mean response of the entire population of Oakridge and Westfir lies within (plus or minus) 5.0% of the survey response. Oakridge has 1526 households and Westfir has 100 households.

DEMOGRAPHIC BREAKDOWN BY YEAR

SEX	2010	2005
Male	49%	50%
Female	51%	50%
AGE		
18-24	4%	4%
25-34	6%	7%
35-44	9%	14%
45-54	21%	26%
55-64	33%	25%
65+	28%	24%
INCOME		
Under $15,000	16%	22%
$15,000-$24,999	18%	33%
$25,000-$34,999	16%	17%
$35,000-$49,999	17%	8%
$50,000 and Up	16%	9%
YEARS IN COMMUNITY		
Under one year	3%	5%
1-5 years	15%	19%
6-10 years	17%	9%
Over 10 years	65%	67%
OWN OR RENT?		
Own	83%	83%
Rent	16%	16%
DWELLING TYPE		
Single Family	77%	79%
Mobile Home	19%	13%
Apartment	3%	4%
Duplex	1%	3%

MINIMUM DIFFERENCE IN PERCENTAGE POINTS REQUIRED FOR STATISTICAL SIGNIFICANCE IN COMPARISON OF REPORTED PERCENTAGES FOR SUBGROUPS WITH 95% CONFIDENCE

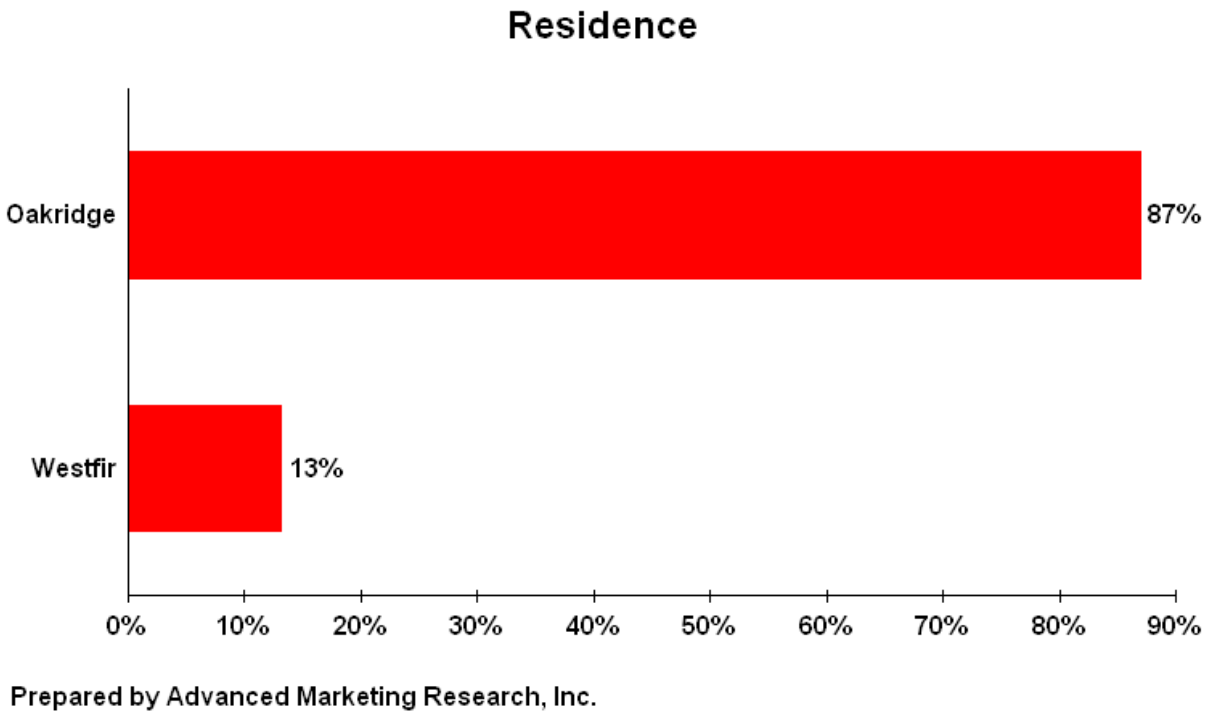
Subsample	50	100	150	200	250	300	350	400	450	500	600
50	20%	17%	16%	15%	15%	15%	15%	15%	15%	15%	15%
100		14%	13%	12%	12%	11%	11%	11%	11%	11%	11%
150			11%	11%	10%	10%	10%	9%	9%	9%	9%
200				10%	9%	9%	9%	8%	8%	8%	8%
250					9%	8%	8%	8%	8%	8%	7%
300						8%	8%	7%	7%	7%	7%
350							7%	7%	7%	7%	6%
400								7%	7%	7%	6%
450									7%	6%	6%
500										6%	6%
600											6%

Minimums are for reported percentages near 50%. When much smaller or much larger percentages are reported, a slightly smaller minimum is required.

ANALYSIS OF DATA

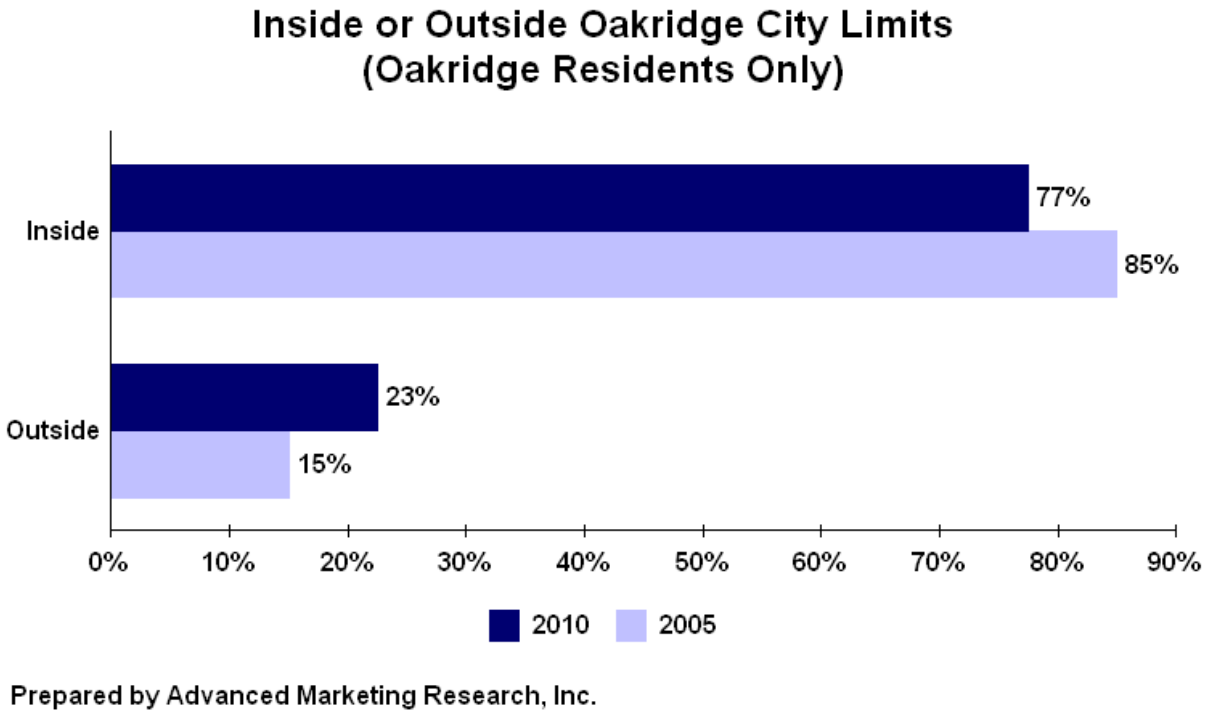
RESIDENCE (Q2)

87% of respondents live in Oakridge, 13% in Westfir.



LIVE INSIDE OR OUTSIDE OAKRIDGE CITY LIMITS (Q3)

77% of the Oakridge residents surveyed live inside city limits, down from 85% in 2005. 23% live outside city limits.

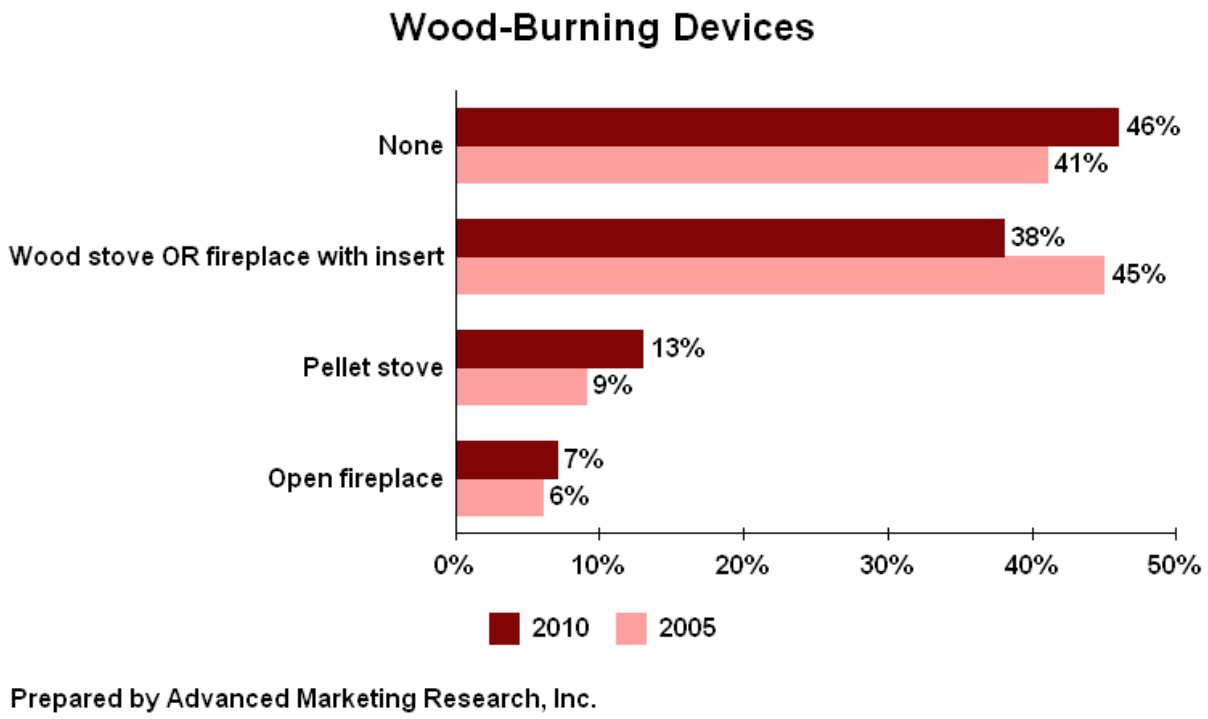


Demographic Differences

Oakridge residents with no wood burning devices are more likely than others to live inside city limits. Oakridge residents with wood stoves are more likely than others to live outside city limits.

WOOD-BURNING DEVICES (Q4)

38% of respondents have a wood stove or fireplace with insert. 13% have a pellet stove. 7% have an open fireplace. 46% have no wood-burning devices. There have been no significant changes since 2005.



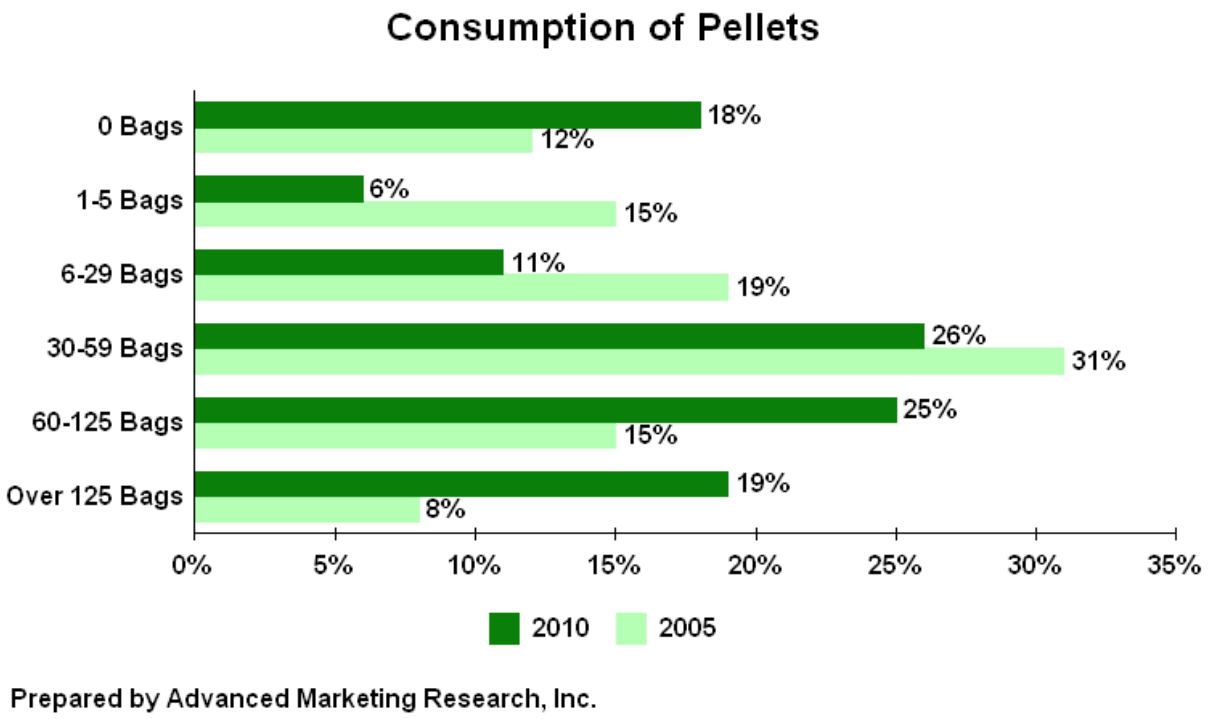
Demographic Differences

Oakridge residents not living within city limits and those respondents living in single family dwellings are more likely than others to have a wood stove or fireplace with insert.

Oakridge residents living inside city limits, renters, and those living in mobile homes are more likely than others to have *no* wood-burning devices.

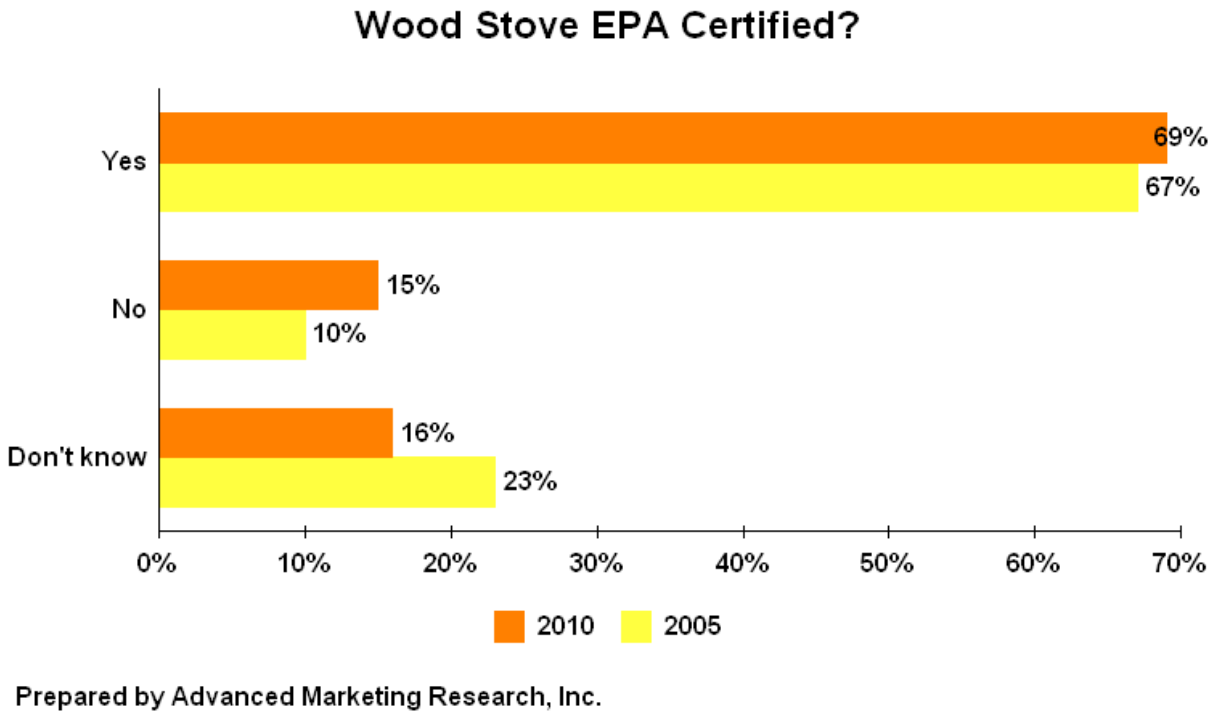
PELLET CONSUMPTION (Q5)

Although statistically there are not more people with pellet stoves than there were in 2005 (39 currently compared with 26 in 2005), those with pellet stoves are burning more bags of pellets per burning season than they were in 2005. Currently 17% burn one to twenty-nine bags, compared with 34% in 2005. And currently 44% burn over sixty bags, compared with 23% in 2005.



EPA CERTIFIED STOVES (Q6)

69% believe that their wood stove or fireplace with insert is EPA certified as "clean burning" (less than twenty-five years old). 15% say their stove in *not* EPA certified. 16% are unsure if their stove is certified. There have been no significant changes since 2005.

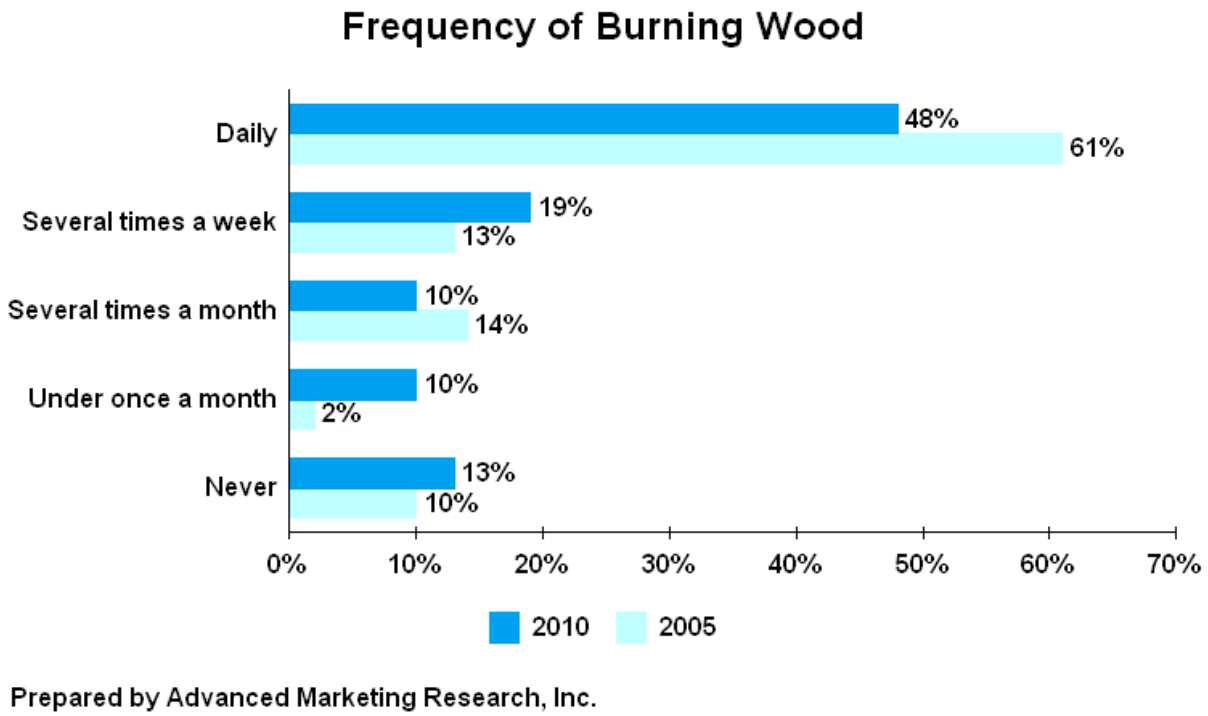


Demographic Differences

35 to 54 year-olds are more likely than others to say their wood stove *is* EPA certified.

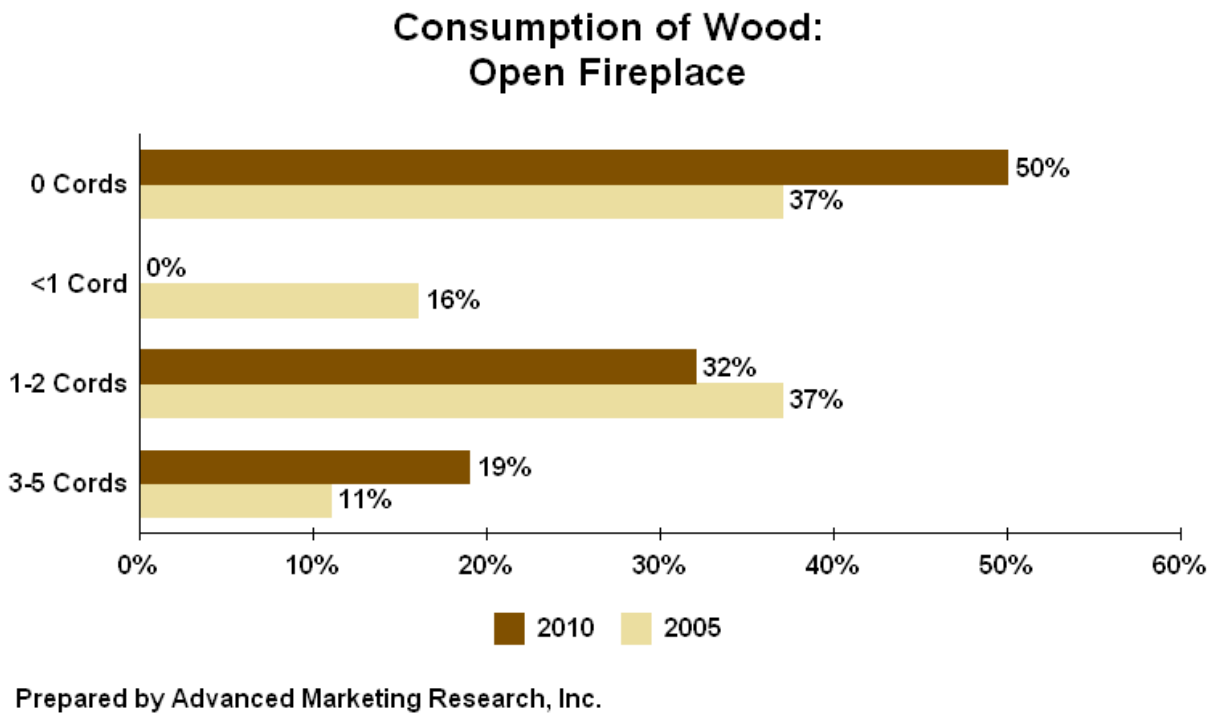
FREQUENCY OF BURNING WOOD (Q7)

Of those with a wood stove, fireplace with insert, or open fireplace (n=135), 48% burn wood daily in the winter months (down from 61% in 2005). 19% burn several times a week, 10% burn several times a month, and 10% burn less often than once a month. 13% never burn wood in these devices.



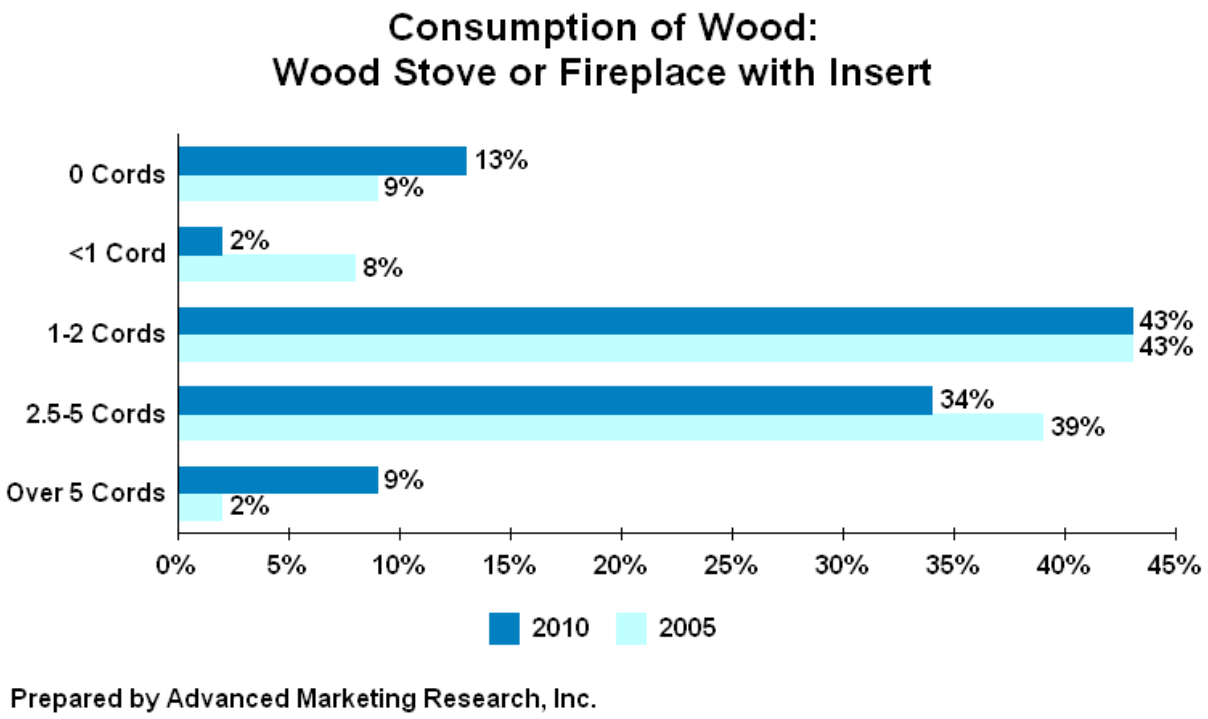
CONSUMPTION OF WOOD: OPEN FIREPLACE (Q8)

Of those with an open fireplace (n=22), 50% do not burn wood in their open fireplace, 32% burn one to two cords, and 19% burn three to five cords of wood per winter.



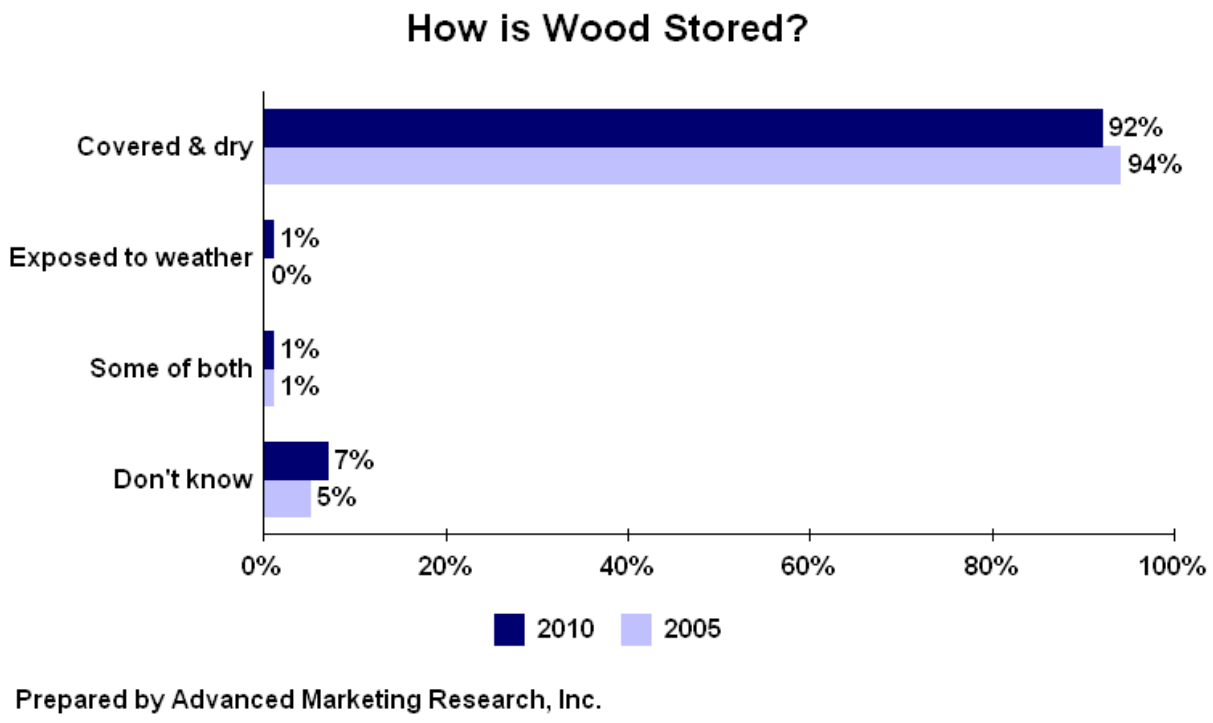
CONSUMPTION OF WOOD: WOOD STOVE (Q9)

Of those with a wood stove or fireplace with insert (n=117), 13% do not burn wood in it, 2% burn less than one cord, 43% burn one to two cords, and 43% burn over two cords of wood per winter. There have been no significant changes since 2005.



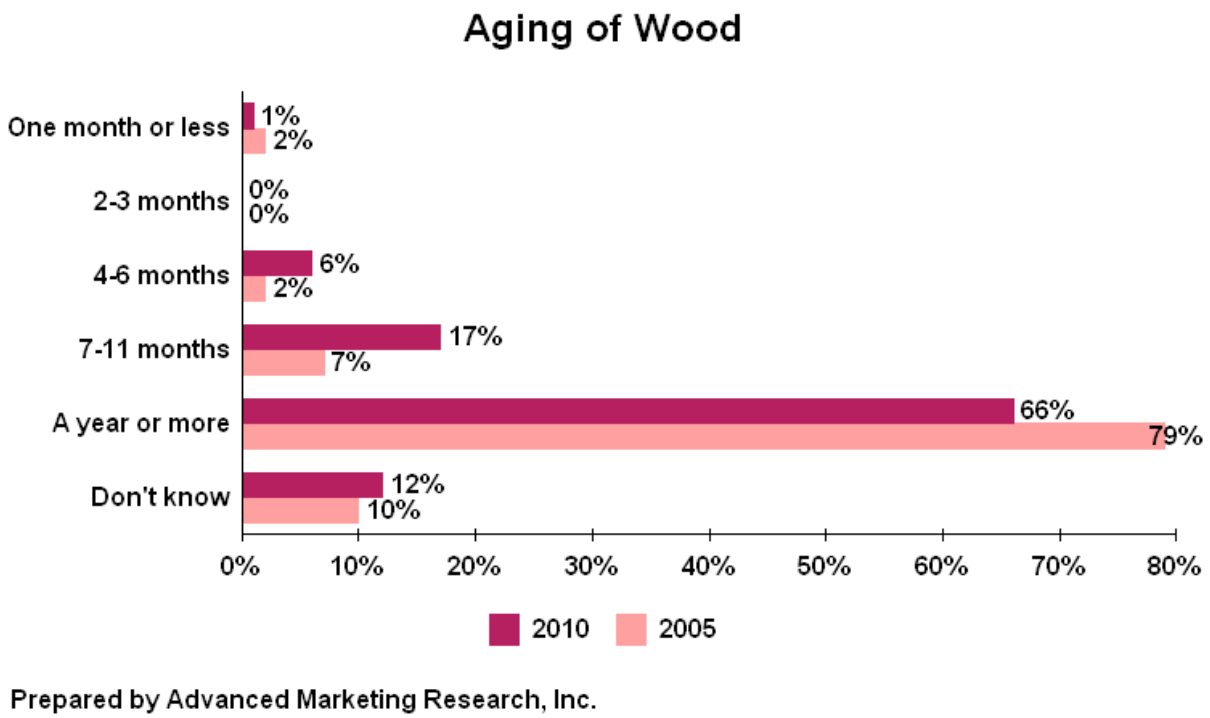
HOW IS WOOD STORED? (Q10)

The vast majority of wood (92%) is stored covered and dry. There have been no significant changes since 2005.



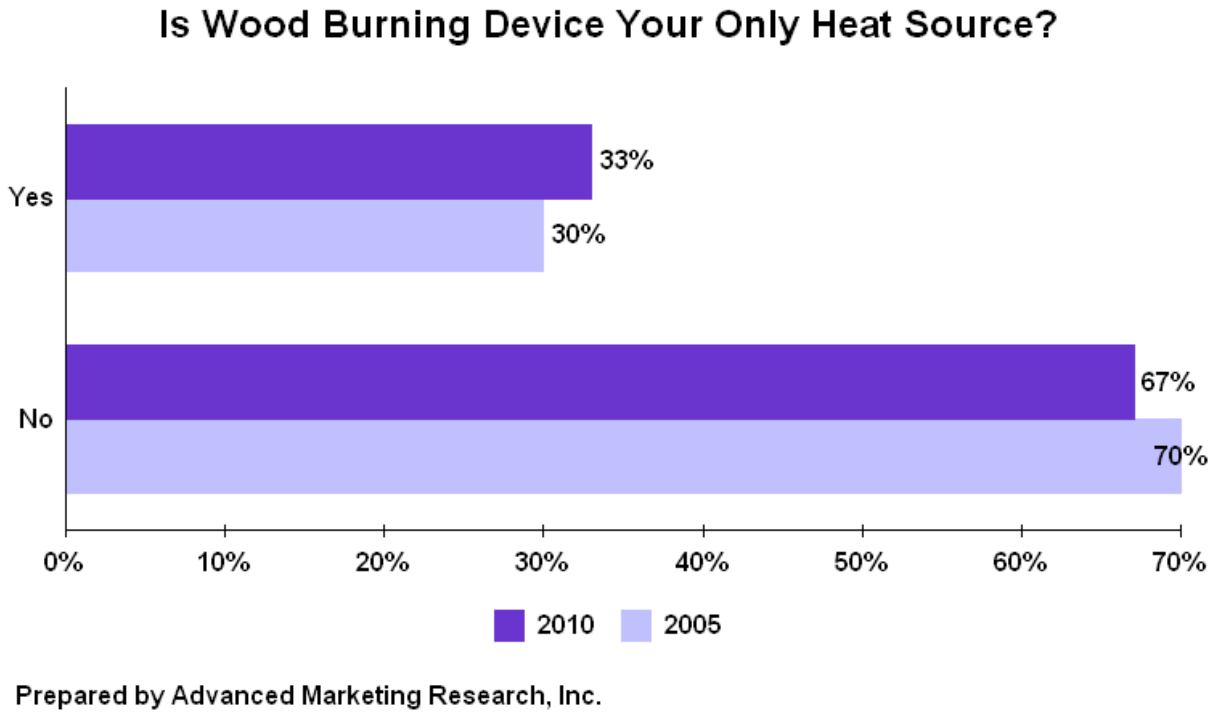
AGING OF WOOD (Q11)

66% of those burning wood (n=135) use wood that has aged for a year or more (down from 79% in 2005). 17% use wood that has aged for seven to eleven months. 7% use wood that has aged for six months or less. 12% are unsure how long their wood has aged when they burn it.



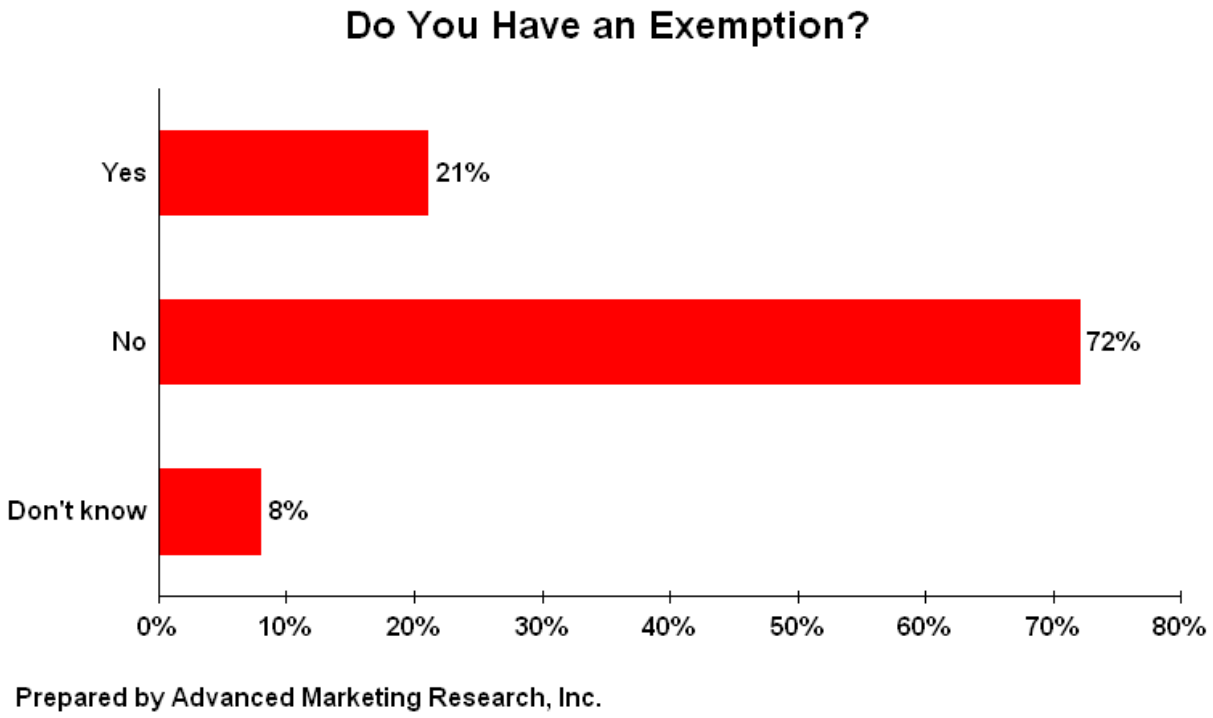
SOURCES OF HEAT (Q12)

For 33% of those who burn wood (not including pellets), their wood-burning device is the only heat source for their residence. 67% have an alternate source of heat. There have been no significant changes since 2005.



HOME HEATING EXEMPTION (Q13)

21% of Oakridge residents who burn wood (n=116) currently have a home wood heating exemption from the City of Oakridge, while 72% do not. 8% are unsure.

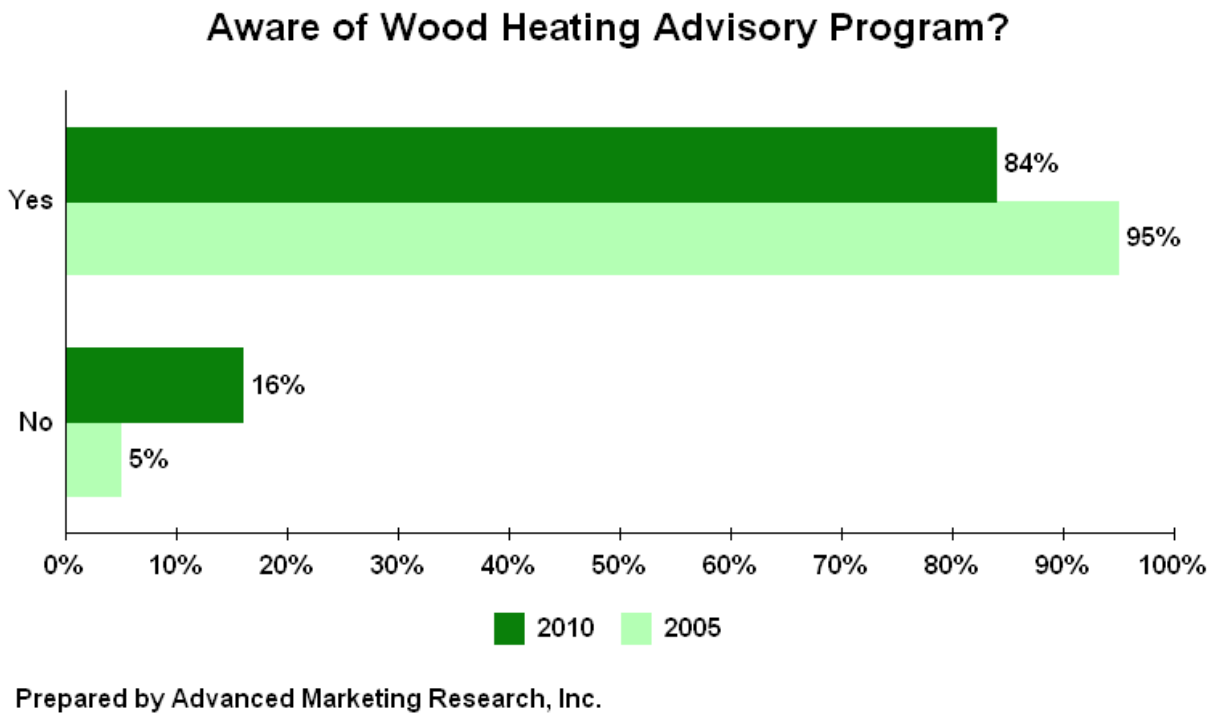


Demographic Differences

Those with internet access at home are less likely than others to have a home wood heating exemption.

AWARENESS OF WOOD HEATING ADVISORY PROGRAM (Q14)

84% of respondents (down from 95% in 2005) are aware of the Home Wood Heating Advisory Program with its red, yellow, and green advisory system. 16% are unaware of the program.



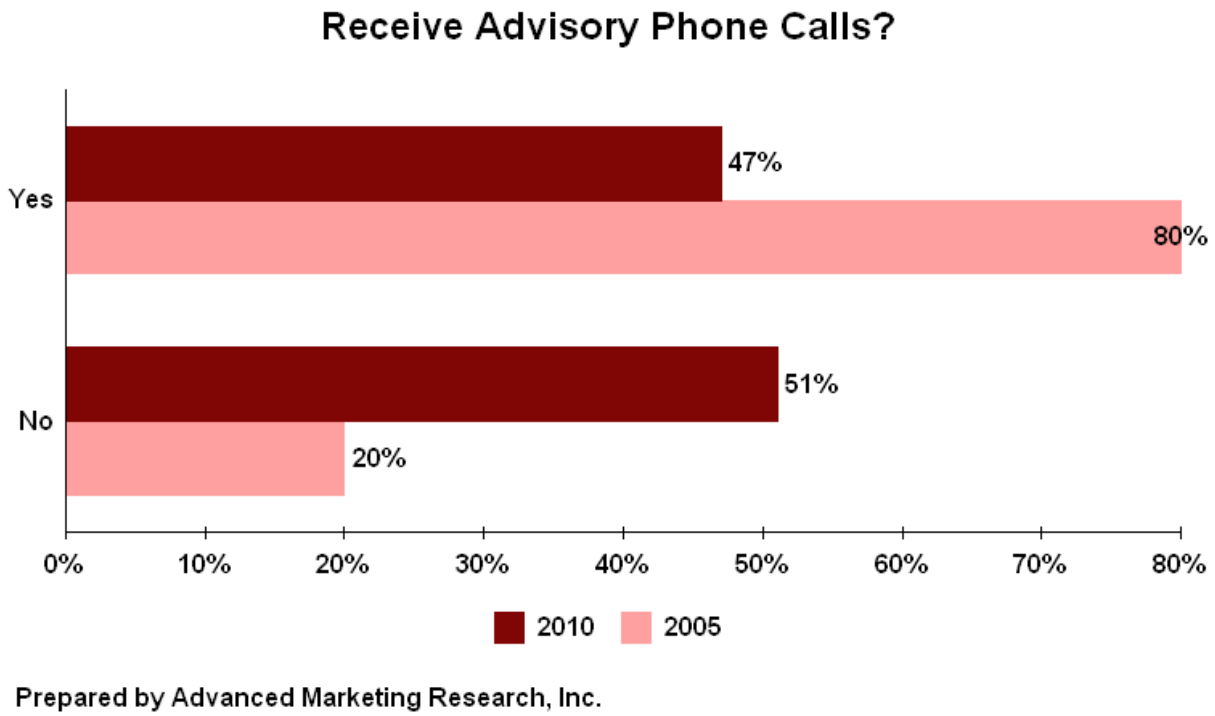
Demographic Differences

Females, 55 to 64 year-olds, those living in single-family dwellings, those with internet access at home, and those who have lived in the area for more than ten years are more likely than others to be aware of the program. Males, 18 to 34 year-olds, those without internet access at home, and those living in the area for five years or less are more likely than others to be unaware of the program.

ADVISORY PHONE CALLS (Q15-Q17)

47% of respondents receive occasional phone calls notifying them of whether or not they should burn wood based on air quality in their community (down from 80% in 2005). 51% do not receive such phone calls (up from 20% in 2005).

Of those not receiving calls (n=160), 81% don't know why; they have never been called (up from 63% in 2005). 7% say they don't know why; the calls just stopped. 7% don't burn wood. 4% asked to be removed from the list (down from 22% in 2005).



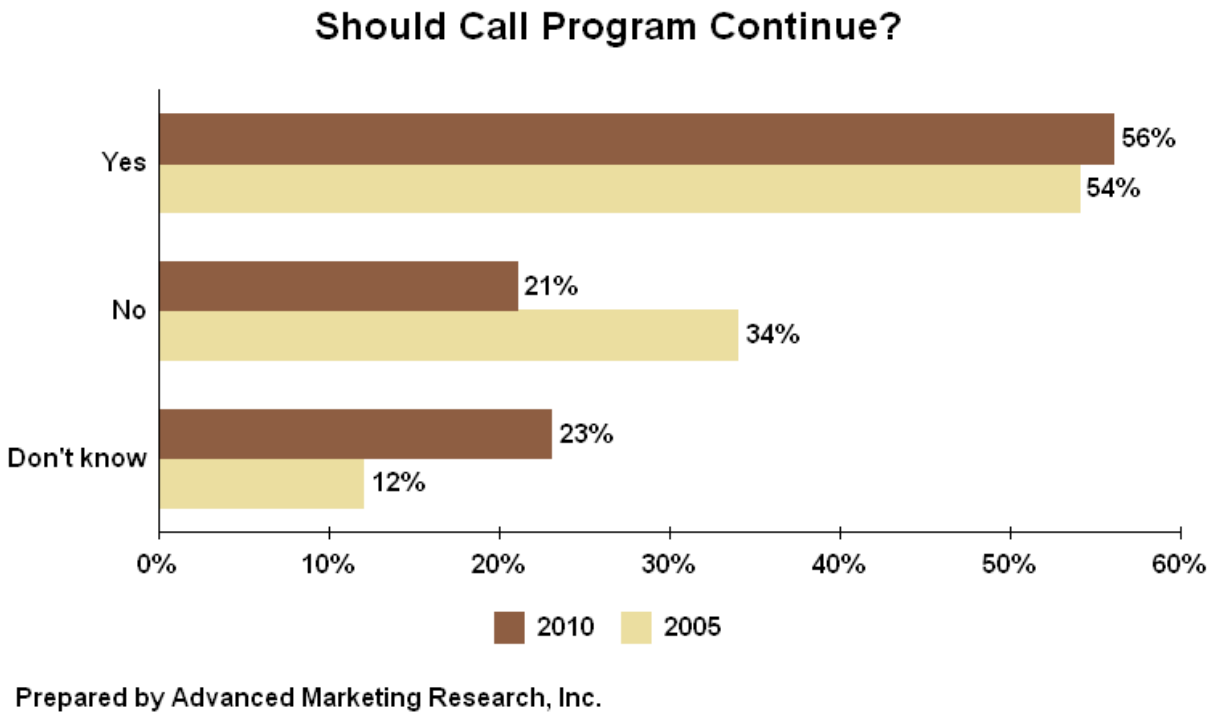
Demographic Differences

35 to 54 year-olds, those earning $35,000 to $49,999, Oakridge residents living inside city limits, Oakridge residents, and residents of over ten years are more likely than others to receive advisory phone calls.

SHOULD THE CALL PROGRAM CONTINUE? (Q18-Q19)

56% of respondents feel that the notification call program is a useful program that should continue. 21% do not feel it should continue (down from 34% in 2005). 23% are unsure (up from 12% in 2005).

Those who do not feel the program is useful or are unsure (n=138) gave the following reasons: "We don't burn wood" (20%), "the calls are ineffective; some have to burn to keep warm" (20%), "it is unnecessary" (9%), and "unfamiliar with the program" (9%). (For responses less than 9%, see Table 19. For verbatim comments, see Table 19V.)



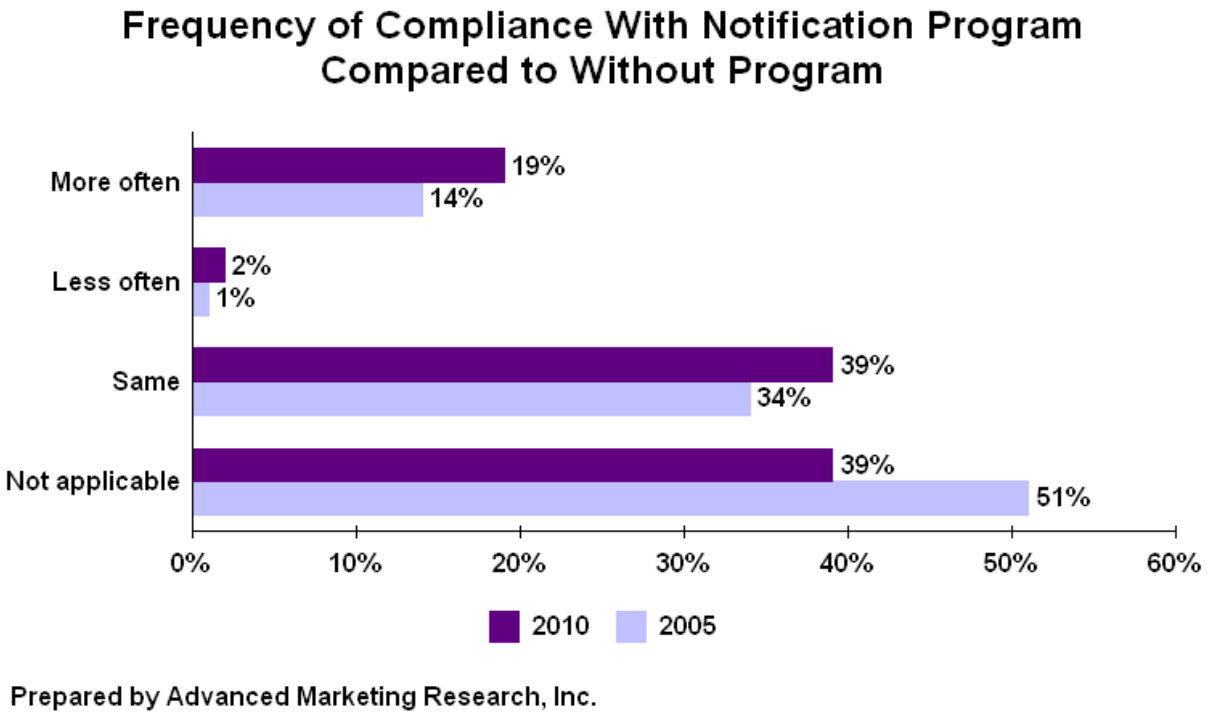
Demographic Differences

Those who have lived in the community for more than ten years are more likely than others to feel the program should continue. Oakridge residents living outside city limits are more likely than others to feel the program should *not* continue.

FOLLOWING THE ADVISORY (Q20)

Of those who receive advisory calls (n=146), 19% said that in general, the notification call program causes them to follow the wood burning advisory more often than they would without it. 2% said they follow the advisory less often than they would without the notification system. 39% report no change in following the advisory. 39% said "not applicable," they don't burn wood (down from 51% in 2005).

It should be noted that the wording of this question changed from 2005: "This year, did you follow the wood burning advisory more often, less often, or the same as in past years?" to the current wording: "In general, does the notification call program cause you to follow the wood burning advisory more often, less often, or the same as you would without it?"

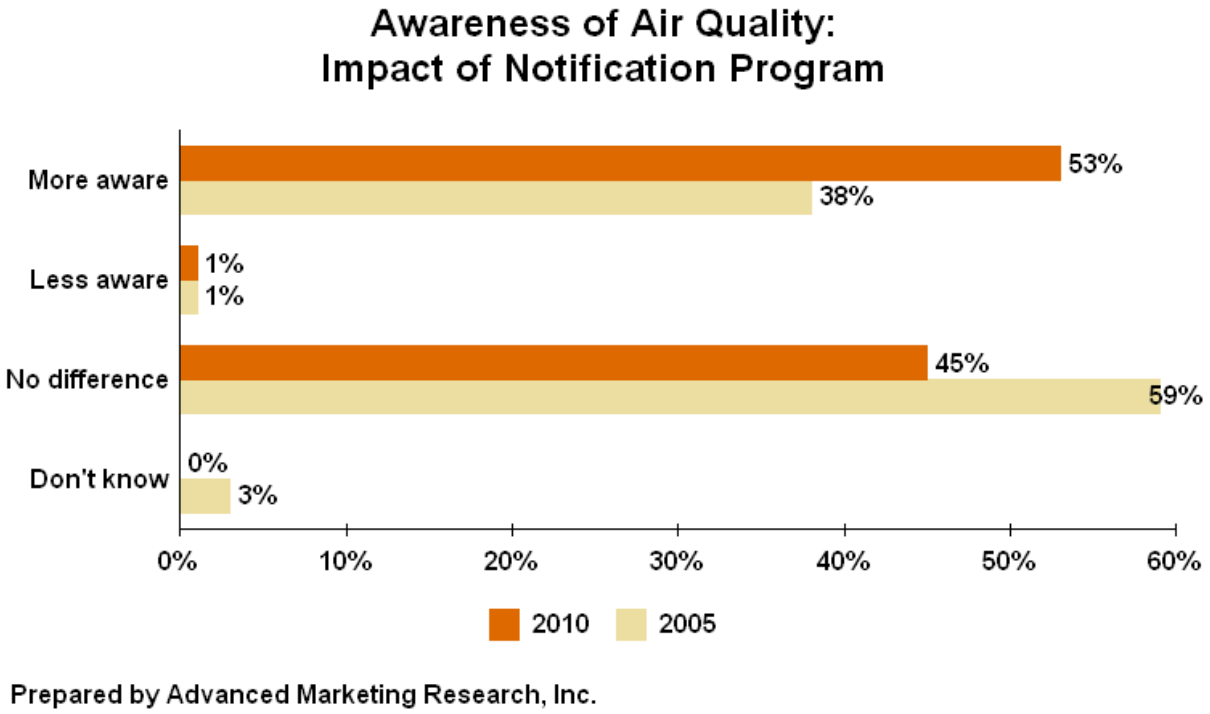


Demographic Differences

Those with wood stoves are more likely than others to say they are following the advisory the same as they would without the notification system. Those for who wood is the only source of heat are more likely than others to say they are following the advisory more often than they would without the notification system.

AWARENESS OF AIR QUALITY (Q21)

Of those who receive advisory calls (n=146), 53% feel that the telephone advisory program has made them more aware of air quality in their community (up from 38% in 2005). 1% feel that they are less aware of air quality. 45% feel there is no difference in their awareness (down from 59% in 2005).

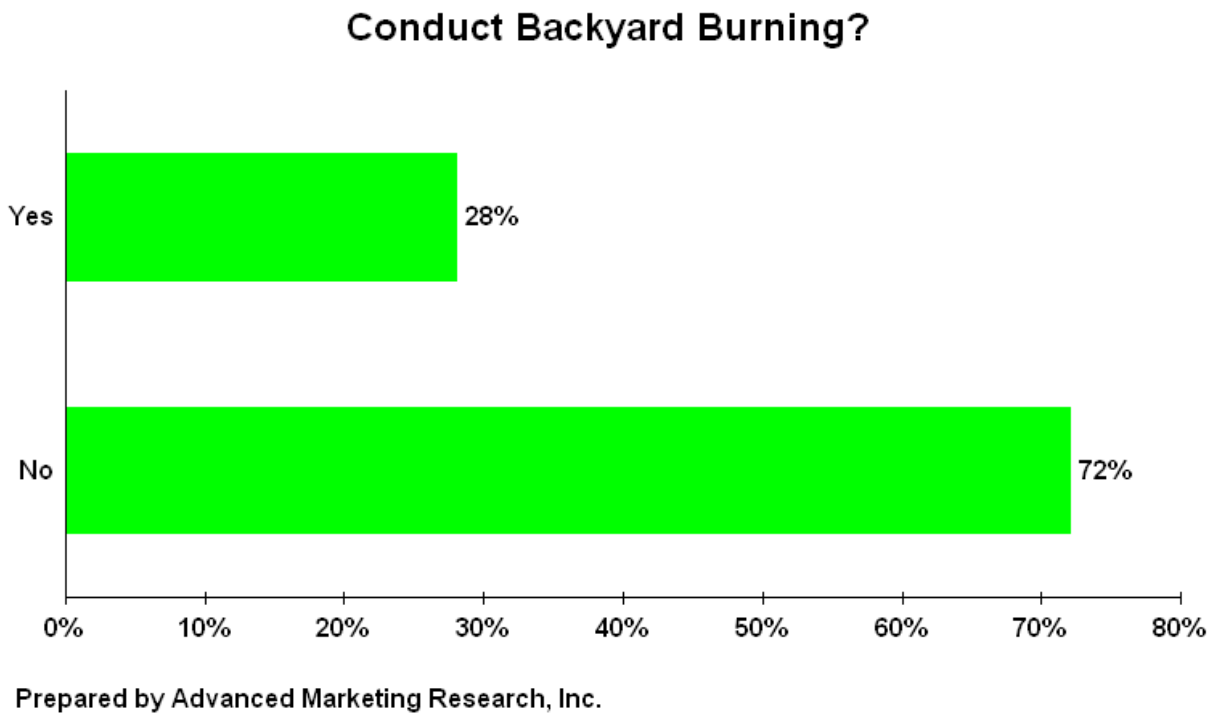


BACKYARD BURNING (Q22-Q24)

28% of respondents conduct backyard burning of yard trimmings at their residence; 72% do not.

Of those who do backyard burning (n=88), 82% do it once per backyard burning season. 14% burn once a month and 3% burn once a week.

Of those who do backyard burning (n=88), the majority (58%) burn one to five cubic yards per burning season. 19% burn less than one cubic yard, and 18% burn more than five cubic yards. 5% are unsure of how much they burn.

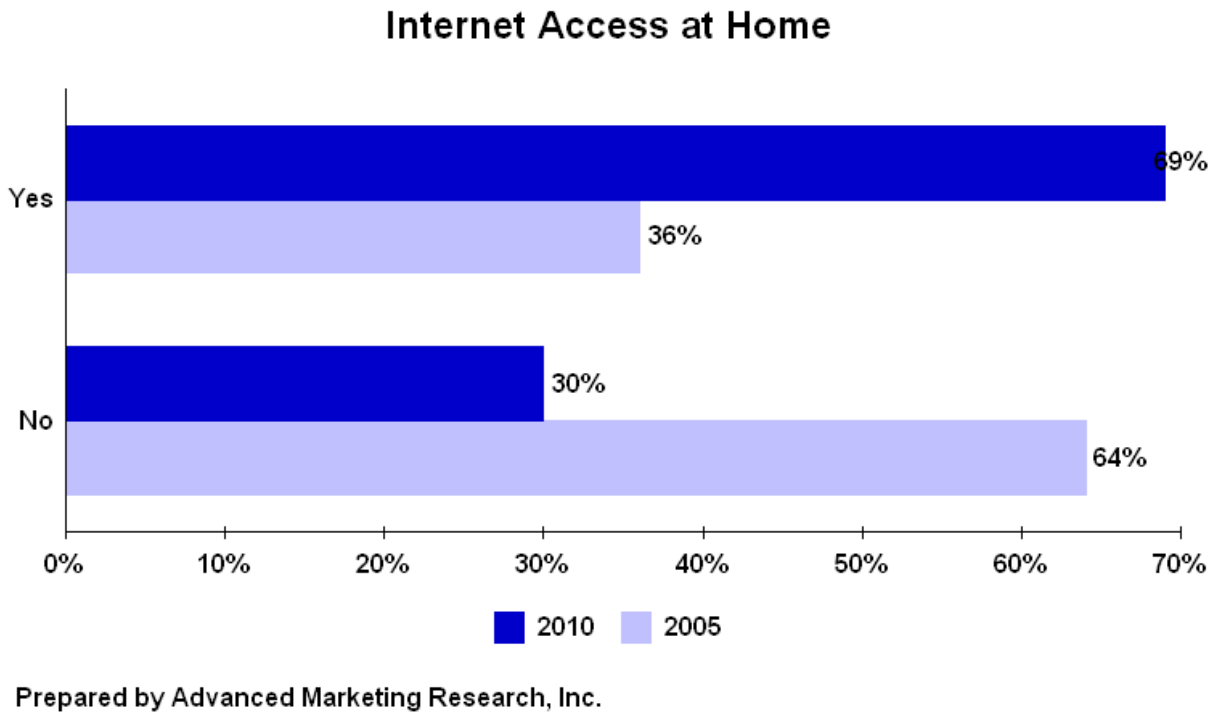


Demographic Differences

35 to 54 year-olds and Oakridge residents living outside city limits are more likely than others to do backyard burning.

INTERNET ACCESS AT HOME (Q25)

69% of respondents have internet access at home (up from 36% in 2005); 30% do not.



Demographic Differences

Females and those earning over $35,000 are more likely than others to have internet access at home. Males, seniors, Oakridge residents living inside city limits, and those earning under $15,000 are less likely than others to have internet access at home.

DATA TABLES

QUESTIONNAIRE INSTRUMENT

Table 2: Do you live in Oakridge zip code 97463 or Westfir zip code 97492?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Oakridge 97463 - CONTINUE	271 87%	24 100%	83 100% +++	9 100%	69 85%	17 100%	14 74%
Westfir 97492 - CONTINUE	41 13%	0 0%	0 0%	0 0%	12 15%	0 0%	5 26%
Chi Square			0.00 .999			5.02 .081	

Prepared by Advanced Marketing Research, Inc.

Table 3: Do you live inside or outside Oakridge city limits?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	271	24	83	9	69	17	14
Inside	210 77%	21 88%	48 58% ---	6 67%	47 68% --	9 53%	9 64%
Outside	61 23%	3 13%	35 42% +++	3 33%	22 32% ++	8 47%	5 36%
Don't know/Refused	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			7.19 .027			1.38 .501	

Prepared by Advanced Marketing Research, Inc.

Table 4: Do you currently have an open fireplace, a pellet stove, a wood stove, or a fireplace with insert? (MULTIPLE RESPONSES POSSIBLE; CODE ALL THAT APPLY)

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
None	143 46%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Wood stove OR fireplace with insert	117 38%	23 96%	69 83% +++	8 89%	81 100% +++	17 100%	19 100%
Pellet stove	39 13%	0 0%	4 5% --	0 0%	4 5% --	0 0%	1 5%
Open fireplace (no insert)	22 7%	2 8%	17 20% +++	1 11%	0 0%	3 18%	1 5%
Chi Square			3.75 .710			12.82 .046	

Prepared by Advanced Marketing Research, Inc.

Table 5: Approximately how many bags of pellet fuel did you burn during the last heating season (October 2009 through April 2010)? (ONE BAG = 50 POUNDS) (ROUND TO THE NEAREST WHOLE BAG) **(HIT "ENTER" IF "DON'T KNOW")**

Number of bags of pellets burned

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	39	0	4	0	4	0	1
0	7 18%	0 0%	2 50%	0 0%	2 50%	0 0%	1 100%
1	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
2	1 3%	0 0%	1 25%	0 0%	1 25%	0 0%	0 0%
12	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
13	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
20	2 5%	0 0%	1 25%	0 0%	1 25%	0 0%	0 0%
30	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
40	2 5%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
50	7 18%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
75	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
80	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
100	5 13%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
120	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
125	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
150	4 10%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
160	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
180	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
200	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%

(continued)

Table 5: Approximately how many bags of pellet fuel did you burn during the last heating season (October 2009 through April 2010)? (ONE BAG = 50 POUNDS) (ROUND TO THE NEAREST WHOLE BAG) **(HIT "ENTER" IF "DON'T KNOW")**

Number of bags of pellets burned

(continued)

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	39	0	4	0	4	0	1
Minimum	0	0	0	0	0	0	0
Maximum	200	0	20	0	20	0	0
Mean	66	0	6	0	6	0	0
S.D.	59	0	10	0	10	0	0
S.E.	9	0	5	0	5	0	0

Table 6: To the best of your knowledge, is your (wood stove AND/OR fireplace with insert) EPA certified as "clean burning" (less than 25 years old)? (MULTIPLE RESPONSES POSSIBLE, IF MULTIPLE DEVICES) (EPA=Environmental Protection Agency)

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	117	23	69	8	81	17	19
Yes	81 69%	18 78%	43 62% -	8 100%	81 100% +++	0 0%	0 0%
No	17 15%	3 13%	14 20% ++	0 0%	0 0%	17 100%	0 0%
Don't know/Refused	19 16%	2 9%	12 17%	0 0%	0 0%	0 0%	19 100%
Chi Square			6.01 .199			234.00 .001	

Prepared by Advanced Marketing Research, Inc.

Table 7: During the winter months, do you burn wood: daily, several times a week, several times a month, less than once a month, or never?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	135	24	83	9	81	17	19
Daily	65 48%	18 75%	31 37% ---	5 56%	46 57% ++	8 47%	7 37%
Several times a week	26 19%	4 17%	18 22%	2 22%	16 20%	2 12%	6 32%
Several times a month	13 10%	2 8%	10 12%	0 0%	7 9%	2 12%	2 11%
Less than once a month	14 10%	0 0%	12 14% ++	0 0%	6 7%	4 24%	1 5%
Never	17 13%	0 0%	12 14%	2 22%	6 7% --	1 6%	3 16%
Don't know/Refused	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			16.16 .040			8.97 .345	

Prepared by Advanced Marketing Research, Inc.

Table 8: Approximately how many cords of wood did you burn in your open fireplace during the last heating season (October 2009 through April 2010)? (ONE DECIMAL ALLOWED; e.g., 2.5) **(HIT "ENTER" IF DON'T KNOW)**

Number of cords burned in open fireplace

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	22	2	17	1	0	3	1
0	11	0	8	1	0	2	0
	50%	0%	47%	100%	0%	67%	0%
1	6	0	6	0	0	1	0
	27%	0%	35%	0%	0%	33%	0%
2	1	1	0	0	0	0	1
	5%	50%	0%	0%	0%	0%	100%
3	3	1	2	0	0	0	0
	14%	50%	12%	0%	0%	0%	0%
5	1	0	1	0	0	0	0
	5%	0%	6%	0%	0%	0%	0%
Minimum	0	2	0	0	0	0	2
Maximum	5	3	5	0	0	1	2
Mean	1	3	1	0	0	0	2
S.D.	1	1	1	0	0	1	0
S.E.	0	1	0	0	0	0	0

Table 9: Approximately how many cords of wood did you burn in your (wood stove AND/OR fireplace with insert) during the last heating season (October 2009 through April 2010)? (ONE DECIMAL ALLOWED; e.g., 2.5) (**HIT "ENTER" IF DON'T KNOW)**

Number of cords burned in wood stove and/or fireplace with insert

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	117	23	69	8	81	17	19
0	15	0	13	1	9	3	3
	13%	0%	19%	13%	11%	18%	16%
0.5	1	0	1	0	0	1	0
	1%	0%	1%	0%	0%	6%	0%
0.75	1	0	1	0	1	0	0
	1%	0%	1%	0%	1%	0%	0%
1	26	4	19	0	15	5	6
	22%	17%	28%	0%	19%	29%	32%
1.5	1	0	1	0	1	0	0
	1%	0%	1%	0%	1%	0%	0%
2	23	4	12	2	16	2	5
	20%	17%	17%	25%	20%	12%	26%
3	20	5	8	3	17	0	3
	17%	22%	12%	38%	21%	0%	16%
3.5	1	0	1	0	1	0	0
	1%	0%	1%	0%	1%	0%	0%
4	14	8	4	0	8	4	2
	12%	35%	6%	0%	10%	24%	11%
5	5	0	2	2	5	0	0
	4%	0%	3%	25%	6%	0%	0%
6	4	1	3	0	3	1	0
	3%	4%	4%	0%	4%	6%	0%
8	2	1	0	0	2	0	0
	2%	4%	0%	0%	2%	0%	0%
9	2	0	2	0	1	1	0
	2%	0%	3%	0%	1%	6%	0%
10	2	0	2	0	2	0	0
	2%	0%	3%	0%	2%	0%	0%
Minimum	0	1	0	0	0	0	0
Maximum	10	8	10	5	10	9	4
Mean	3	3	2	3	3	2	2
S.D.	2	2	2	2	2	2	1
S.E.	0	0	0	1	0	1	0

Table 10: In general, is your wood supply covered and dry, or exposed to wet weather?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	135	24	83	9	81	17	19
Covered and dry	124 92%	24 100%	75 90%	8 89%	79 98% +++	17 100%	16 84%
Exposed to weather	1 1%	0 0%	1 1%	0 0%	1 1%	0 0%	0 0%
Some of both	1 1%	0 0%	1 1%	0 0%	0 0%	0 0%	1 5%
Don't know/Refused	9 7%	0 0%	6 7%	1 11%	1 1% ---	0 0%	2 11%
Chi Square			3.02 .806			11.62 .071	

Prepared by Advanced Marketing Research, Inc.

Table 11: In general, how long has your wood aged when you use it? (MULTIPLE RESPONSES POSSIBLE)

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	135	24	83	9	81	17	19
One month or less	1 1%	0 0%	1 1%	0 0%	1 1%	0 0%	0 0%
2-3 months	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
4-6 months	8 6%	2 8%	5 6%	1 11%	6 7%	1 6%	0 0%
7-11 months	23 17%	5 21%	17 20%	0 0%	15 19%	2 12%	5 26%
A year or more	89 66%	17 71%	50 60% -	7 78%	55 68%	13 76%	11 58%
Don't know/Refused	16 12%	0 0%	10 12%	2 22%	5 6% --	1 6%	3 16%
Chi Square			6.83 .555			5.31 .724	

Prepared by Advanced Marketing Research, Inc.

Table 12: Is a wood burning device the only heat source for your residence? (PELLETS ARE NOT CONSIDERED WOOD)

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	135	24	83	9	81	17	19
Yes	45 33%	19 79%	18 22% ---	3 33%	32 40% +	5 29%	6 32%
No	90 67%	5 21%	65 78% +++	6 67%	49 60% -	12 71%	13 68%
Don't know/Refused	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			27.23 .001			0.88 .645	

Prepared by Advanced Marketing Research, Inc.

Table 13: Do you currently have a home wood heating exemption from the City of Oakridge?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	116	24	83	9	69	17	14
Yes	24 21%	24 100%	0 0%	0 0%	18 26% +	3 18%	2 14%
No	83 72%	0 0%	83 100% +++	0 0%	43 62% ---	14 82%	12 86%
Don't know/Refused	9 8%	0 0%	0 0%	9 100%	8 12% +	0 0%	0 0%
Chi Square			232.00 .001			6.01 .199	

Prepared by Advanced Marketing Research, Inc.

Table 14: Are you aware of the Home Wood Heating Advisory Program with its RED, YELLOW, and GREEN advisory system?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Yes	262 84%	22 92%	71 86%	6 67%	66 81%	17 100%	13 68%
No	47 15%	2 8%	12 14%	3 33%	15 19%	0 0%	6 32%
Don't know/Refused	3 1%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			3.28 .512			6.13 .189	

Prepared by Advanced Marketing Research, Inc.

Table 15: Do you receive occasional phone calls notifying you of whether or not you should burn wood based on air quality in your community?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Yes	146 47%	16 67%	49 59% +++	4 44%	42 52%	13 76%	10 53%
No	160 51%	7 29%	34 41% --	5 56%	39 48%	3 18%	8 42%
Don't know/Refused	6 2%	1 4%	0 0%	0 0%	0 0%	1 6%	1 5%
Chi Square			5.66 .226			9.15 .057	

Prepared by Advanced Marketing Research, Inc.

Table 16: Do you know why you are not receiving notification calls?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	160	7	34	5	39	3	8
I don't know - they have never called	130 81%	6 86%	30 88%	4 80%	37 95% ++	2 67%	7 88%
I don't know - they stopped calling (not because I told them to)	11 7%	0 0%	1 3%	1 20%	1 3%	0 0%	0 0%
I don't burn wood	11 7%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
I told them to stop calling	6 4%	0 0%	3 9% +	0 0%	0 0%	1 33%	1 13%
Just moved here	1 1%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Have an exemption	1 1%	1 14%	0 0%	0 0%	1 3% +	0 0%	0 0%
Chi Square			9.94 .446			10.28 .416	

Table 18: Do you feel that the notification call program is a useful program that should continue?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Yes	174 56%	17 71%	47 57%	3 33%	46 57%	9 53%	11 58%
No	66 21%	2 8%	21 25%	2 22%	15 19%	5 29%	3 16%
Don't know/Refused	72 23%	5 21%	15 18%	4 44%	20 25%	3 18%	5 26%
Chi Square			6.88 .143			1.41 .842	

Prepared by Advanced Marketing Research, Inc.

Table 20: In general, does the notification call program cause you to follow the wood burning advisory more often, less often, or the same as you would without it?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	146	16	49	4	42	13	10
More often	28 19%	5 31%	15 31% ++	2 50%	12 29% +	3 23%	3 30%
Less often	3 2%	0 0%	2 4%	0 0%	2 5%	0 0%	0 0%
The same	57 39%	10 63%	26 53% ++	2 50%	24 57% +++	8 62%	6 60%
Not applicable (don't burn wood)	57 39%	1 6%	6 12% ---	0 0%	4 10% ---	2 15%	1 10%
Don't know/Refused	1 1%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			2.33 .969			1.59 .991	

Prepared by Advanced Marketing Research, Inc.

Table 21: Has the notification call program made you more aware of air quality in your community, less aware, or no difference in awareness?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	146	16	49	4	42	13	10
More aware	78 53%	9 56%	27 55%	3 75%	24 57%	5 38%	7 70%
Less aware	2 1%	0 0%	1 2%	0 0%	1 2%	0 0%	0 0%
No difference	66 45%	7 44%	21 43%	1 25%	17 40%	8 62%	3 30%
Don't know/Refused	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			0.96 .915			3.12 .538	

Prepared by Advanced Marketing Research, Inc.

Table 22: Do you conduct backyard burning of yard trimmings at your residence?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Yes	88 28%	6 25%	34 41% +++	3 33%	29 36% +	6 35%	6 32%
No	224 72%	18 75%	49 59% ---	6 67%	52 64% -	11 65%	13 68%
Don't know/Refused	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			2.09 .351			0.12 .941	

Prepared by Advanced Marketing Research, Inc.

Table 23: How often do you do backyard burning of yard trimmings: daily, once a week, once a month, or once per backyard burning season?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	88	6	34	3	29	6	6
Daily	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Once a week	3 3%	0 0%	1 3%	0 0%	0 0%	1 17%	0 0%
Once a month	12 14%	0 0%	5 15%	0 0%	3 10%	0 0%	2 33%
Once per backyard burning season	72 82%	6 100%	28 82%	3 100%	25 86%	5 83%	4 67%
Don't know/Refused	1 1%	0 0%	0 0%	0 0%	1 3%	0 0%	0 0%
Mean S.D.	3.8 0.5	4.0 0.0	3.8 0.5	4.0 0.0	3.9 0.3	3.7 0.8	3.7 0.5
Chi Square			1.85 .933			9.49 .148	

Prepared by Advanced Marketing Research, Inc.

Table 24: How much do you burn in one backyard burning season: less than one cubic yard, one to five cubic yards, or more than five cubic yards?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	88	6	34	3	29	6	6
Less than one cubic yard	17 19%	1 17%	6 18%	2 67%	6 21%	2 33%	1 17%
One to five cubic yards	51 58%	4 67%	20 59%	1 33%	15 52%	3 50%	4 67%
More than five cubic yards	16 18%	1 17%	7 21%	0 0%	6 21%	1 17%	1 17%
Don't know/Refused	4 5%	0 0%	1 3%	0 0%	2 7%	0 0%	0 0%
Mean S.D.	2.0 0.6	2.0 0.6	2.0 0.6	1.3 0.6	2.0 0.7	1.8 0.8	2.0 0.6
Chi Square			4.53 .606			1.57 .954	

Prepared by Advanced Marketing Research, Inc.

Table 25: Do you have internet access AT HOME?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Yes	216 69%	12 50%	64 77% +	5 56%	55 68%	12 71%	14 74%
No	93 30%	12 50%	19 23%	3 33%	26 32%	5 29%	5 26%
Don't know/Refused	3 1%	0 0%	0 0%	1 11%	0 0%	0 0%	0 0%
Chi Square			18.85 .001			0.26 .992	

Prepared by Advanced Marketing Research, Inc.

Table 26: How long have you lived in your community?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Less than one year	8 3%	0 0%	2 2%	0 0%	1 1%	0 0%	1 5%
1-5 years	48 15%	3 13%	10 12%	1 11%	12 15%	1 6%	4 21%
6-10 years	52 17%	0 0%	13 16%	1 11%	11 14%	1 6%	3 16%
Over ten years	202 65%	21 88%	57 69%	7 78%	56 69%	15 88%	11 58%
Don't know/Refused	2 1%	0 0%	1 1%	0 0%	1 1%	0 0%	0 0%
Chi Square			5.92 .656			5.70 .681	

Prepared by Advanced Marketing Research, Inc.

Table 27: Do you own or rent your residence?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Own	259 83%	19 79%	73 88%	7 78%	73 90% ++	15 88%	15 79%
Rent	51 16%	4 17%	9 11%	2 22%	7 9% --	2 12%	4 21%
Don't know/Refused	2 1%	1 4%	1 1%	0 0%	1 1%	0 0%	0 0%
Chi Square			2.49 .647			2.80 .591	

Prepared by Advanced Marketing Research, Inc.

Table 28: Is your residence a: single family home, mobile home, townhouse, condominium, duplex, apartment, or something else?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Single family	240 77%	22 92%	73 88% +++	9 100%	72 89% +++	16 94%	15 79%
Mobile home	58 19%	2 8%	8 10% --	0 0%	7 9% ---	1 6%	4 21%
Apartment	10 3%	0 0%	1 1%	0 0%	1 1%	0 0%	0 0%
Duplex	3 1%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Don't know/Refused	1 0%	0 0%	1 1% +	0 0%	1 1% +	0 0%	0 0%
Chi Square			1.82 .986			3.83 .872	

Table 30: Has your home been weatherized within the last five years?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Yes	143 46%	11 46%	38 46%	3 33%	44 54% +	6 35%	6 32%
No	151 48%	12 50%	41 49%	5 56%	31 38% --	11 65%	13 68%
Don't know/Refused	18 6%	1 4%	4 5%	1 11%	6 7%	0 0%	0 0%
Chi Square			1.03 .905			9.29 .054	

Prepared by Advanced Marketing Research, Inc.

Table 31: Please tell me when I read the category that contains your age:

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
18-24	12 4%	1 4%	3 4%	1 11%	2 2%	0 0%	2 11%
25-34	18 6%	0 0%	4 5%	1 11%	4 5%	0 0%	2 11%
35-44	27 9%	5 21%	6 7%	0 0%	10 12%	0 0%	0 0%
45-54	66 21%	3 13%	23 28% +	3 33%	24 30% ++	2 12%	4 21%
55-64	103 33%	11 46%	29 35%	2 22%	21 26%	10 59%	9 47%
65 or older	86 28%	4 17%	18 22%	2 22%	20 25%	5 29%	2 11%
REFUSED - DO NOT READ	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			11.04 .355			19.22 .038	

Prepared by Advanced Marketing Research, Inc.

Table 32: Please tell me when I read the category that contains your household's annual income, before taxes:

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Under $15,000	49 16%	4 17%	12 14%	0 0%	9 11%	4 24%	4 21%
$15,000 - $24,999	55 18%	6 25%	10 12%	2 22%	13 16%	3 18%	3 16%
$25,000 - $34,999	51 16%	2 8%	14 17%	1 11%	9 11%	3 18%	4 21%
$35,000 - $49,999	52 17%	8 33%	14 17%	1 11%	17 21%	3 18%	5 26%
$50,000 or more	50 16%	2 8%	20 24% ++	2 22%	18 22% +	4 24%	2 11%
DON'T KNOW/REFUSED - DO NOT READ	55 18%	2 8%	13 16%	3 33%	15 19%	0 0%	1 5%
Chi Square			12.52 .252			9.67 .470	

Prepared by Advanced Marketing Research, Inc.

Table 33: THANK YOU FOR YOUR TIME! Hang up and record: Gender:

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Male	154	12	31	4	35	7	7
	49%	50%	37%	44%	43%	41%	37%
			--				
Female	158	12	52	5	46	10	12
	51%	50%	63%	56%	57%	59%	63%
			++				
Chi Square			1.30			0.26	
			.522			.878	

Prepared by Advanced Marketing Research, Inc.

Table 1. 2008 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	0.4	0.8	0.1%	0.1%
Oakridge Sand & Gravel: Cement plant	0.1	0.1	0.0%	0.0%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	42.3	7%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	158.9	174.8	30%	32%
Residential Wood Combustion: Certified Woodstove/Insert[2]	228.0	250.8	43%	45%
Pellet Stoves	6.7	7.4	1%	1%
All Other Stationary Area Sources	47.4	4.7	9%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	26.6	37.3	5%	7%
Re-Entrained Road Dust	12.1	27.8	2%	5%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
	---	---		
Total, All Sources, lbs/day	**525**	**552**		

(1) Worst-case day = Peak month production/20 workdays.

(2) Worst-case day = Peak Heating Degree Day

Updated, MLH 5/23/12

Table 2. 2014 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.1%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	3.7%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	29.6	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	106.1	81.7	22%	21%
Residential Wood Combustion: Certified Woodstove/Insert[2]	252.4	194.4	52%	51%
Pellet Stoves	7.3	8.0	1%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	15.7	22.2	3%	6%
Re-Entrained Road Dust	7.1	16.3	1%	4%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
	---	---		
Total, All Sources, lbs/day	**486**	**381**		

(1) Worst-case day = Permitted hourly (x24) operating capacity

(2) Worst-case day = Peak Heating Degree Day

Updated, MLH 5/23/12

Table 3. Oakridge NAA 2008 Residential Wood Combustion $PM_{2.5}$
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	$PM_{2.5}$ Emissions			(9)
					Annual	PM Season		Worst Case
Woodburning Device	Base Year Wood Fuel Use (tons/yr)	$PM_{2.5}$ EF (lbs/ton)	Relative HDD	Activity (days/wk)	(6) Annual (tons/yr)	(7) Typical Day (lb/day)	(8) Worst Case Day (lb/day)	Day Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	23.6	1.10	7	2.3	38	42	42
21-04-008-320 Certified Non-Cat Wood-Stove	770.6	19.6	1.10	7	7.6	126	138	138
21-04-008-330 Certified Cat Wood-Stove	192.6	20.4	1.10	7	2.0	33	36	36
21-04-008-310 Conv Wood Stove	334.1	30.6	1.10	7	5.1	85	94	94
21-04-008-230 Fireplace Insert Cert Catalyst	84.3	20.4	1.10	7	0.9	14	16	16
21-04-008-220 Fireplace Insert Cert Non-Cat	337.1	19.6	1.10	7	3.3	55	61	61
21-04-008-210 Fireplace Insert Conv.	289.0	30.6	1.10	7	4.4	74	81	81
21-04-008-400 Exempt Pellet Stove	264.5	3.1	1.10	7	0.4	7	7	7
21-04-008-510 Central Furnace	0.0	27.6	1.10	7	0.0	0	0	0
Total	2,467.7				25.9	432	475	**475**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge and 2008 Klamath Falls Wood Burning Survey Results.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion PM2.5 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	23.6	1
2104008210	30.6	1
2104008220	19.6	1
2104008230	20.4	1
2104008310	30.6	1
2104008320	19.6	1
2104008330	20.4	1
2104008400	3.06	3
2104008510	27.6	3
2104008610	27.6	3
2104008700	23.6	3
2104009000	28.4	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011.

Table 3-a. Oakridge NAA 2008 Residential Wood Combustion Household Survey
and PM2.5 Area Source Emissions From Residential Wood Heating

(1)	(2)	(2)	(2)	(3)	(4)	(4)	(4)	(5)	$PM_{2.5}$ Emissions			(9)
									Annual	PM Season		Worst Case
Woodburning Device	Base Year Wood Fuel Use Survey (Households)	Base Year Wood Fuel Use (tons/HH)	Base Year Wood Fuel Use (tons/year)	$PM_{2.5}$ EF (lbs/ton)	Average Heating Degree Days (HDD)	Peak Heating Degree Days (HDD)	Relative HDD	Activity (days/wk)	(6) Annual (tons/yr)	(7) Typical Day (lb/day)	(8) Worst Case Day (lb/day)	Day Advisory Controlled (lbs/day)
Oakridge NAA												
21-04-008-100 Fireplace without Insert	123	1.6	195.6	23.6	26	28	1.10	7	2.3	38	42	42
21-04-008-320 Certified Non-Cat Wood-Stove	256	3.0	770.6	19.6	26	28	1.10	7	7.6	126	138	138
21-04-008-330 Certified Cat Wood-Stove	64	3.0	192.6	20.4	26	28	1.10	7	2.0	33	36	36
21-04-008-310 Conv Wood Stove	111	3.0	334.1	30.6	26	28	1.10	7	5.1	85	94	94
21-04-008-230 Fireplace Insert Cert Catalyst	28	3.0	84.3	20.4	26	28	1.10	7	0.9	14	16	16
21-04-008-220 Fireplace Insert Cert Non-Cat	112	3.0	337.1	19.6	26	28	1.10	7	3.3	55	61	61
21-04-008-210 Fireplace Insert Conv.	96	3.0	289.0	30.6	26	28	1.10	7	4.4	74	81	81
21-04-008-400 Exempt Pellet Stove	228	1.2	264.5	3.1	26	28	1.10	7	0.4	7	7	7
21-04-008-510 Central Furnace	0	0.0	0.0	27.6	26	28	1.10	7	0.0	0	0	0
Total	1,018		2,468						25.9	432	475	**475**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge and 2008 Klamath Falls Wood Burning Survey Results.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion PM2.5 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	23.6	1
2104008210	30.6	1
2104008220	19.6	1
2104008230	20.4	1
2104008310	30.6	1
2104008320	19.6	1
2104008330	20.4	1
2104008400	3.06	3
2104008510	27.6	3
2104008610	27.6	3
2104008700	23.6	3
2104009000	28.4	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

(Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011.

Table 4. Oakridge NAA 2014 Residential Wood Combustion $PM_{2.5}$
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	$PM_{2.5}$ Emissions			(9)
					Annual	PM Season		Worst Case
Woodburning Device	2014 Wood Fuel Use (tons/yr)	$PM_{2.5}$ EF (lbs/ton)	Relative HDD	Activity (days/wk)	(6) Annual (tons/yr)	(7) Typical Day (lb/day)	(8) Worst Case Day (lb/day)	Day 30% Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	23.6	1.10	7	2.3	38	42	30
21-04-008-320 Certified Non-Cat Wood-Stove	879.4	19.6	1.10	7	8.6	144	158	111
21-04-008-330 Certified Cat Wood-Stove	188.9	20.4	1.10	7	1.9	32	35	25
21-04-008-310 Conv Wood Stove	191.8	30.6	1.10	7	2.9	49	54	38
21-04-008-230 Fireplace Insert Cert Catalyst	82.6	20.4	1.10	7	0.8	14	15	11
21-04-008-220 Fireplace Insert Cert Non-Cat	383.6	19.6	1.10	7	3.8	63	69	48
21-04-008-210 Fireplace Insert Conv.	224.3	30.6	1.10	7	3.4	57	63	44
21-04-008-400 Exempt Pellet Stove	286.5	3.1	1.10	7	0.4	7	8	8
21-04-008-510 Central Furnace	0.0	27.6	1.10	7	0.0	0	0	0
Total	2,432.7				24.3	404	445	**314**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge Wood Burning Survey Results and subsequent heating unit replacements verified by LRAPA.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion PM2.5 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	23.6	1
2104008210	30.6	1
2104008220	19.6	1
2104008230	20.4	1
2104008310	30.6	1
2104008320	19.6	1
2104008330	20.4	1
2104008400	3.06	3
2104008510	27.6	3
2104008610	27.6	3
2104008700	23.6	3
2104009000	28.4	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011 increased by 30% compliance after 2012 strategy implementation.

Table 4-a. Oakridge NAA 2014 Residential Wood Combustion PM2.5
Area Source Emissions From Residential Wood Heating

(1) Woodburning Device	(2) 2014 Wood Fuel Use (Households)	(2) 2014 Wood Fuel Use (tons/HH)	(2) 2014 Wood Fuel Use (tons/year)	(3) $PM_{2.5}$ EF (lbs/ton)	(4) Average Heating Degree Days (HDD)	(4) Peak 2% Heating Degree Days (HDD)	(4) Relative HDD	(5) Activity (days/wk)	$PM_{2.5}$ Emissions Annual (6) Annual (tons/yr)	PM Season (7) Typical Day (lb/day)	PM Season (8) Worst Case Day (lb/day)	(9) Worst Case Day 30% Advisory Controlled (lbs/day)
Oakridge NAA												
21-04-008-100 Fireplace without Insert	123	1.6	195.6	23.6	26	28	1.10	7	2.3	38	42	30
21-04-008-320 Certified Non-Cat Wood-Stove	298	3.0	879.4	19.6	26	28	1.10	7	8.6	144	158	111
21-04-008-330 Certified Cat Wood-Stove	64	3.0	188.9	20.4	26	28	1.10	7	1.9	32	35	25
21-04-008-310 Conv Wood Stove	65	3.0	191.8	30.6	26	28	1.10	7	2.9	49	54	38
21-04-008-230 Fireplace Insert Cert Catalyst	28	3.0	82.6	20.4	26	28	1.10	7	0.8	14	15	11
21-04-008-220 Fireplace Insert Cert Non-Cat	130	3.0	383.6	19.6	26	28	1.10	7	3.8	63	69	48
21-04-008-210 Fireplace Insert Conv.	76	3.0	224.3	30.6	26	28	1.10	7	3.4	57	63	44
21-04-008-400 Exempt Pellet Stove	247	1.2	286.5	3.1	26	28	1.10	7	0.4	7	8	8
21-04-008-510 Central Furnace	0	0.0	0.0	27.6	26	28	1.10	7	0.0	0	0	0
Total	1,031		2,433						24.3	404	445	**314**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge Wood Burning Survey Results and subsequent heating unit replacements verified by LRAPA.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion PM2.5 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	23.6	1
2104008210	30.6	1
2104008220	19.6	1
2104008230	20.4	1
2104008310	30.6	1
2104008320	19.6	1
2104008330	20.4	1
2104008400	3.06	3
2104008510	27.6	3
2104008610	27.6	3
2104008700	23.6	3
2104009000	28.4	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =
(Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.
8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011 increased by 30% compliance after 2012 strategy implementation.

Table 5. Oakridge NAA 2008 Residential Wood Combustion NOx
Area Source Emissions From Residential Wood Heating

(1) Woodburning Device	(2) Base Year Wood Fuel Use (tons/yr)	(3) NOx EF (lbs/ton)	(4) Relative HDD	(5) Activity (days/wk)	NOx Emissions Annual (6) Annual (tons/yr)	NOx Emissions PM Season (7) Typical Day (lb/day)	NOx Emissions PM Season (8) Worst Case Day (lb/day)	(9) Worst Case Day Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	2.6	1.10	7	0.3	4	5	5
21-04-008-320 Certified Non-Cat Wood-Stove	770.6	2.3	1.10	7	0.9	15	16	16
21-04-008-330 Certified Cat Wood-Stove	192.6	2.0	1.10	7	0.2	3	4	4
21-04-008-310 Conv Wood Stove	334.1	2.8	1.10	7	0.5	8	9	9
21-04-008-230 Fireplace Insert Cert Catalyst	84.3	2.0	1.10	7	0.1	1	2	2
21-04-008-220 Fireplace Insert Cert Non-Cat	337.1	2.3	1.10	7	0.4	6	7	7
21-04-008-210 Fireplace Insert Conv.	289.0	2.8	1.10	7	0.4	7	7	7
21-04-008-400 Exempt Pellet Stove	264.5	3.8	1.10	7	0.5	8	9	9
21-04-008-510 Central Furnace	0.0	1.8	1.10	7	0.0	0	0	0
Total	2,467.7				3.2	53	58	**58**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge and 2008 Klamath Falls Wood Burning Survey Results.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion NOx emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	2.6	1
2104008210	2.8	1
2104008220	2.3	3
2104008230	2.0	1
2104008310	2.8	1
2104008320	2.3	3
2104008330	2.0	1
2104008400	3.8	3
2104008510	1.8	3
2104008610	1.8	3
2104008700	2.6	1
2104009000	7.7	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011.

Table 6. Oakridge NAA 2014 Residential Wood Combustion NOx
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	NOx Emissions			(9)
					Annual	PM Season		Worst Case
					(6)	(7)	(8)	Day 30%
Woodburning Device	2014 Wood Fuel Use (tons/yr)	NOx EF (lbs/ton)	Relative HDD	Activity (days/wk)	Annual (tons/yr)	Typical Day (lb/day)	Worst Case Day (lb/day)	Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	2.6	1.10	7	0.3	4	5	3
21-04-008-320 Certified Non-Cat Wood-Stove	879.4	2.3	1.10	7	1.0	17	18	13
21-04-008-330 Certified Cat Wood-Stove	188.9	2.0	1.10	7	0.2	3	3	2
21-04-008-310 Conv Wood Stove	191.8	2.8	1.10	7	0.3	4	5	3
21-04-008-230 Fireplace Insert Cert Catalyst	82.6	2.0	1.10	7	0.1	1	2	1
21-04-008-220 Fireplace Insert Cert Non-Cat	383.6	2.3	1.10	7	0.4	7	8	6
21-04-008-210 Fireplace Insert Conv.	224.3	2.8	1.10	7	0.3	5	6	4
21-04-008-400 Exempt Pellet Stove	286.5	3.8	1.10	7	0.5	9	10	10
21-04-008-510 Central Furnace	0.0	1.8	1.10	7	0.0	0	0	0
Total	2,432.7				3.1	52	57	**43**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge Wood Burning Survey Results and subsequent heating unit replacements verified by LRAPA.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion NOx emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	2.6	1
2104008210	2.8	1
2104008220	2.3	3
2104008230	2.0	1
2104008310	2.8	1
2104008320	2.3	3
2104008330	2.0	1
2104008400	3.8	3
2104008510	1.8	3
2104008610	1.8	3
2104008700	2.6	1
2104009000	7.7	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011 increased by 30% compliance after 2012 strategy implementation.

Table 7. Oakridge NAA 2008 Residential Wood Combustion SO2
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	SO2 Emissions			(9)
					Annual	PM Season		Worst Case
					(6)	(7)	(8)	Day
Woodburning Device	Base Year Wood Fuel Use (tons/yr)	SO2 EF (lbs/ton)	Relative HDD	Activity (days/wk)	Annual (tons/yr)	Typical Day (lb/day)	Worst Case Day (lb/day)	Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	0.4	1.10	7	0.0	1	1	1
21-04-008-320 Certified Non-Cat Wood-Stove	770.6	0.4	1.10	7	0.2	3	3	3
21-04-008-330 Certified Cat Wood-Stove	192.6	0.4	1.10	7	0.0	1	1	1
21-04-008-310 Conv Wood Stove	334.1	0.4	1.10	7	0.1	1	1	1
21-04-008-230 Fireplace Insert Cert Catalyst	84.3	0.4	1.10	7	0.0	0	0	0
21-04-008-220 Fireplace Insert Cert Non-Cat	337.1	0.4	1.10	7	0.1	1	1	1
21-04-008-210 Fireplace Insert Conv.	289.0	0.4	1.10	7	0.1	1	1	1
21-04-008-400 Exempt Pellet Stove	264.5	0.3	1.10	7	0.0	1	1	1
21-04-008-510 Central Furnace	0.0	2.0	1.10	7	0.0	0	0	0
Total	2,467.7				0.5	8	9	**9**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge and 2008 Klamath Falls Wood Burning Survey Results.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion SO2 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	0.4	1
2104008210	0.4	1
2104008220	0.4	3
2104008230	0.4	1
2104008310	0.4	1
2104008320	0.4	3
2104008330	0.4	1
2104008400	0.32	3
2104008510	2.03	3
2104008610	2.03	3
2104008700	0.4	1
2104009000	unknown	--

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011.

Table 8. Oakridge NAA 2014 Residential Wood Combustion SO2
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	SO2 Emissions			(9)
					Annual	PM Season		Worst Case
					(6)	(7)	(8)	Day 30%
Woodburning Device	2014 Wood Fuel Use (tons/yr)	SO2 EF (lbs/ton)	Relative HDD	Activity (days/wk)	Annual (tons/yr)	Typical Day (lb/day)	Worst Case Day (lb/day)	Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	0.4	1.10	7	0.0	1	1	1
21-04-008-320 Certified Non-Cat Wood-Stove	879.4	0.4	1.10	7	0.2	3	3	2
21-04-008-330 Certified Cat Wood-Stove	188.9	0.4	1.10	7	0.0	1	1	0
21-04-008-310 Conv Wood Stove	191.8	0.4	1.10	7	0.0	1	1	0
21-04-008-230 Fireplace Insert Cert Catalyst	82.6	0.4	1.10	7	0.0	0	0	0
21-04-008-220 Fireplace Insert Cert Non-Cat	383.6	0.4	1.10	7	0.1	1	1	1
21-04-008-210 Fireplace Insert Conv.	224.3	0.4	1.10	7	0.0	1	1	1
21-04-008-400 Exempt Pellet Stove	286.5	0.3	1.10	7	0.0	1	1	1
21-04-008-510 Central Furnace	0.0	2.0	1.10	7	0.0	0	0	0
Total	2,432.7				0.5	8	9	**6**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge Wood Burning Survey Results and subsequent heating unit replacements verified by LRAPA.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion SO2 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	0.4	1
2104008210	0.4	1
2104008220	0.4	3
2104008230	0.4	1
2104008310	0.4	1
2104008320	0.4	3
2104008330	0.4	1
2104008400	0.32	3
2104008510	2.03	3
2104008610	2.03	3
2104008700	0.4	1
2104009000	unknown	--

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011 increased by 30% compliance after 2012 strategy implementation.

Table 9. Oakridge NAA 2008 Residential Wood Combustion VOC
Area Source Emissions From Residential Wood Heating

(1) Woodburning Device	(2) Base Year Wood Fuel Use (tons/yr)	(3) VOC EF (lbs/ton)	(4) Relative HDD	(5) Activity (days/wk)	VOC Emissions Annual (6) Annual (tons/yr)	VOC Emissions PM Season (7) Typical Day (lb/day)	VOC Emissions PM Season (8) Worst Case Day (lb/day)	(9) Worst Case Day Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	18.9	1.10	7	1.8	31	34	34
21-04-008-320 Certified Non-Cat Wood-Stove	770.6	12.0	1.10	7	4.6	77	85	85
21-04-008-330 Certified Cat Wood-Stove	192.6	15.0	1.10	7	1.4	24	26	26
21-04-008-310 Conv Wood Stove	334.1	53.0	1.10	7	8.9	148	162	162
21-04-008-230 Fireplace Insert Cert Catalyst	84.3	15.0	1.10	7	0.6	11	12	12
21-04-008-220 Fireplace Insert Cert Non-Cat	337.1	12.0	1.10	7	2.0	34	37	37
21-04-008-210 Fireplace Insert Conv.	289.0	53.0	1.10	7	7.7	128	140	140
21-04-008-400 Exempt Pellet Stove	264.5	0.0	1.10	7	0.0	0	0	0
21-04-008-510 Central Furnace	0.0	11.7	1.10	7	0.0	0	0	0
Total	2,467.7				27.1	451	497	**497**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge and 2008 Klamath Falls Wood Burning Survey Results.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion VOC emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	18.9	1
2104008210	53	1
2104008220	12	3
2104008230	15	1
2104008310	53	1
2104008320	12	3
2104008330	15	1
2104008400	0.041	3
2104008510	11.7	3
2104008610	11.7	3
2104008700	18.9	1
2104009000	39.56	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011.

Table 10. Oakridge NAA 2014 Residential Wood Combustion VOC
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	VOC Emissions			(9)
					Annual	PM Season		Worst Case
	2014				(6)	(7)	(8)	Day 30%
Woodburning Device	Wood Fuel Use (tons/yr)	VOC EF (lbs/ton)	Relative HDD	Activity (days/wk)	Annual (tons/yr)	Typical Day (lb/day)	Worst Case Day (lb/day)	Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	18.9	1.10	7	1.8	31	34	24
21-04-008-320 Certified Non-Cat Wood-Stove	879.4	12.0	1.10	7	5.3	88	97	68
21-04-008-330 Certified Cat Wood-Stove	188.9	15.0	1.10	7	1.4	24	26	18
21-04-008-310 Conv Wood Stove	191.8	53.0	1.10	7	5.1	85	93	65
21-04-008-230 Fireplace Insert Cert Catalyst	82.6	15.0	1.10	7	0.6	10	11	8
21-04-008-220 Fireplace Insert Cert Non-Cat	383.6	12.0	1.10	7	2.3	38	42	30
21-04-008-210 Fireplace Insert Conv.	224.3	53.0	1.10	7	5.9	99	109	76
21-04-008-400 Exempt Pellet Stove	286.5	0.0	1.10	7	0.0	0	0	0
21-04-008-510 Central Furnace	0.0	11.7	1.10	7	0.0	0	0	0
Total	2,432.7				22.5	375	412	**289**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge Wood Burning Survey Results and subsequent heating unit replacements verified by LRAPA.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion VOC emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	18.9	1
2104008210	53	1
2104008220	12	3
2104008230	15	1
2104008310	53	1
2104008320	12	3
2104008330	15	1
2104008400	0.041	3
2104008510	11.7	3
2104008610	11.7	3
2104008700	18.9	1
2104009000	39.56	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011 increased by 30% compliance after 2012 strategy implementation.

Table 11. Oakridge NAA 2008 Residential Wood Combustion NH3
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	NH3 Emissions			(9)
					Annual	PM Season		Worst Case
					(6)	(7)	(8)	Day
Woodburning Device	Base Year Wood Fuel Use (tons/yr)	NH3 EF (lbs/ton)	Relative HDD	Activity (days/wk)	Annual (tons/yr)	Typical Day (lb/day)	Worst Case Day (lb/day)	Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	1.8	1.10	7	0.2	3	3	3
21-04-008-320 Certified Non-Cat Wood-Stove	770.6	0.9	1.10	7	0.3	6	6	6
21-04-008-330 Certified Cat Wood-Stove	192.6	0.9	1.10	7	0.1	1	2	2
21-04-008-310 Conv Wood Stove	334.1	1.7	1.10	7	0.3	5	5	5
21-04-008-230 Fireplace Insert Cert Catalyst	84.3	0.9	1.10	7	0.0	1	1	1
21-04-008-220 Fireplace Insert Cert Non-Cat	337.1	0.9	1.10	7	0.2	3	3	3
21-04-008-210 Fireplace Insert Conv.	289.0	1.7	1.10	7	0.2	4	5	5
21-04-008-400 Exempt Pellet Stove	264.5	0.3	1.10	7	0.0	1	1	1
21-04-008-510 Central Furnace	0.0	1.8	1.10	7	0.0	0	0	0
Total	2,467.7				1.4	23	25	**25**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge and 2008 Klamath Falls Wood Burning Survey Results.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion NH3 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	1.8	1
2104008210	1.7	1
2104008220	0.9	3
2104008230	0.9	1
2104008310	1.7	1
2104008320	0.9	3
2104008330	0.9	1
2104008400	0.3	3
2104008510	1.8	3
2104008610	1.8	3
2104008700	1.8	1
2104009000	unknown	--

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011.

Table 12. Oakridge NAA 2014 Residential Wood Combustion NH3
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	NH3 Emissions			(9)
					Annual	PM Season		Worst Case
	2014				(6)	(7)	(8)	Day 30%
Woodburning	Wood Fuel	NH3				Typical	Worst Case	Advisory
Device	Use (tons/yr)	EF (lbs/ton)	Relative HDD	Activity (days/wk)	Annual (tons/yr)	Day (lb/day)	Day (lb/day)	Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	1.8	1.10	7	0.2	3	3	2
21-04-008-320 Certified Non-Cat Wood-Stove	879.4	0.9	1.10	7	0.4	7	7	5
21-04-008-330 Certified Cat Wood-Stove	188.9	0.9	1.10	7	0.1	1	2	1
21-04-008-310 Conv Wood Stove	191.8	1.7	1.10	7	0.2	3	3	2
21-04-008-230 Fireplace Insert Cert Catalyst	82.6	0.9	1.10	7	0.0	1	1	0
21-04-008-220 Fireplace Insert Cert Non-Cat	383.6	0.9	1.10	7	0.2	3	3	2
21-04-008-210 Fireplace Insert Conv.	224.3	1.7	1.10	7	0.2	3	3	2
21-04-008-400 Exempt Pellet Stove	286.5	0.3	1.10	7	0.0	1	1	1
21-04-008-510 Central Furnace	0.0	1.8	1.10	7	0.0	0	0	0
Total	2,432.7				1.3	21	23	**16**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge Wood Burning Survey Results and subsequent heating unit replacements verified by LRAPA.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion NH3 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	1.8	1
2104008210	1.7	1
2104008220	0.9	3
2104008230	0.9	1
2104008310	1.7	1
2104008320	0.9	3
2104008330	0.9	1
2104008400	0.3	3
2104008510	1.8	3
2104008610	1.8	3
2104008700	1.8	1
2104009000	unknown	--

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011 increased by 30% compliance after 2012 strategy implementation.

Appendix D-3
Transportation Sources Emission Inventory

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477

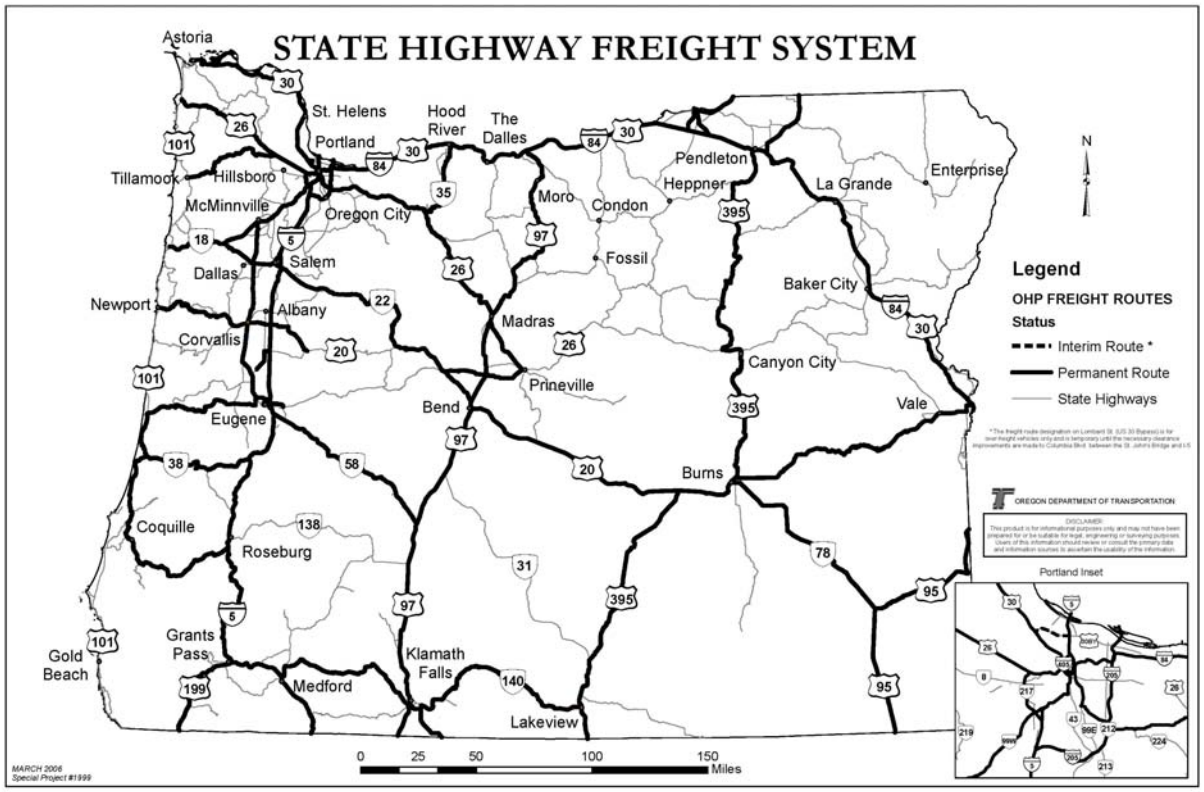
Subject: Westfir-Oakridge PM 2.5 Emissions Report
Date: 3/23/2012
Author: Josh Roll – LCOG Transportation and Land Use Planner
Email: jroll@lcog.org
Phone: 541-682-2454

Section 1

Introduction

The Lane Council of Governments has been tasked with determining the Fine Particle matter emissions (PM2.5) from transportation sources for the Westfir-Oakridge non-attainment area in Lane County for Lane Regional Air Protection Agency (LRAPA). The City of Oakridge is located in Lane County, approximately 40 miles east of the Eugene-Springfield Metropolitan Area. The Middle Fork of the Willamette River creates the southern edge of Oakridge. Salmon Creek serves as the eastern boundary of the study area, and flows southwest through the city, merging with the Middle Fork. The City of Westfir is located roughly 1 mile north of Oakridge. Highway 58 in Oakridge is an area of both high automobile and freight traffic with Highway 58 classified as a state freight route (See figure 1.1). Using two primary forecasting tools, a simplified 4-step travel demand model and the Environmental Protection Agency's (EPA) model Motor Vehicle Emission Simulator (MOVES), LCOG completed the analysis detailed in this report.

Figure 1.1



Section 2

Travel Demand Estimation

With support and direction from the Oregon Department of Transportation, LCOG deployed the Oregon Small Urban Model (OSUM). OSUM uses travel behavior relationships estimated on travel survey data from approximately 3,200 two-day household activity surveys administered over eight rural counties throughout Oregon. The model also uses household and employment land use information and external traffic counts to inform its travel demand estimation process. OSUM represents the state of the practice for travel demand modeling for small urban communities in Oregon.

Currently land use assumptions regarding households and employment relate to a base year of 2002 and a future year of 2025. Updating the land use information was not deemed necessary at this time and instead the desired forecast years, 2008, 2014, and 2024, were interpolated using linear interpolation. It was necessary to account for seasonal variation of travel in the study area from external sources. This was done by updating the external traffic flow inputs with observed highway counts for two cordon locations that reflected the particular month in which the traffic counts were collected. Tables 2.1 through 2.4 below detail the differences between seasons (months) of each forecast year. The cordon counts and their seasonal adjustments are based on observed seasonal variation recorded by ODOT permanent automatic traffic recorder (ATR) stations.[1] Figure 2.1 below shows the locations of each external cordon point. This approach assumes all local traffic remains stable and only external traffic flows fluctuate according to season.

Travel demand was forecast at the hourly level because the emissions calculation process requires hourly VMT in order to apply the hourly emissions rates correctly due to the sensitivity of the emissions rates to temperature at which the travel activity is occurring. See Figure 2.2 for an example of hourly variation of VMT for a selected month and year.

[1] ODOT Permanent Automatic Traffic Recorder Station Trend Summaries: http://www.oregon.gov/ODOT/TD/TDATA/tsm/docs/2002_ATR.pdf

Figure 2.1

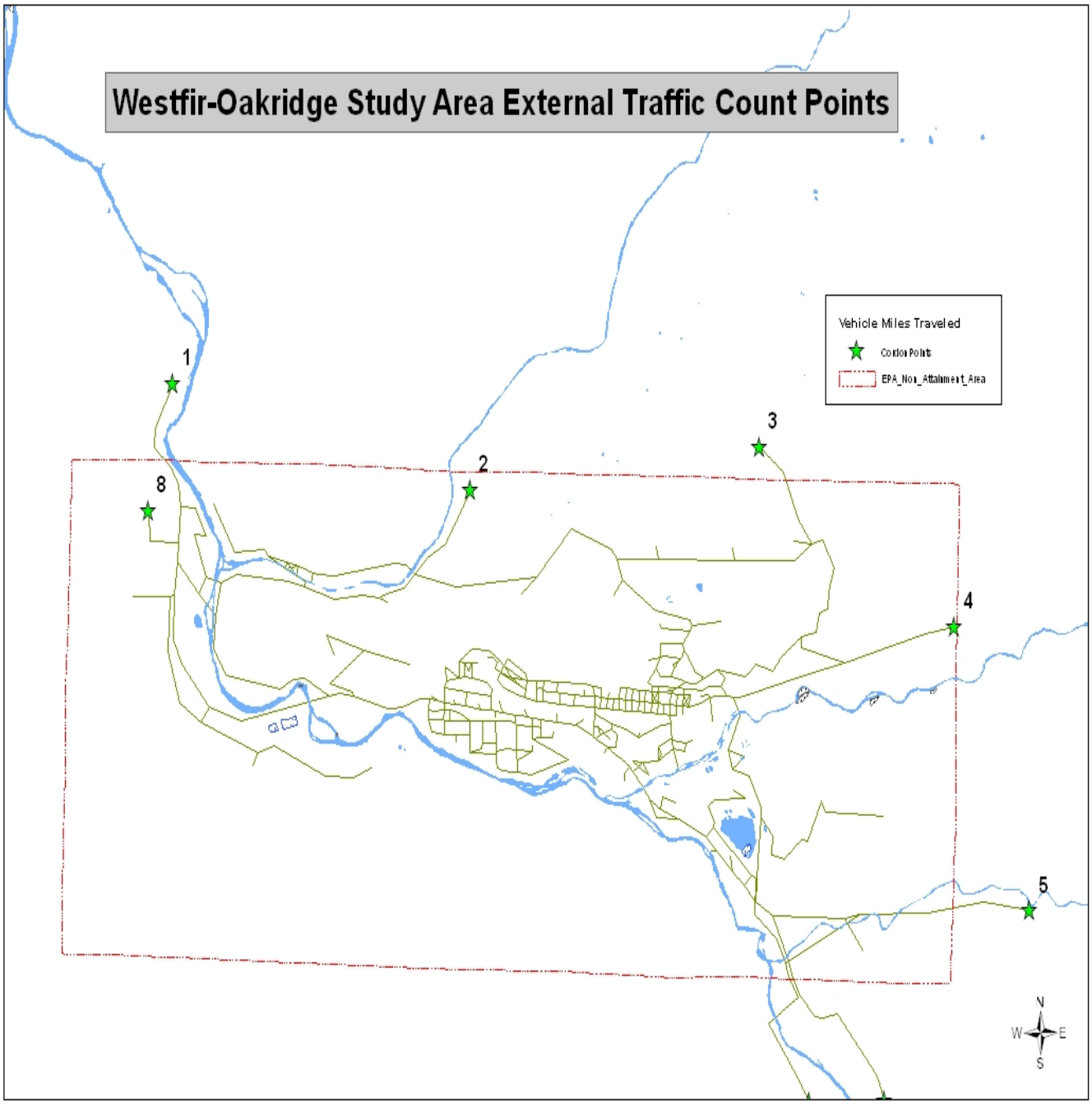

Westfir-Oakridge Study Area External Traffic Count Points
Vehicle Miles Traveled
Cordon Points
EPA_Non_Attainment_Area
1
2
3
4
5
8
N
W
E
S

Figure 2.2

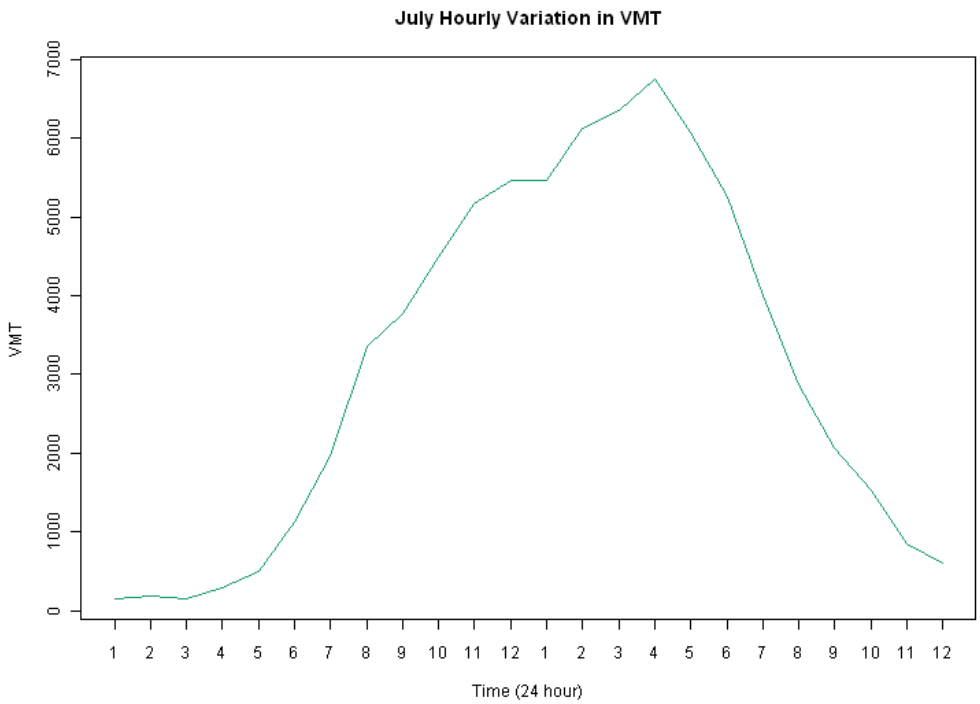


Table 2.1

	April				
CountPoint	**2002**	**2008**	**2014**	**2024**	**2025**
1	3588	3857	4125	4572	4616.1
2	300	300	300	300	300
3	490	490	490	490	490
4	150	150	150	150	150
5	2622	2799	2975	3269	3298.2
6	320	320	320	320	320
7	180	180	180	180	180
8	120	120	120	120	120

Table 2.2

	July				
CountPoint	**2002**	**2008**	**2014**	**2024**	**2025**
1	5980	6427	6874	7619	7693.5
2	300	300	300	300	300
3	490	490	490	490	490
4	150	150	150	150	150
5	4370	4664	4958	5448	5497
6	320	320	320	320	320
7	180	180	180	180	180
8	120	120	120	120	120

Table 2.3

	September				
CountPoint	**2002**	**2008**	**2014**	**2024**	**2025**
1	5616	6036	6456	7156	7225.2
2	300	300	300	300	300
3	490	490	490	490	490
4	150	150	150	150	150
5	4104	4381	4657	5117	5162.4
6	320	320	320	320	320
7	180	180	180	180	180
8	120	120	120	120	120

Table 2.4

	December				
CountPoint	**2002**	**2008**	**2014**	**2024**	**2025**
1	3172	3410	3647	4042	4080.9
2	300	300	300	300	300
3	490	490	490	490	490
4	150	150	150	150	150
5	2318	2474	2630	2890	2915.8
6	320	320	320	320	320
7	180	180	180	180	180
8	120	120	120	120	120

It was necessary to account for weekend travel differently than weekday travel because observed highway counts demonstrated higher volumes on those days, likely due to weekend recreation travel. It was also necessary to adjust the weekend travel according to the season, since the weekend travel in each season varies. Using traffic counts from the ATR weekday and weekend differences were observed and a weekend factor was calculated. Because the weekend versus weekday difference was observed on the Highway 58 facility we assume that local road traffic remains stable throughout the week and the weekend therefore the adjustment factor is only applied to the travel activity associated with the highway facility traversing the study area. The figures in Table 2.5 describe just how different highway travel is on the weekends, with up to 92% (the winter factor) more travel being observed on those days versus weekdays.

Table 2.5

Season	**Weekend Factor**
Spring	1.68
Summer	1.63
Fall	1.46
Winter	1.92

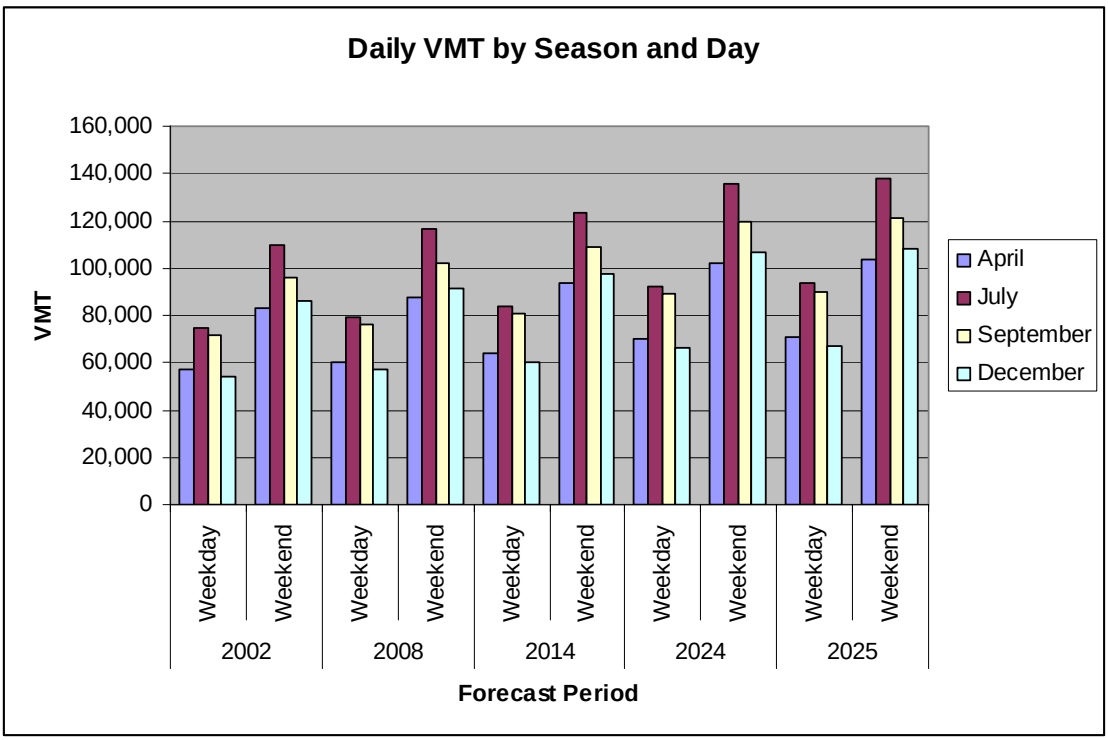
Table 2.6 and Figure 2.3 detail the VMT calculated for each of the forecast years and seasons including the weekday and weekend values. As expected the summer and fall travel activity is higher, again most likely due recreational travel. Also, a significant amount of travel occurs

during the weekend. Instead of calculating travel activity for each month it was deemed reasonable to calculate one month of activity per season and factor up the values. Using an assumed 65 days of weekday travel per season and 26 days of weekend travel, an annual VMT was calculated which is also displayed in Table 2.6.

Table 2.6

Daily and Annual VMT by Month										
	2002		2008		2014		2024		2025	
Month	**Weekday**	**Weekend**	**Weekday**	**Weekend**	**Weekday**	**Weekend**	**Weekday**	**Weekend**	**Weekday**	**Weekend**
April	56,802	82,767	60,205	87,857	63,922	93,386	70,036	102,462	71,051	103,760
July	74,538	109,337	79,188	116,298	84,167	123,719	92,408	135,988	93,643	137,611
September	71,822	96,030	76,310	102,131	81,084	108,607	89,022	119,346	90,198	120,780
December	53,714	86,109	56,902	91,390	60,409	97,167	66,164	106,610	67,134	107,918
Total Annual	26,427,322		28,058,910		29,817,705		32,720,530		33,153,430	

Figure 2.3



Additionally, Table 2.7 and Table 2.8 detail the VMT on Highway 58 versus the local roads for both the weekdays and the weekends. As can be observed from the tables, weekend and weekday travel on local roads remains stable while the travel on Highway 58 facilities is higher, more so on weekends especially in July and September calculations.

Table 2.7

Weekday Daily and Annual VMT by Month for Highway 58 vs. Local Roads										
	2002		2008		2014		2024		2025	
Month	Hwy	NonHwy	Hwy	NonHwy	Hwy	NonHwy	Hwy	NonHwy	Hwy	NonHwy
April	38,184	18,619	40,665	19,539	43,328	20,594	47,685	22,351	48,102	22,949
July	55,236	19,302	58,904	20,284	62,782	21,385	69,175	23,234	69,791	23,851
September	52,628	19,194	56,131	20,179	59,833	21,251	65,922	23,100	66,483	23,715
December	35,212	18,503	37,487	19,416	39,954	20,456	43,963	22,201	44,331	22,802
Total Annual	11,781,856	4,915,126	12,557,187	5,162,161	13,383,317	5,439,535	14,738,375	5,907,598	14,866,014	6,065,602

Table 2.8

Weekend Daily and Annual VMT by Month for Highway 58 vs. Local Roads										
	2002		2008		2014		2024		2025	
Month	Hwy	NonHwy	Hwy	NonHwy	Hwy	NonHwy	Hwy	NonHwy	Hwy	NonHwy
April	64,149	18,619	68,318	19,539	72,792	20,594	80,111	22,351	80,811	22,949
July	90,035	19,302	96,014	20,284	102,335	21,385	112,755	23,234	113,760	23,851
September	76,836	19,194	81,952	20,179	87,356	21,251	96,246	23,100	97,066	23,715
December	67,606	18,503	71,974	19,416	76,711	20,456	84,409	22,201	85,116	22,802
Total Annual	7,764,290	1,966,050	8,274,698	2,064,864	8,819,040	2,175,814	9,711,519	2,363,039	9,795,573	2,426,241

Section 3

Emissions Estimation

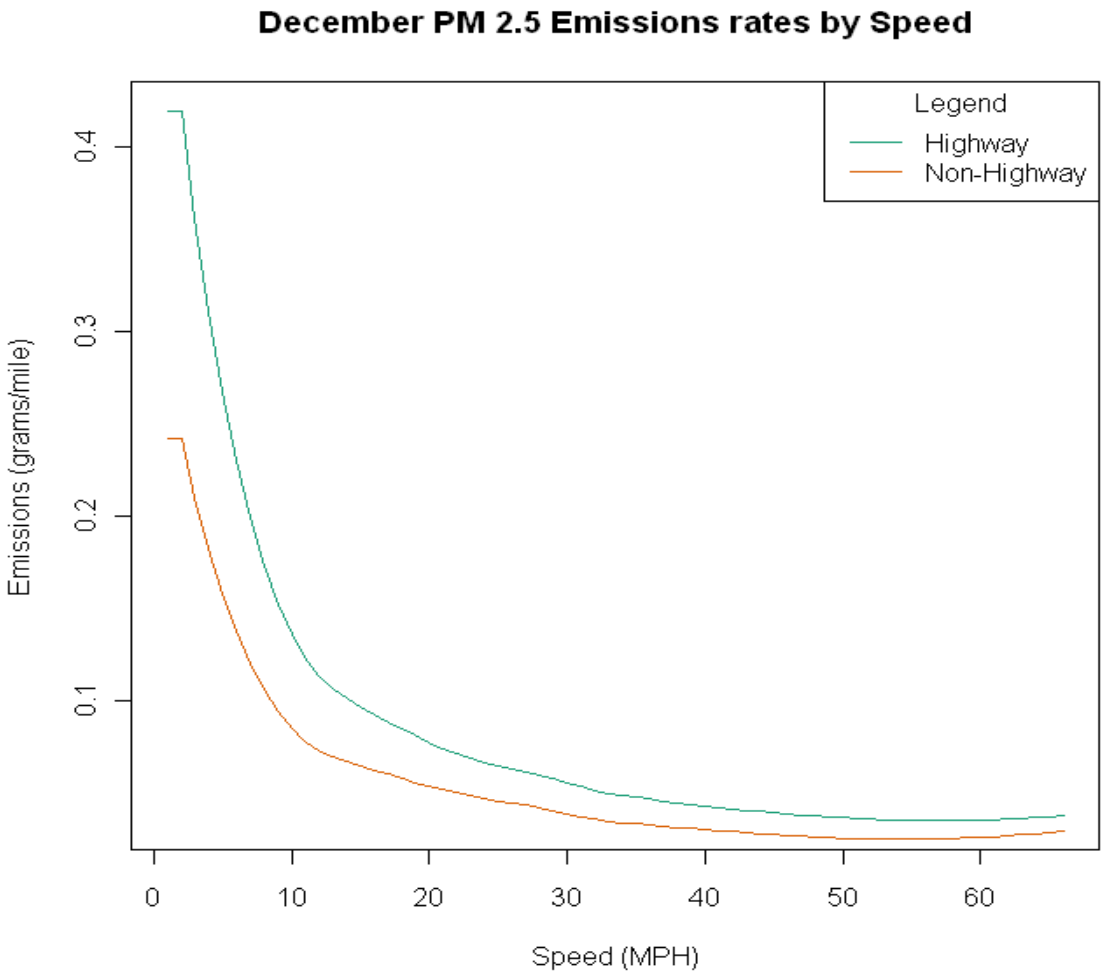
MOVES represents the latest in mobile source emissions forecasting (EPA 2010). The MOVES model incorporates input data that include vehicle fleet composition, traffic activities, fuel information and meteorology parameters and conducts modal-based emissions calculations using a set of model functions. Based on the resulting modal-based vehicle emission rates, emission inventories or emission factors are then generated for the desired geographic scale (macro, meso or micro scales) as well as temporal resolution (year, day and hour). For our purposes the emission factor approach was selected that computes emission rates by Source Bins defined to represent unique combinations of vehicle class, model year group, vehicle weight, engine size, and technology, and fuel types. (EPA 2002, 2007) The temporal resolution selected reflects emissions rates computed at the hourly level as per EPA's Technical Guidance for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity (EPA 2010). Using this approach requires a post process that is explained in detail below.

Using fuel formulation, fleet age distribution, meteorological information, fleet population, and VMT by vehicle type, MOVES estimates emissions for PM 2.5 source bins or each of the forecast periods.[2] The source bins are parsed categories of vehicle type, fuel type, and model year. Two types of outputs make up the bulk of what MOVES computes for emissions analysis, distance rates and vehicle rates. Distance rates are grams per mile emission rates for PM 2.5 pollutants based on speed for each source bin. Speed does not vary significantly between forecast periods, since the growth in vehicle traffic does not cause enough congestion to reduce traffic flow to less than free flow speeds. Nevertheless, speed has a considerable impact on emissions as detailed in Figure 3.1. This figure details composite PM2.5 emissions factors computed through MOVES for highway and non-highway facilities. The emissions are 'composite' because they represent the sum of all the different vehicle types' emissions rates weighted by their respective percentage assumed to be a part of the fleet mix for highway and non-highway traffic. Table 3.1 details these assumed fleet mix for our study area. Appendix A details all of the emission rate curves for each year and each vehicle type for gasoline and diesel vehicles separately. The future emission rates are substantially lower then the base year scenarios (2002 and 2008) due to technology improvements in the fleet for all vehicles. This can be most readily observed in the diesel vehicles, but is also seen in the gasoline vehicles.

Vehicle rates outputs are emission rates for the selected pollutants by vehicle type for non running emissions (crankcase start exhaust, crankcase extended idle exhaust, and extended idle exhaust). These rates are applied to the vehicle population in order to calculate idling emissions. The assumed vehicle populations are details in Appendix B and show very small amounts of growth overall between forecast periods**.**

[2] These inputs can be obtained upon request from LCOG, see contact info above.

Figure 3.1


December PM 2.5 Emissions rates by Speed
Legend
Highway
Non-Highway
Emissions (grams/mile)
0.1
0.2
0.3
0.4
0
10
20
30
40
50
60
Speed (MPH)

Assumptions of fleet composition for highway facilities came from an ODOT Automated Travel Data sensor located on Highway-58 less than a half mile east of the study area. Non-highway fleet mix assumptions come from national fleet mix values for 2009 because the break down for Lane County at the level of type of fuel consumed and vehicle type is not available. Since the highway facilities are assumed to have much more heavy duty truck traffic the respective emissions rates are also much higher.

Table 3.1

MOVES Vehicle Type	Description	Fuel	Hwy 58 %	Local %
11	Motor Cycle	Gas	0.00%	0.43%
21	Passenger Car	Gas	20.90%	52.83%
21	Passenger Car	Diesel	0.10%	0.21%
31	Passenger Truck	Gas	44.90%	27.92%
31	Passenger Truck	Diesel	0.50%	0.28%
32	Commercial Truck	Gas	3.40%	8.86%
32	Commercial Truck	Diesel	0.20%	0.57%
41	Intercity Bus	Diesel	0.10%	0.04%
42	Transit Bus	Diesel	0.00%	0.00%
43	School Bus	Diesel	0.60%	0.29%
51	Refuse Truck	Diesel	0.00%	0.07%
52	Single Short Haul	Gas	7.50%	1.00%
52	Single Short Haul	Diesel	17.60%	2.34%
53	Single Long Haul	Gas	0.50%	0.06%
53	Single Long Haul	Diesel	1.10%	0.14%
61	Combo Short Haul	Diesel	1.50%	2.84%
62	Combo Long Haul	Diesel	1.10%	2.11%

Section 4

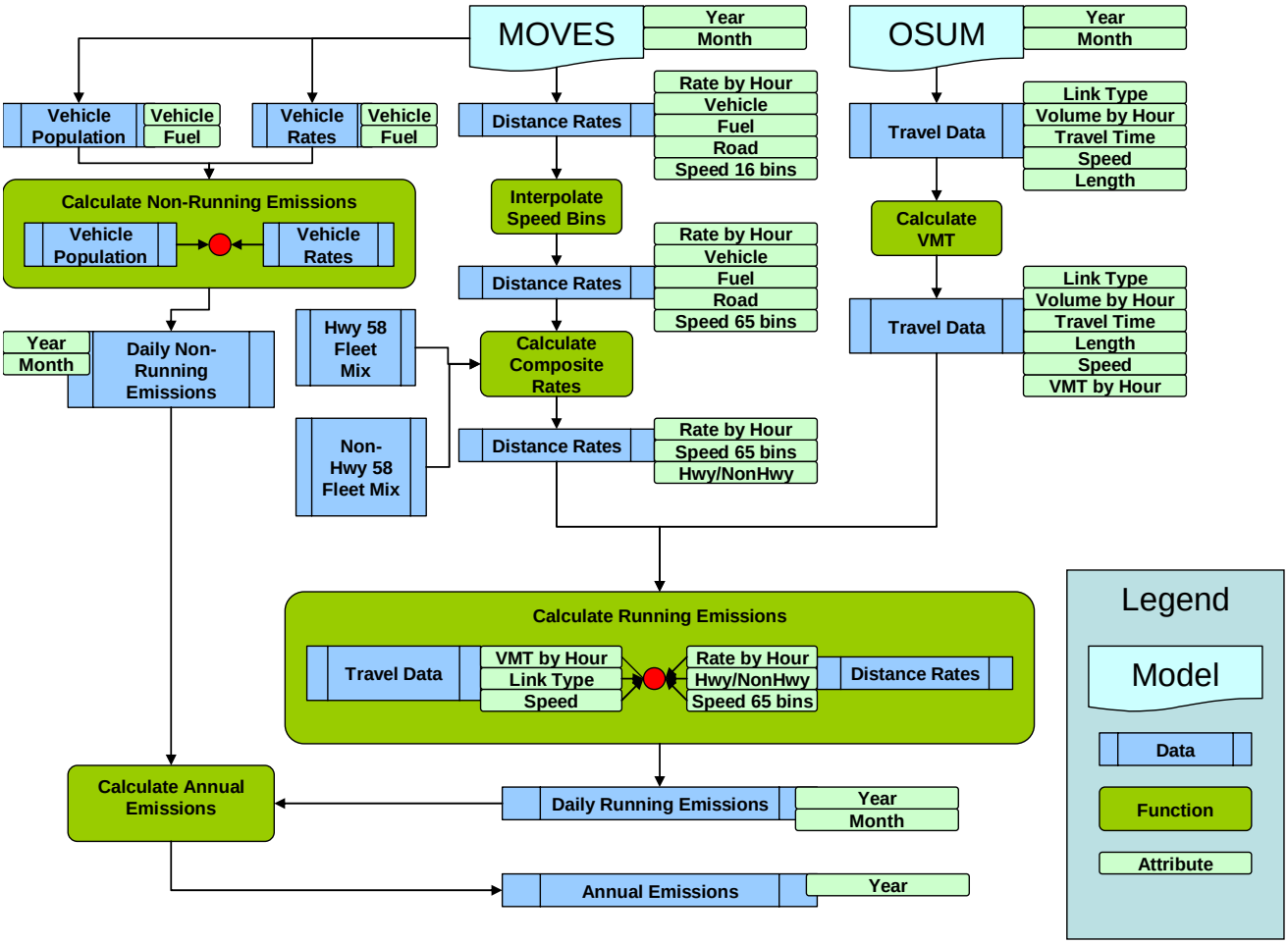
Methodology Discussion

Combining the results from the OSUM travel model and emissions rates from the MOVES emissions model was done using a post process developed using the R statistical program, an open source scripting language. The process uses the MOVES outputs and combines them with travel activity data from the OSUM model. Figure 4.1 below lays out the basic flow of this process including the inputs to both models and the post process. EPA MOVES Technical Guidance(EPA 2010) specifies that hourly rates be used for SIP analysis therefore emission rates and travel activity were broken into these temporal bins . To calculate emissions factors, MOVES model requires local inputs to account for the vehicle population, fuel specifications, local weather data (meteorological) and the vehicle age distribution. Fuel specifications detail the relevant aspects of gasoline and diesel fuels used by vehicles such as sulfur content and ethanol content. MOVES defaults for fuels specifications were used for all scenarios and seasons. The vehicle age distributions impacts the assumed efficiency of vehicles and can have a dramatic impact on the emissions rates since an older fleet has a much less efficient emissions profile(again see Appendix B for emission rate curves comparisons between years). This distribution was gleaned from registration data for 2008 and is assumed not to change for the

base and future years. In other words, if in the base year we assume that 2% of the fleet is 25 years old then in the future we make the same assumption though a vehicle that's 25 years old in 2025 will be much more efficient than a car that's 25 years old in 2002 but this will be reflected in the emissions output.

The household and employment inputs for the OSUM model are described in detail in Appendix C while the external traffic inputs are described in Tables 2.1 through 2.4 above. For the land use information for interim years 2008, 2014, and 2024, linear interpolation was used to compute households and employment by TAZ. This process was assessed as reasonable given the work that would be needed to forecast those years through a land use allocation modeling process.

Figure 4.1



Section 5

Results

Table 5.1 details summary results of the PM 2.5 analysis for the Westfir-Oakridge area. Both daily and annual computations are shown for total emissions (lbs.). The seasonal variation is reflected in the VMT (Table 2.6 above) but due to higher emissions rates in the winter from colder average temperatures, daily emissions remain relatively stable across forecast seasons. Due to overall fleet efficiency gains and technology improvements, daily and annual emissions drop considerably even though VMT (Table 5.2 and Figure 5.1) continues to increase into the future albeit marginally.

Table 5.1

Total Daily and Annual Emissions(lbs.) by Month										
	2002		2008		2014		2024		2025	
Month	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
April	31.1	41.7	22.4	29.9	13.2	17.3	7.0	8.9	6.9	8.6
July	31.5	44.5	22.7	32.0	12.8	17.9	6.1	8.3	6.0	7.9
September	32.4	41.7	23.3	30.0	13.3	16.9	6.6	8.1	6.4	7.8
December	37.9	52.5	27.2	37.3	16.7	22.2	9.5	12.2	9.3	11.8
Total Annual	12,503.0		8,986.7		5,228.4		2,699.4		2,642.8	

Table 5.2

Year	Total Annual VMT
2002	26,427,322
2008	28,058,910
2014	29,817,705
2024	32,720,530
2025	33,153,430

Figure 5.1

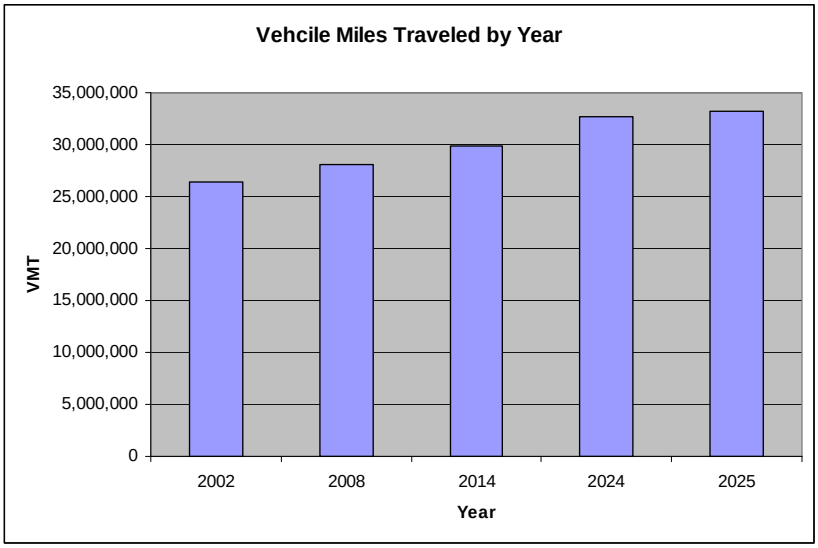
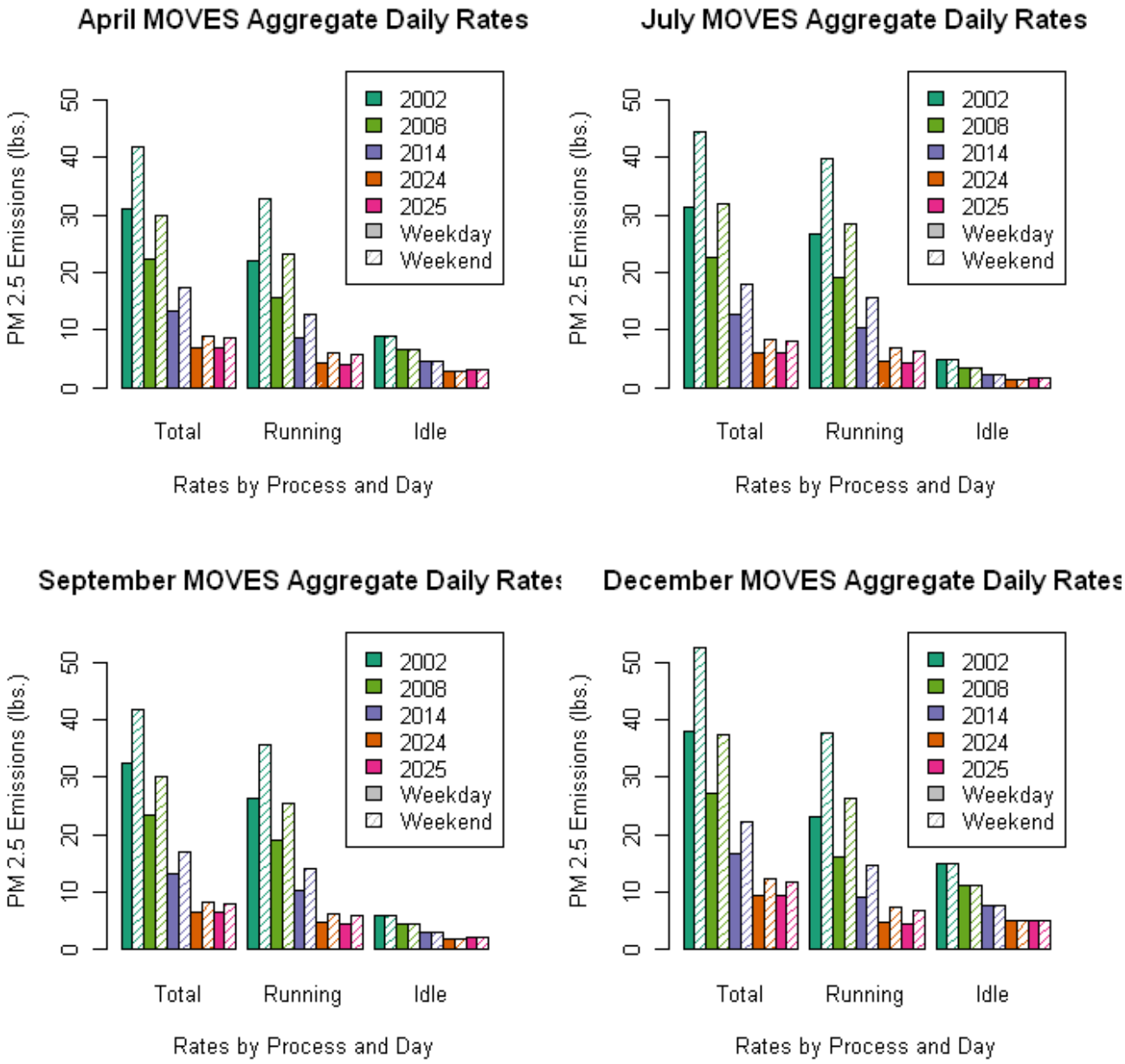


Figure 5.2 details the decrease in daily rates for total, running, and idling emissions across the forecast periods. As the fleet advances into the future PM 2.5 rates for all months and both weekday and weekend decrease significantly by the forecast horizon year 2025.

Figure 5.2



In order to get an idea of the relative contribution of emissions by vehicle type and fuel type the daily emissions were broken out by these source bin categories. Tables 5.3 and 5.4 and their accompanying charts in figure 5.3 and 5.4 show total and percentage total daily weekday emissions for the month of April broken out by source bin. All other months' charts and can be found in Appendix D. As demonstrated in the graph single-short haul remains the largest emitter of PM2.5 running emissions with gasoline passenger trucks following closely by 2025.
Idling emissions are dominated by passenger cars and trucks because the analysis assumes little dwell time for fright traffic.

Table 5.3

	Weekday					
April	SourceBin	2002	2008	2014	2024	2025
	ComboLongHaul.Diesel	2.99617	2.09202	1.03961	0.30600	0.27289
	ComboLongHaul.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	ComboShortHaul.Diesel	3.54258	2.42672	1.13820	0.33139	0.29758
	ComboShortHaul.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	ComTruck.Diesel	0.21391	0.15464	0.09651	0.03392	0.03220
	ComTruck.Gas	0.31865	0.23696	0.17397	0.15749	0.15702
	InterBus.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	InterBus.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	MotorCycle.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	MotorCycle.Gas	0.00686	0.00714	0.00752	0.00818	0.00839
	MotorHome.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	MotorHome.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	PassCar.Diesel	0.04262	0.02514	0.00907	0.00229	0.00227
	PassCar.Gas	1.38698	1.02815	0.78180	0.67225	0.67801
	PassTruck.Diesel	0.23895	0.17303	0.08700	0.02743	0.02380
	PassTruck.Gas	2.41393	1.69855	1.14632	1.03820	1.01324
	RefuseTruck.Diesel	0.04355	0.03157	0.01508	0.00489	0.00458
	RefuseTruck.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	SchoolBus.Diesel	0.33939	0.25773	0.12604	0.04415	0.04057
	SchoolBus.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	SingleLongHaul.Diesel	0.59367	0.45212	0.26481	0.09887	0.08716
	SingleLongHaul.Gas	0.06726	0.02578	0.01293	0.01052	0.00950
	SingleShortHaul.Diesel	9.28105	6.87804	3.70139	1.31253	1.17970
	SingleShortHaul.Gas	0.78418	0.32147	0.17350	0.15053	0.14480
	TransitBus.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	TransitBus.Gas	0.00000	0.00000	0.00000	0.00000	0.00000

Figure 5.3

	Weekday					
April		2002	2008	2014	2024	2025
	ComboLongHaul.Diesel	0.13454	0.13233	0.11849	0.07288	0.06906
	ComboLongHaul.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	ComboShortHaul.Diesel	0.15908	0.15350	0.12973	0.07893	0.07530
	ComboShortHaul.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	ComTruck.Diesel	0.00961	0.00978	0.01100	0.00808	0.00815
	ComTruck.Gas	0.01431	0.01499	0.01983	0.03751	0.03973
	InterBus.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	InterBus.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	MotorCycle.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	MotorCycle.Gas	0.00031	0.00045	0.00086	0.00195	0.00212
	MotorHome.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	MotorHome.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	PassCar.Diesel	0.00191	0.00159	0.00103	0.00055	0.00057
	PassCar.Gas	0.06228	0.06504	0.08911	0.16011	0.17157
	PassTruck.Diesel	0.01073	0.01095	0.00992	0.00653	0.00602
	PassTruck.Gas	0.10840	0.10744	0.13065	0.24727	0.25641
	RefuseTruck.Diesel	0.00196	0.00200	0.00172	0.00116	0.00116
	RefuseTruck.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	SchoolBus.Diesel	0.01524	0.01630	0.01437	0.01051	0.01027
	SchoolBus.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	SingleLongHaul.Diesel	0.02666	0.02860	0.03018	0.02355	0.02206
	SingleLongHaul.Gas	0.00302	0.00163	0.00147	0.00250	0.00240
	SingleShortHaul.Diesel	0.41676	0.43507	0.42187	0.31261	0.29853
	SingleShortHaul.Gas	0.03521	0.02033	0.01977	0.03585	0.03664
	TransitBus.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	TransitBus.Gas	0.00000	0.00000	0.00000	0.00000	0.00000

Figure 5.3

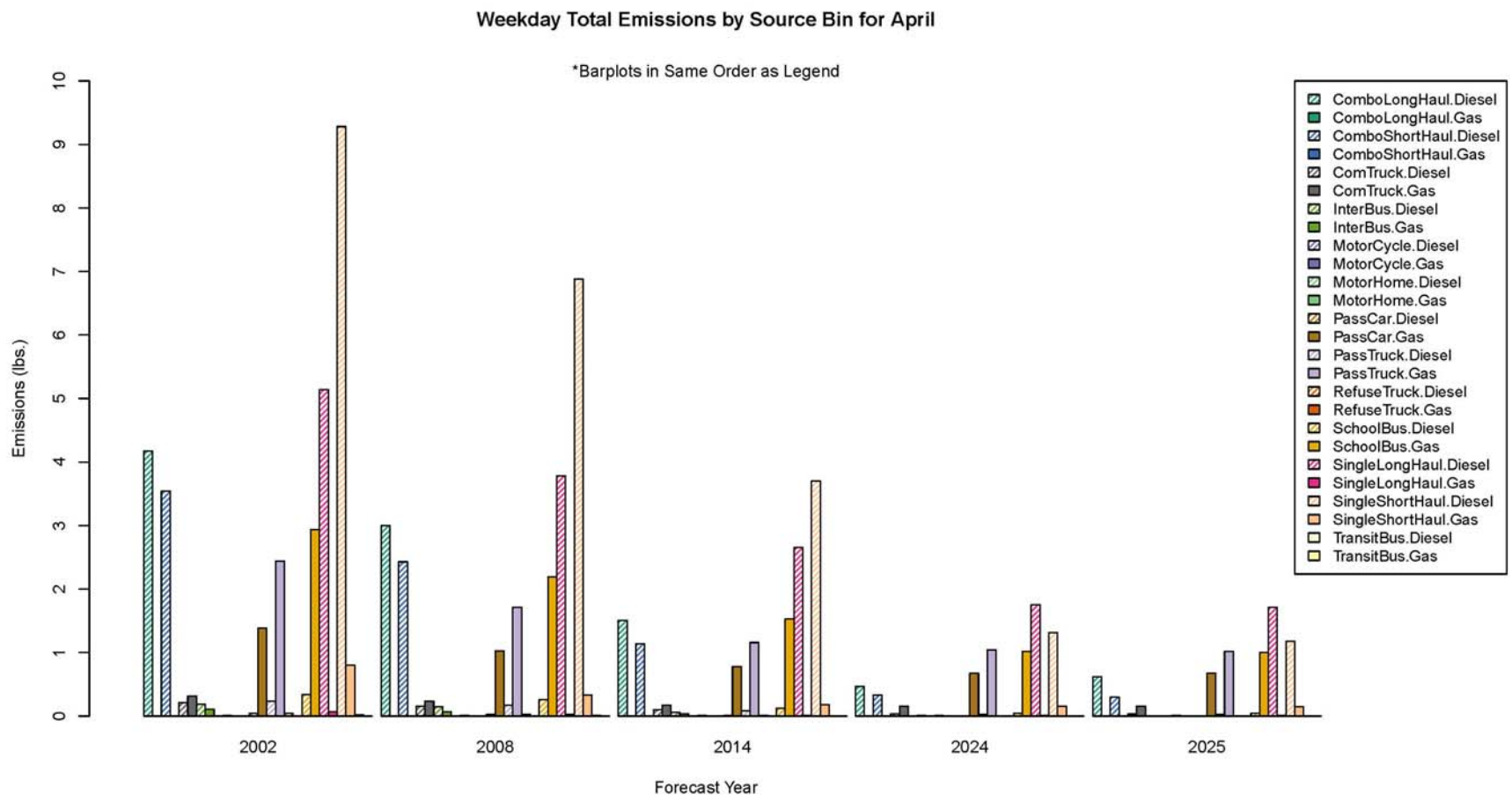
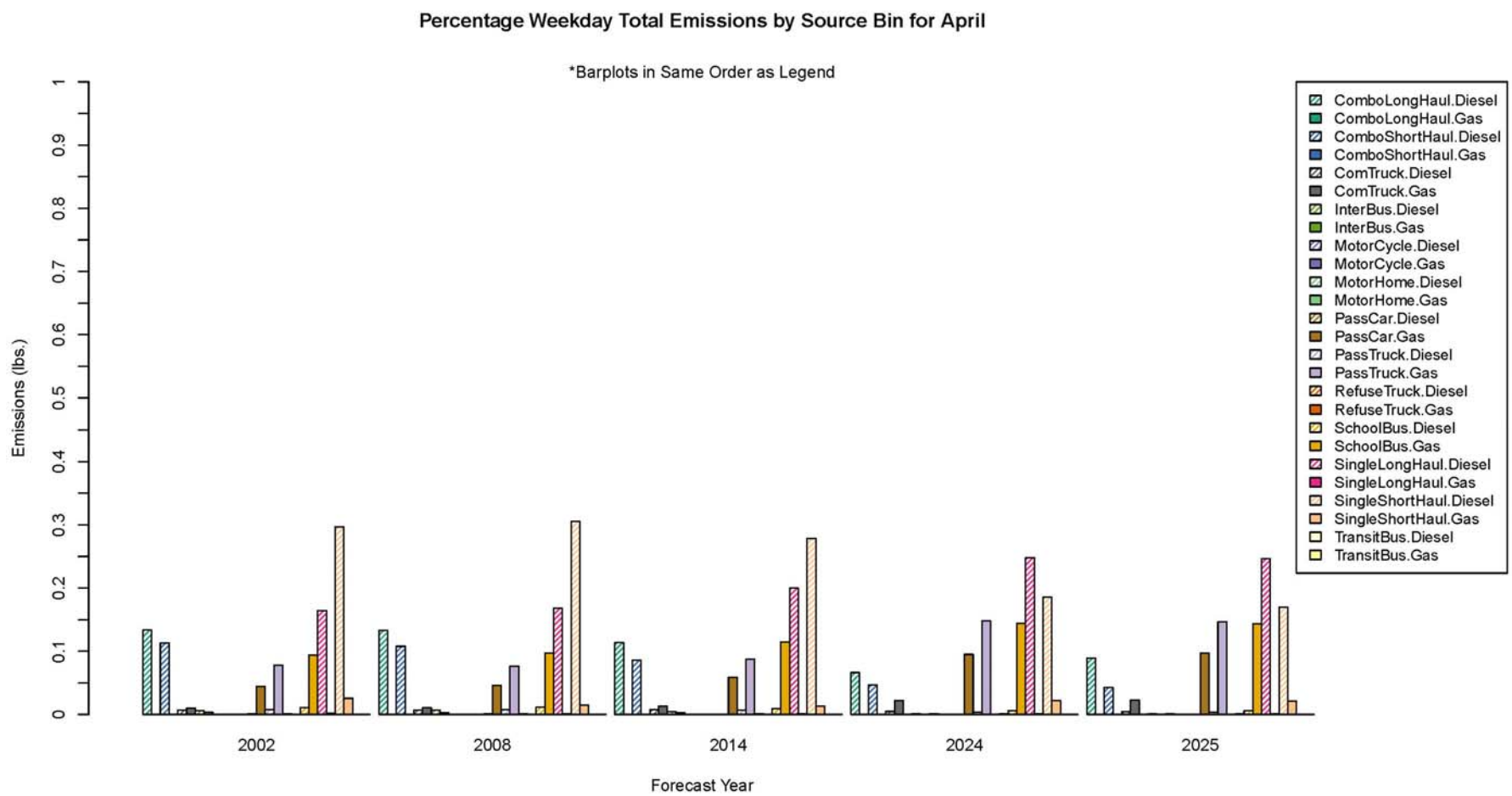

Weekday Total Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
5
6
7
8
9
10
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

Figure 5.4


Percentage Weekday Total Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

If the emission source bins are aggregated the results for weekday total emissions can be observed in table 5.4 and figure 5.5 below. Due to the heavy flow of diesel freight traffic diesel remains the largest emitter of PM2.5 into the future though its share does decrease even though its proportion of travel remains stable.

Figure 5.4

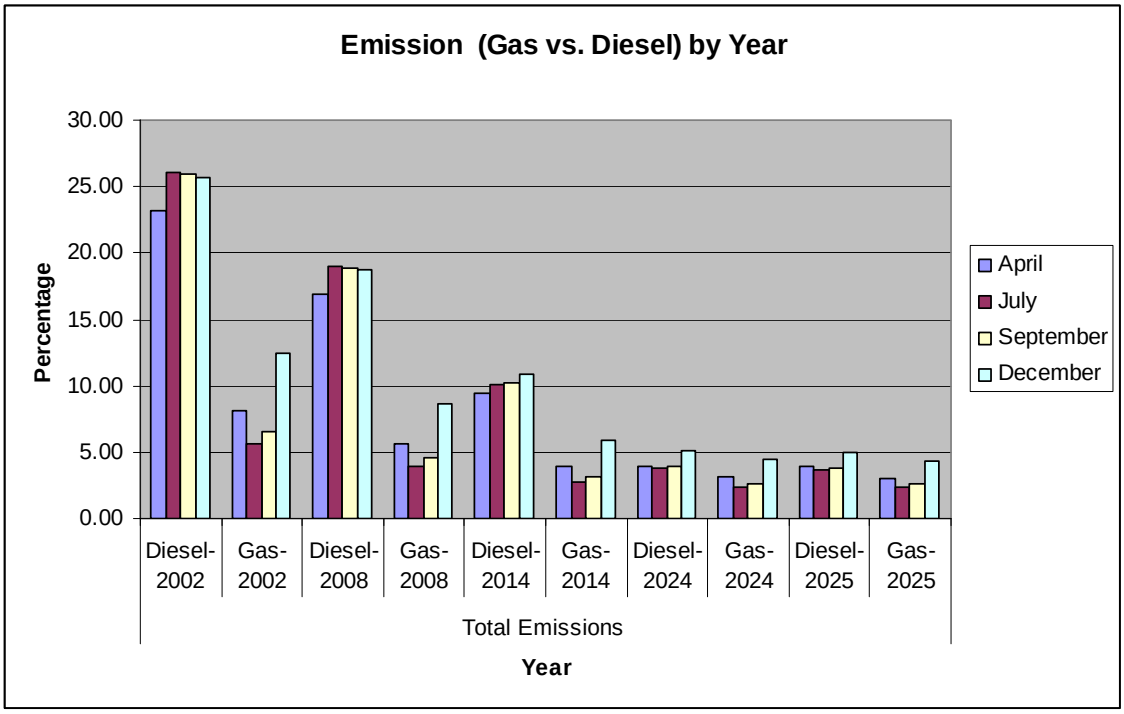
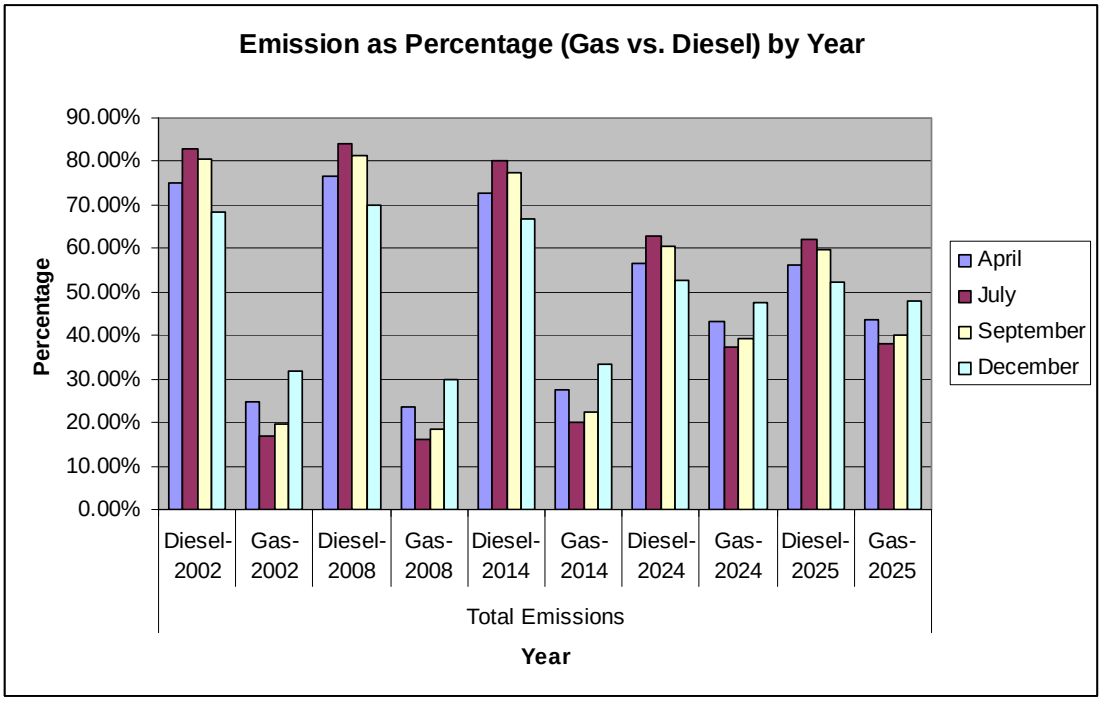


Figure 5.5



Sources

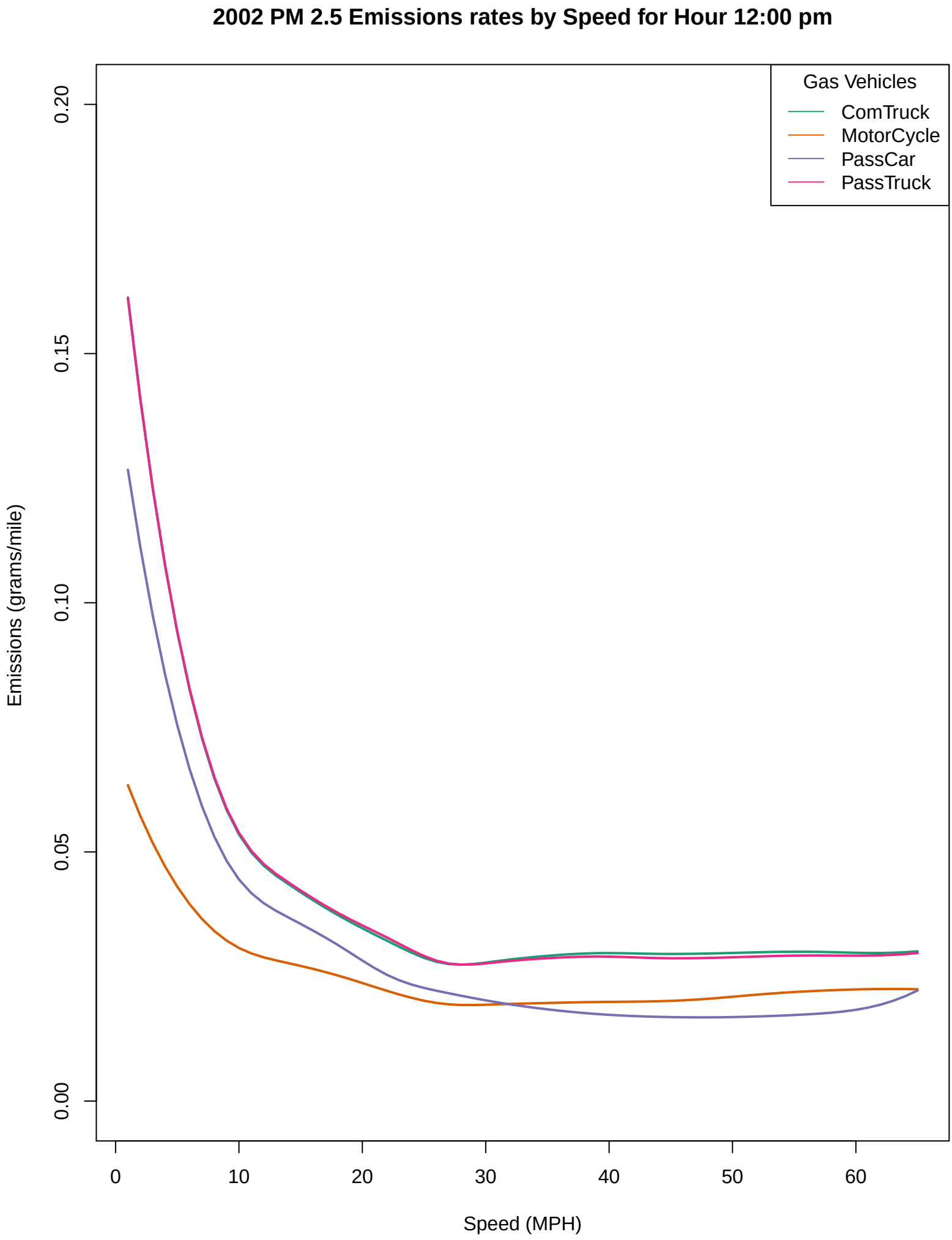
1. USEPA. Motor Vehicle Emission Simulator (MOVES) Publication EPA-420-B-10-036, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, 2010.

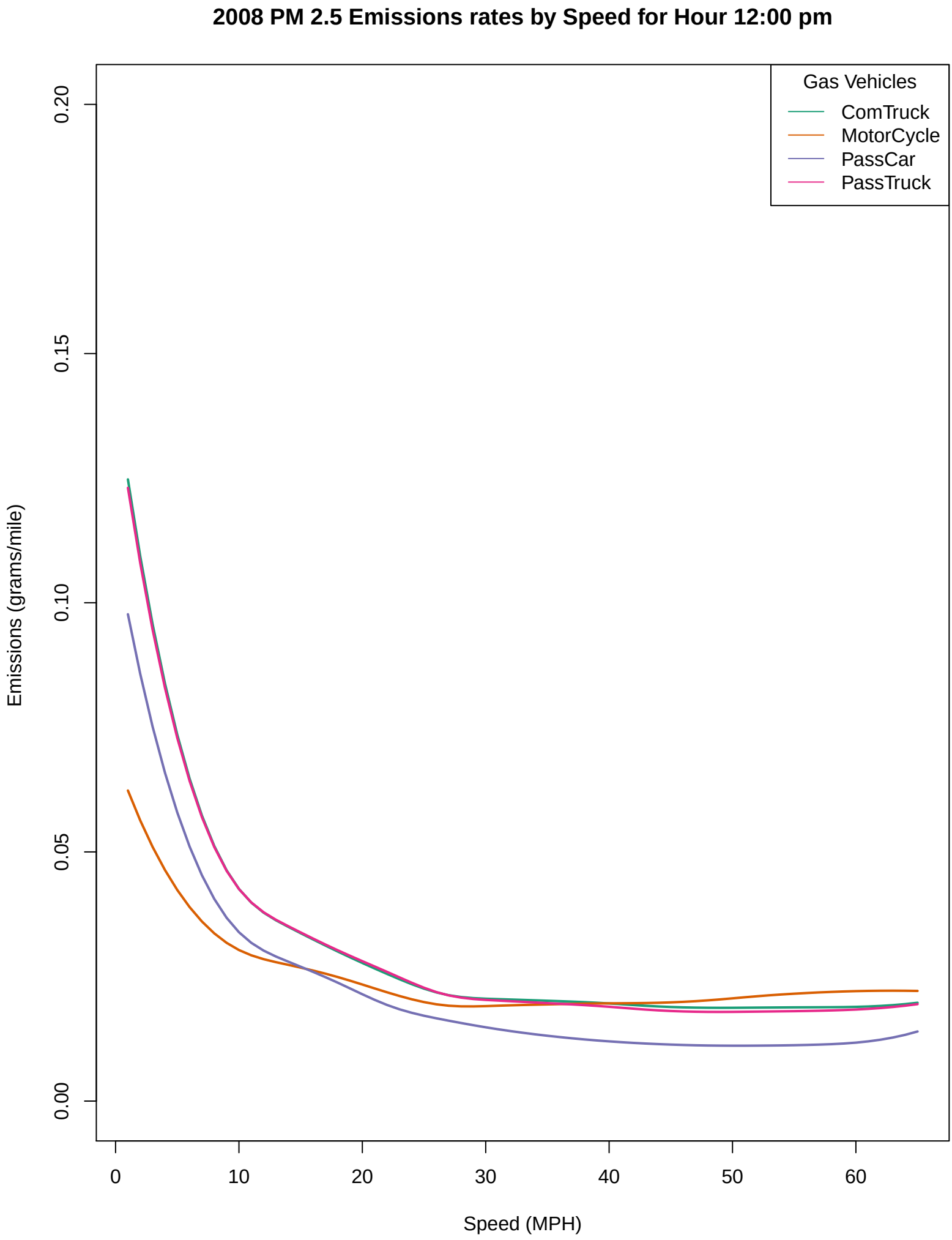
2. USEPA. *Draft Design and Implementation Plan for EPA's Multi-Scale Motor Vehicle and Equipment Emission System (MOVES).* Publication EPA420-P-02-006, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, 2002.

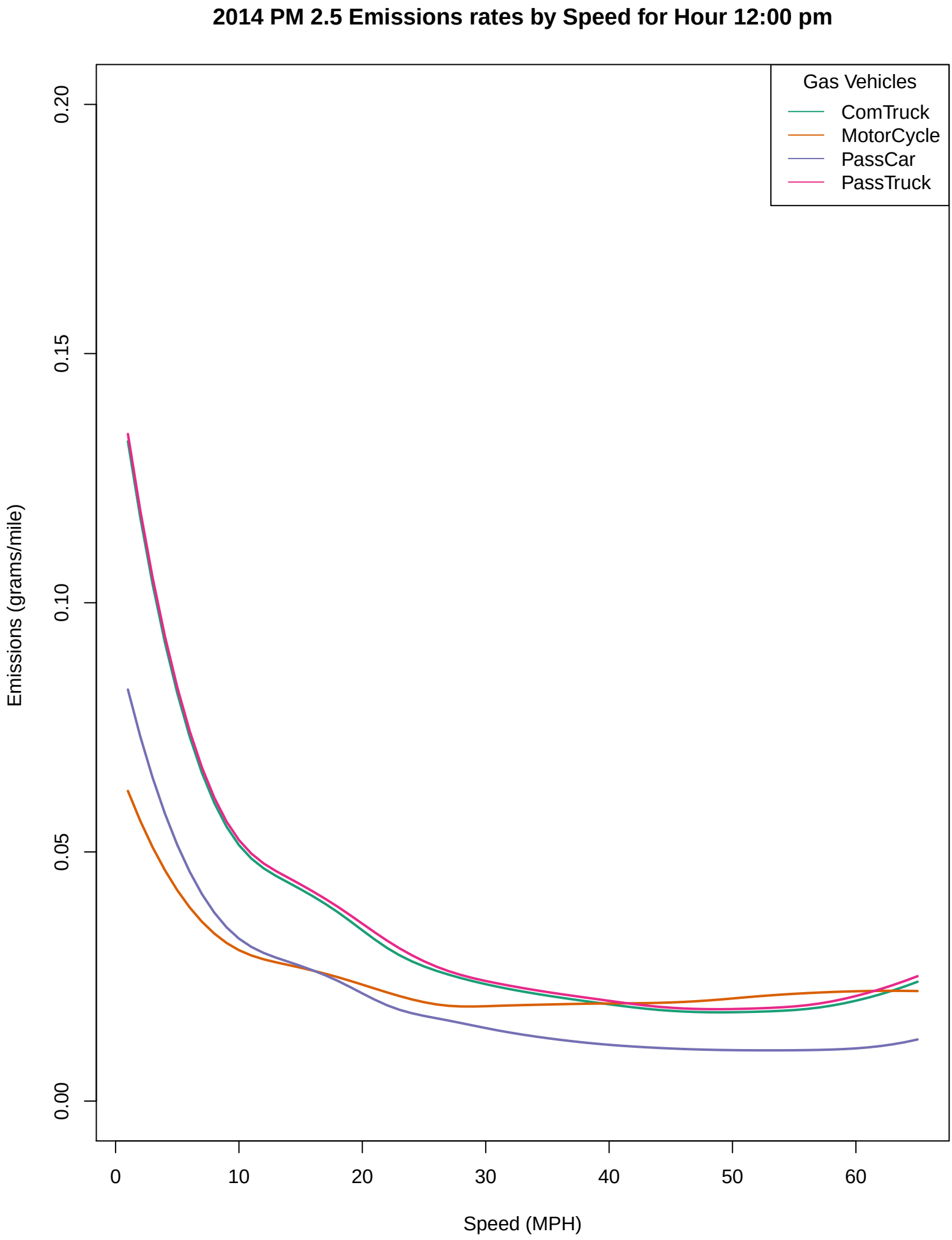
3. USEPA. *Motor Vehicle Emission Simulator Highway Vehicle Implementation (MOVES-HVI) Demonstration Version: Software Design and Reference Manual Draft*. Publication EPA420-P-07-001, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, 2007.

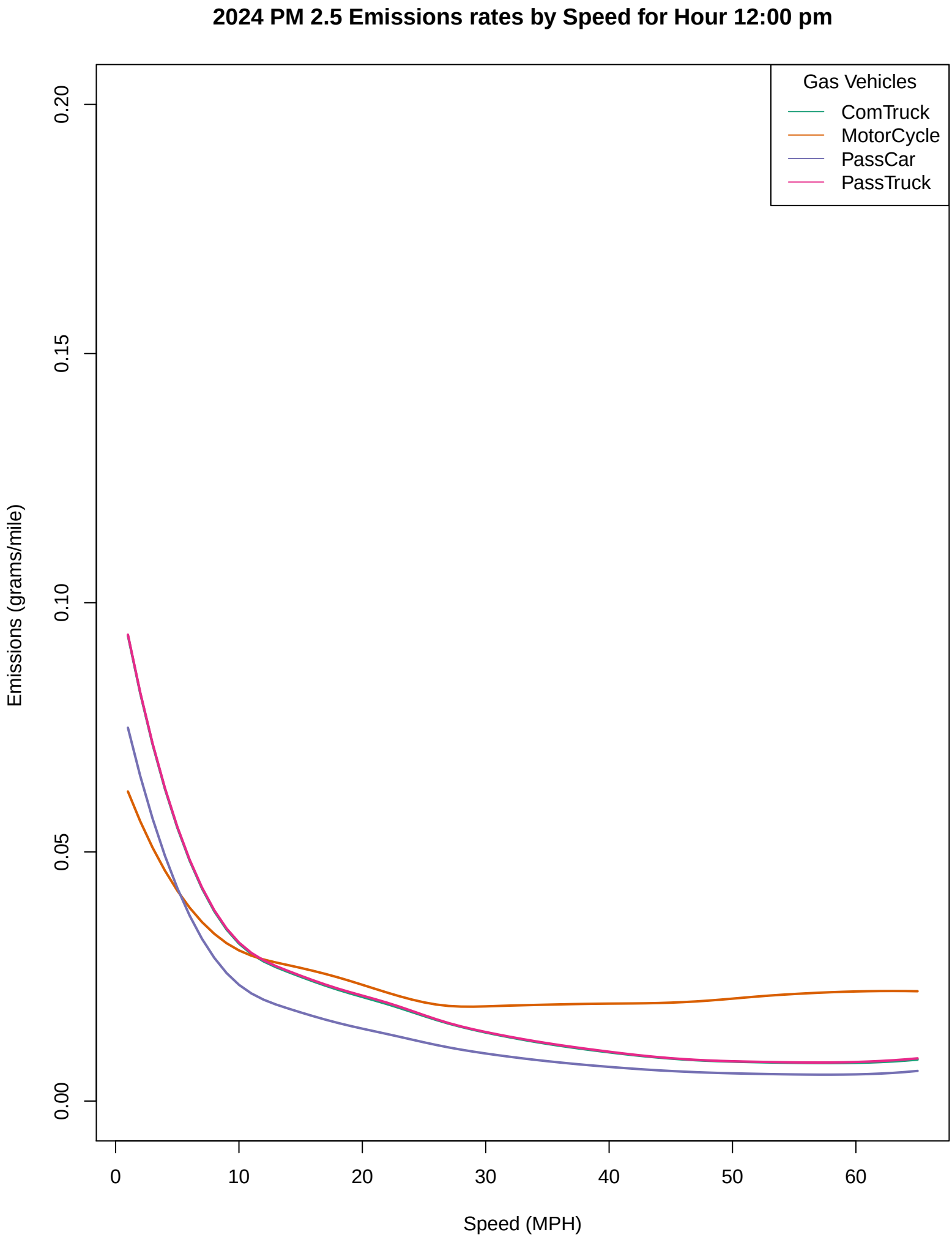
4. USEPA. Technical guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity. Publication EPA-420-B-10-023, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, 2010

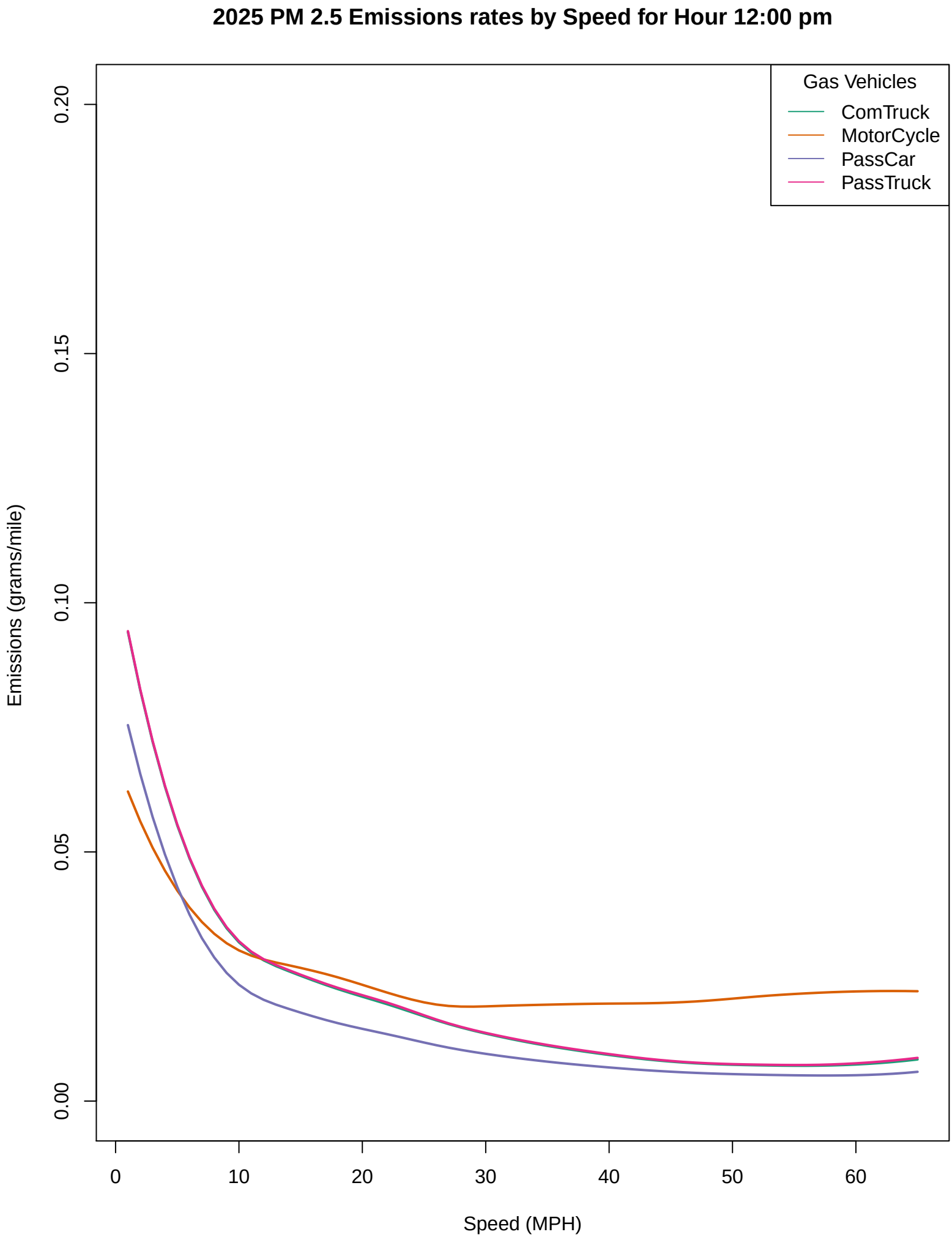
Appendix A
Emission Rate Curves

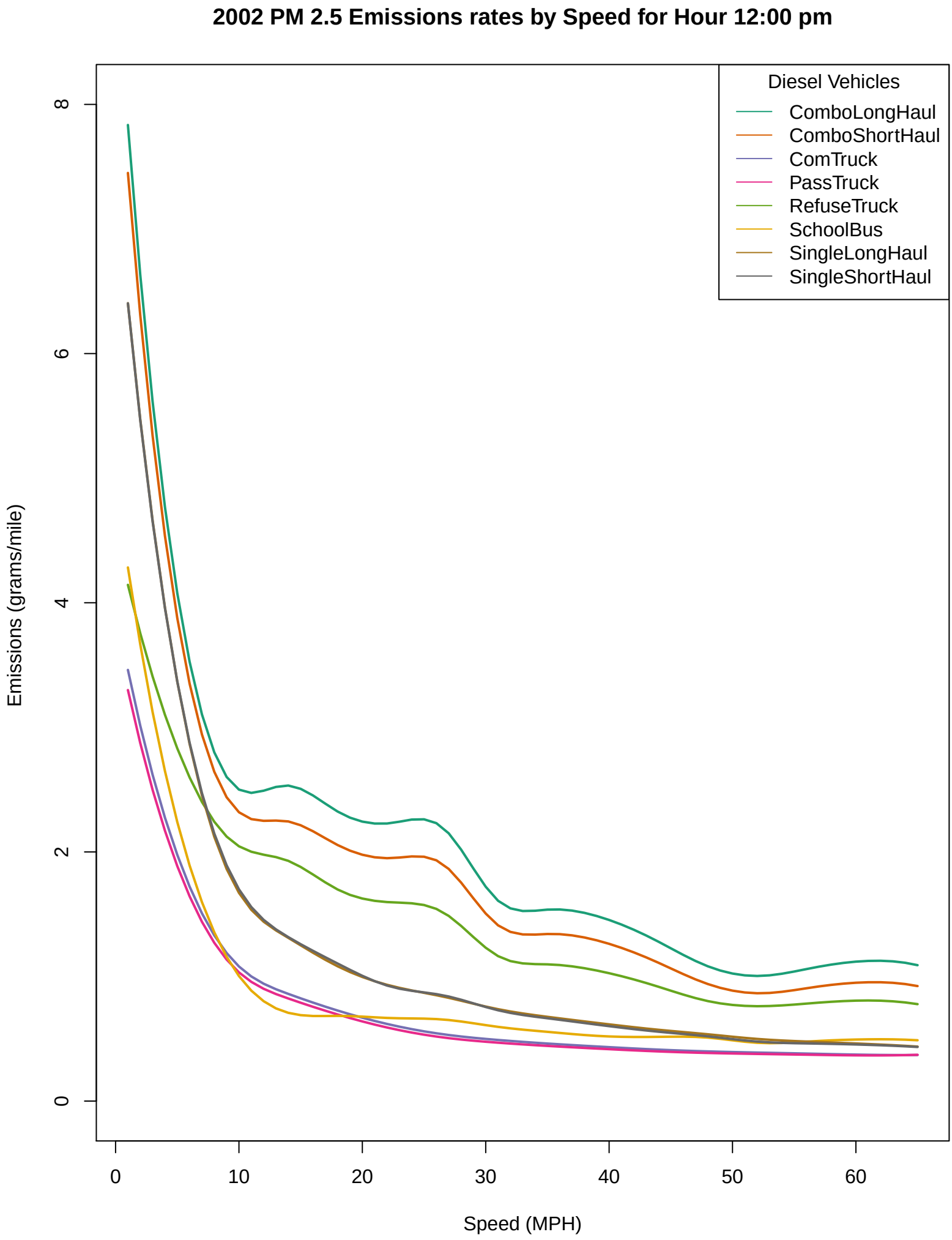

2002 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Gas Vehicles
ComTruck
MotorCycle
PassCar
PassTruck
Emissions (grams/mile)
0.00
0.05
0.10
0.15
0.20
0
10
20
30
40
50
60
Speed (MPH)

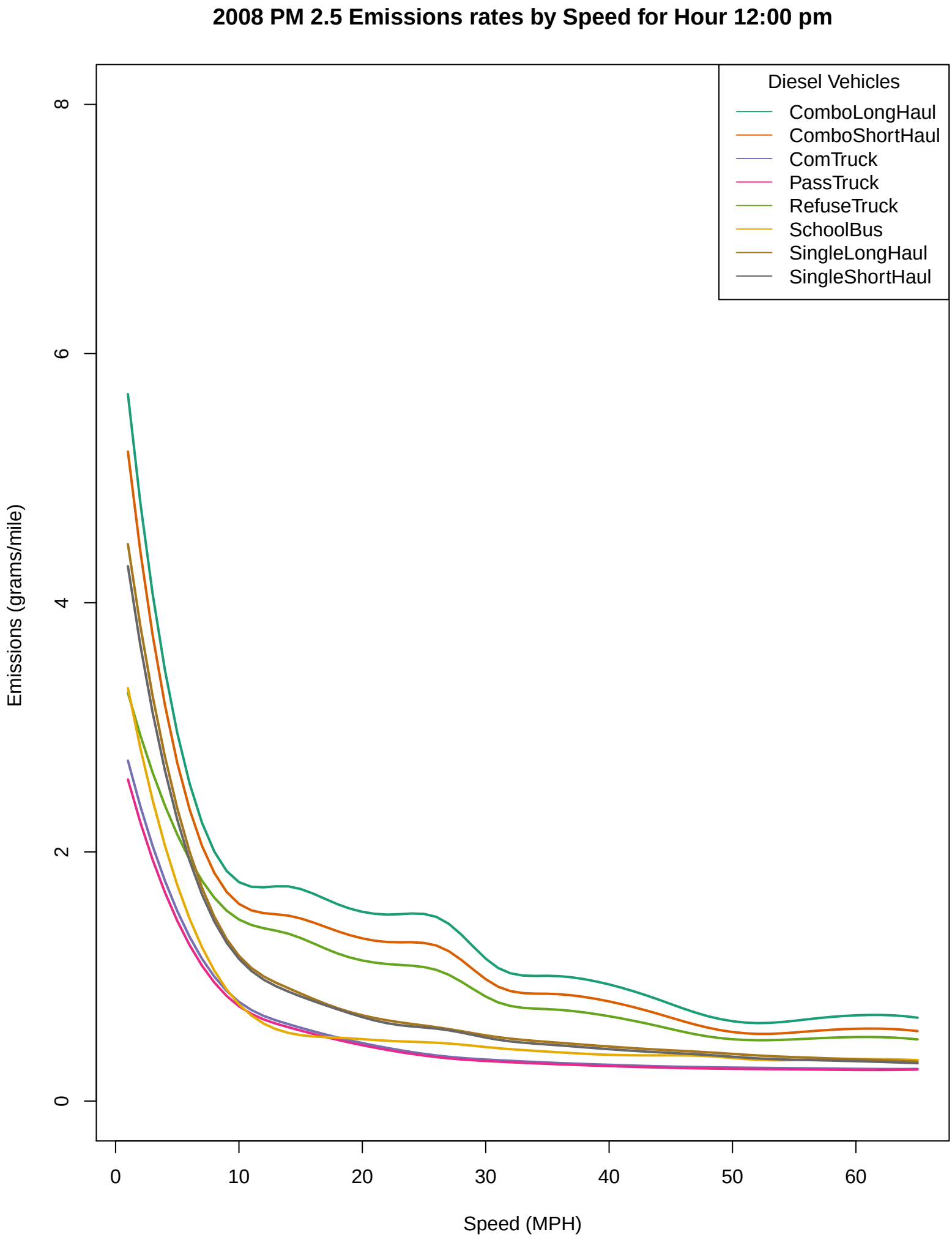

2008 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Gas Vehicles
ComTruck
MotorCycle
PassCar
PassTruck
Emissions (grams/mile)
0.00
0.05
0.10
0.15
0.20
0
10
20
30
40
50
60
Speed (MPH)

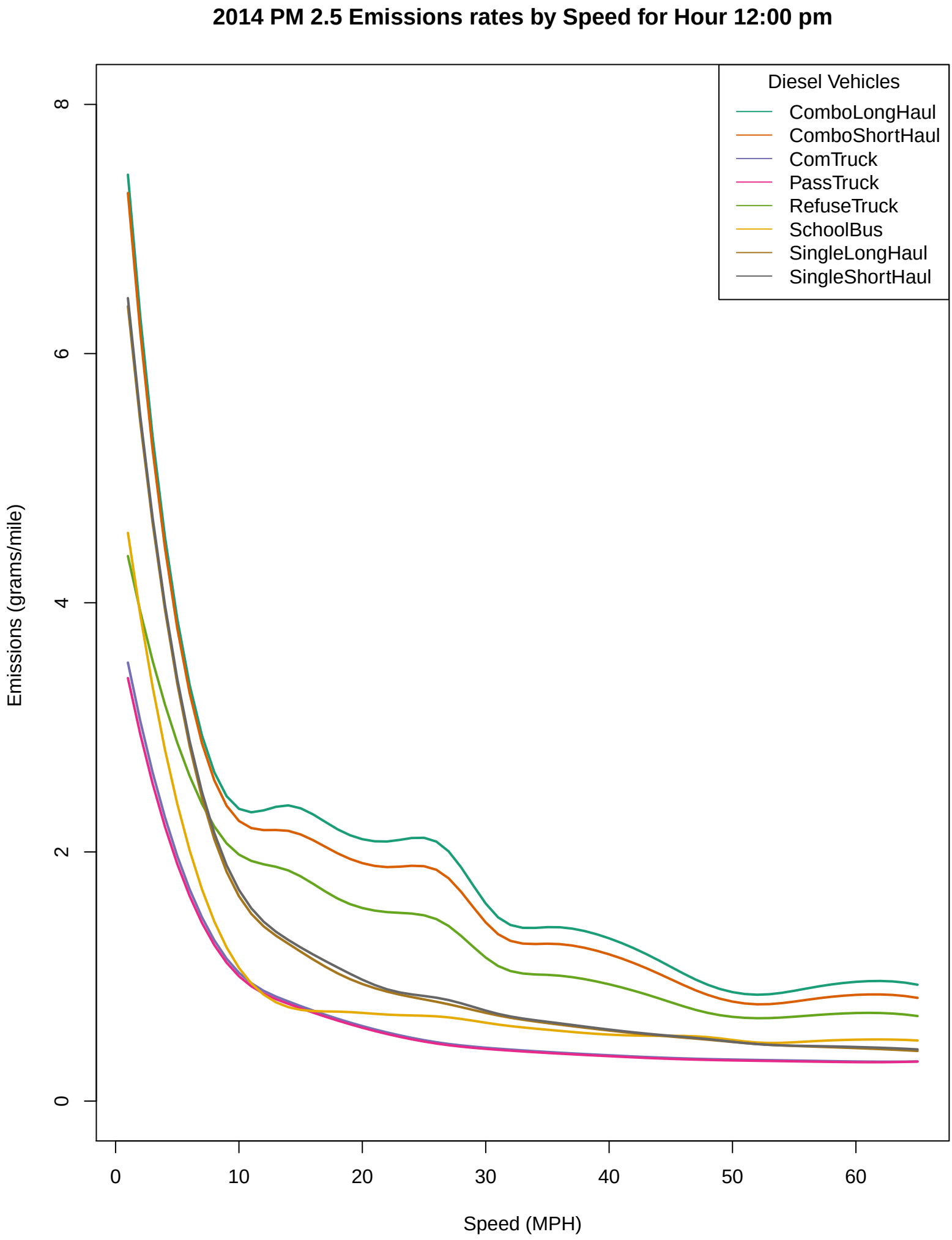

2014 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Gas Vehicles
ComTruck
MotorCycle
PassCar
PassTruck
Emissions (grams/mile)
0.00
0.05
0.10
0.15
0.20
0
10
20
30
40
50
60
Speed (MPH)

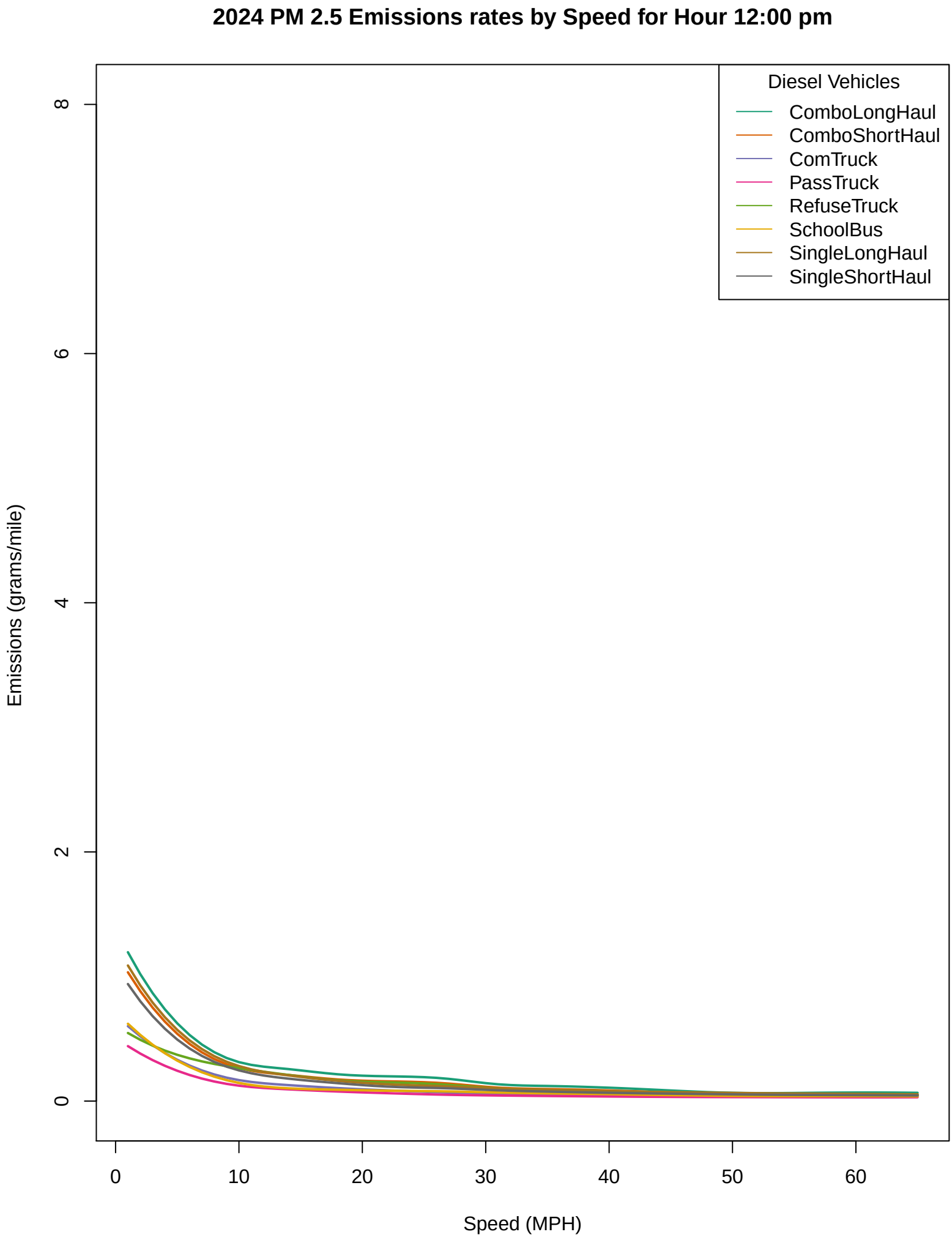

2024 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Gas Vehicles
ComTruck
MotorCycle
PassCar
PassTruck
Emissions (grams/mile)
0.00
0.05
0.10
0.15
0.20
0
10
20
30
40
50
60
Speed (MPH)

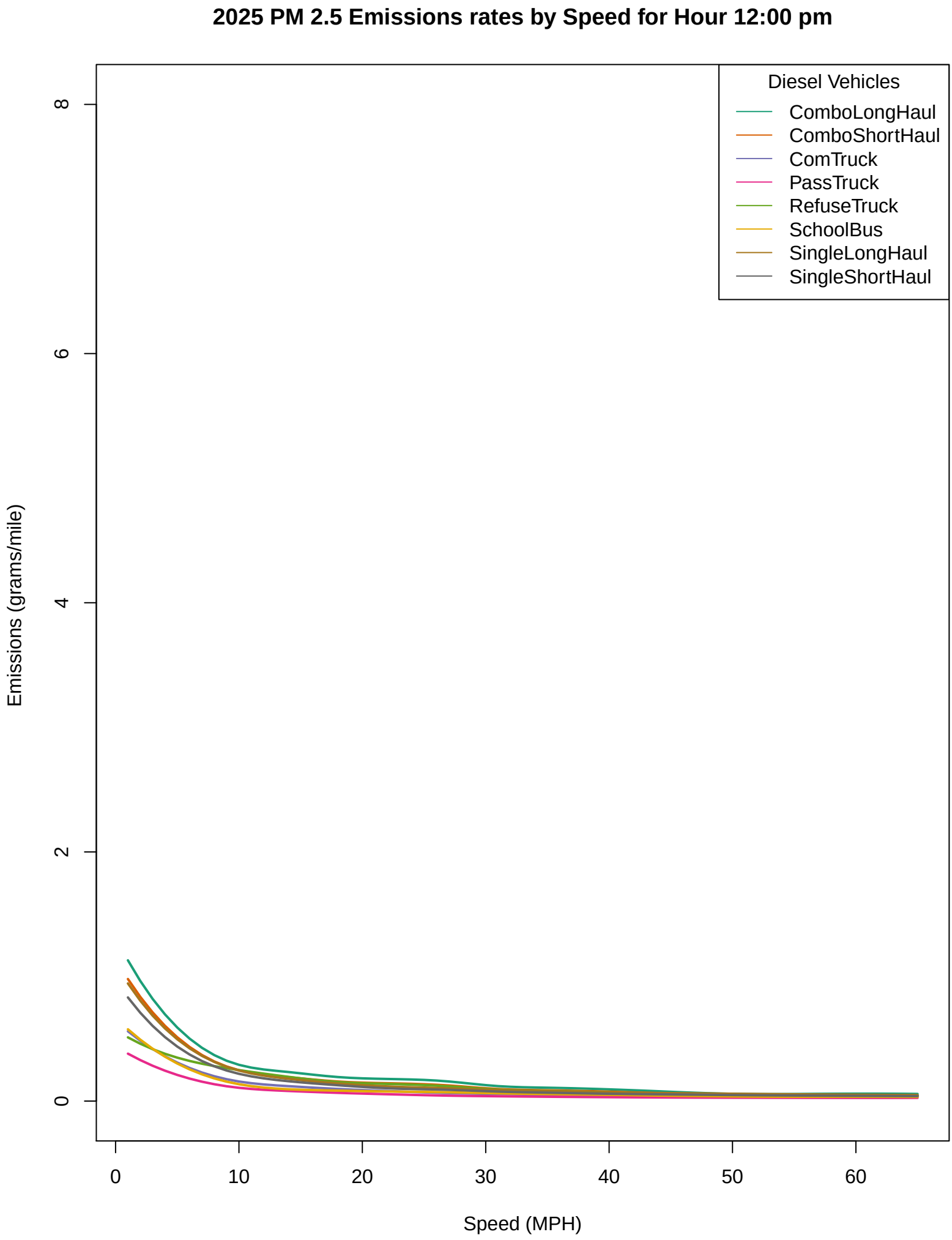

2025 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Gas Vehicles
ComTruck
MotorCycle
PassCar
PassTruck
Emissions (grams/mile)
0.00
0.05
0.10
0.15
0.20
0
10
20
30
40
50
60
Speed (MPH)


2002 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Diesel Vehicles
ComboLongHaul
ComboShortHaul
ComTruck
PassTruck
RefuseTruck
SchoolBus
SingleLongHaul
SingleShortHaul
Emissions (grams/mile)
0
2
4
6
8
0
10
20
30
40
50
60
Speed (MPH)


2008 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Diesel Vehicles
ComboLongHaul
ComboShortHaul
ComTruck
PassTruck
RefuseTruck
SchoolBus
SingleLongHaul
SingleShortHaul
Emissions (grams/mile)
0
2
4
6
8
0
10
20
30
40
50
60
Speed (MPH)


2014 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Diesel Vehicles
ComboLongHaul
ComboShortHaul
ComTruck
PassTruck
RefuseTruck
SchoolBus
SingleLongHaul
SingleShortHaul
Emissions (grams/mile)
0
2
4
6
8
0
10
20
30
40
50
60
Speed (MPH)


2024 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Diesel Vehicles
ComboLongHaul
ComboShortHaul
ComTruck
PassTruck
RefuseTruck
SchoolBus
SingleLongHaul
SingleShortHaul
Emissions (grams/mile)
0
2
4
6
8
0
10
20
30
40
50
60
Speed (MPH)


2025 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Diesel Vehicles
ComboLongHaul
ComboShortHaul
ComTruck
PassTruck
RefuseTruck
SchoolBus
SingleLongHaul
SingleShortHaul
Emissions (grams/mile)
0
2
4
6
8
0
10
20
30
40
50
60
Speed (MPH)

Appendix B
Vehicle Population

Year	MOVES Source Type	Population	Vehicle Description
2002	21	1487	Passenger Car
2002	31	1949	Passenger Truck
2002	32	10	Light Commercial Truck
2002	11	197	Motorcycle
2002	41	0	Intercity Bus
2002	42	0	Transit Bus
2002	43	5	School Bus
2002	51	5	Refuse Truck
2002	52	10	Single Unit Short Haul Truck
2002	53	10	Single Unit Long Haul truck
2002	54	0	Motor Home
2002	61	10	Combination Short Haul Truck
2002	62	10	Combination Long Haul Truck
2008	21	1634	Passenger Car
2008	31	2114	Passenger Truck
2008	32	10	Light Commercial Truck
2008	11	214	Motorcycle
2008	41	0	Intercity Bus
2008	42	0	Transit Bus
2008	43	5	School Bus
2008	51	5	Refuse Truck
2008	52	10	Single Unit Short Haul Truck
2008	53	10	Single Unit Long Haul truck
2008	54	0	Motor Home
2008	61	10	Combination Short Haul Truck
2008	62	10	Combination Long Haul Truck
2014	21	1886	Passenger Car
2014	31	2472	Passenger Truck
2014	32	12	Light Commercial Truck
2014	11	250	Motorcycle
2014	41	0	Intercity Bus
2014	42	0	Transit Bus
2014	43	6	School Bus
2014	51	6	Refuse Truck
2014	52	12	Single Unit Short Haul Truck
2014	53	12	Single Unit Long Haul truck
2014	54	0	Motor Home
2014	61	12	Combination Short Haul Truck
2014	62	12	Combination Long Haul Truck
2024	21	2096	Passenger Car
2024	31	2747	Passenger Truck
2024	32	13	Light Commercial Truck
2024	11	278	Motorcycle
2024	41	0	Intercity Bus

2024	42	0	Transit Bus
2024	43	6	School Bus
2024	51	6	Refuse Truck
2024	52	13	Single Unit Short Haul Truck
2024	53	13	Single Unit Long Haul truck
2024	54	0	Motor Home
2024	61	13	Combination Short Haul Truck
2024	62	13	Combination Long Haul Truck
2025	21	2117	Passenger Car
2025	31	2775	Passenger Truck
2025	32	13	Light Commercial Truck
2025	11	281	Motorcycle
2025	41	0	Intercity Bus
2025	42	0	Transit Bus
2025	43	6	School Bus
2025	51	6	Refuse Truck
2025	52	13	Single Unit Short Haul Truck
2025	53	13	Single Unit Long Haul truck
2025	54	0	Motor Home
2025	61	13	Combination Short Haul Truck
2025	62	13	Combination Long Haul Truck

Appendix C
Household and Employment Assumptions

2025 Oakridge Household and Employment TAZ Allocation Assumptions

TO: Clair Van Bloom, LCOG
Bud Reiff, LCOG

COPIES: Lisa Nell, ODOT
Kevin Urban, City of Oakridge
Frank Angelo, Angelo Eaton & Associates
Kathi Wiederhold, LCOG

FROM: Steve Perone

DATE: June 11, 2004 (revised)

The purpose of this memorandum is to summarize recommendations for TAZ allocation of 20-year household and employment growth in the cities of Oakridge and Westfir. These data will be used as inputs in LCOG's 2025 travel demand forecasts for the build and no-build alternative concepts, as part of the Oakridge Oregon 58 Refinement Plan. The recommendations outlined are based on the population, housing unit and employment forecasts prepared by LCOG and summarized below.

2025 Housing Unit Growth

The following table summarizes existing and future forecast population and housing units for Oakridge and Westfir.

2025 HOUSING AND POPULATION ASSUMPTIONS

Oakridge Population and Housing Units	
2025 Population based on preliminary coordinated population projections	4,000
Average Household Size as assumed in TSP	2.28
Number of 2025 Households	1,754
Assume 5% Vacancy Rate	92
Total 2025 Housing Units	1,846
Total 2002 Housing Units	1,778
2002-2025 Future Housing Units	68
Westfir Population and Housing Units	
2025 Population based on preliminary coordinated population projections	410

2025 HOUSING AND POPULATION ASSUMPTIONS

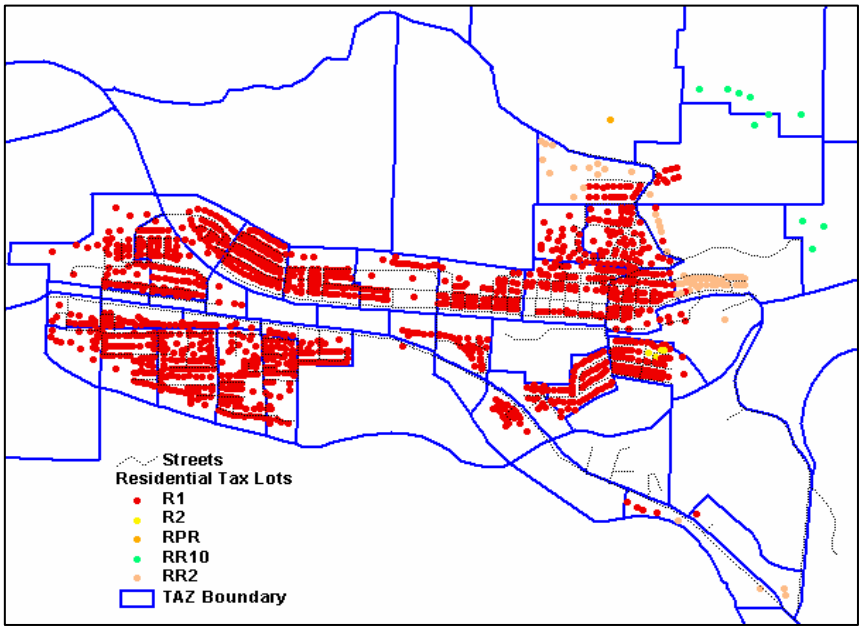
Average Household Size	2.5
Number of 2025 Households	164
Assume 5% Vacancy Rate	9
Total 2025 Housing Units	173
Total 2002 Housing Units	131
2002-2025 Future Housing Units	42

The forecast projects 68 additional housing units in Oakridge and 42 in Westfir in the year 2025, for a total increase of 110 housing units.

2025 Oakridge Housing Unit TAZ Allocation

The following methods and associated steps were utilized to prepare 2025 housing unit estimates by TAZ in the City of Oakridge. The future housing unit estimates will be used to estimate total households by TAZ for travel demand modeling based on average vacancy rates and household size.

1). LCOG's 2002 Regional Land Information Database (RLID) housing unit estimates were compared by TAZ with the number of residential tax lots[1]. Tax lots by TAZ were calculated using the centroid of the tax lot as illustrated in the following figure:



Residential Tax Lots by TAZ

[1] LCOG's Geographic Information System tax lot database was used for this purpose.

2). Using the delta derived in step one (Tax lots - HH Units), all TAZ's with a delta greater than or equal to 10 were selected. This step identifies TAZ's with undeveloped or underdeveloped residential parcels that may see residential growth in the forecasting period. This resulted in a selection of 10 TAZ as follows:

OAKRIDE TRANSPORATION ANALYSIS ZONES IDENTIFIED FOR HOUSEHOLD GROWTH

TAZ	2002 Total RLID Household Units	Total Number of Tax Lots	DELTA	DELTA %
20	1	11	10	6%
22	25	33	10	6%
21	21	45	27	16%
24	2	25	23	14%
23	49	62	16	9%
53	74	84	20	12%
39	63	79	22	13%
27	74	79	13	8%
62	58	63	12	7%
61	92	98	16	9%
TOTAL	459	579	169	100%

In addition to the TAZ's identified above, TAZ id #54 was identified as a candidate for future residential growth based on the number of large subdividable parcels. The allocation assumes that TAZ 54 will receive approximately 9 percent or 6 of the future forecasted housing units.

3). Assigned forecasted future housing units to each TAZ in the group based on the delta percent of the total. The allocation was performed after manually allocating growth to TAZ 54 as described in step 2. The following table presents the *additional* new housing units by TAZ for the year 2025:

OAKRIDE TRANSPORATION ANALYSIS HOUSING UNIT GROWTH

TAZ	DELTA	% of total	New 2025 Housing Units
20	10	6%	3[2]
22	10	6%	4
21	27	16%	10
24	23	14%	9
23	16	9%	6
53	20	12%	7
39	22	13%	8
27	13	8%	5
62	12	7%	4
61	16	9%	6
Subtotal	169	100%	62
54	-	-	6
Total	-	-	**68**

2025 Westfir Housing Unit TAZ Allocation

Forecast 2025 housing unit growth in Westfir is assumed and allocated in proportion to the 2002 RLID estimate. The following table summarizes 2025 Westfir housing unit assumptions:

WESTFIR TRANSPORATION ANALYSIS HOUSING UNIT GROWTH

	Housing Units		
TAZ	2002	**New 2025**	2025 Total
66	45	15	60
67	79	27	106
Total	124[3]	42	166

[2] Rounded down to maintain forecast year control total

[3] Excludes small portion of Westfir in TAZ 50 (assume that is the difference in total housing units 131 vs. 124)

WESTFIR TRANSPORATION ANALYSIS HOUSING UNIT GROWTH

	Housing Units

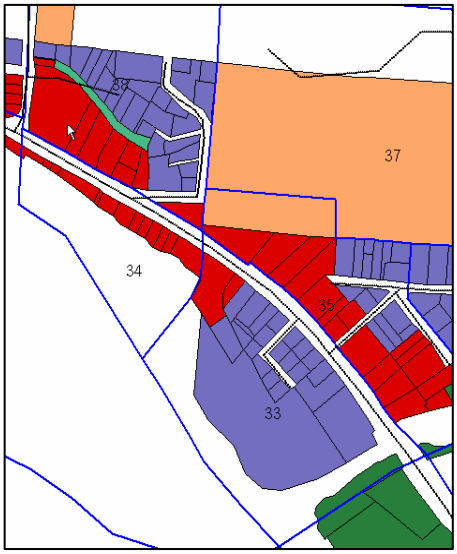
2025 Employment

The majority of employment growth in the City of Oakridge is assumed to occur as part of the development of the Oakridge Industrial Park. The following table summarizes existing and future forecast employment and associated assumptions:

2025 EMPLOYMENT PROJECTION AND ASSUMPTIONS

Oakridge Employment	
2002 Estimated Covered Employment	710
Annual Average Population Growth Rate 2003 to 2025	0.23%
TSP Assumption 3 - 2025 Non-manufacturing employment will grow consistent with population growth.	749
2002 - 2025 Future Non-manufacturing Employment Growth	39
TSP Assumption 2 - Manufacturing will grow by 350 employees	350
2002 - 2025 Total Future Employment Growth	389
Westfir Employment	
2002 Estimated Covered Employment	14
2025 Total Future Employment - No Change	14

All of the manufacturing employment increase will be assigned to the Oakridge Industrial Park, TAZ number 14. Non-manufacturing employment growth is assumed to occur along Oregon 58 east of Crestview in TAZ's 33-35 and 38, as displayed in the figure below:



Oakridge TAZ's Identified for Non-Manufacturing Employment Growth

The following table presents employment growth by TAZ:

OAKRIDGE TAZ EMPLOYMENT GROWTH BY TAZ

TAZ	2025 Employment Growth
33	9
34	10
35	10
38	10
Total	39

That ratio between retail and service employment will be assumed consistent with existing proportions.

Summary

The assumptions outlined above will provide the project team the ability to analyze travel demand impacts that include modest population growth, focused commercial enhancements along Highway 58 in Oakridge and successful economic development

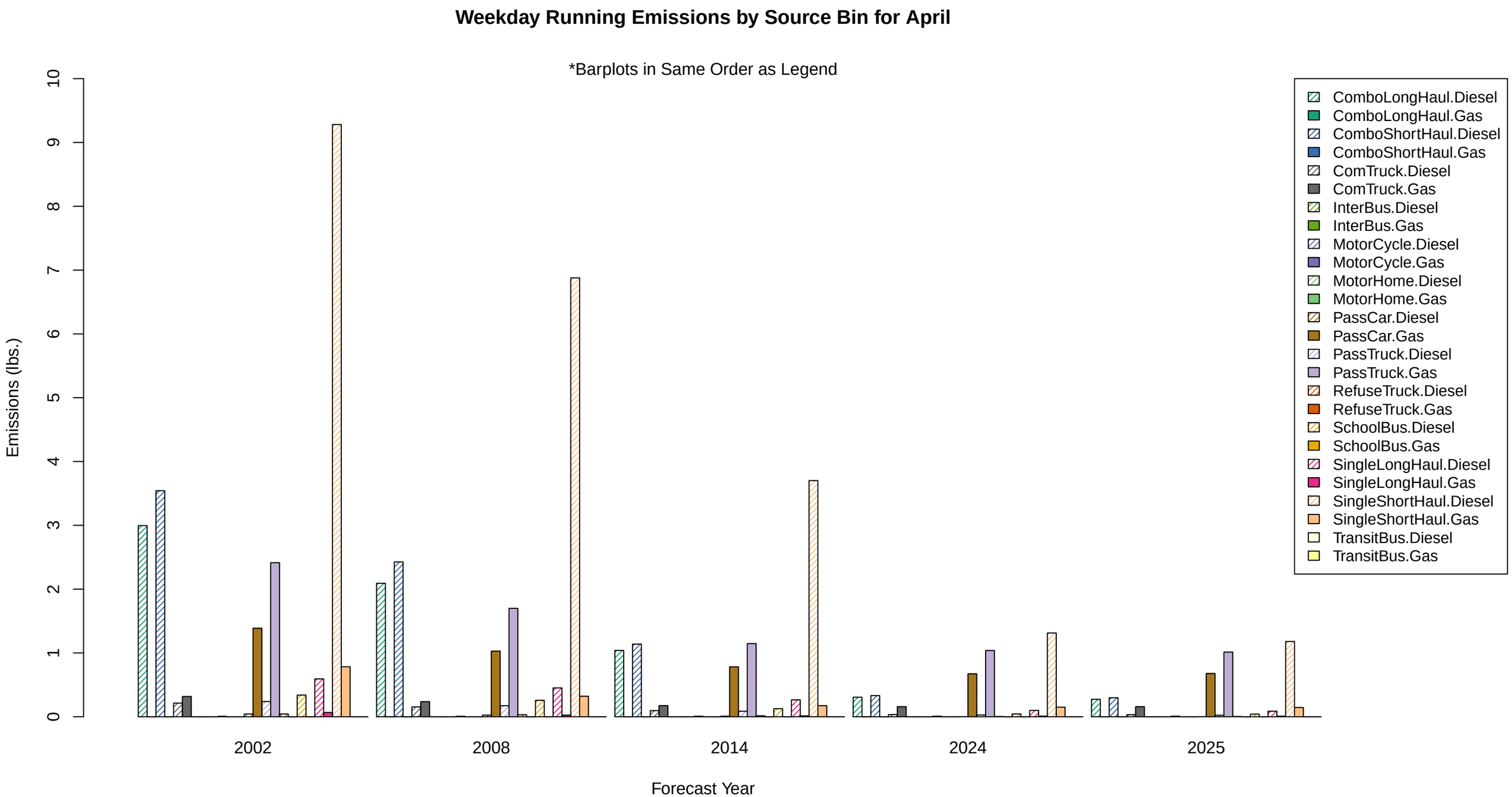
associated with development of the industrial park. The assumptions outlined above should be used to prepare the future year TAZ based socioeconomic inputs for to support travel demand forecasting for development of the refinement plan.

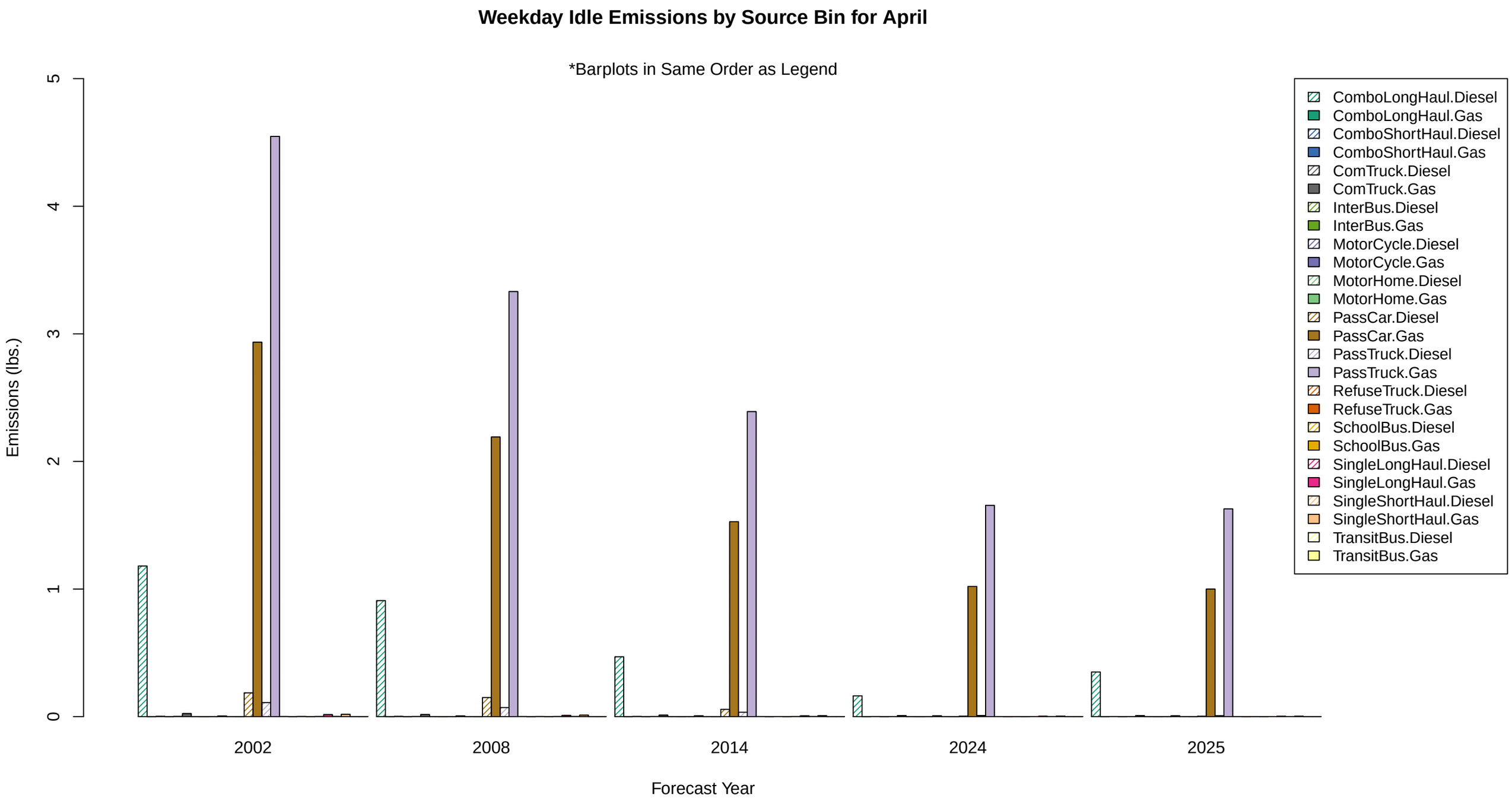
Please contact me directly if you have any questions or concerns about assumptions detailed in this memorandum.

associated with development of the industrial park. The assumptions outlined above should be used to prepare the future year TAZ based socioeconomic inputs for to support travel demand forecasting for development of the refinement plan.

Please contact me directly if you have any questions or concerns about assumptions detailed in this memorandum.

Appendix D
Emissions by Source Bin (& %)


Weekday Running Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
5
6
7
8
9
10
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekday Idle Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
5
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
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SingleShortHaul.Gas
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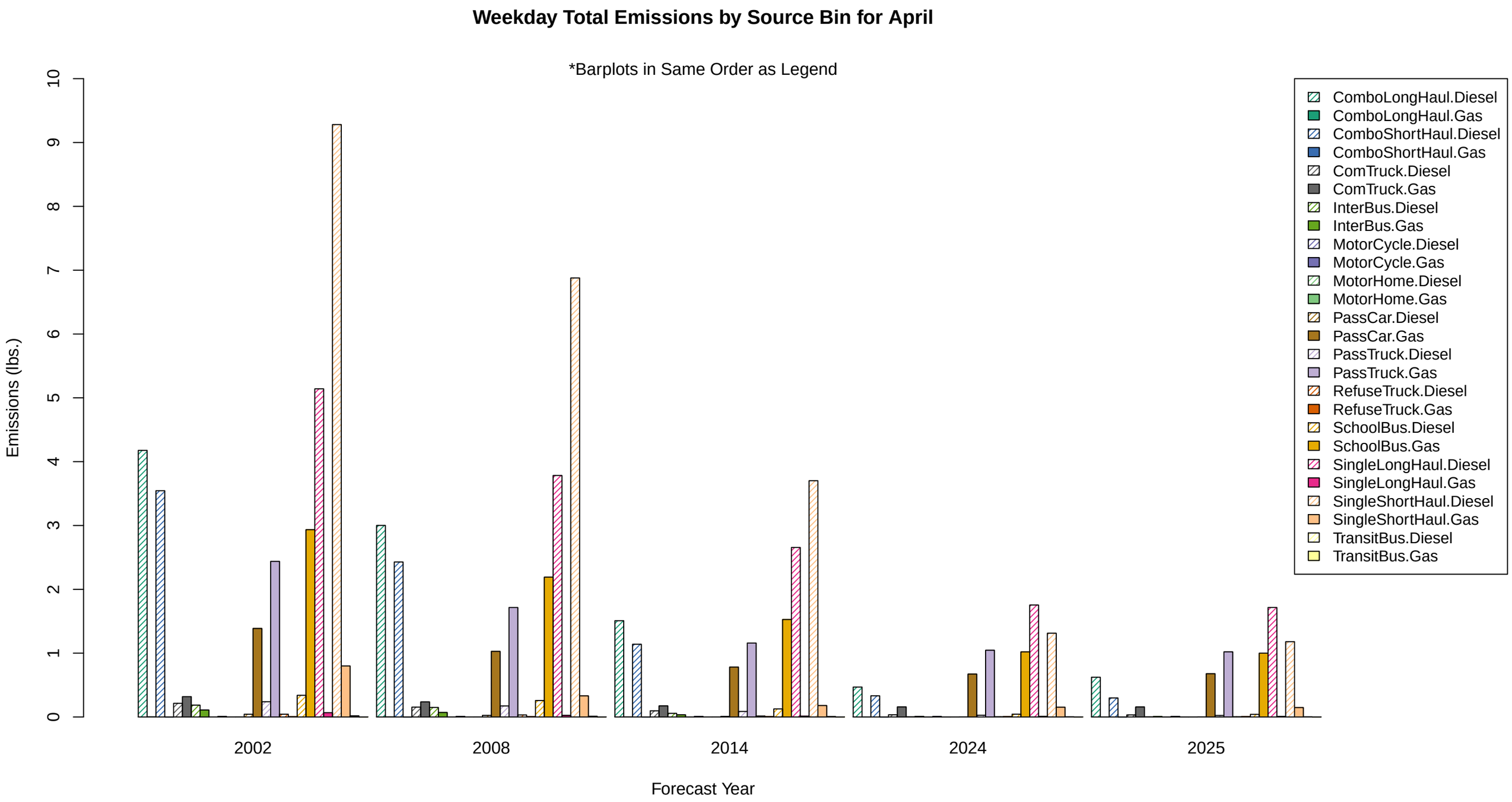
TransitBus.Gas


Weekday Total Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
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2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
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SingleLongHaul.Gas
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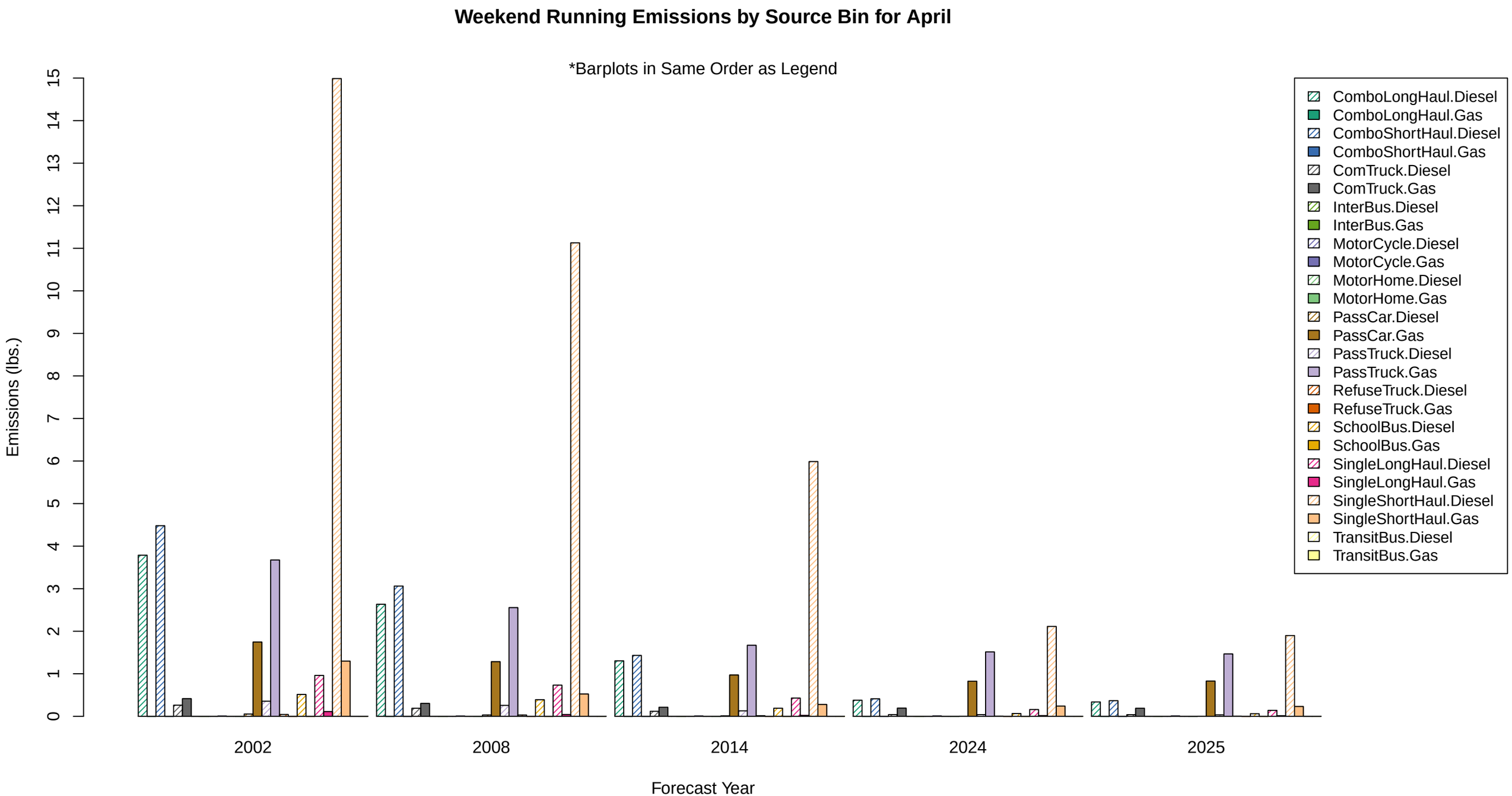
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekend Running Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
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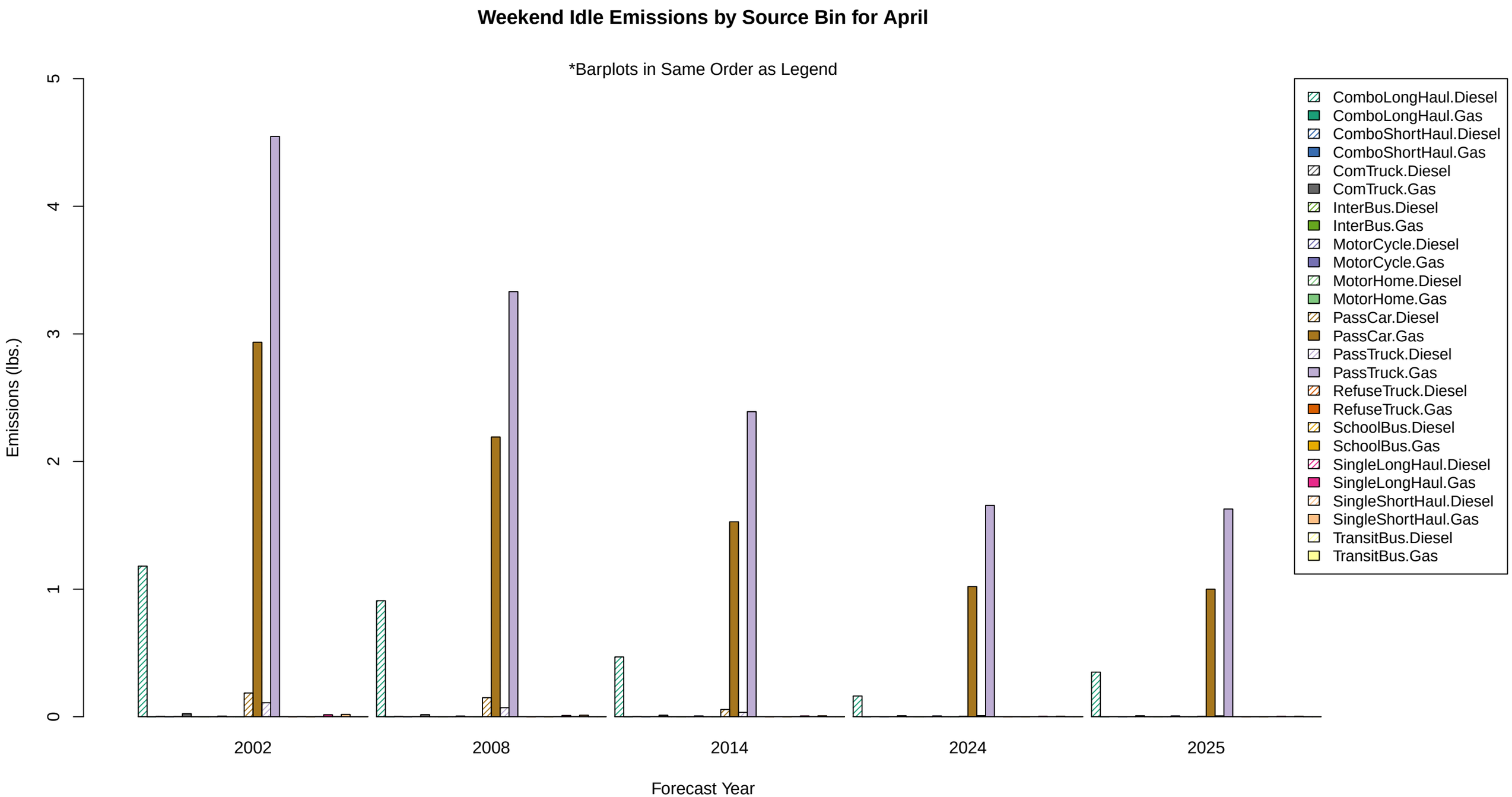
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekend Idle Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
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2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
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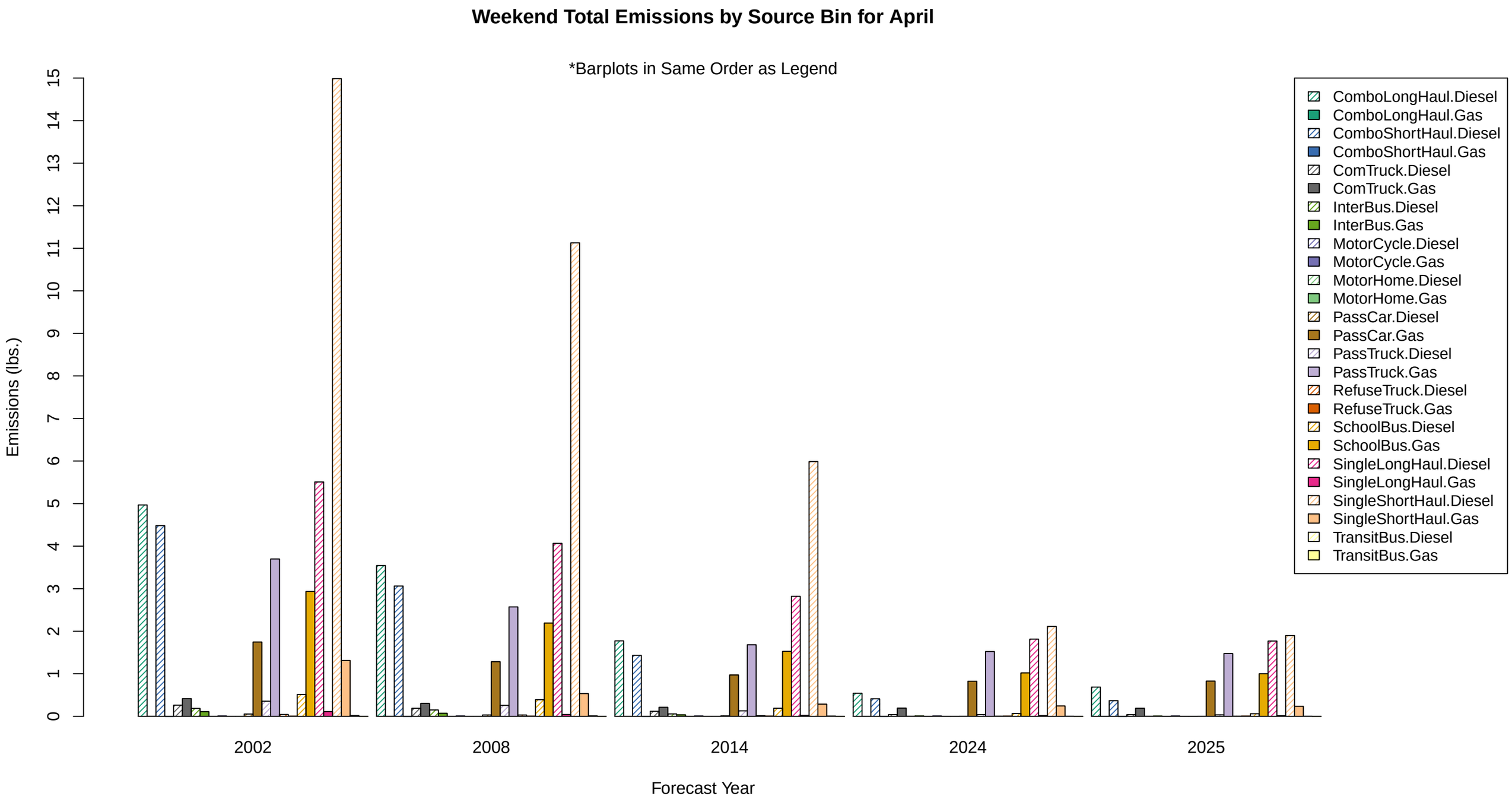
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekend Total Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
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2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
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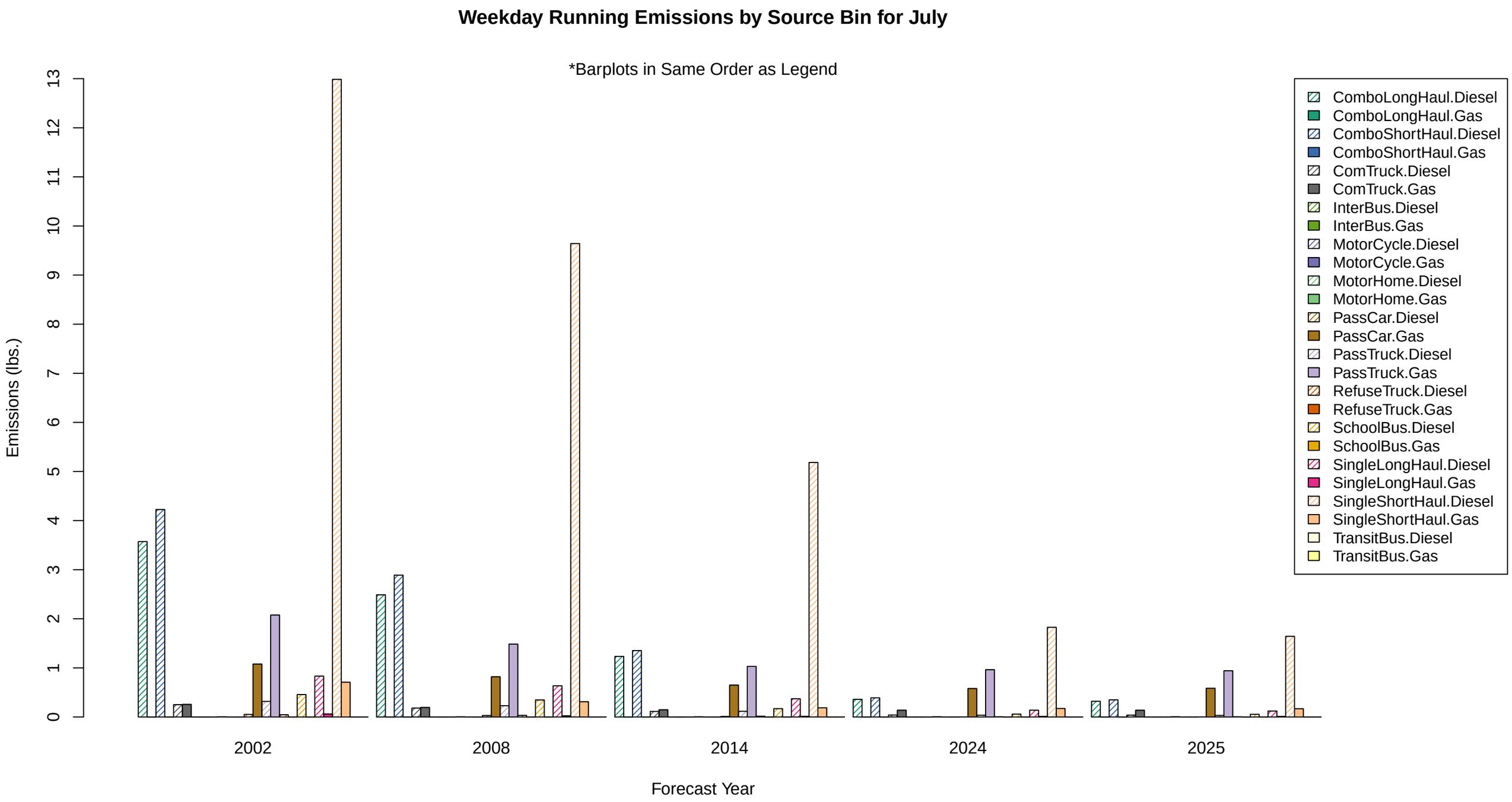
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekday Running Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
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2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
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MotorCycle.Gas
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PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
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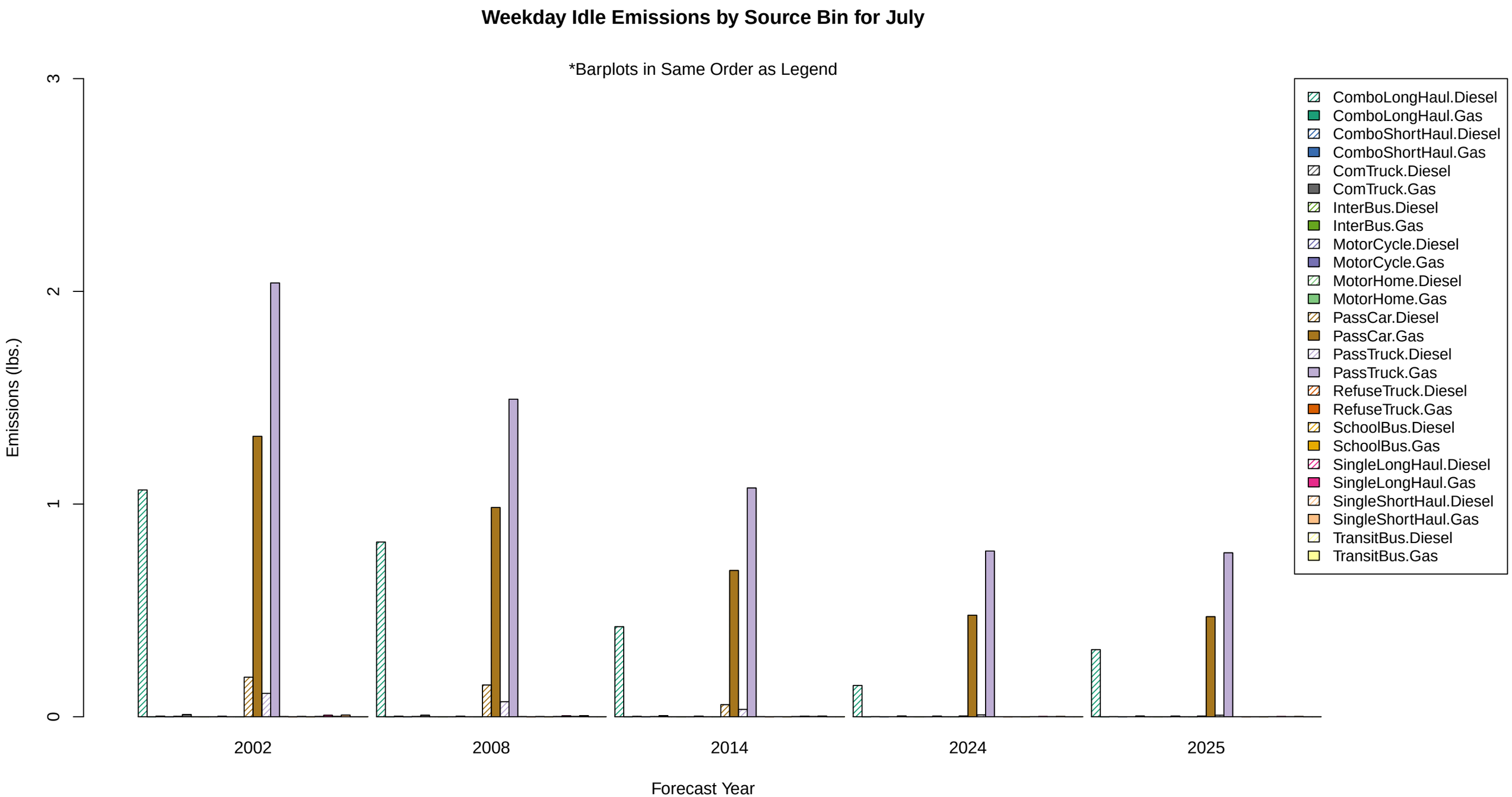
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekday Idle Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
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2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
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PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
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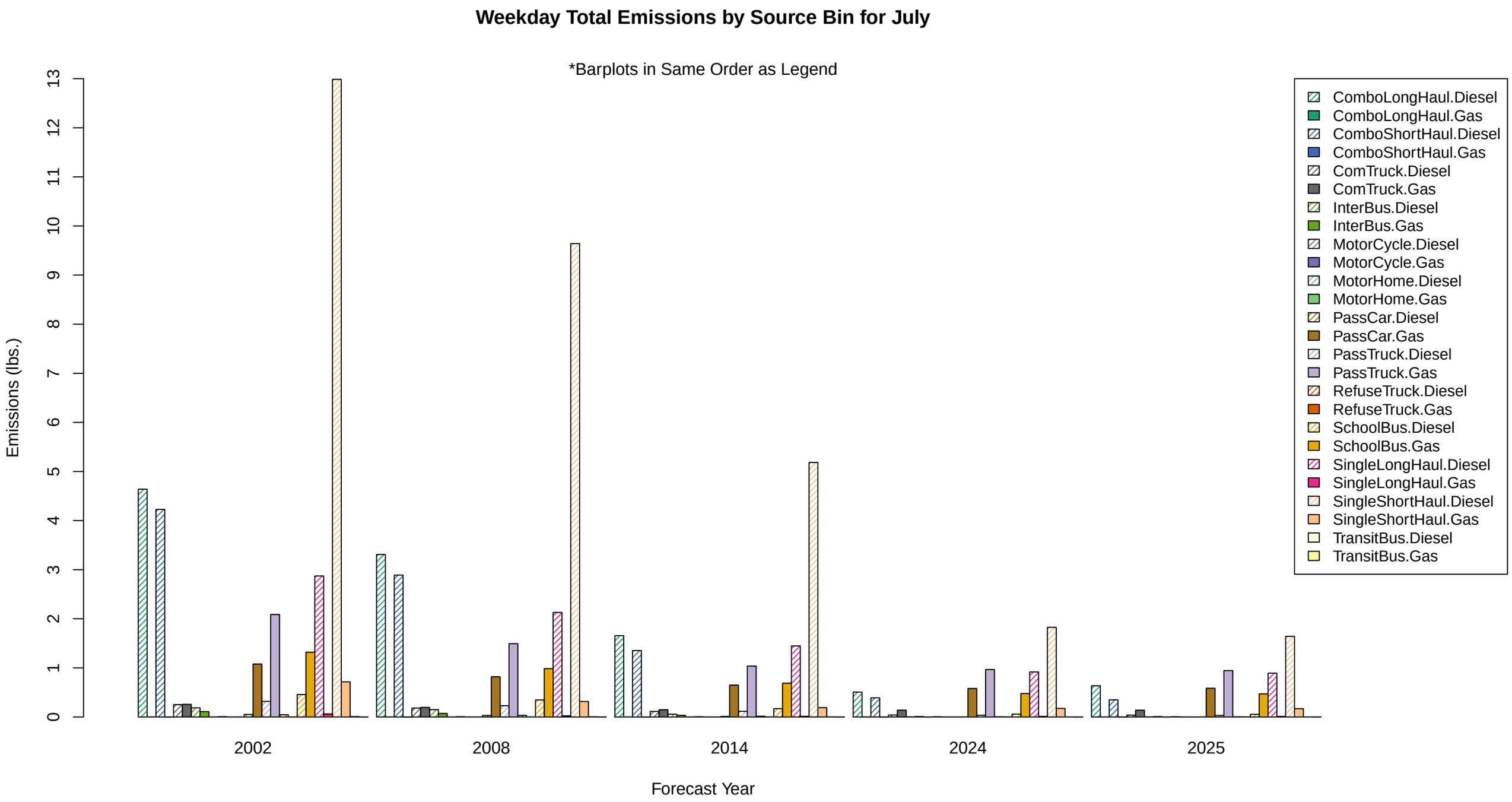
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekday Total Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
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13
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
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MotorCycle.Gas
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PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
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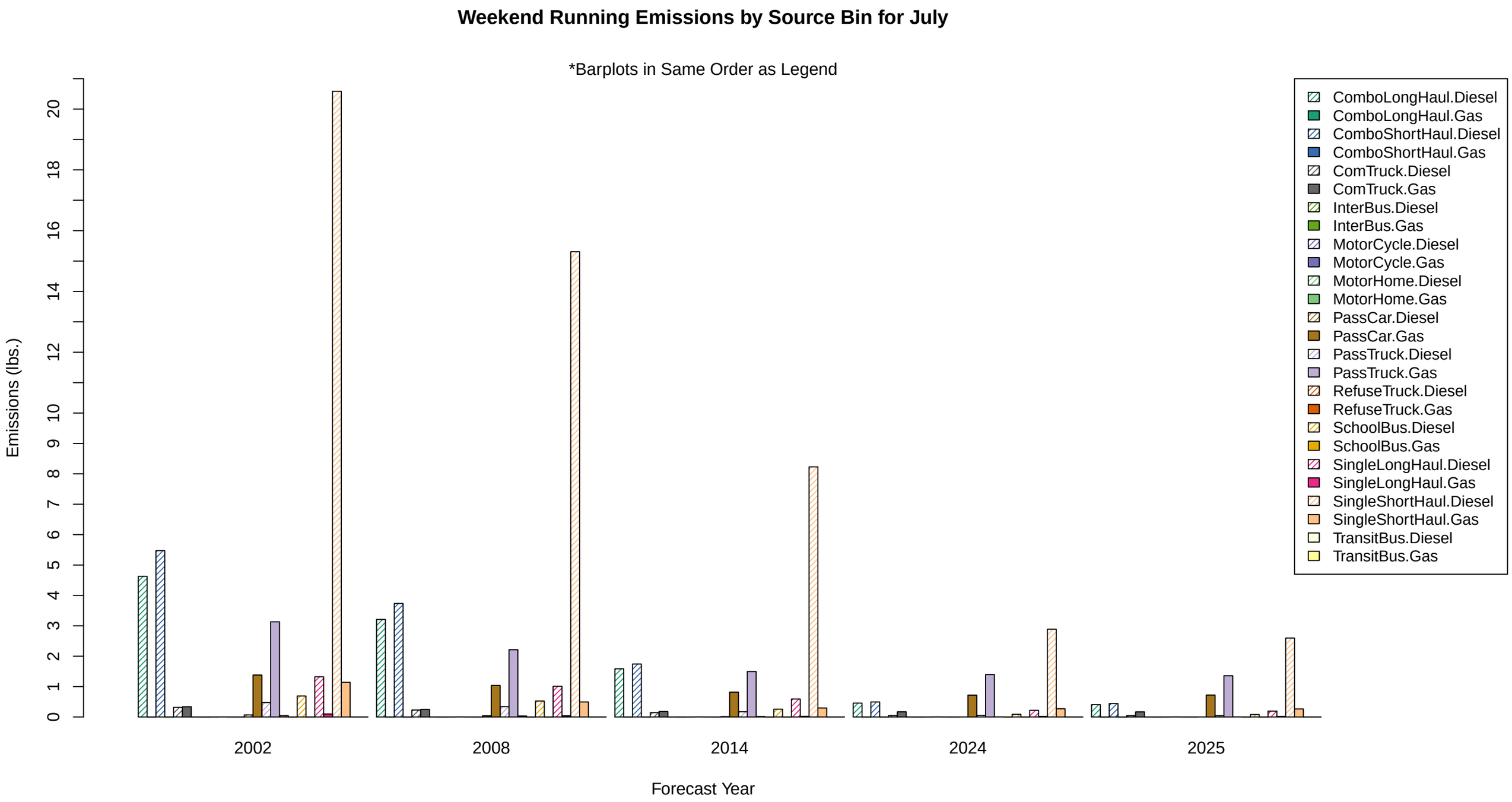
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekend Running Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
5
6
7
8
9
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12
14
16
18
20
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
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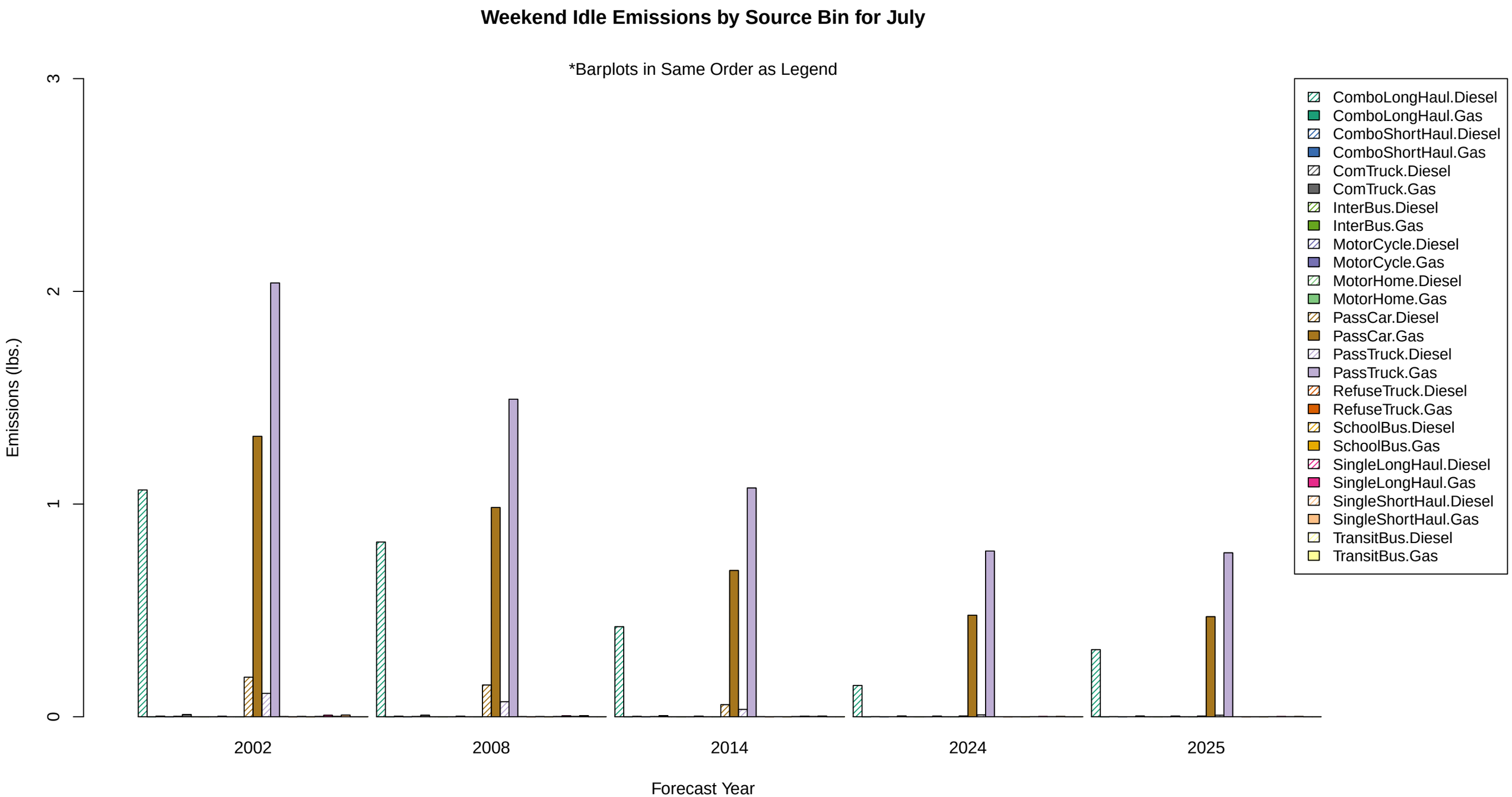
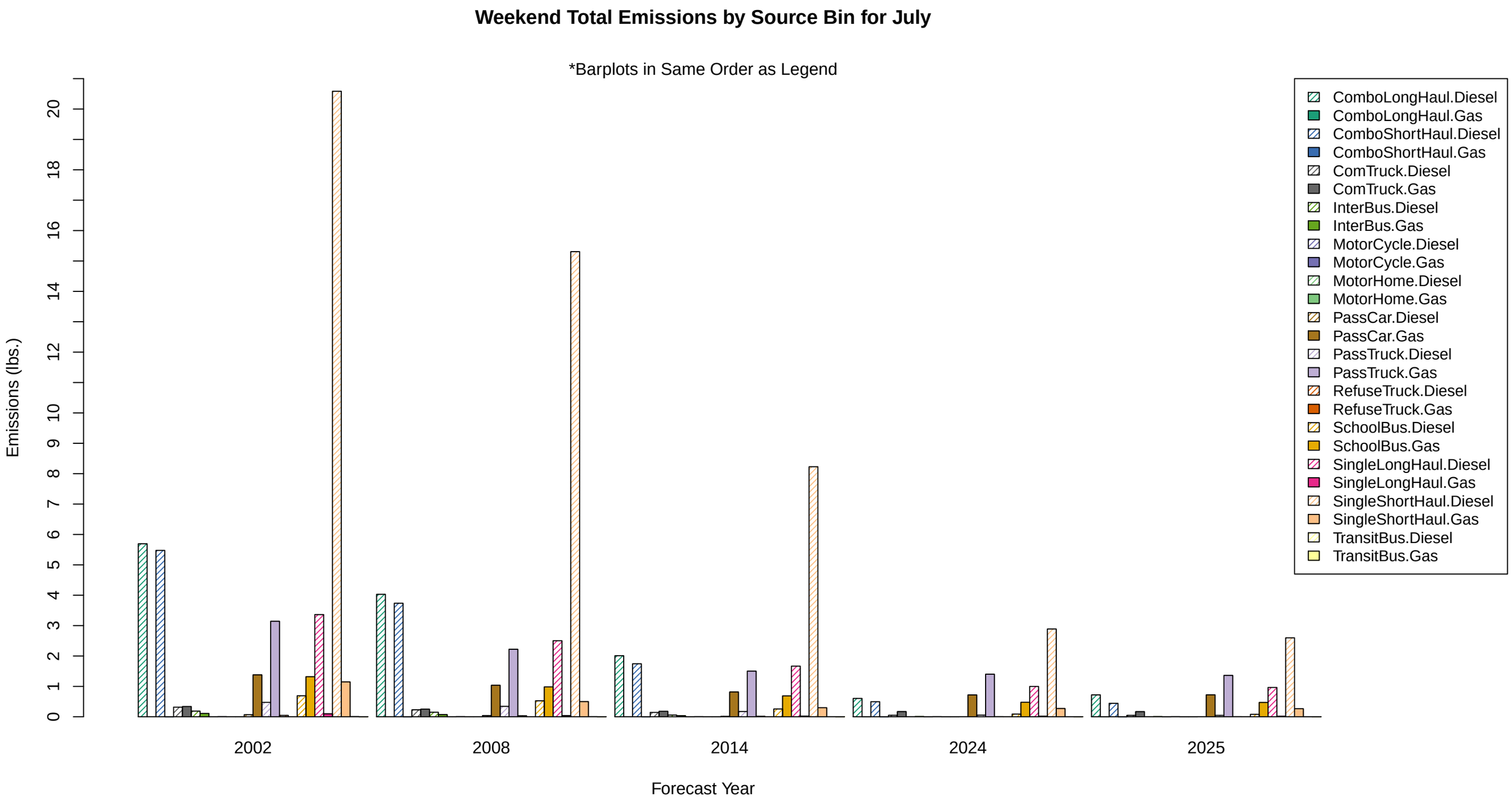
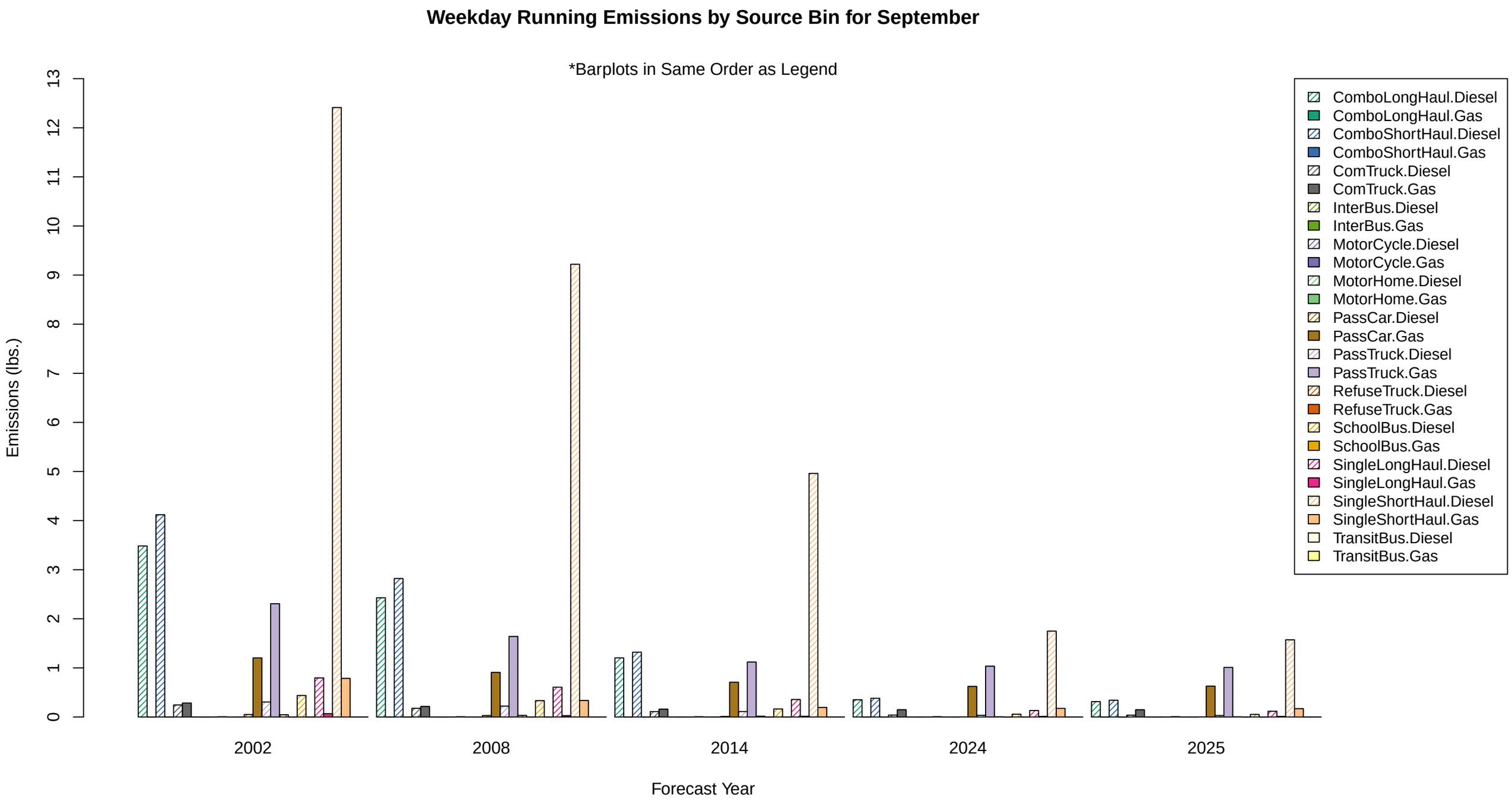
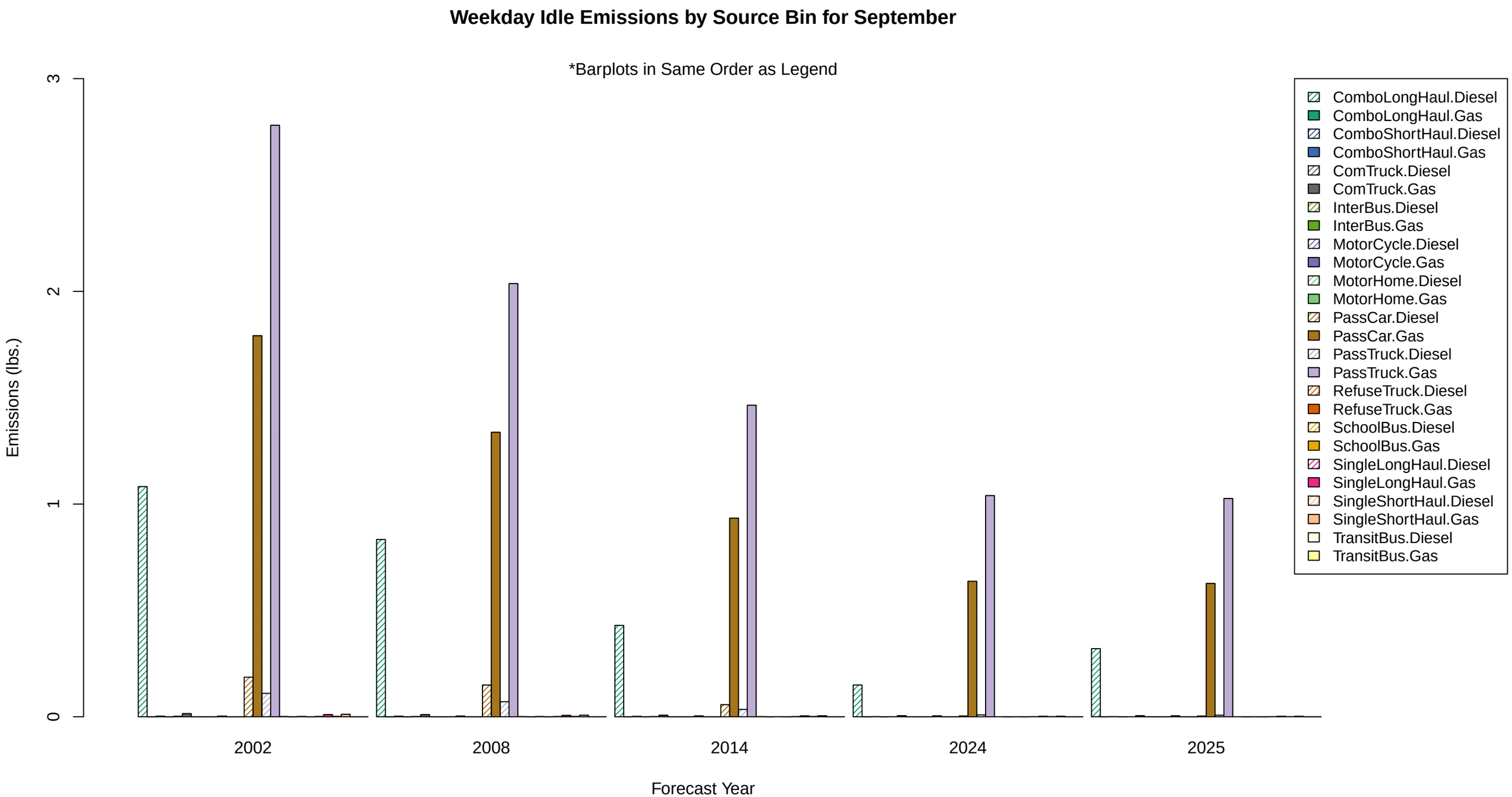
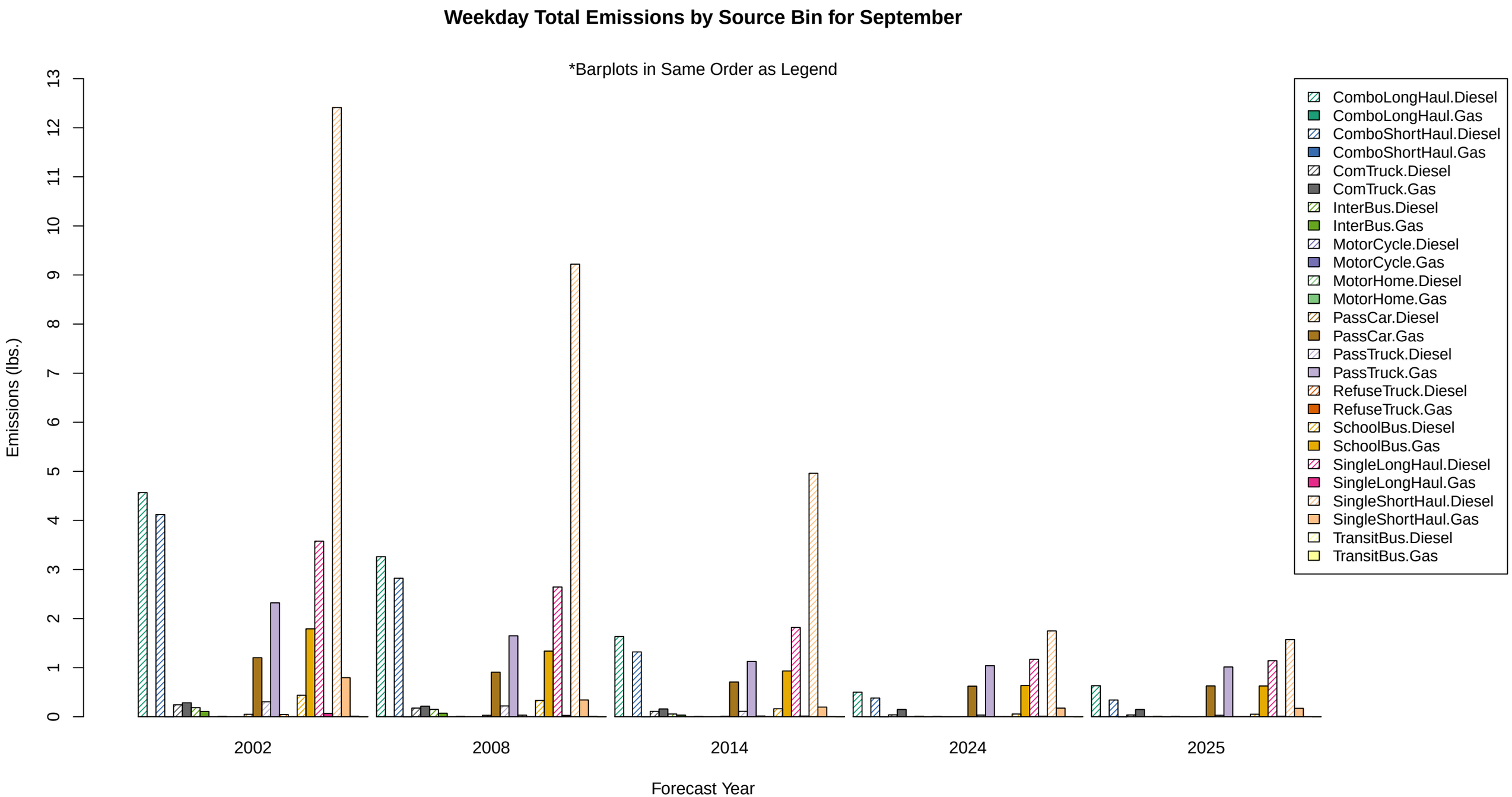
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekend Idle Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekend Total Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
5
6
7
8
9
10
12
14
16
18
20
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekday Running Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekday Idle Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekday Total Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
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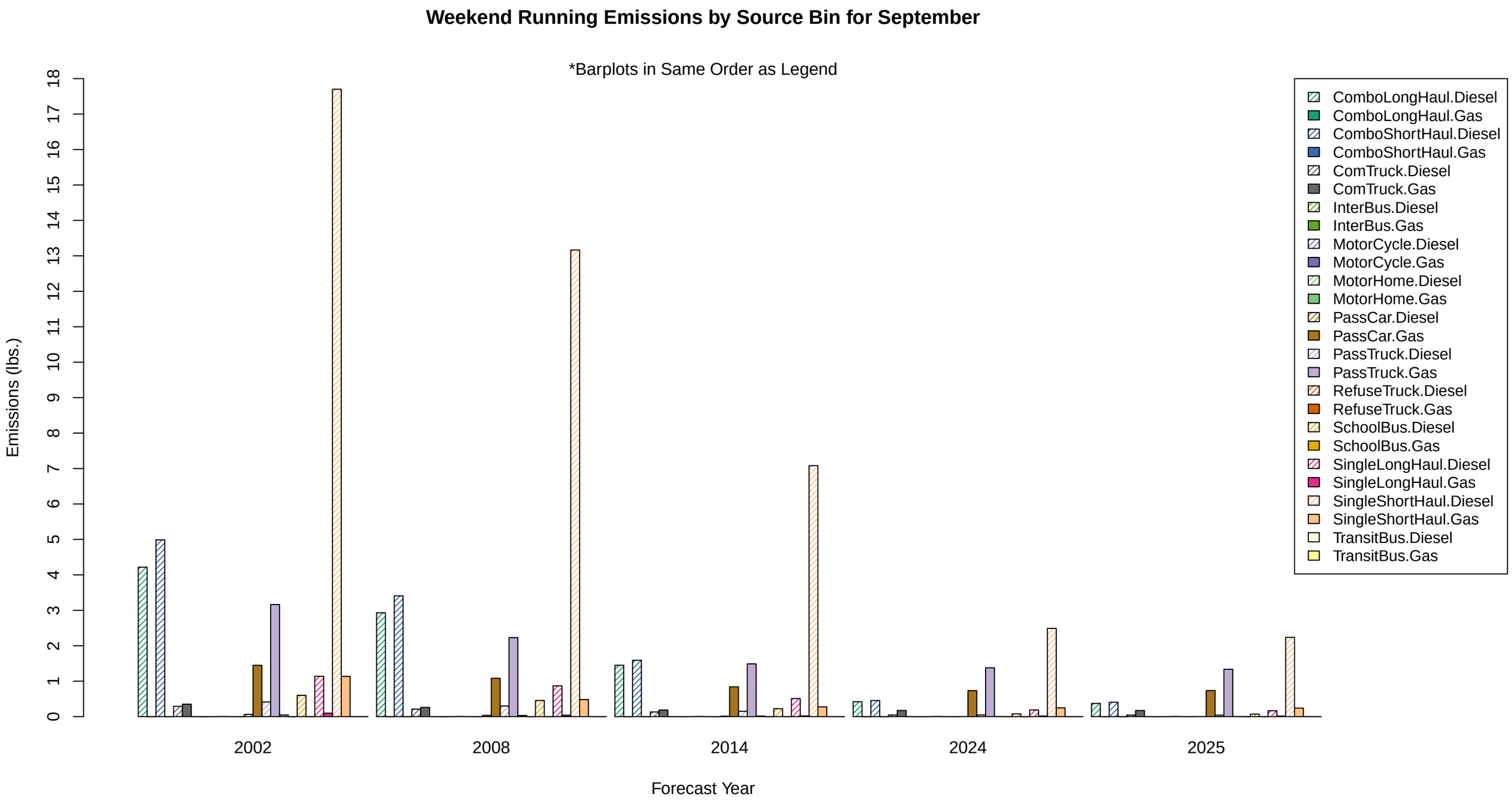
11
12
13
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekend Running Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
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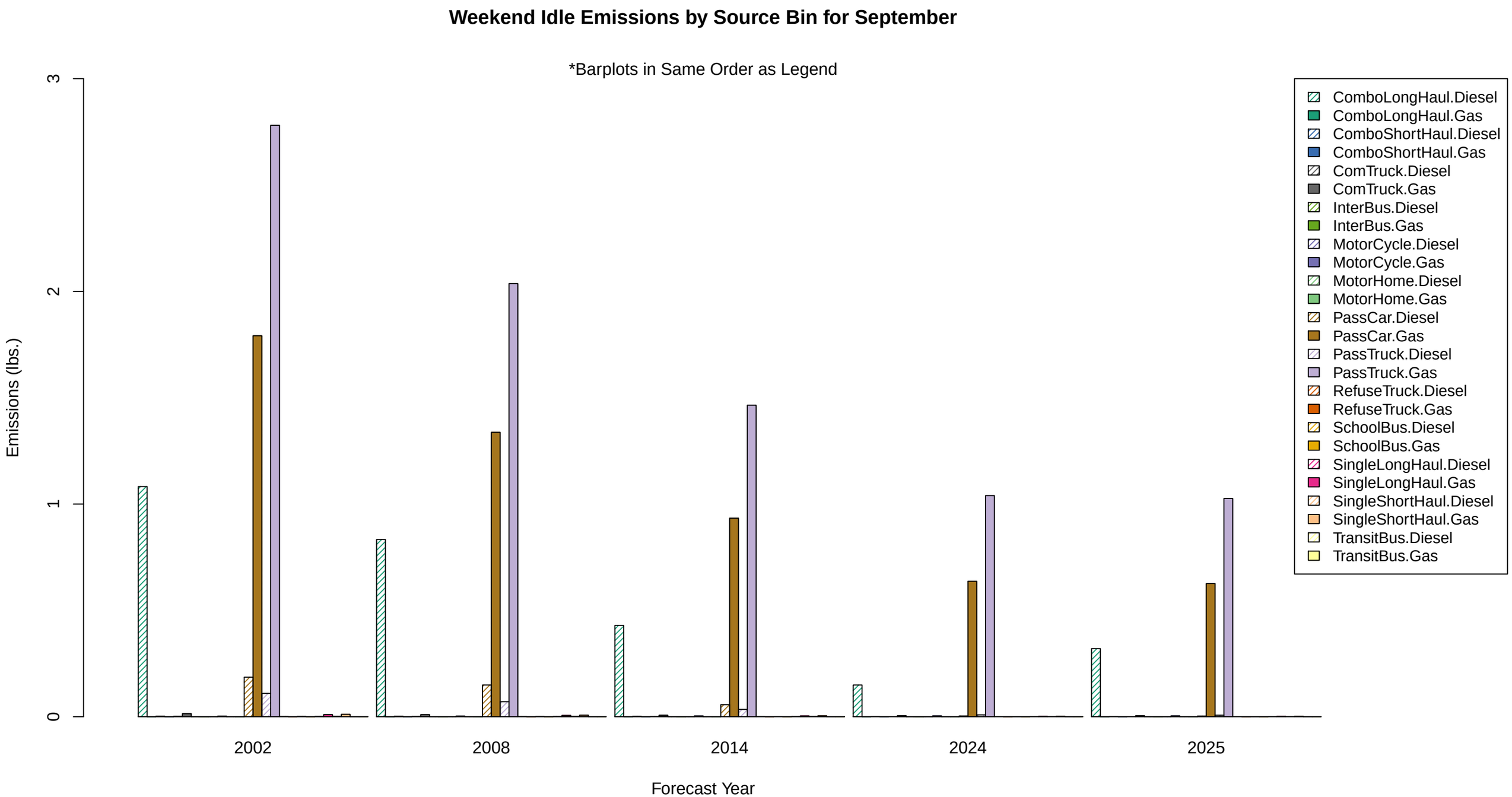
18
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekend Idle Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
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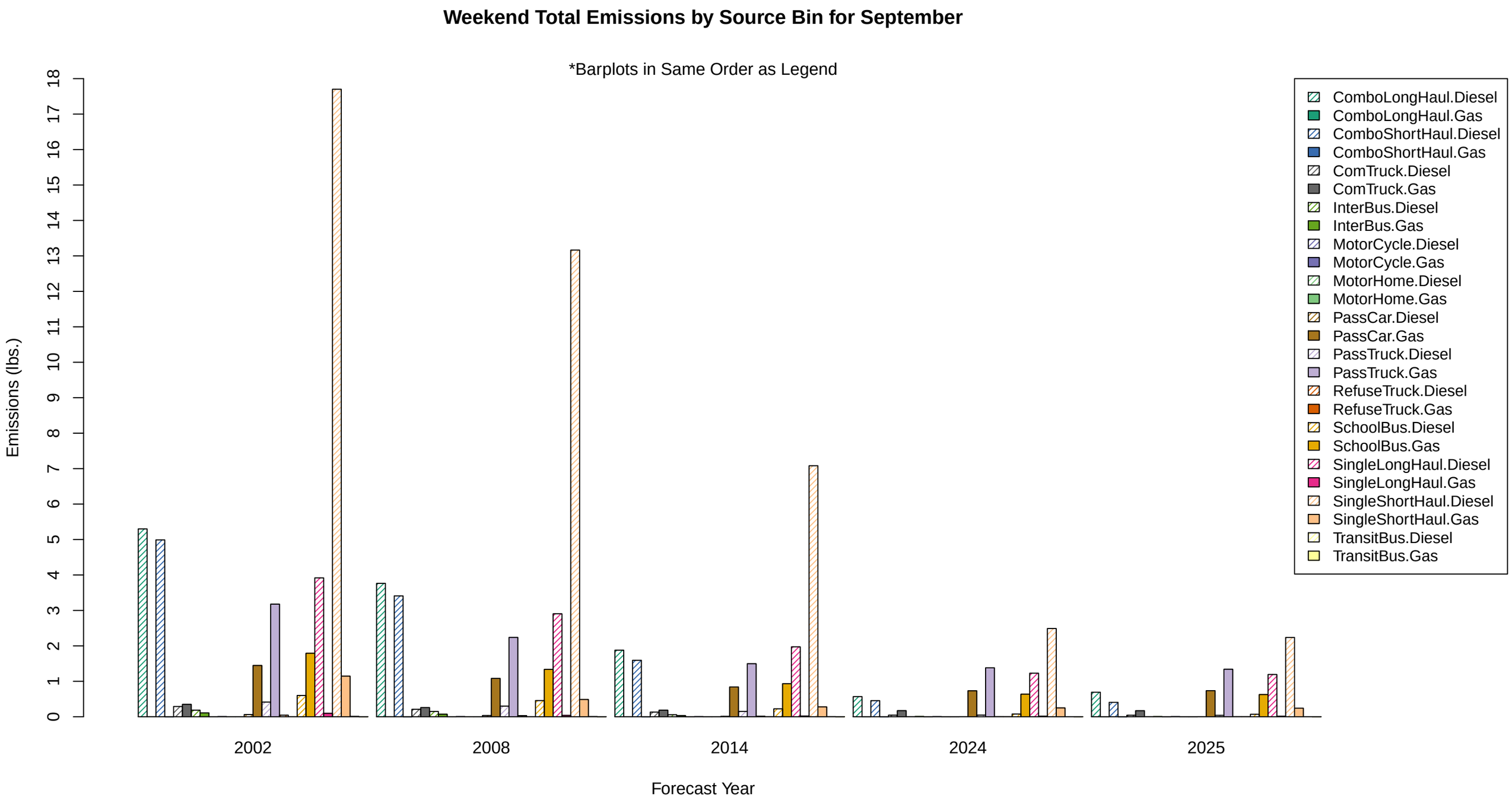
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekend Total Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
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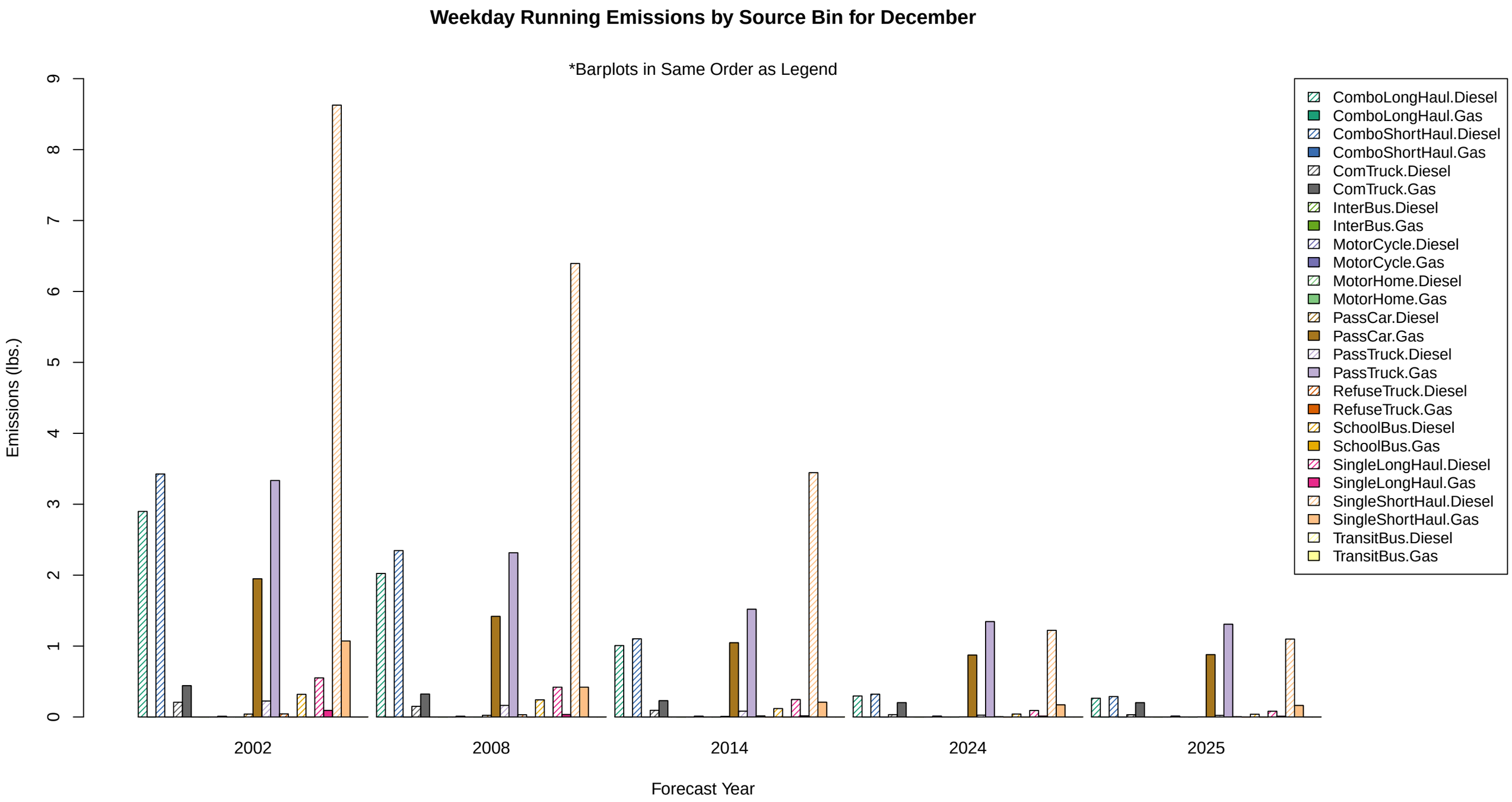
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekday Running Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
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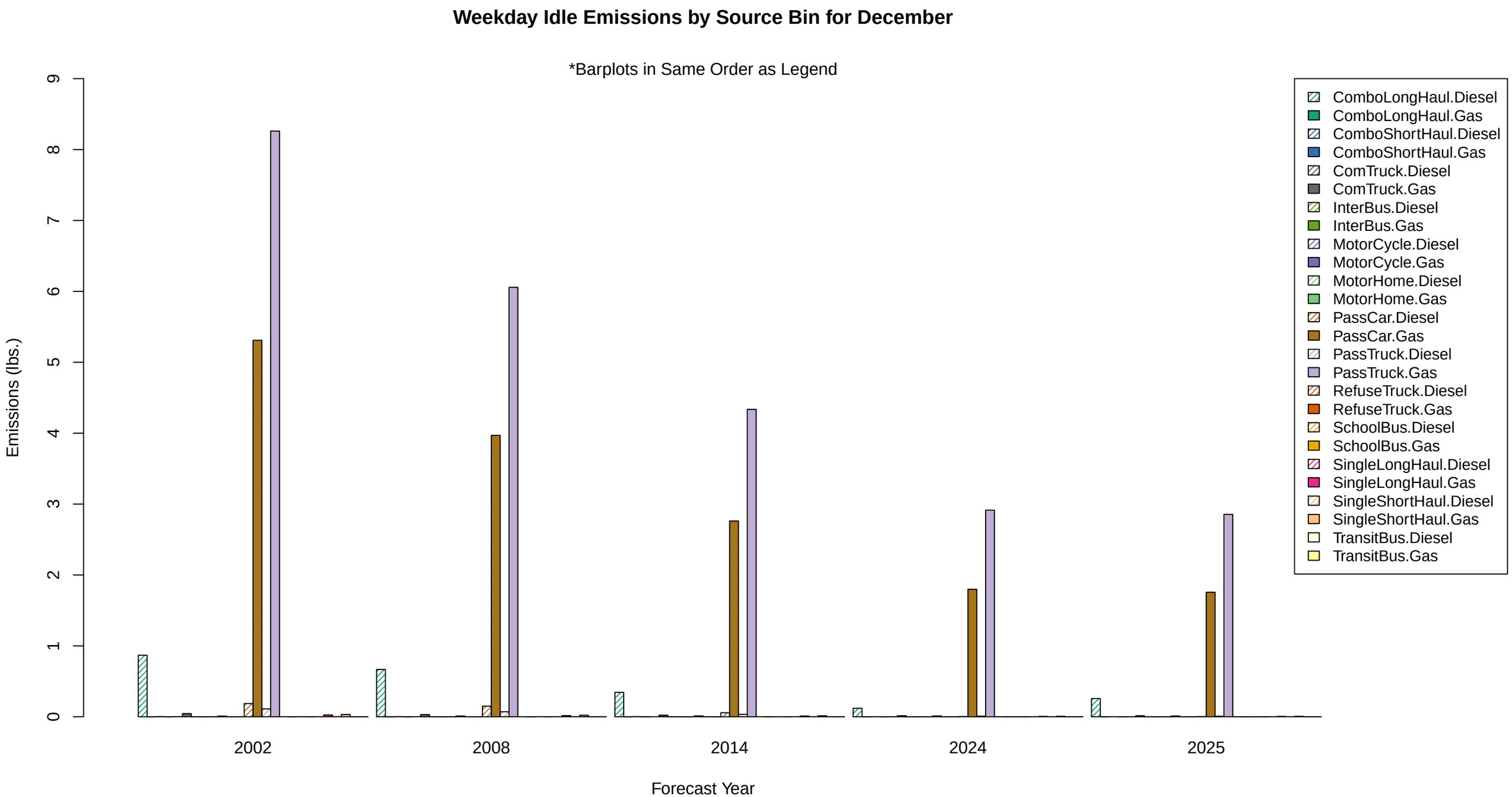
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekday Idle Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
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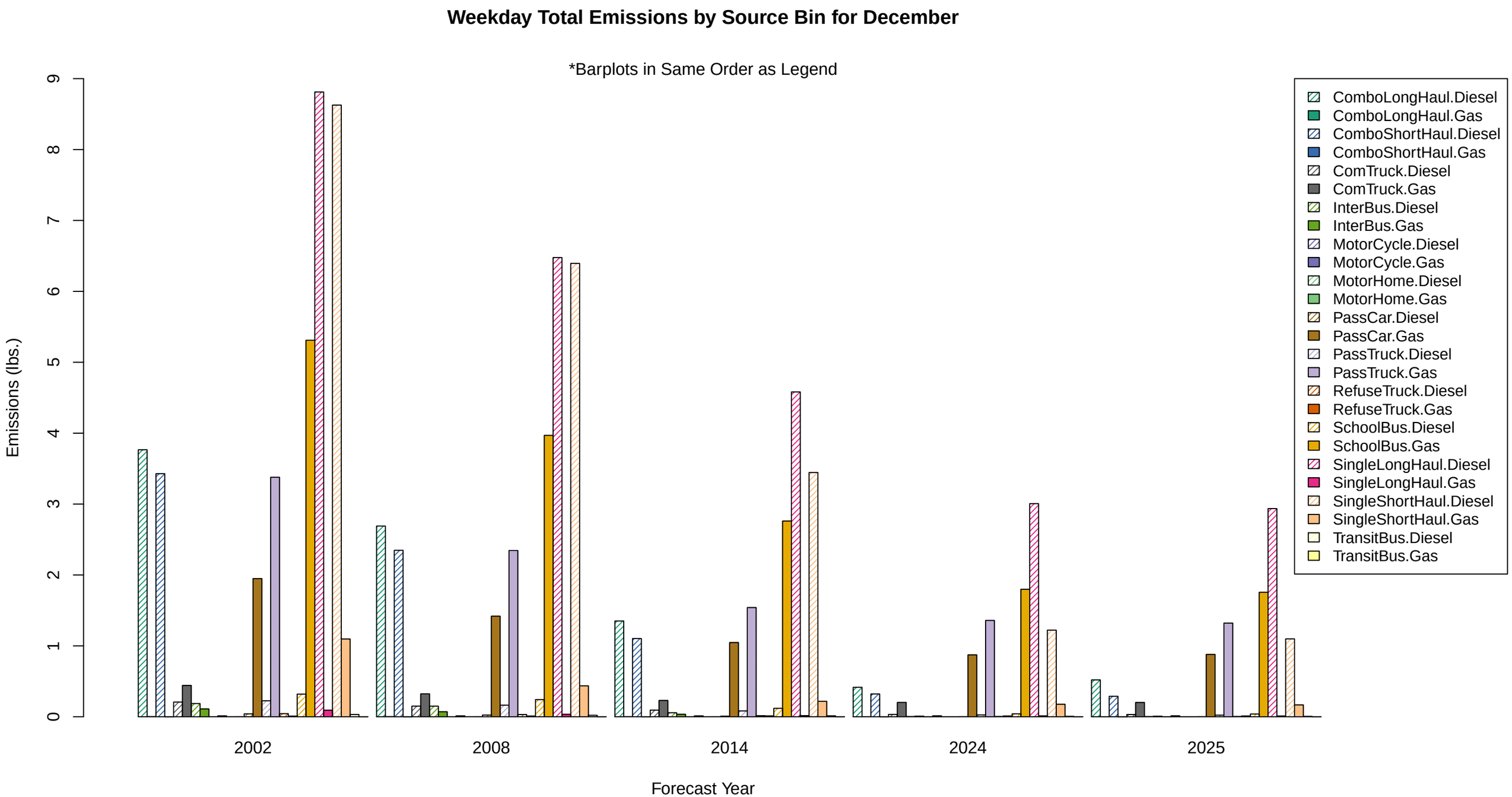
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekday Total Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
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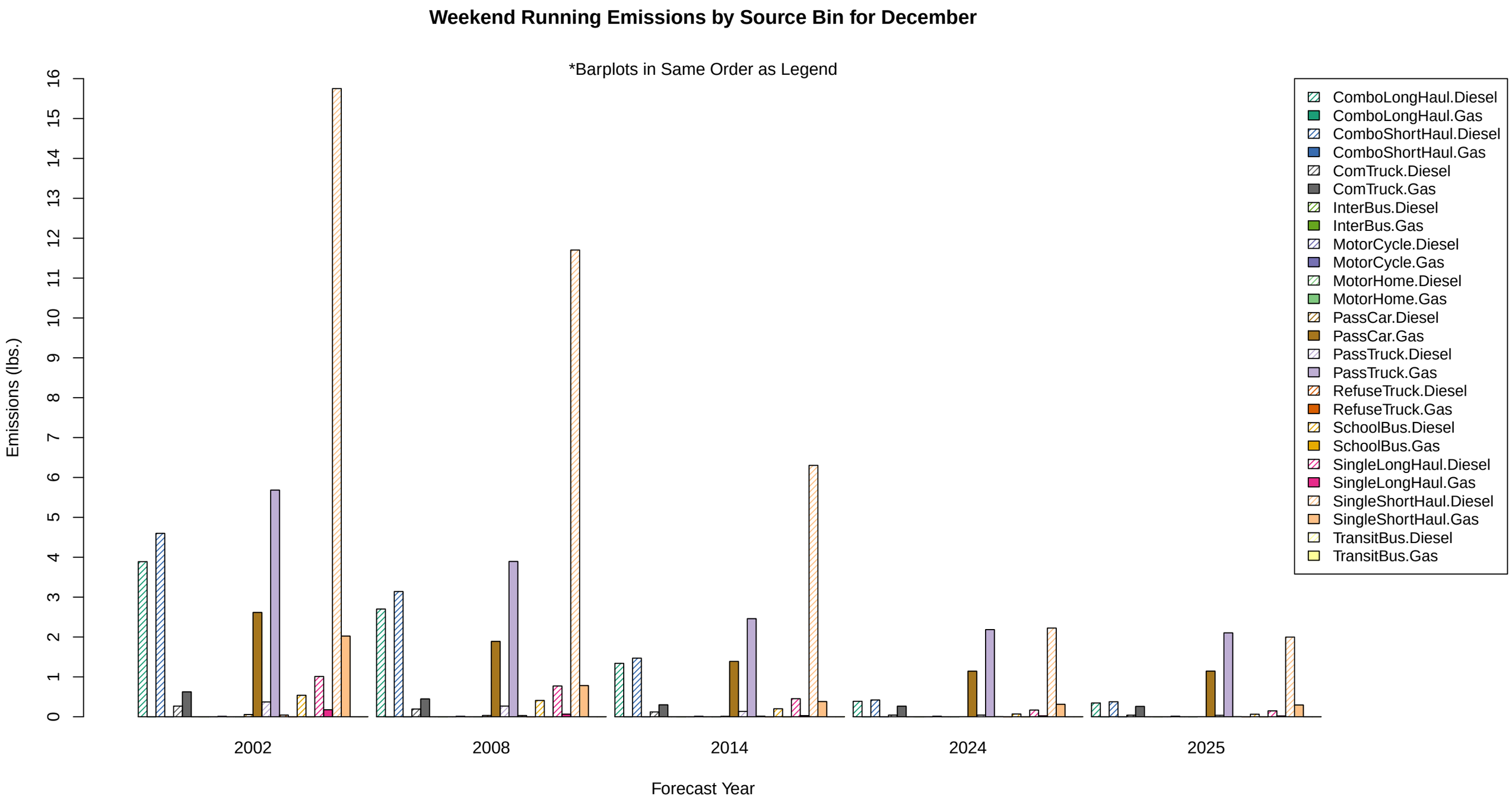
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekend Running Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
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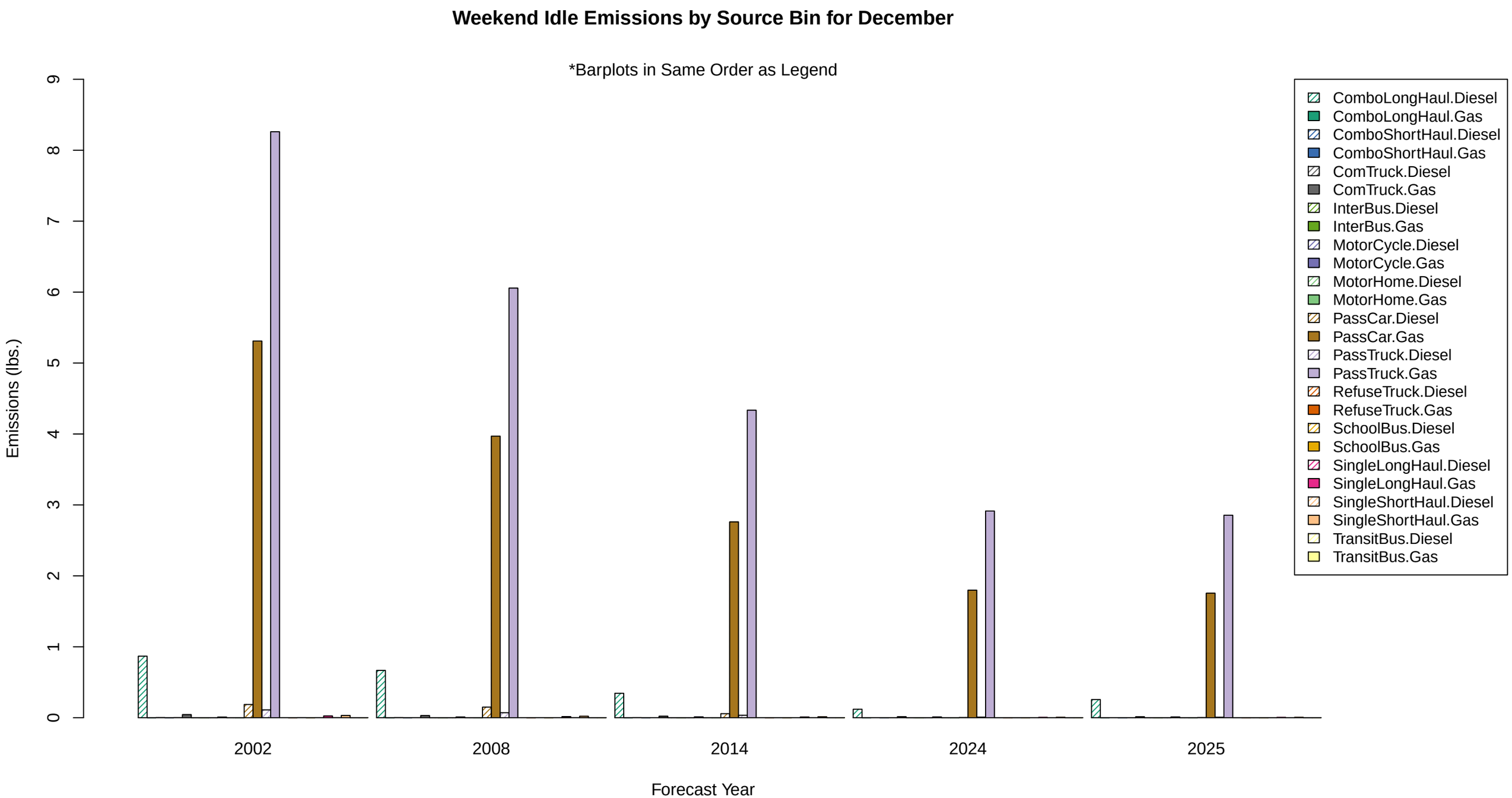
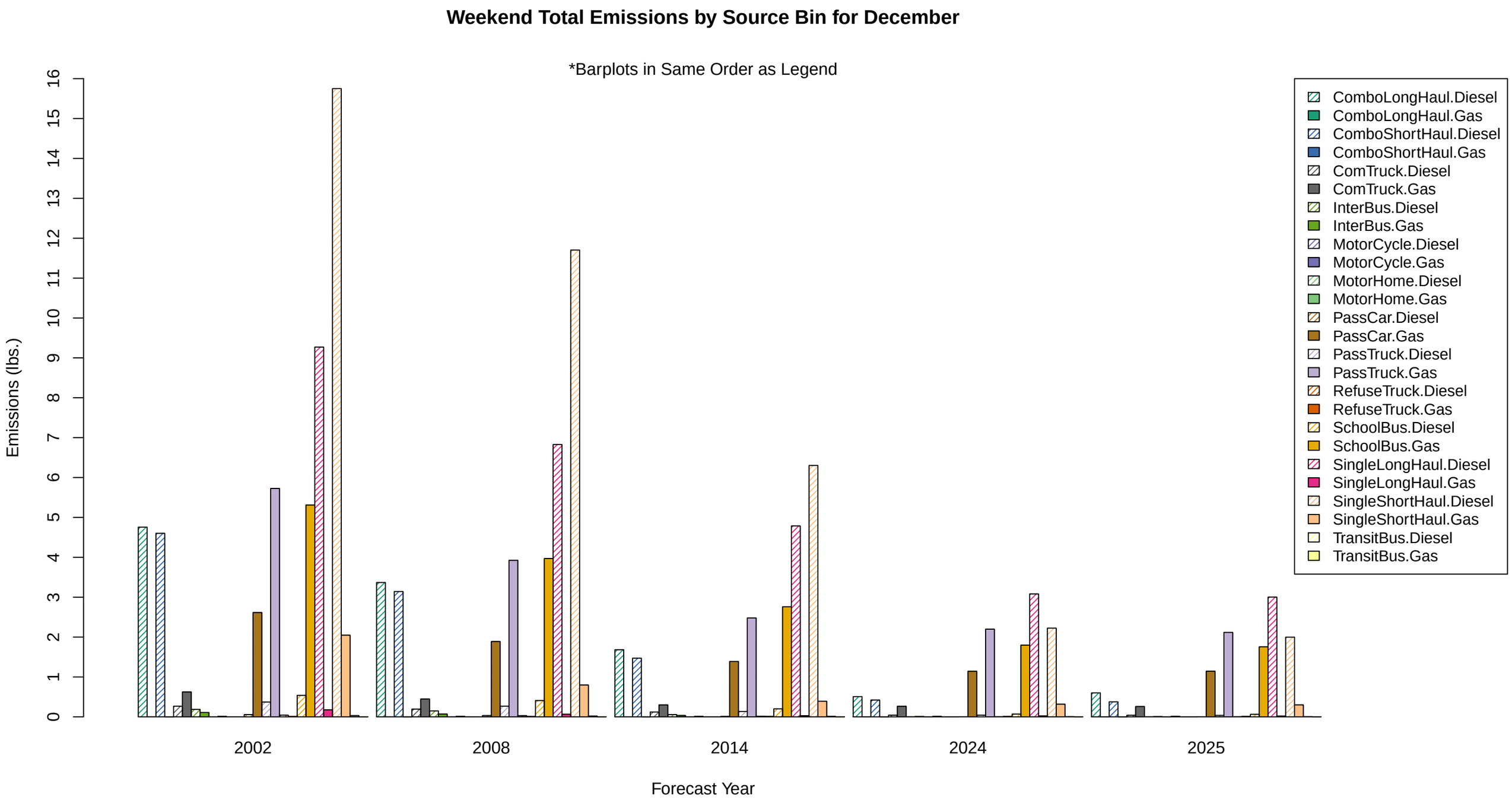
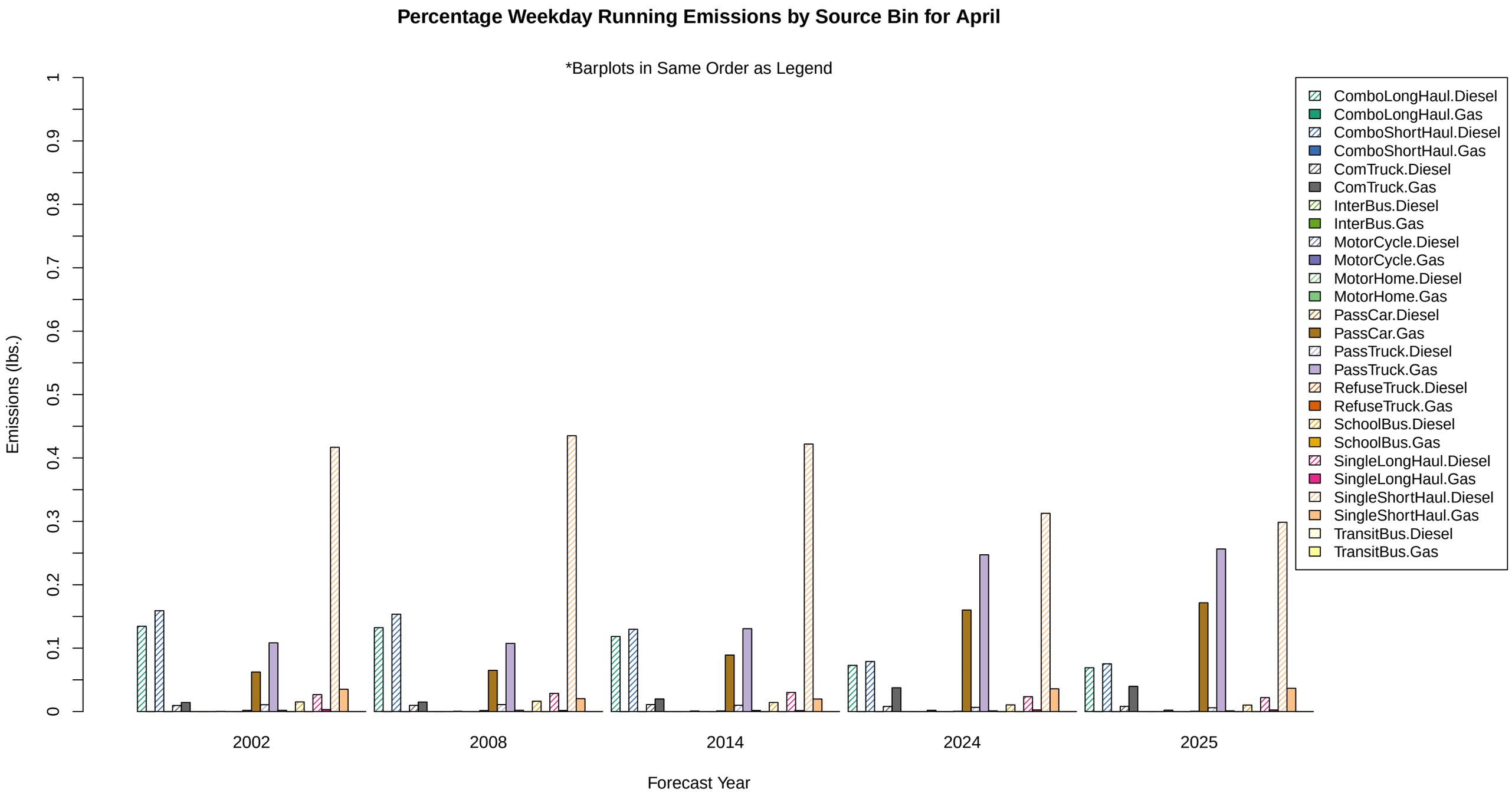
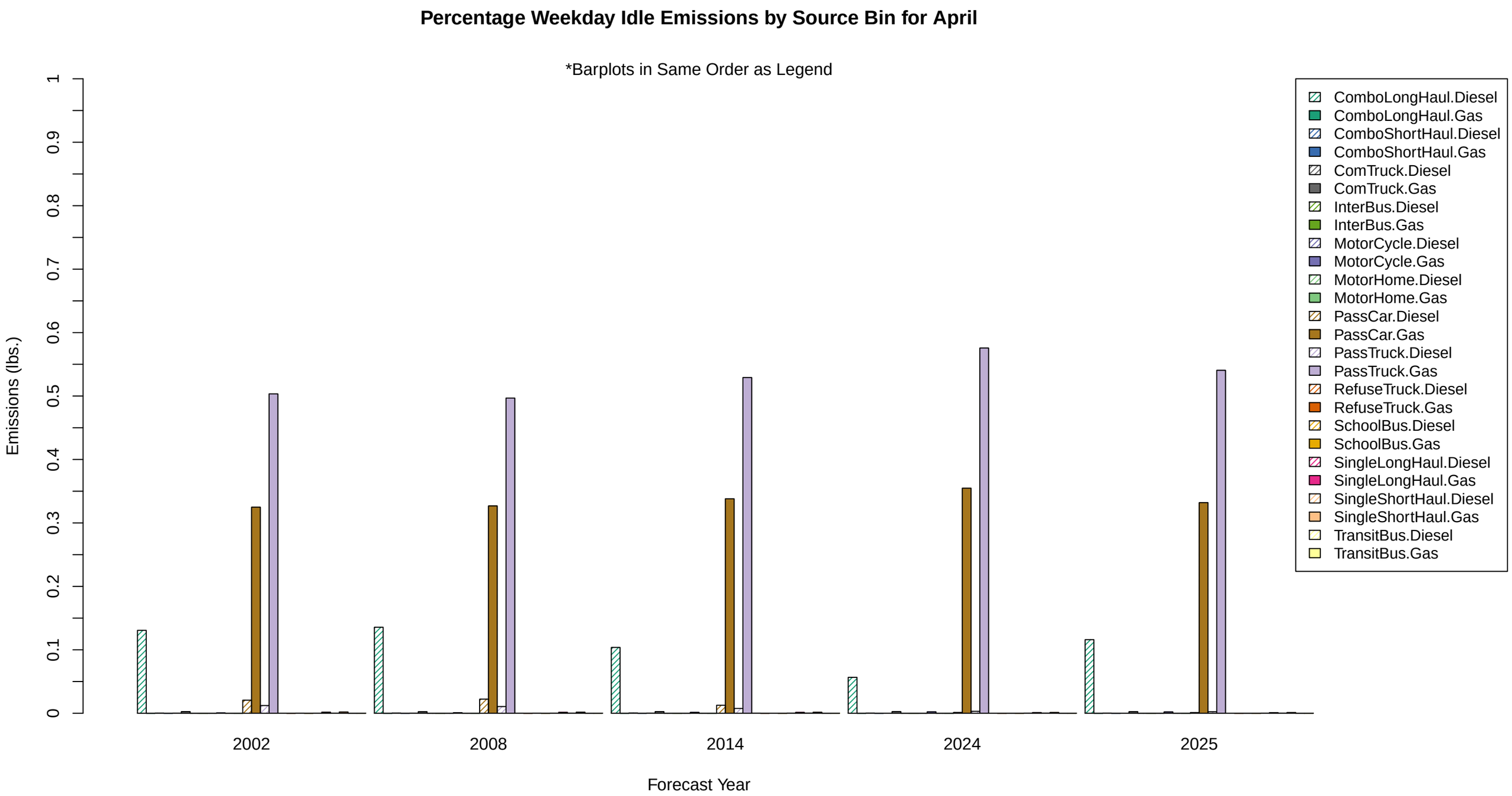
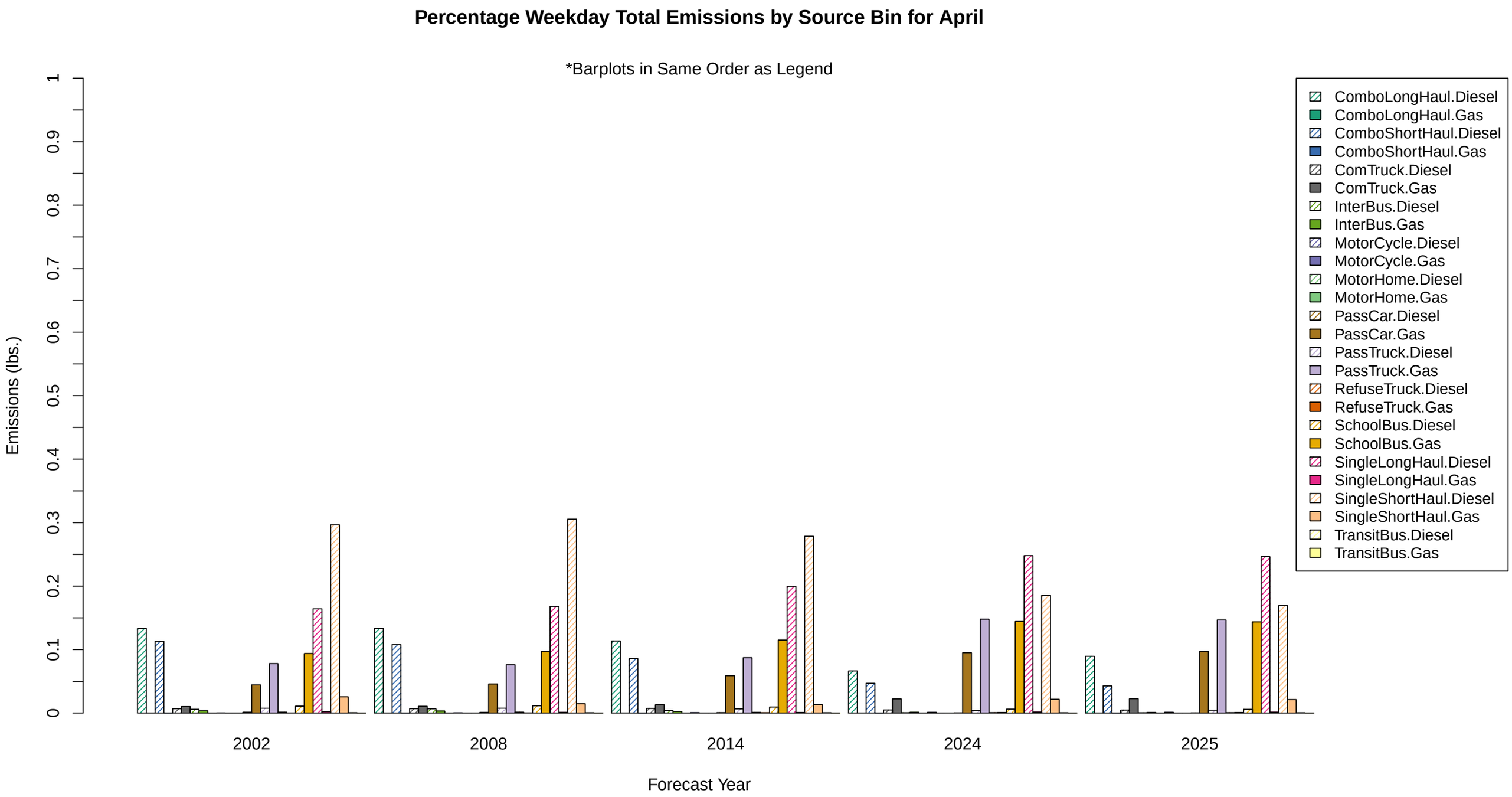
14
15
16
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

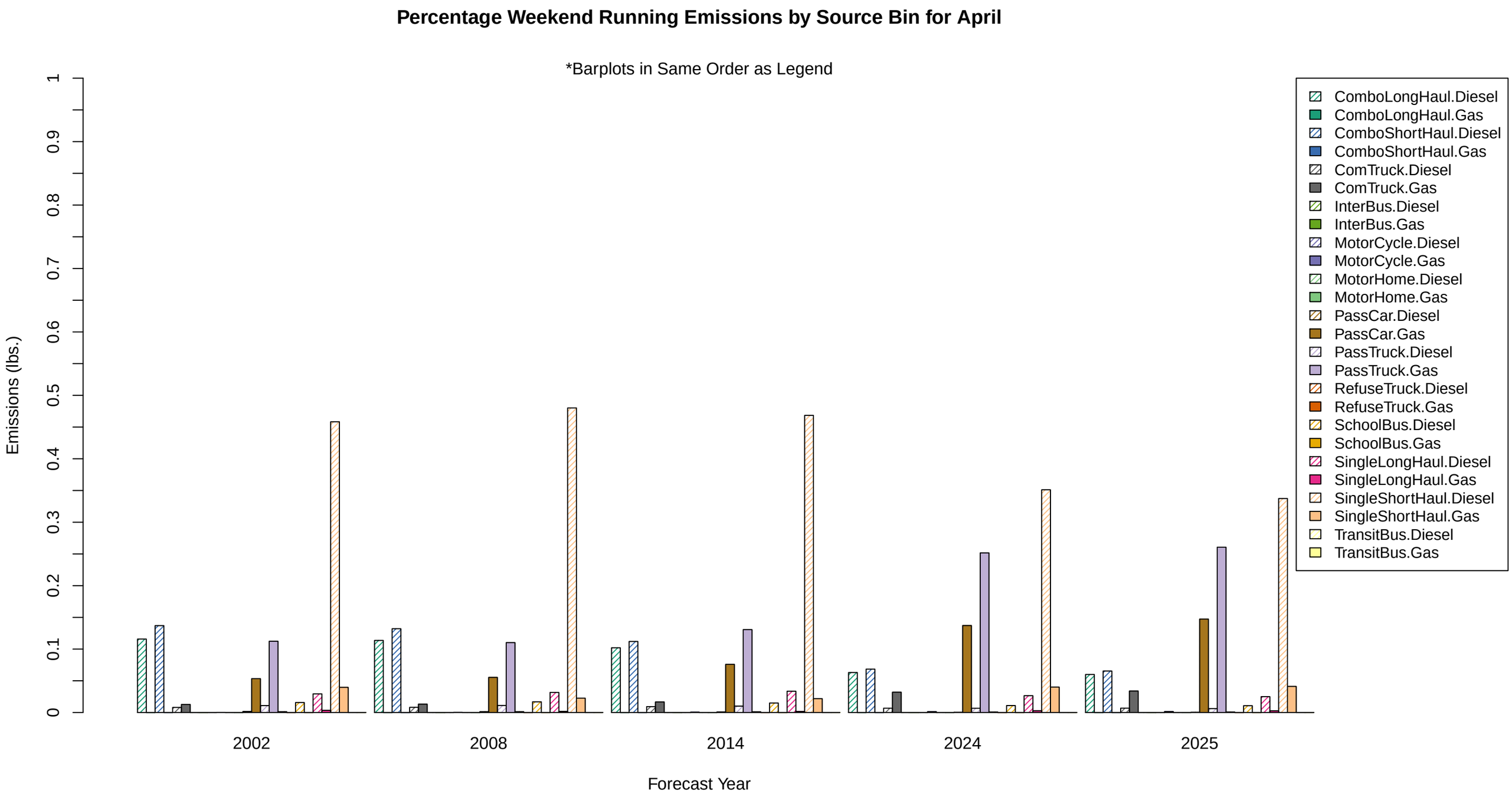

Weekend Idle Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
5
6
7
8
9
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

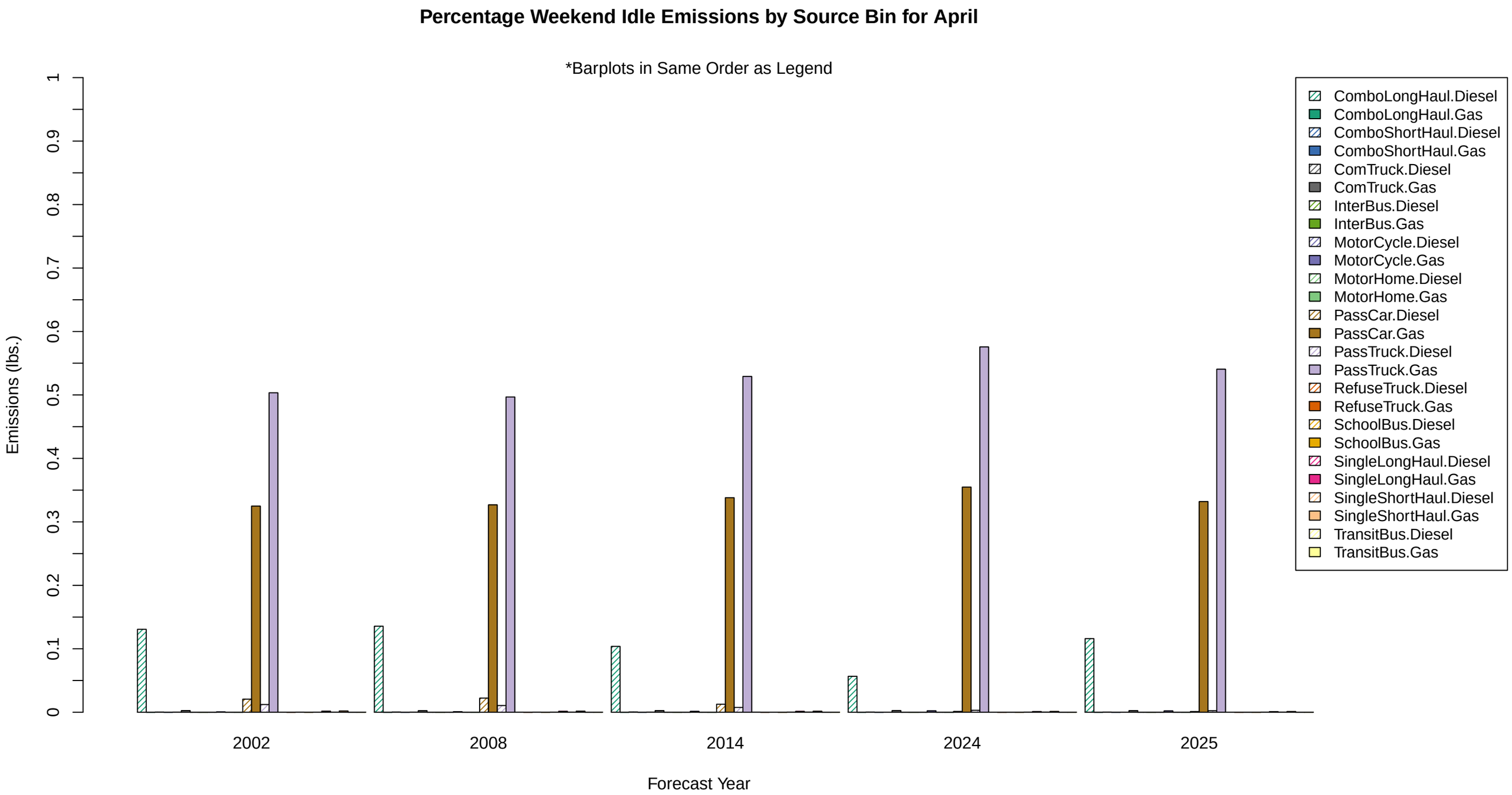

Weekend Total Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Running Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Idle Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Total Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Running Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Idle Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
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ComboShortHaul.Gas
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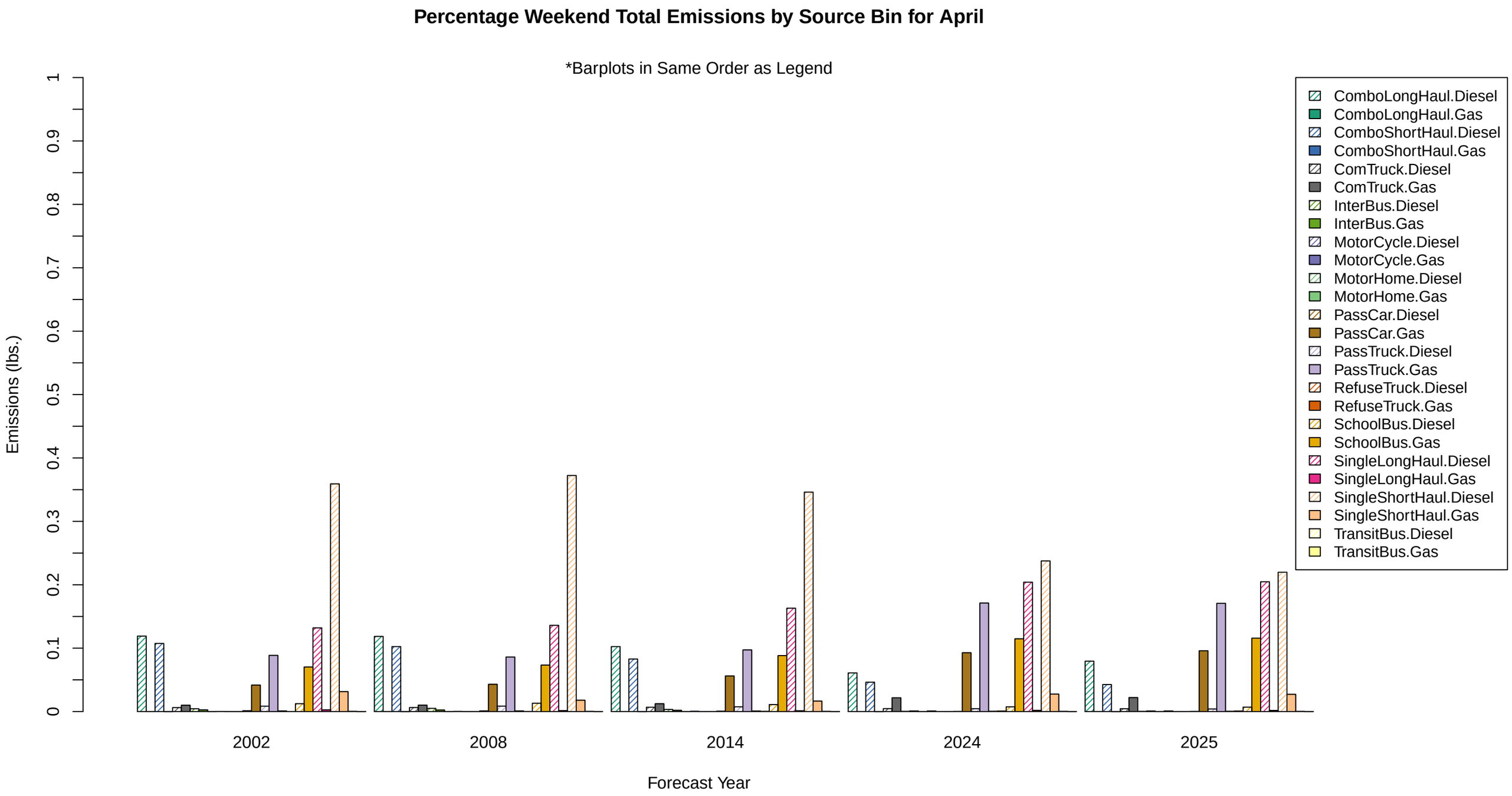
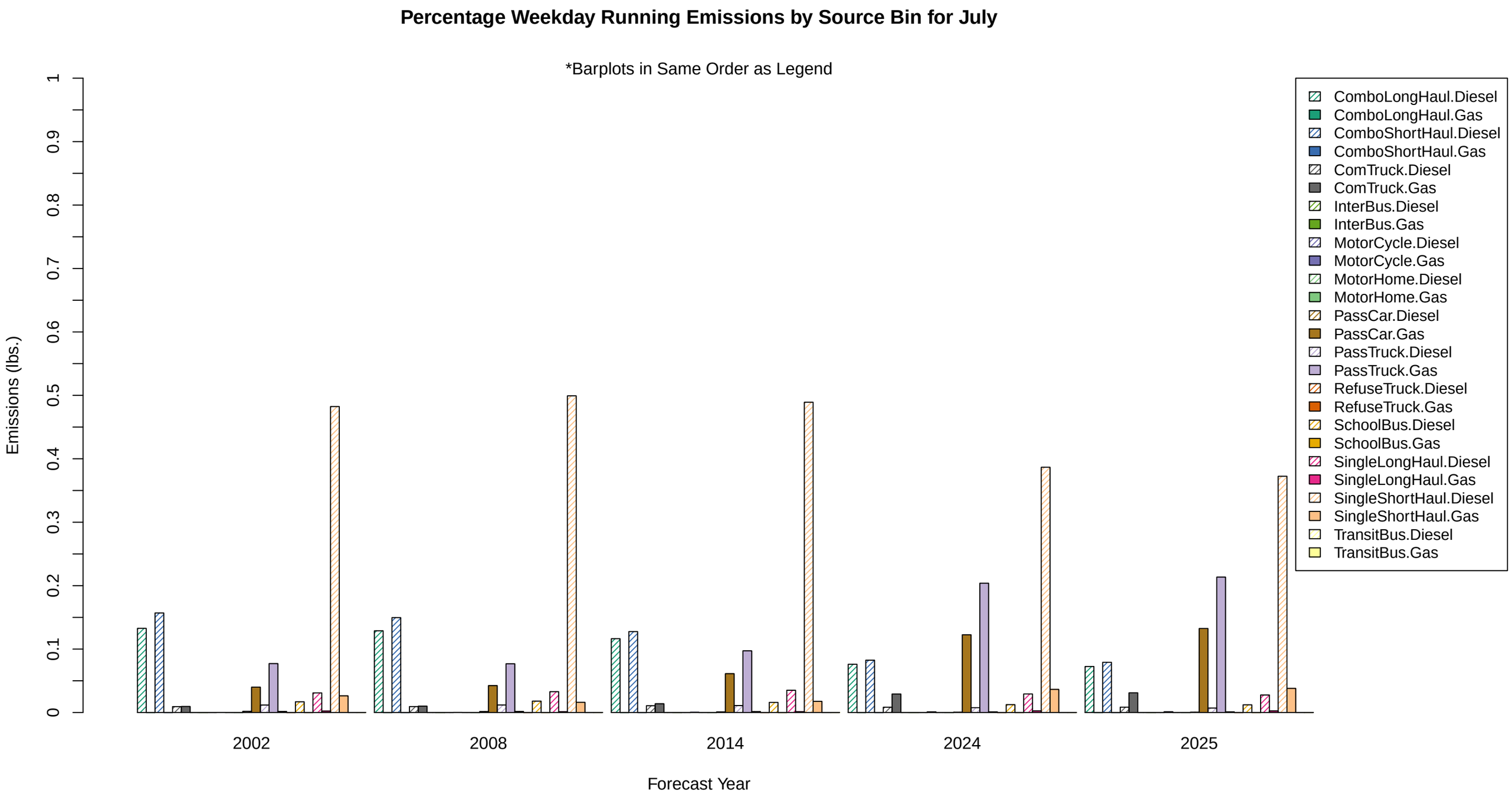
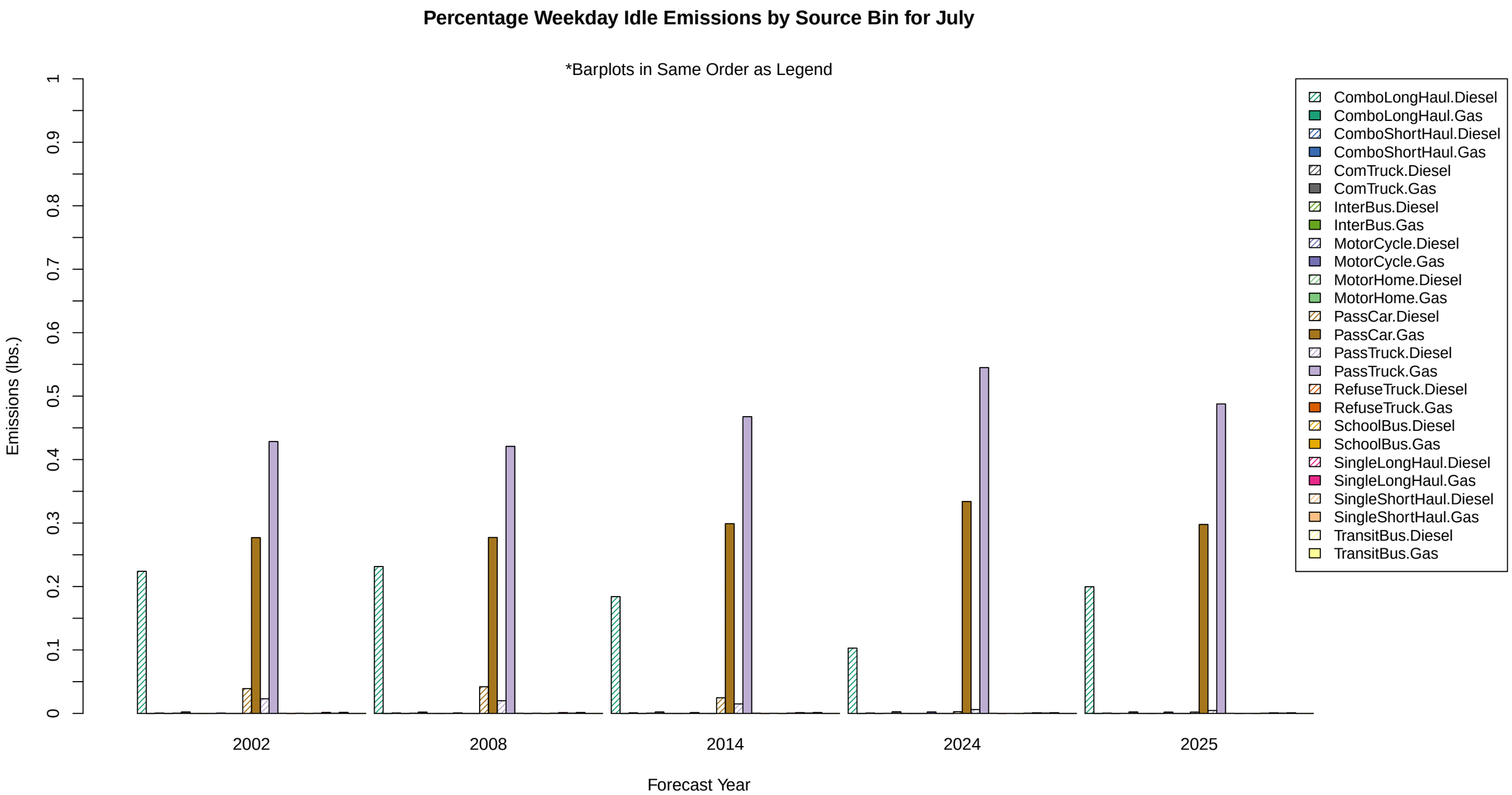
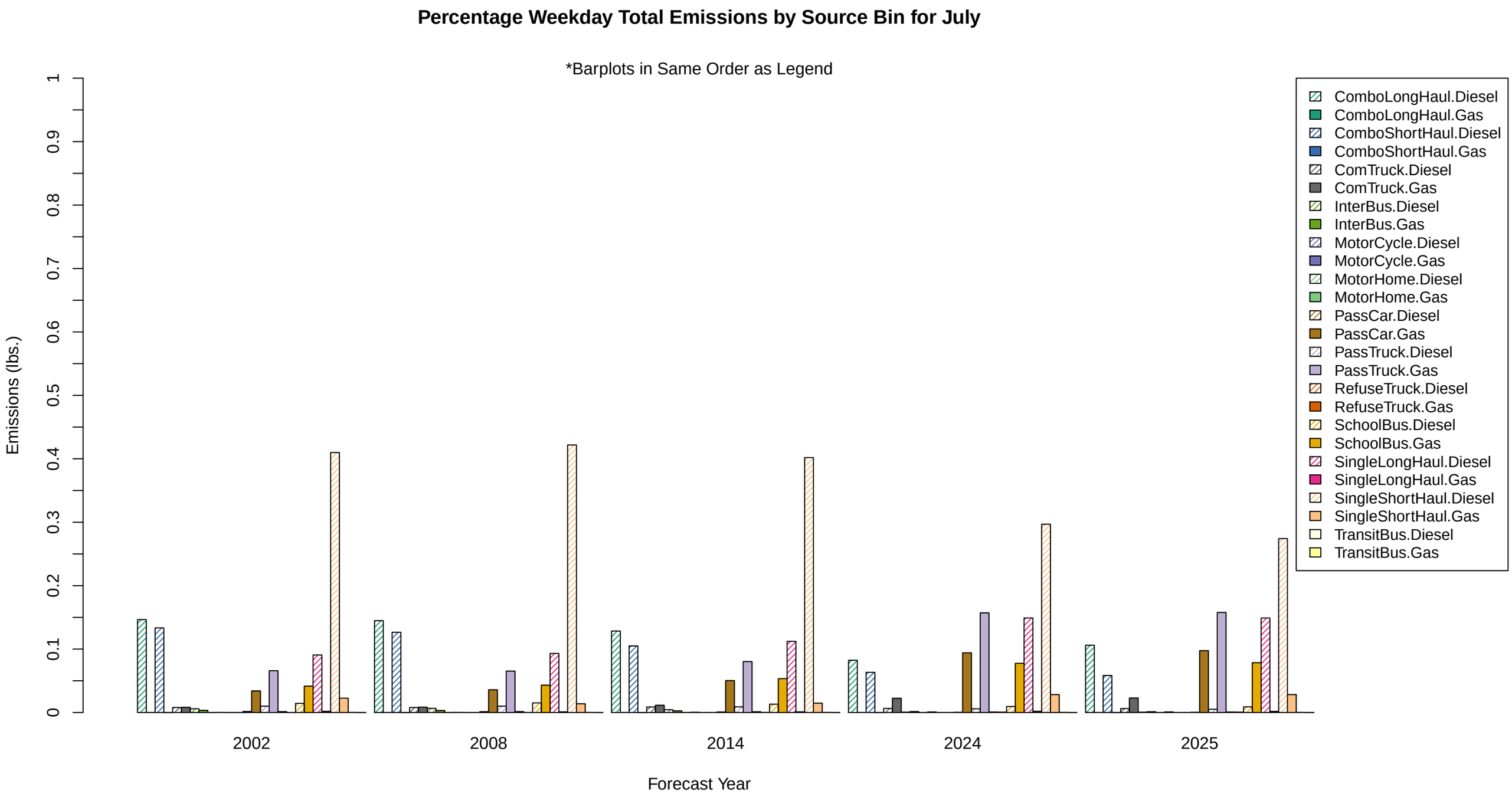
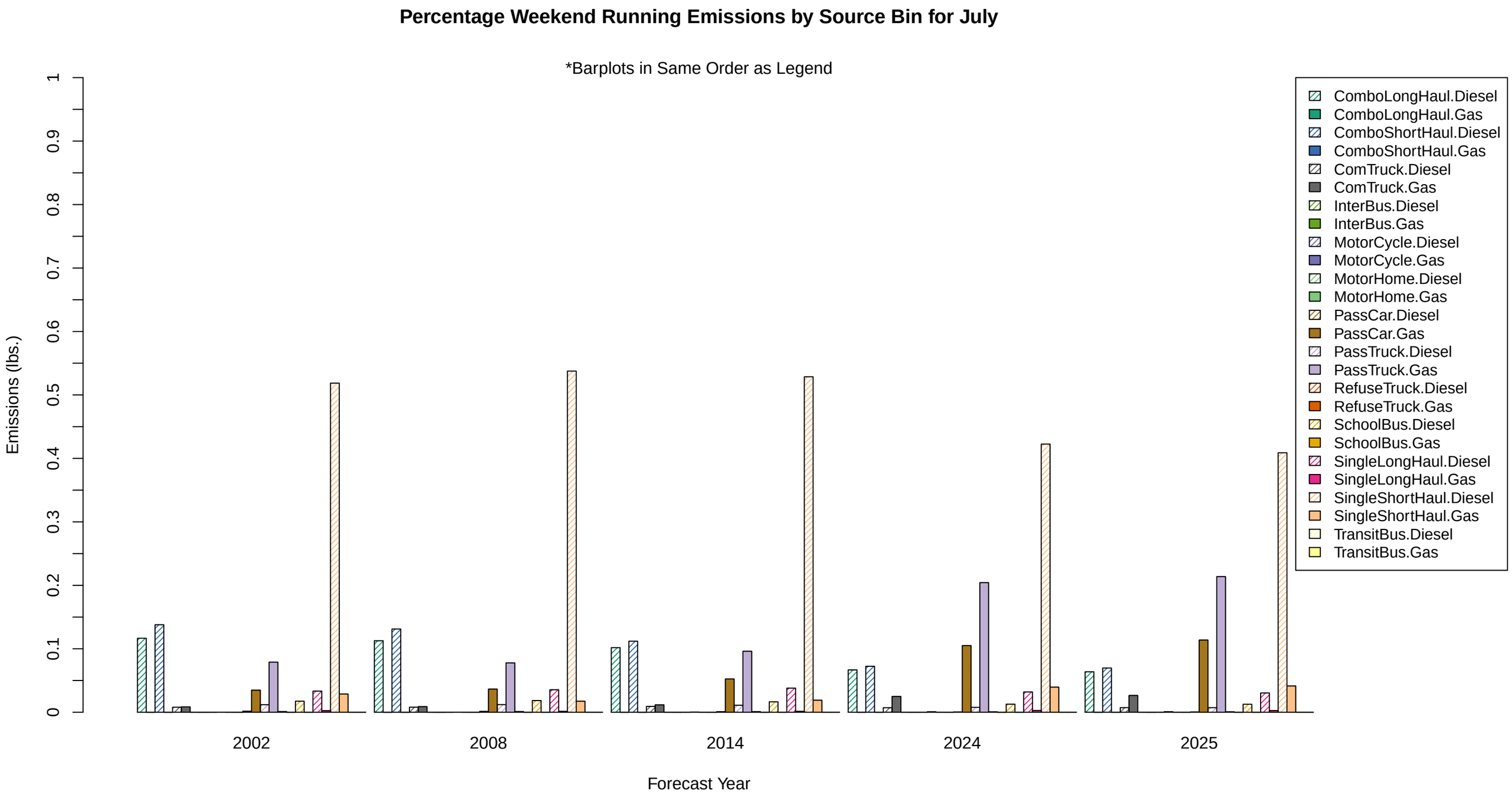
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

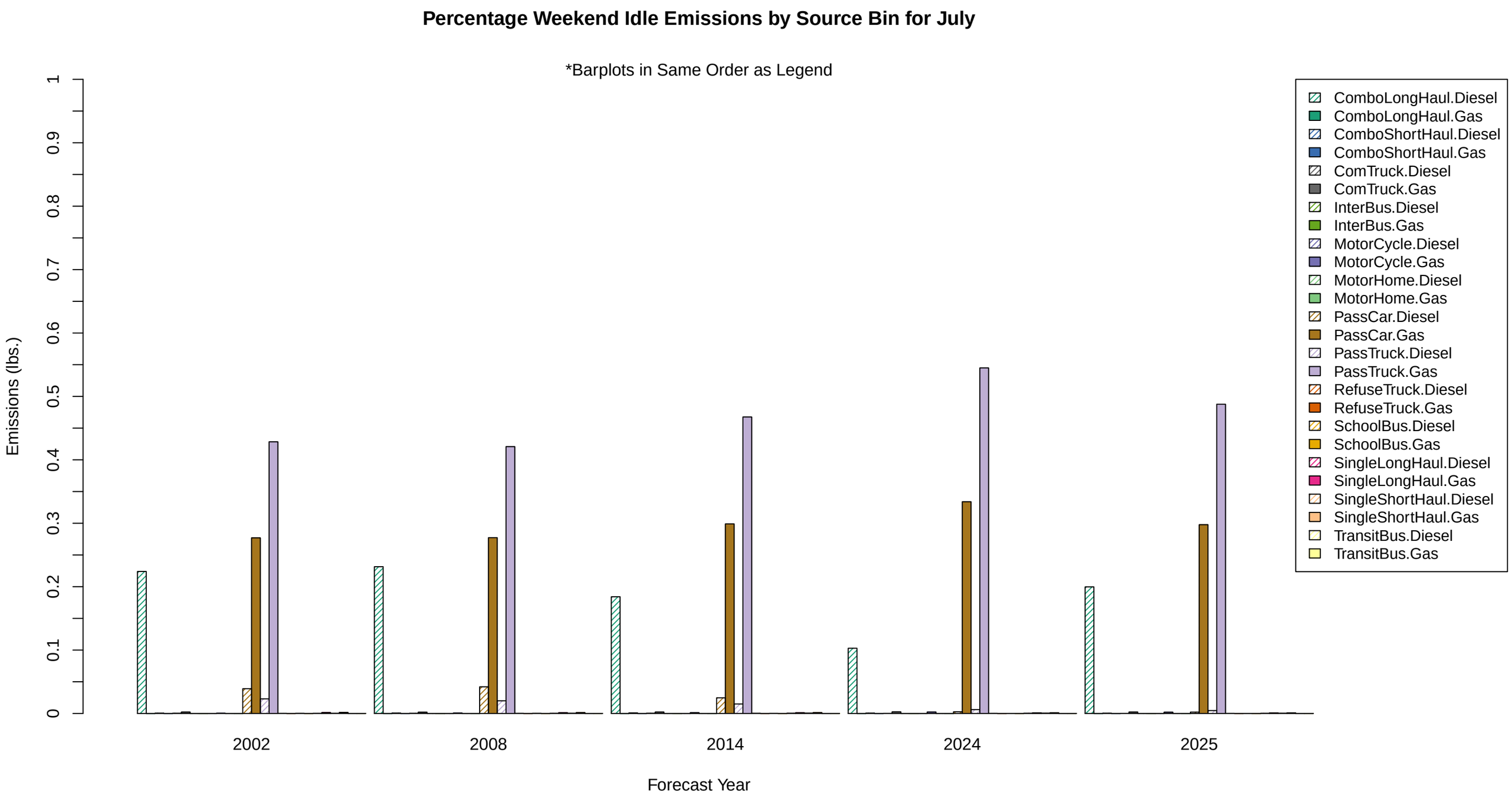

Percentage Weekend Total Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Running Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Idle Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Total Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Running Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Idle Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
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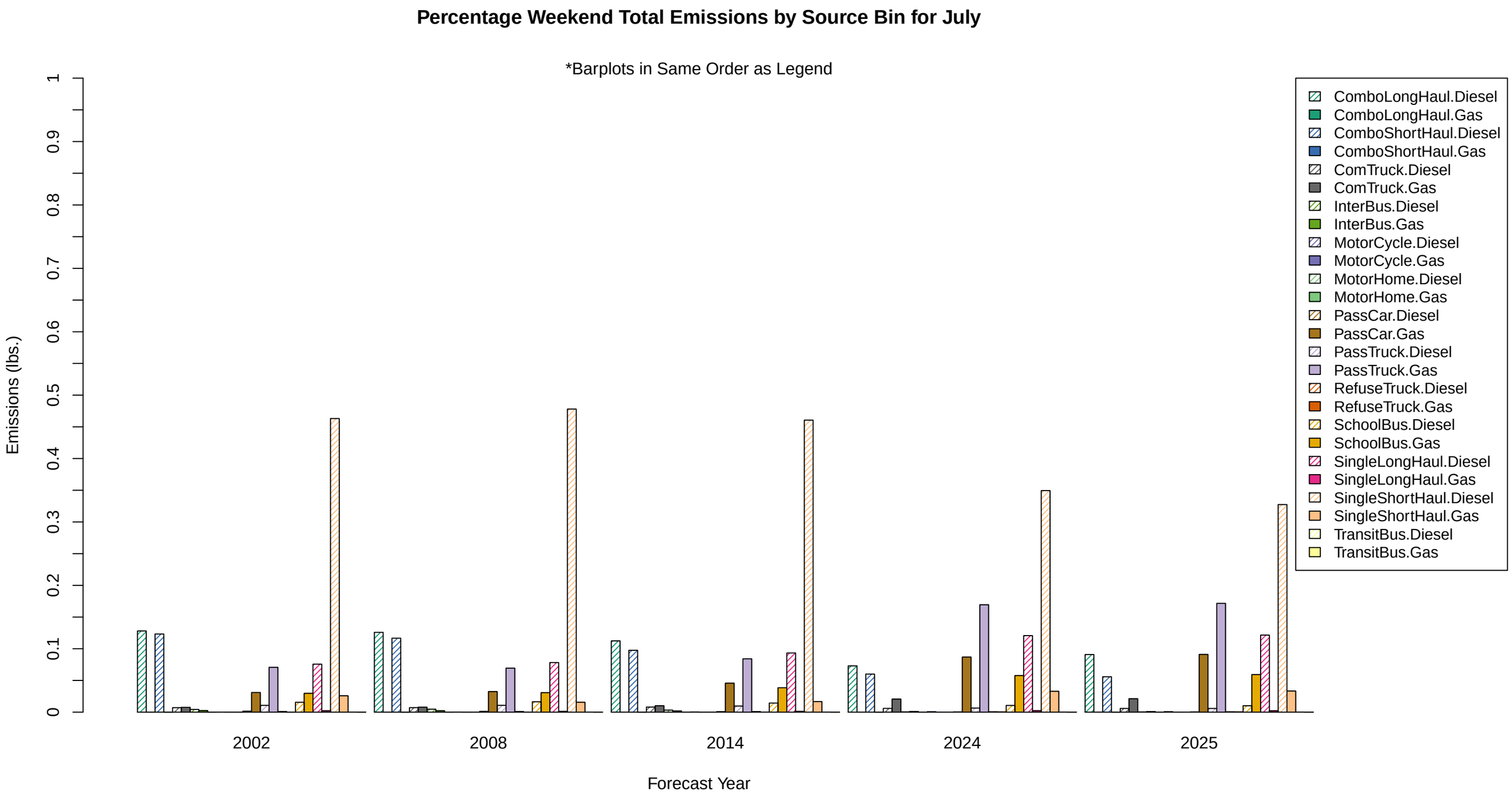
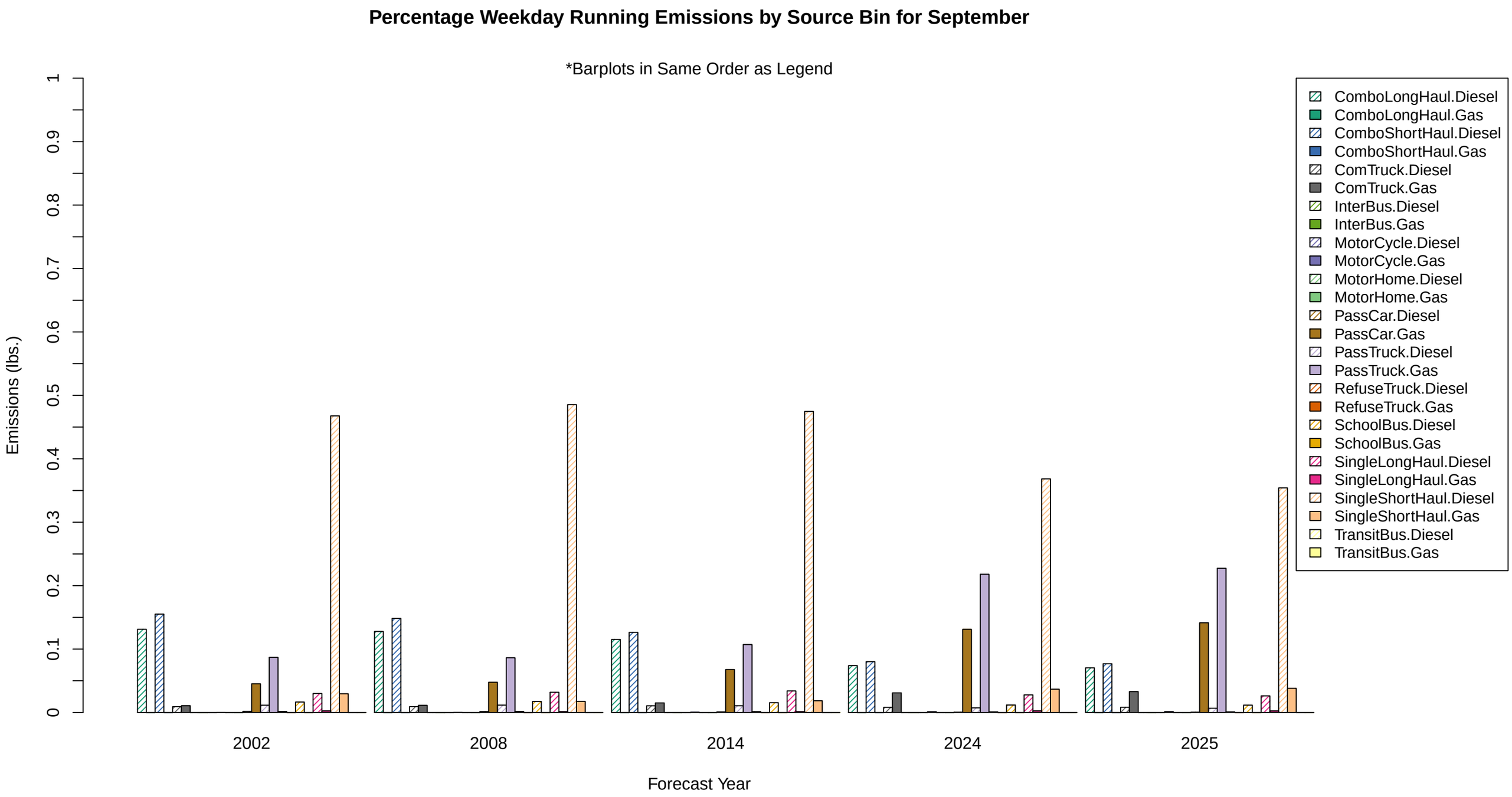
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Total Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Running Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
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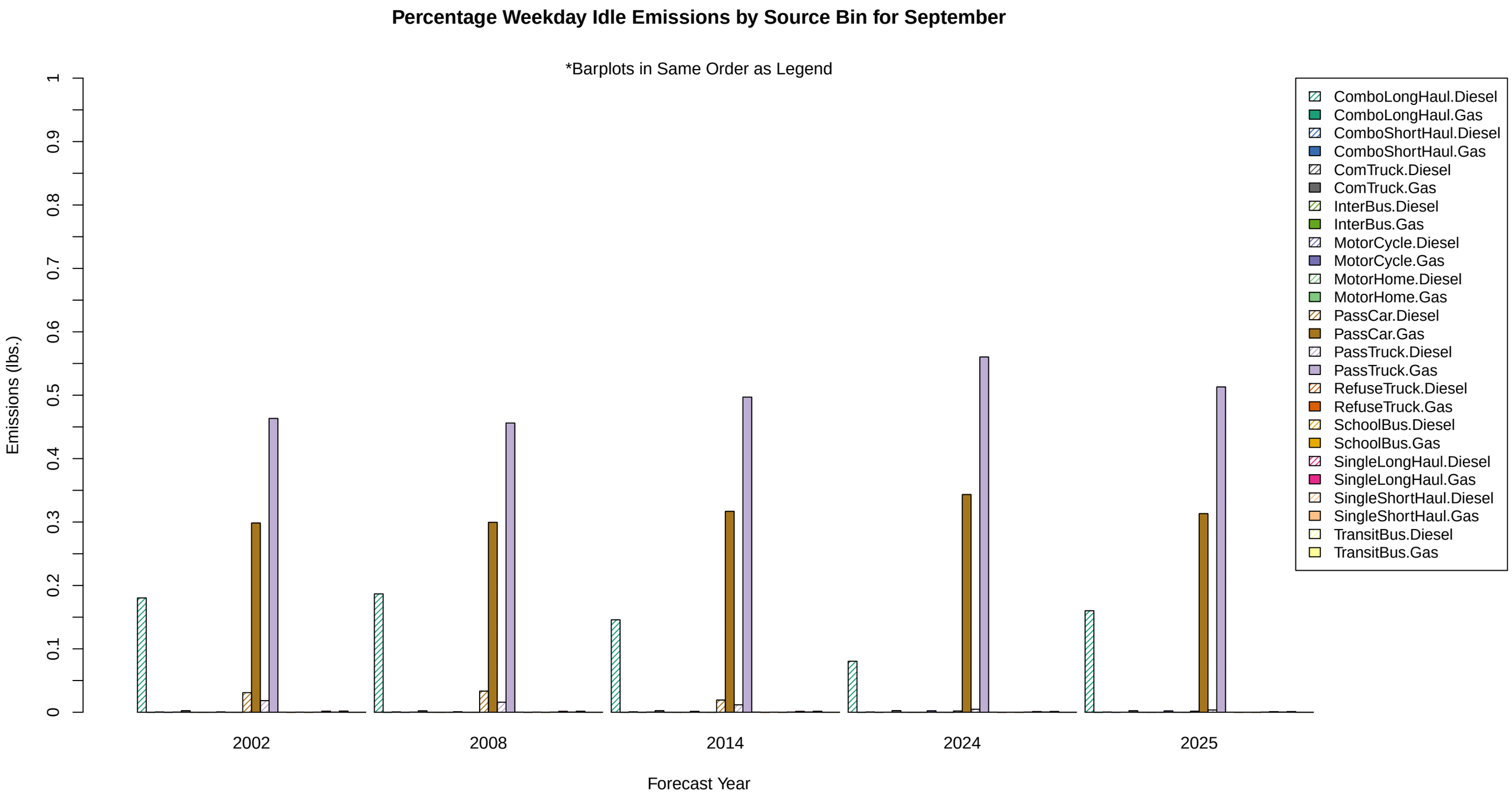
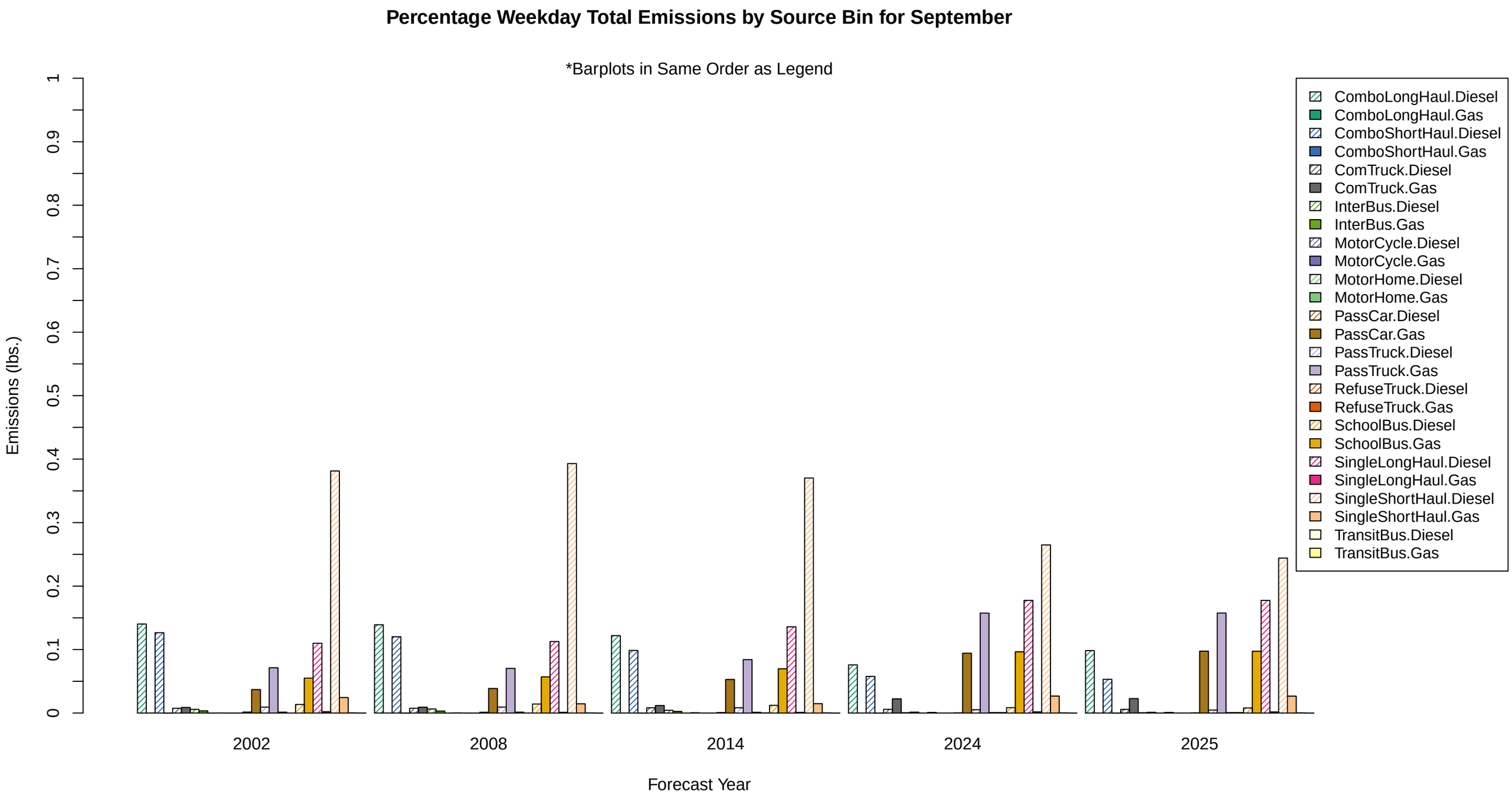
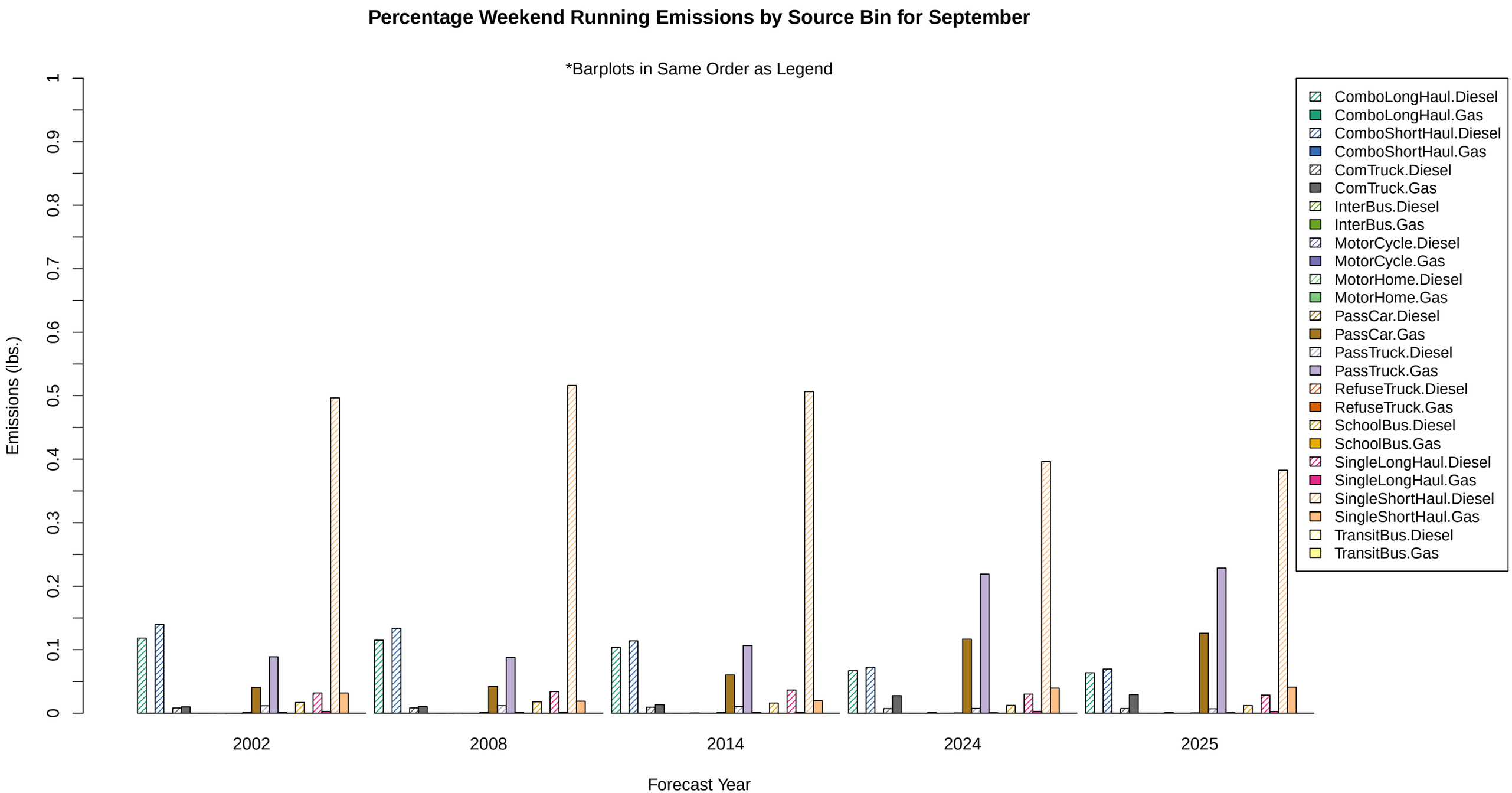
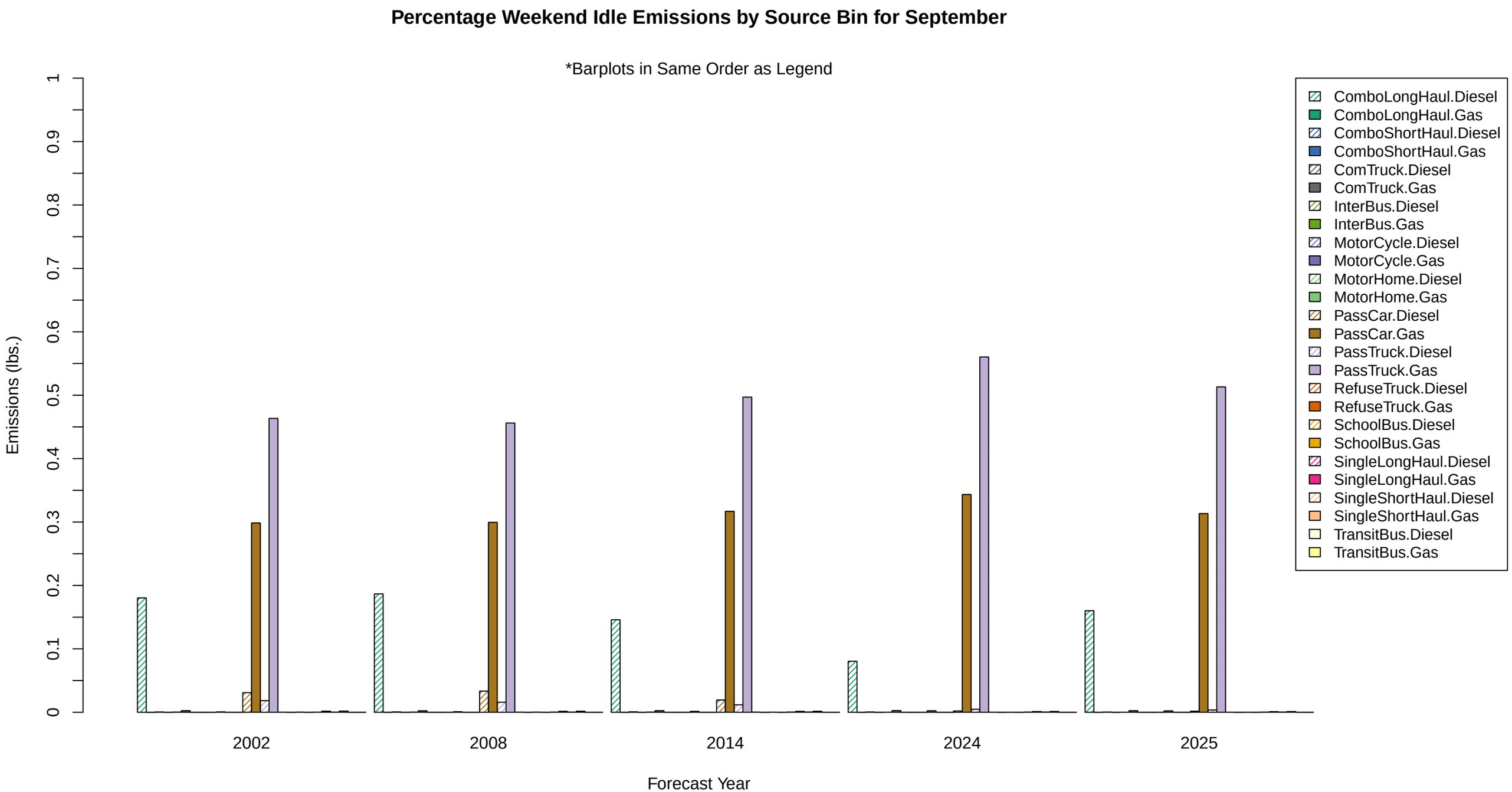
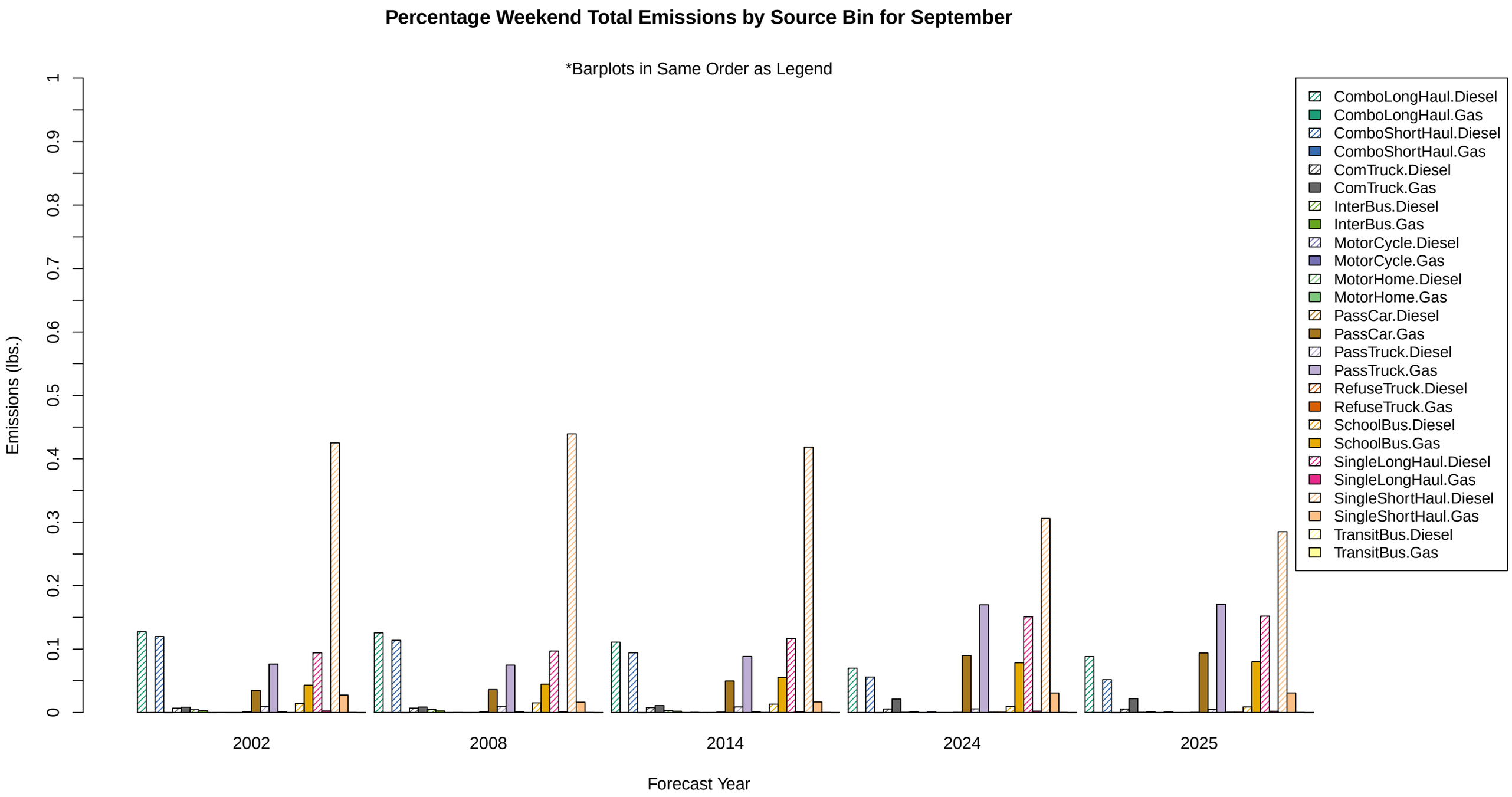
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

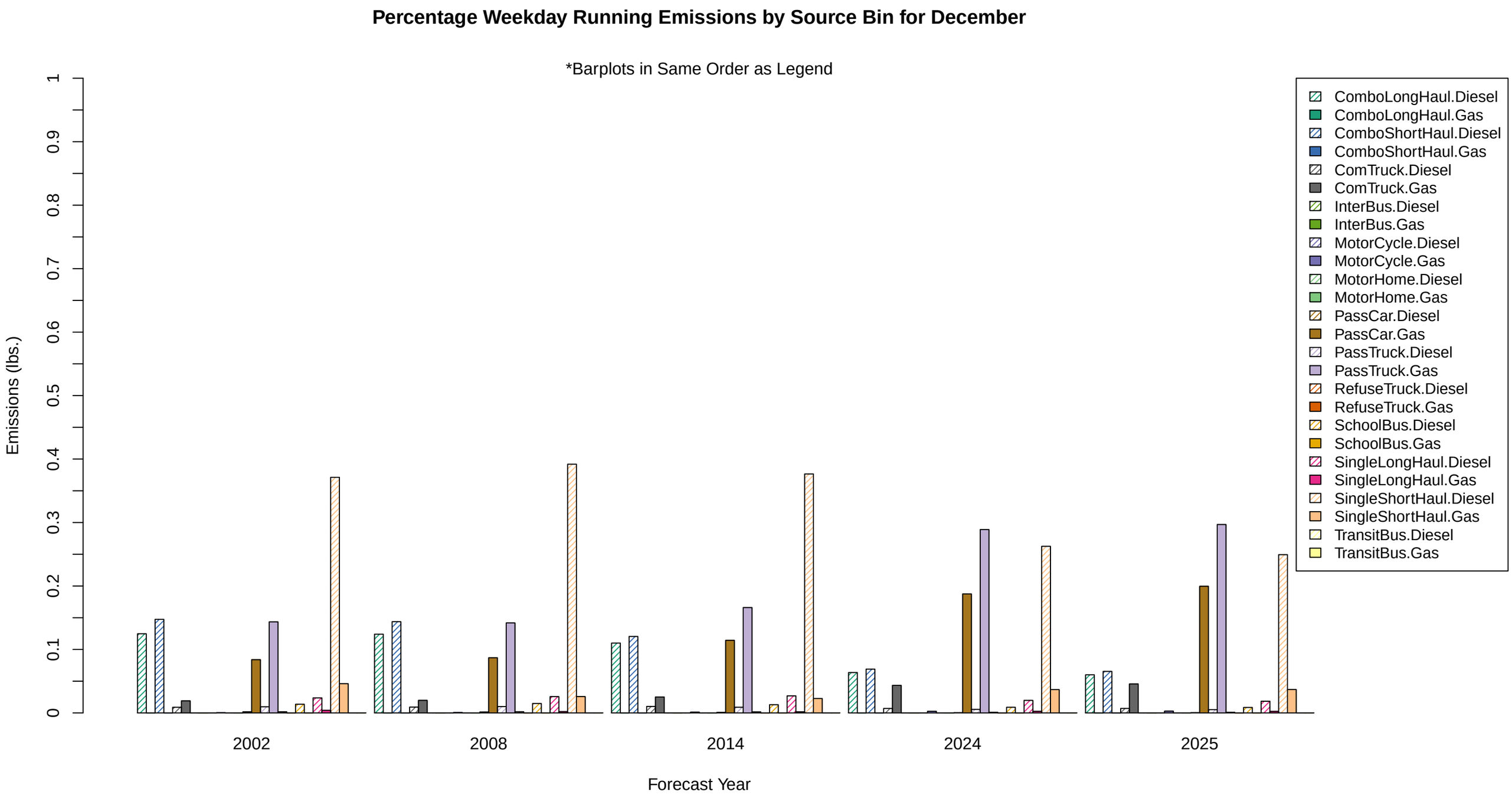

Percentage Weekday Idle Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

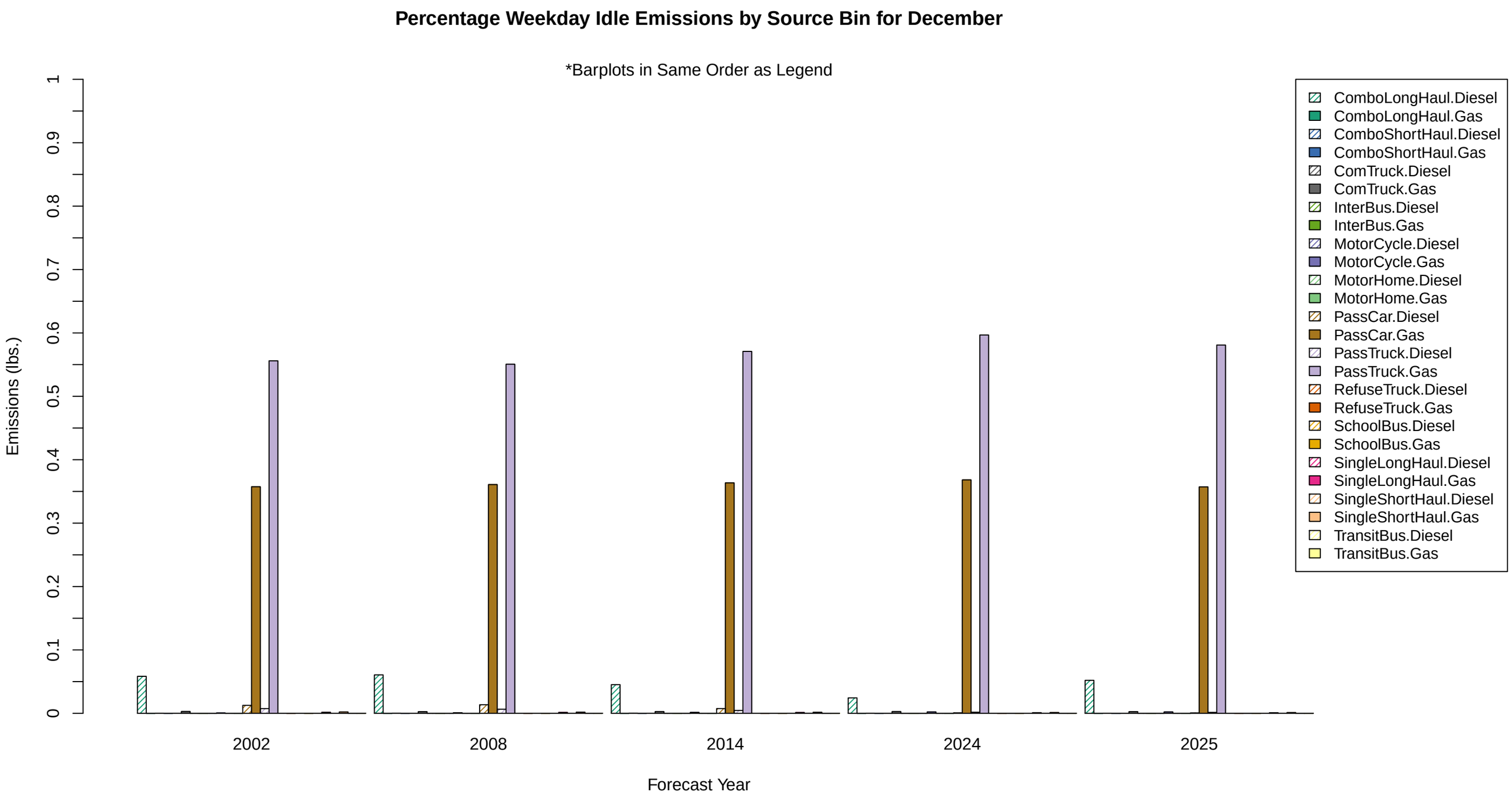

Percentage Weekday Total Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Running Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Idle Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Total Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Running Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Idle Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
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ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
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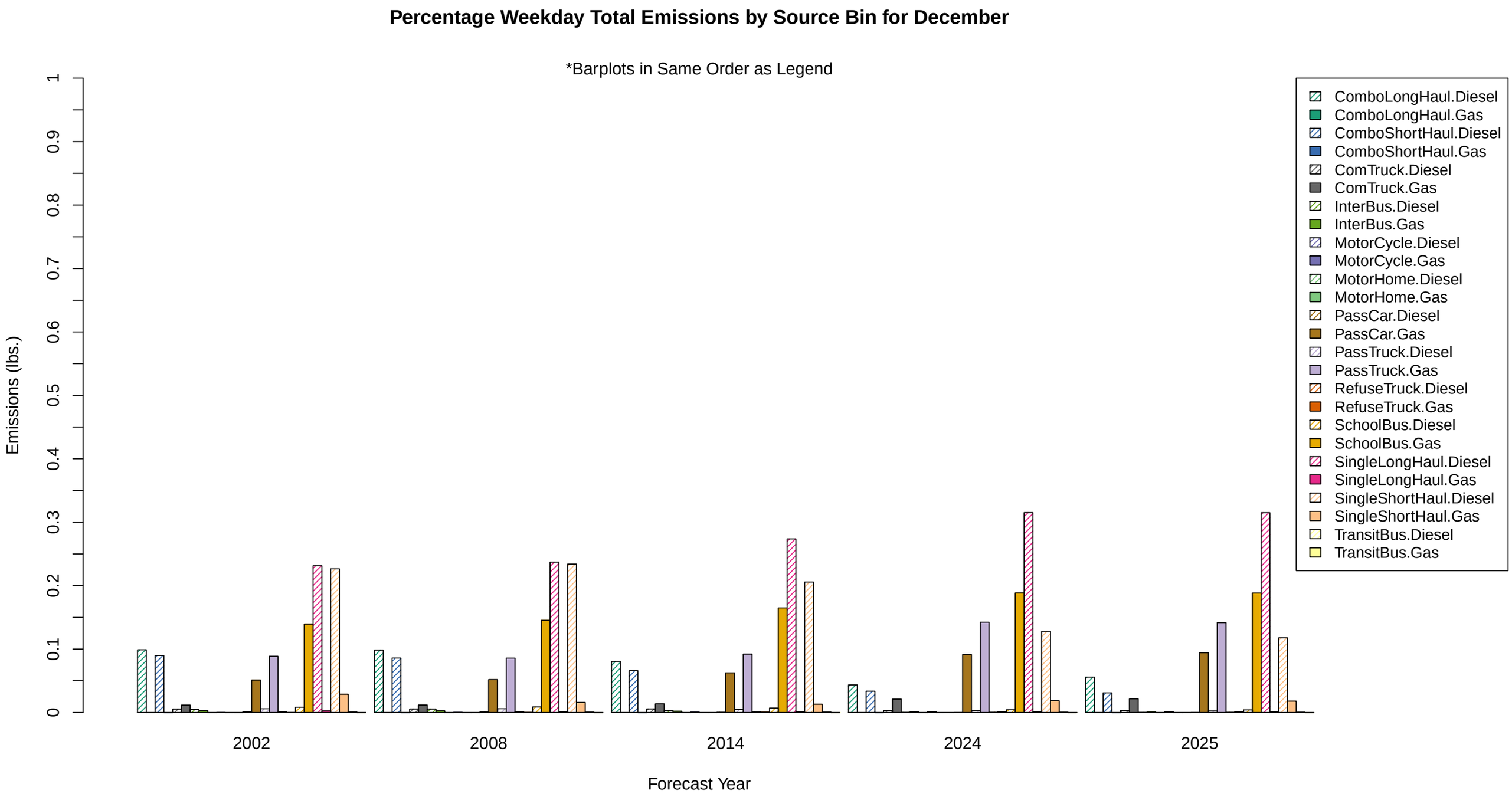
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Total Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
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ComTruck.Gas
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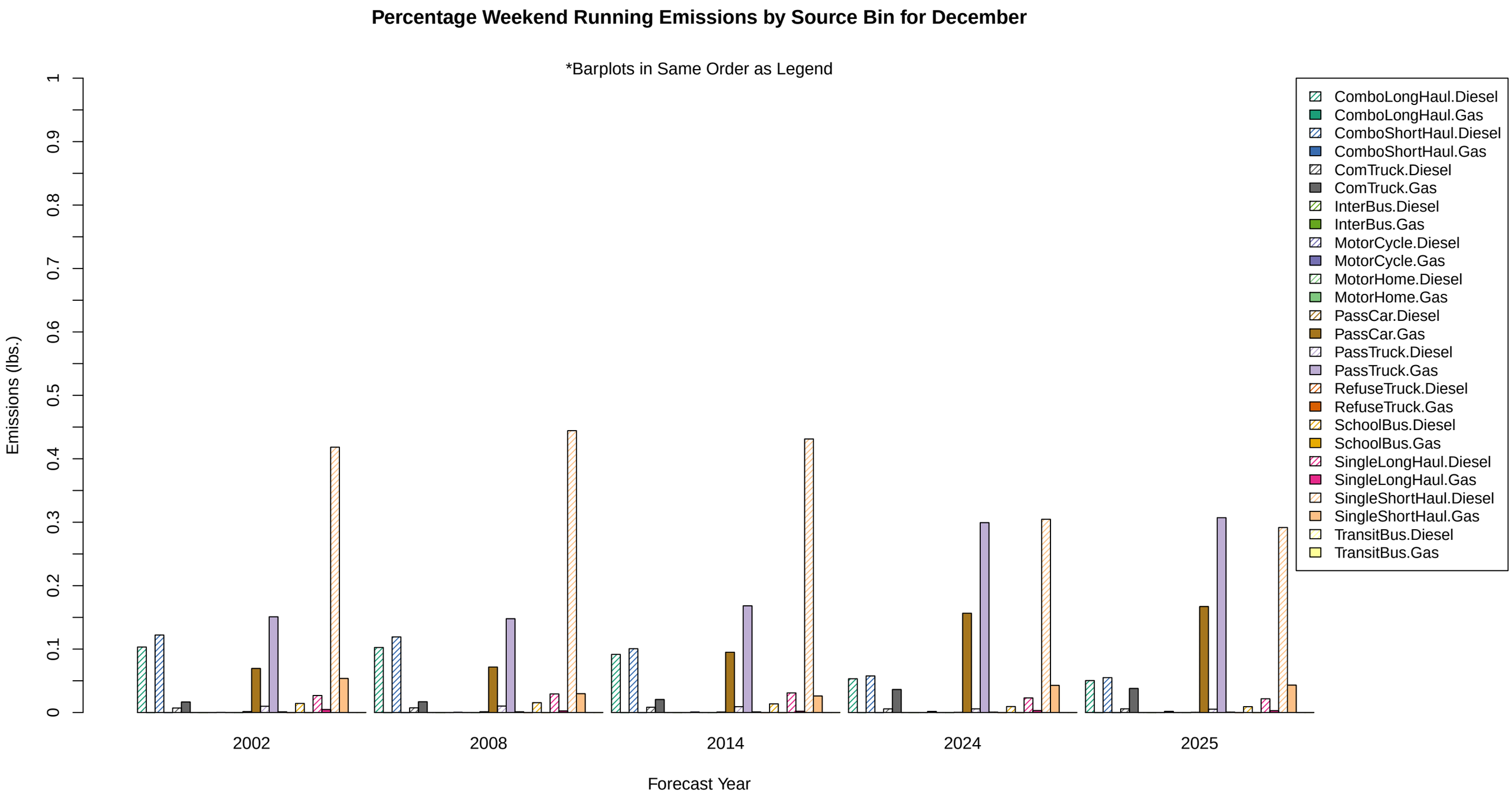
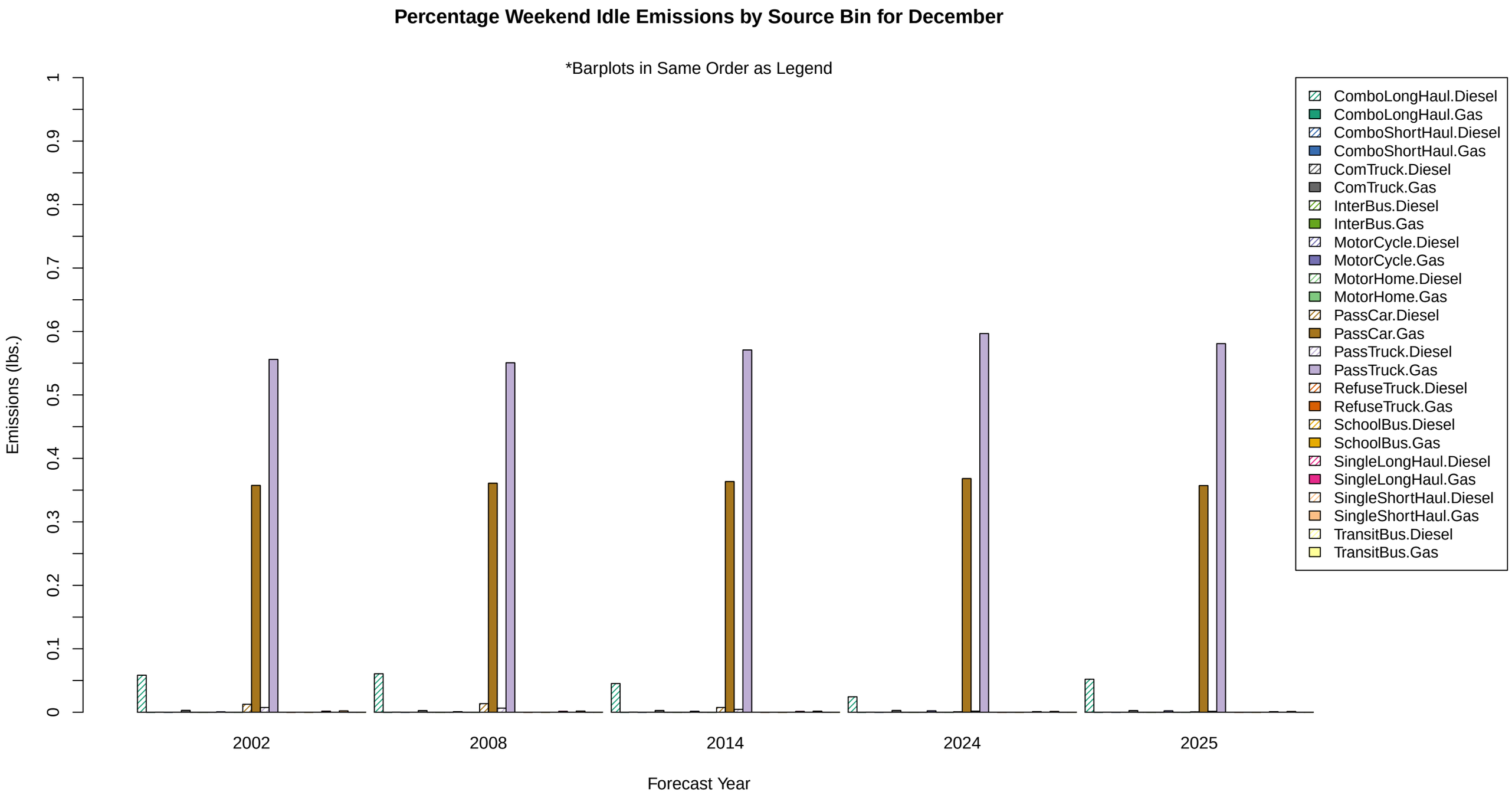
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Running Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Idle Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
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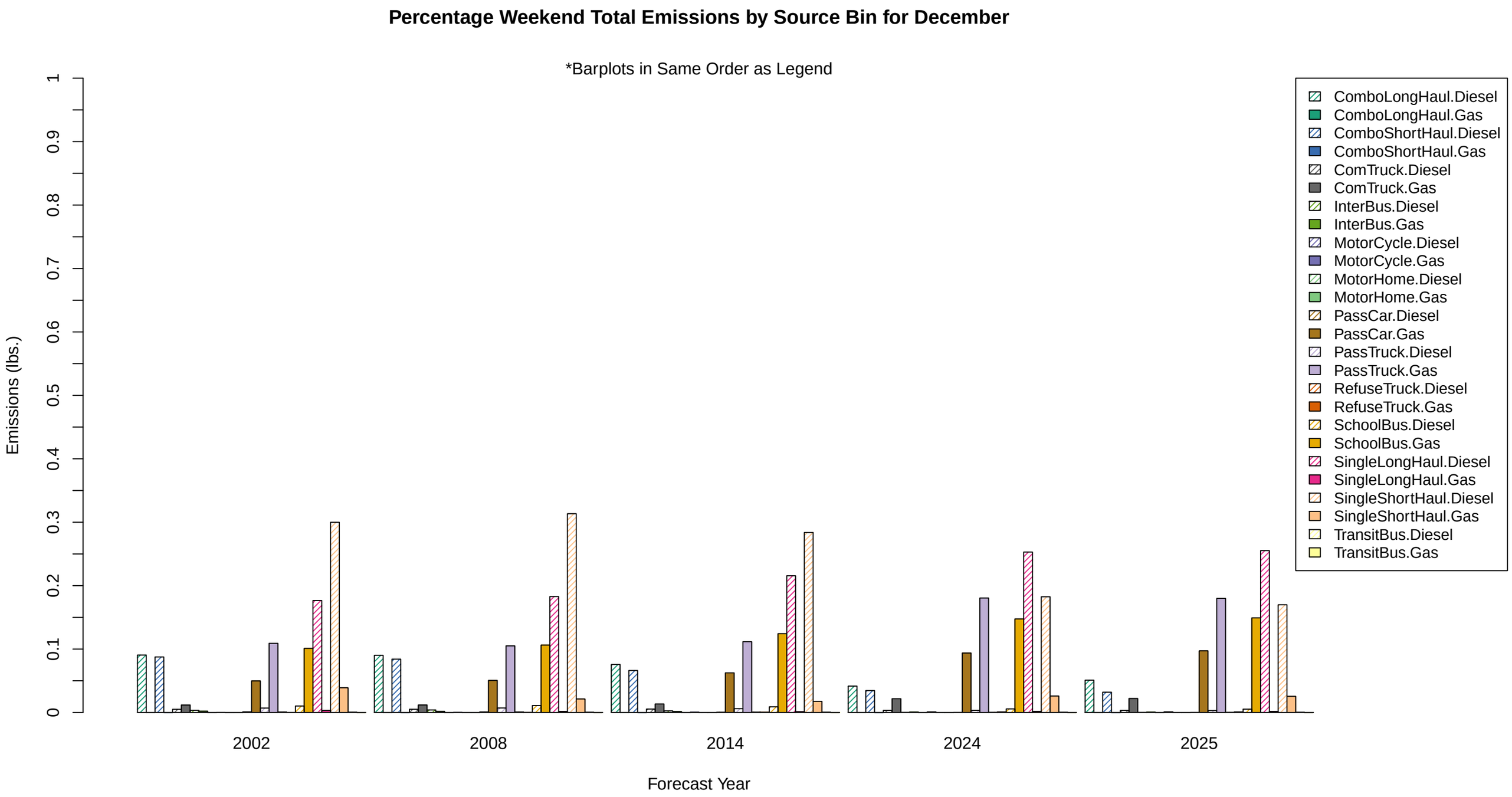
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Total Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
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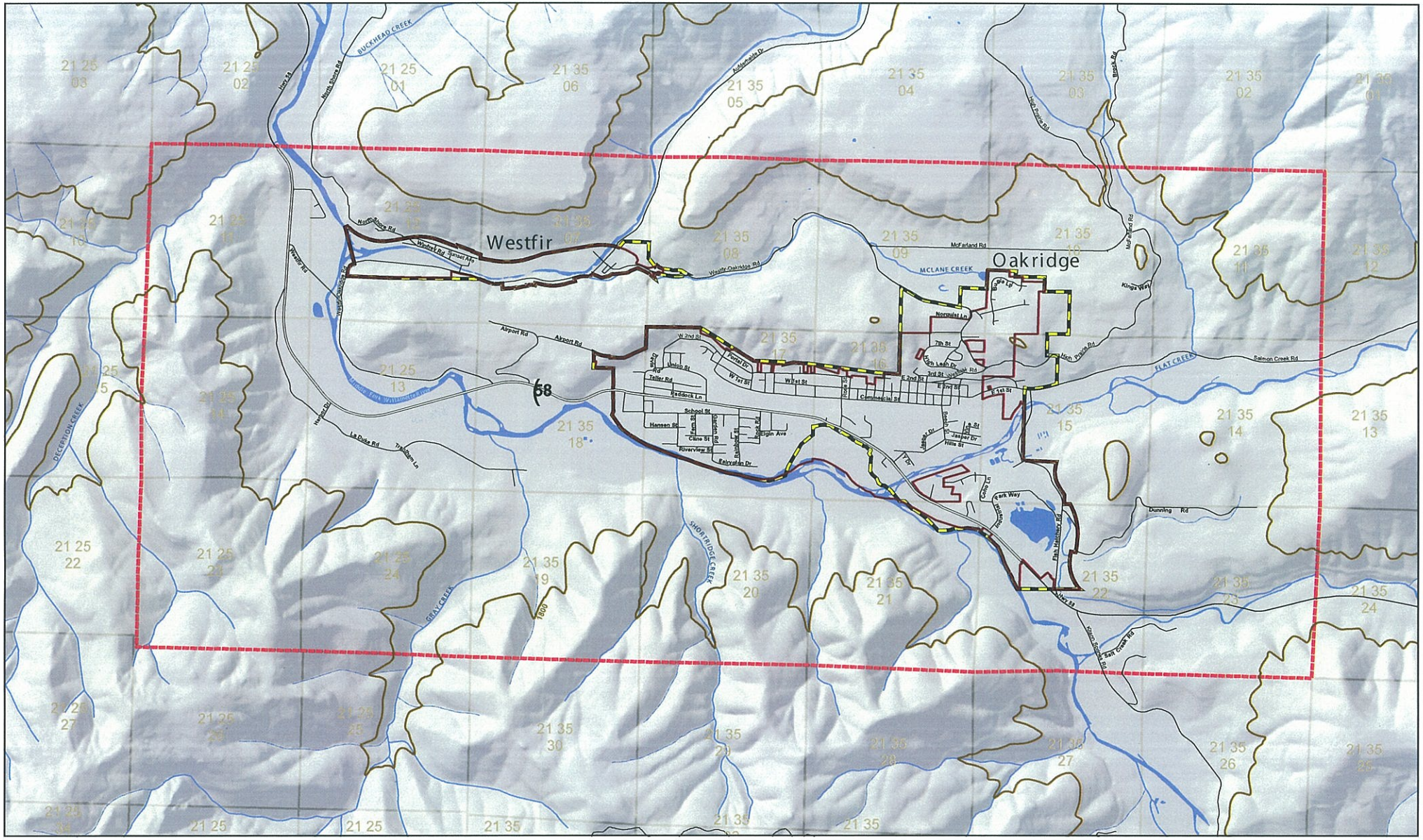
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

Appendix D-4
Railroad Emission Inventory

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477



EPA Non-Attainment Area
1800' Contour
City Limits
Urban Growth Boundary

Rivers and Streams
Intermittent
Perennial

Water Features
Water
Marsh

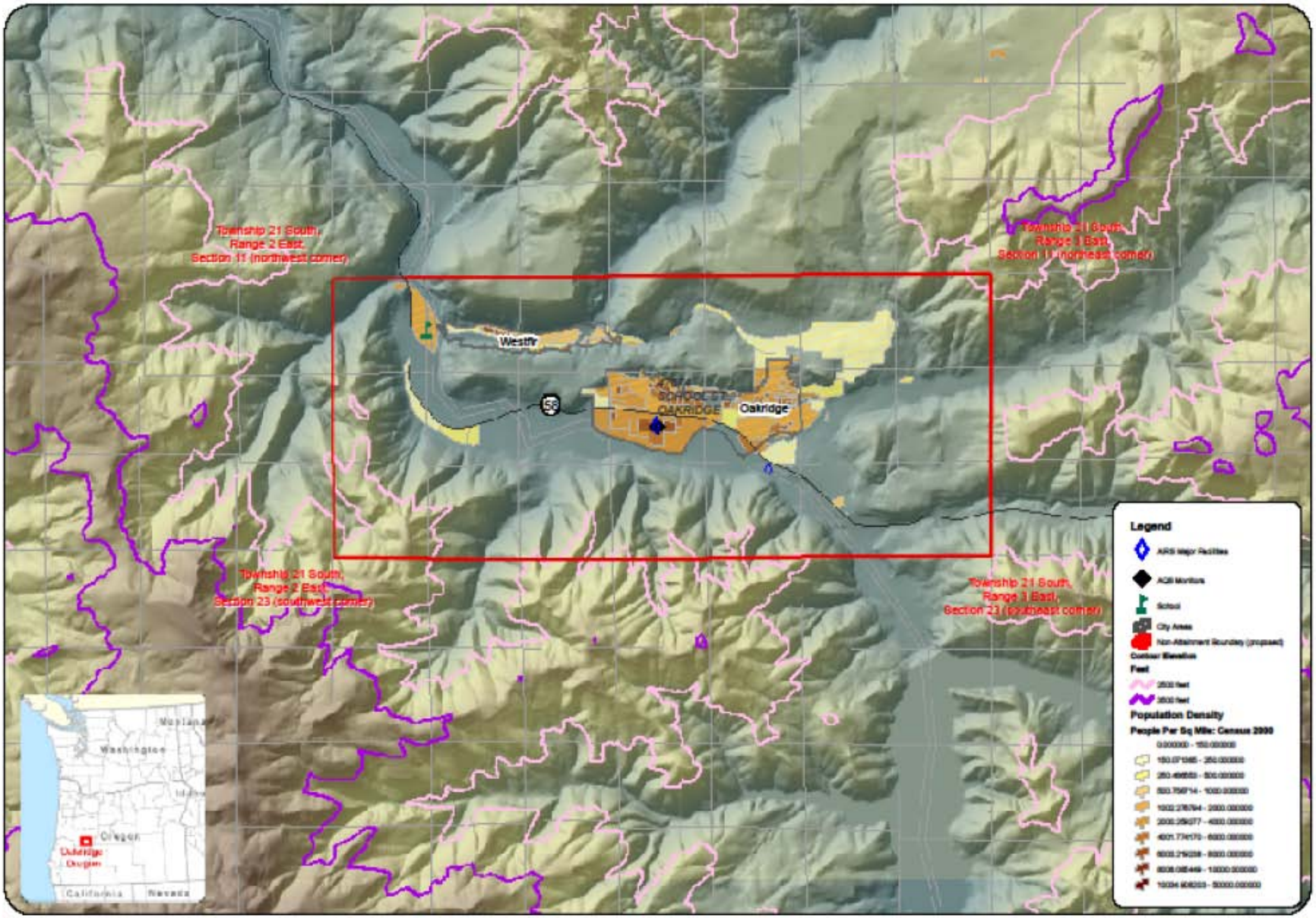
Oakridge / Westfir Oregon

0 1,000 2,000 3,000 Feet

Printing Date: March 30, 2011

The information on this map was derived from digital databases on Lane Council of Governments' regional geographic information system. Care was taken in the creation of this map, but it is provided "as is". LCOG cannot accept any responsibility for errors, omissions, or positional accuracy in the digital data or the underlying records. There are no warranties, expressed or implied, accompanying this product. However, notification of any errors will be appreciated.

MAP PRODUCED BY:
LCOG
LANE COUNCIL OF GOVERNMENTS
859 WILLAMETTE STREET, SUITE 500
EUGENE, OREGON 97401-2910
www.lcog.org (541) 682-4283



The U.S. Environmental Protection Agency (EPA) has compiled this computer representation from data or information sources that may not have been verified by the EPA. This data is offered here as a general representation only, and is not to be re-used without verification by an independent professional qualified to verify such data or information. The EPA does not guarantee the accuracy, completeness, or timeliness of the information shown, and shall not be liable for any loss or injury resulting from reliance upon the information shown.

PM 2.5 Non-Attainment Area (proposed)
Oakridge Oregon Area
shown with Topography & Population Density

From http://www.epa.gov/pmdesignations/2006standards/final/TSD/tsd_4.0_4.10_4.10.3_r10_OR.pdf (Fig. 5.41, Page 27)

NetControl Track Network Map - Windows Internet Explorer provided by Union Pacific

https://home.www.uprr.com/tda2/secure/imap.jsp

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Favorites

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Page Safety Tools

Search or Identify on layer AEI Reader for

Street Satellite

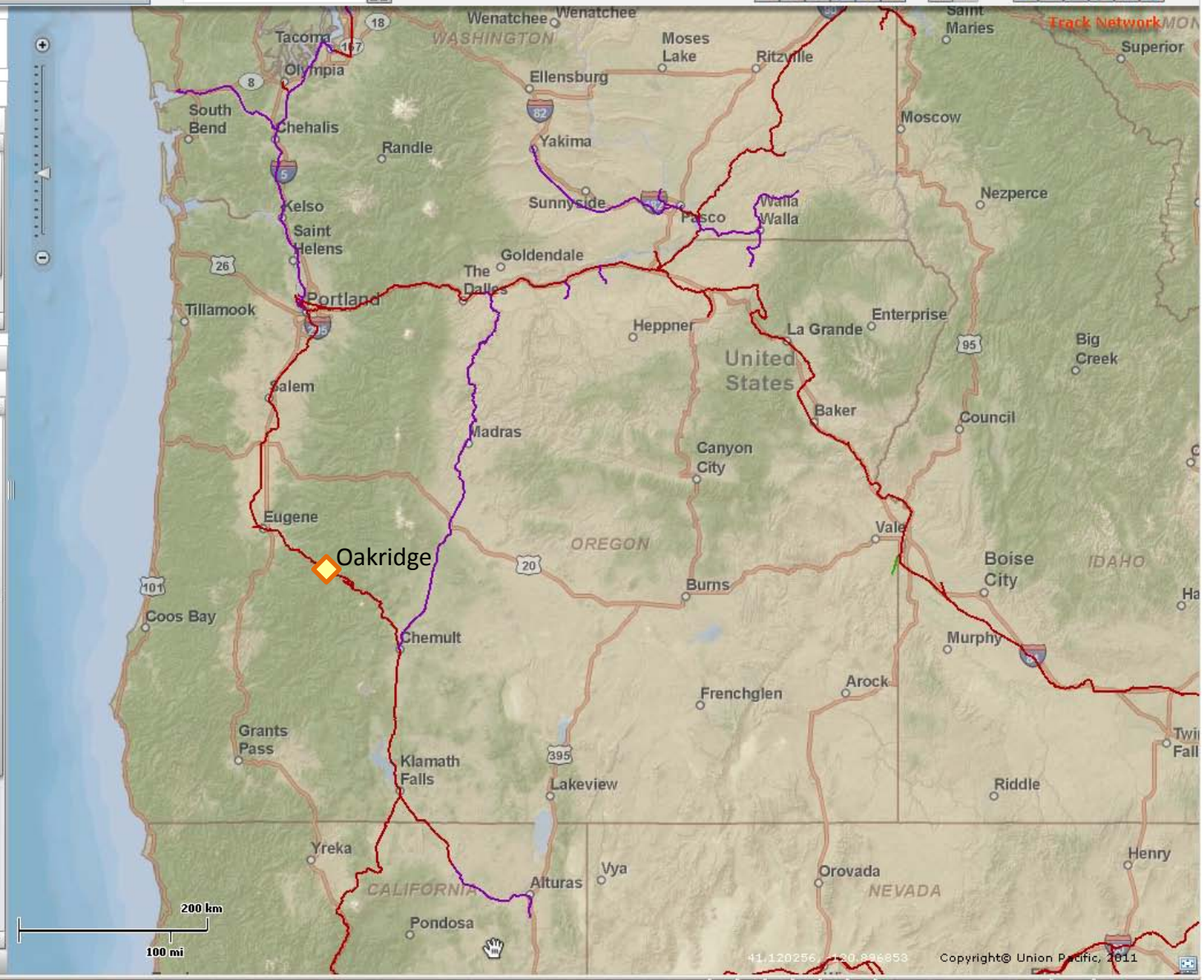
Data Tools Bookmarks

Overlay	Visibility
Track Network	ON
Slow Orders	
Heat / Cold Orders	
Dark Territories	
Bridges and Tunnels	
Telecom Facilities	
Supervisor Territories	
Network Velocity Impact	

Overlay Layers

Visible	Layer
	Point Locations
☑	Mile Post
☐	Mile Post Equation
☐	Rail Crossing
☐	Circ7 Station
☐	Road Crossing
☐	AEI Reader
☐	Control Point
☐	Switch
☐	Signal
☐	Detection Device
	Area - Spans
☐	Bridge
☐	Tunnel
☐	Dark Territory
☐	Subdivision
	Service Unit
☐	Southern
☐	Northern
☐	Western
☐	Region
☐	Dispatcher Key

Feedback



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NetControl Track Network Map - Windows Internet Explorer provided by Union Pacific

https://home.www.uprr.com/tda2/secure/imap.jsp

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Favorites

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Search or Identify on layer AEI Reader for

Street Satellite

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Overlay	Visibility
Track Network	ON
Slow Orders	
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Dark Territories	
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Telecom Facilities	
Supervisor Territories	
Network Velocity Impact	

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☑	Mile Post
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☐	Tunnel
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	Service Unit
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☐	Northern
☐	Western
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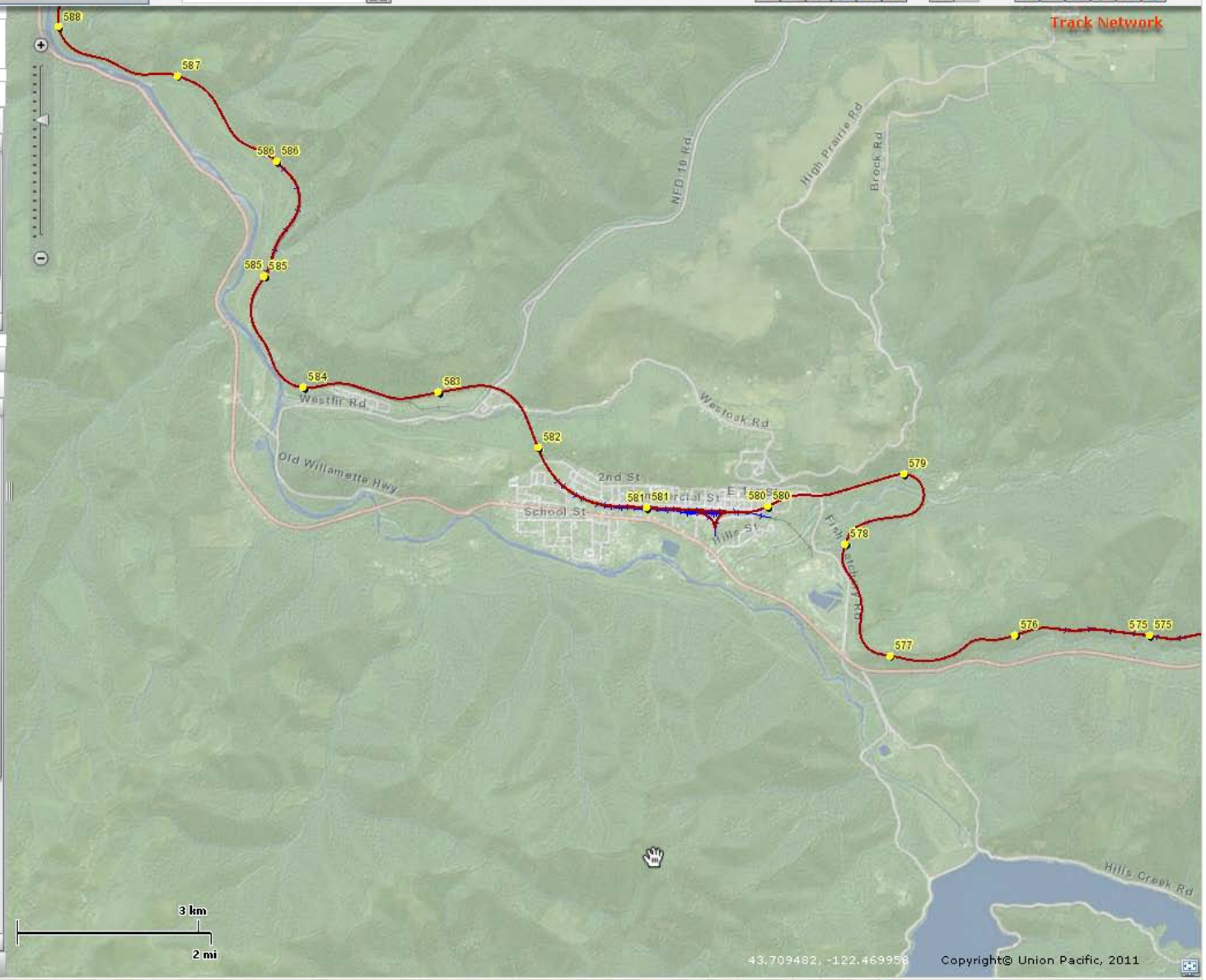
☐	Dispatcher Key

Feedback



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Local intranet

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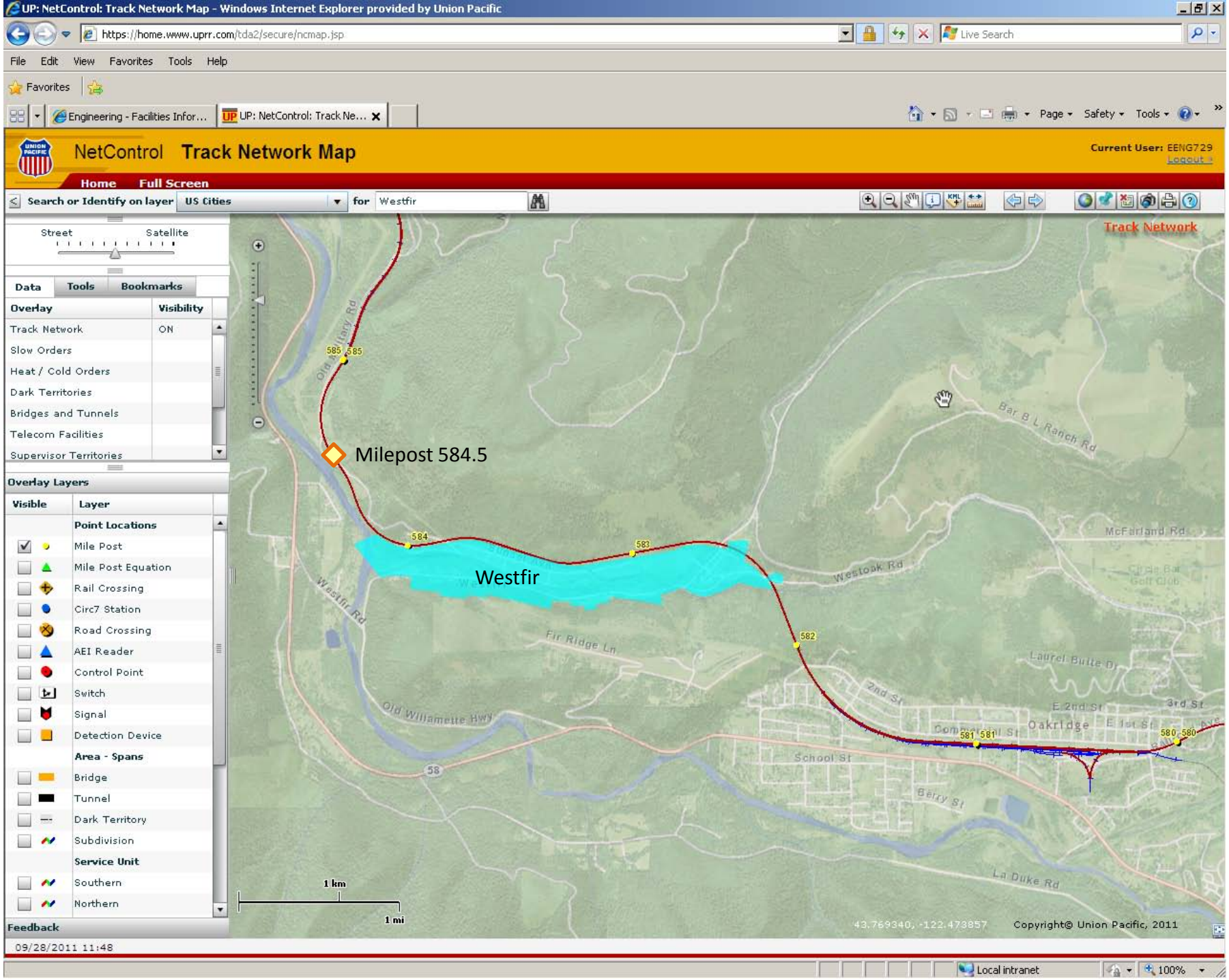
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NetControl Track Network Map
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Northern
Feedback
Milepost 584.5
Westfir
585
584
583
582
581
580
Old Military Rd
Westfir Rd
Fir Ridge Ln
Old Willamette Hwy
Westoak Rd
Bar B L Ranch Rd
McFarland Rd
Laurel Butte Dr
Oakridge
School St
Berry St
La Duke Rd
58
1 km
1 mi
43.769340, -122.473857
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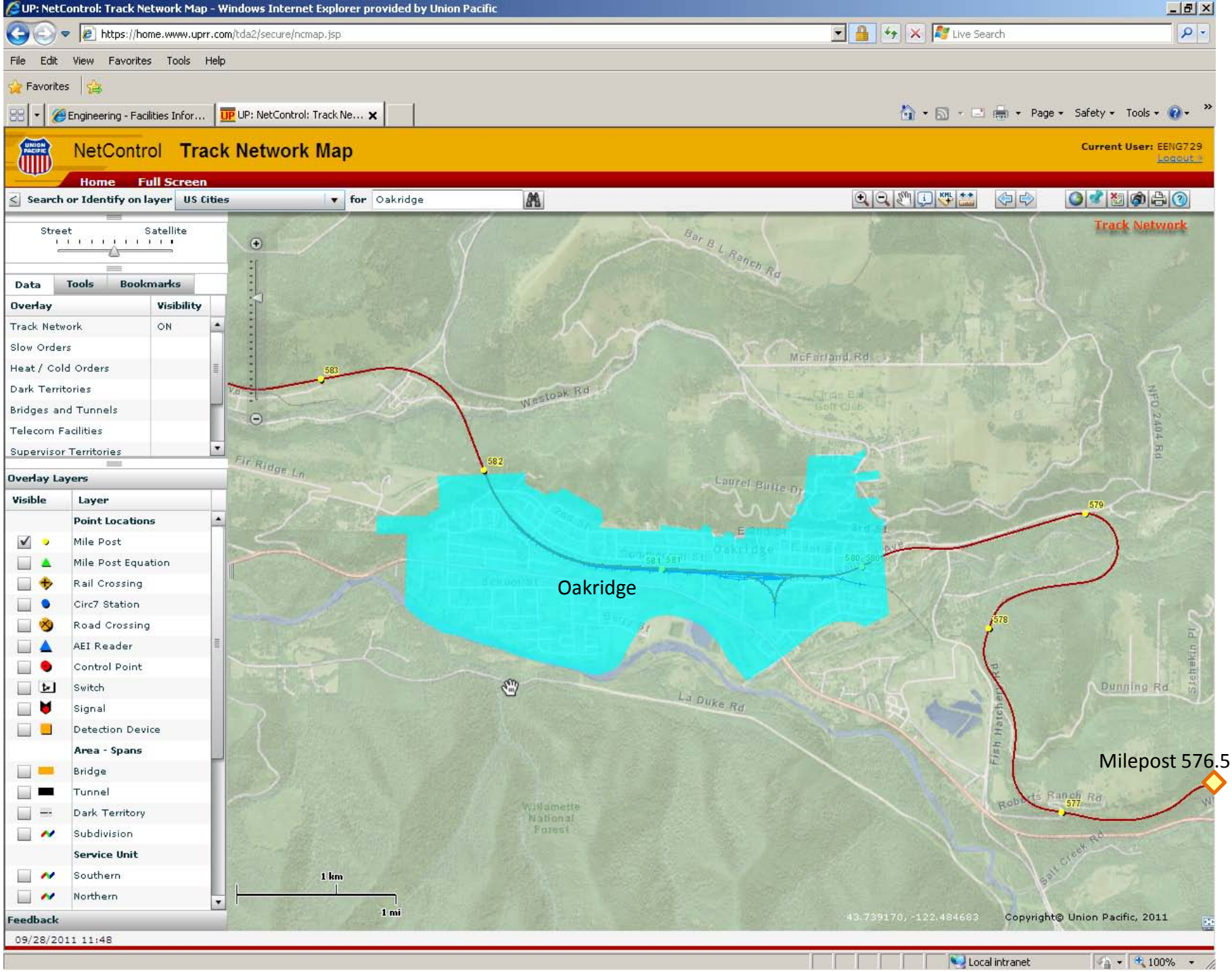
UP: NetControl: Track Network Map - Windows Internet Explorer provided by Union Pacific
https://home.www.uprr.com/tda2/secure/ncmap.jsp
NetControl Track Network Map
Current User: EENG729
Logout
Home
Full Screen
Search or Identify on layer
US Cities
for
Oakridge
Track Network
Street
Satellite
Data
Tools
Bookmarks
Overlay
Visibility
Track Network
ON
Slow Orders
Heat / Cold Orders
Dark Territories
Bridges and Tunnels
Telecom Facilities
Supervisor Territories
Overlay Layers
Visible
Layer
Point Locations
Mile Post
Mile Post Equation
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Circ7 Station
Road Crossing
AEI Reader
Control Point
Switch
Signal
Detection Device
Area - Spans
Bridge
Tunnel
Dark Territory
Subdivision
Service Unit
Southern
Northern
Feedback
Oakridge
Milepost 576.5
583
582
581
580
579
578
577
Bar B L Ranch Rd
McFarland Rd
Westlake Rd
Fir Ridge Ln
Laurel Butte Dr
La Duke Rd
Dunning Rd
Fish Hatchery Rd
Roberts Ranch Rd
Salt Creek Rd
Willamette National Forest
1 km
1 mi
43.739170, -122.484683
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Appendix D-5
Lane County 2008 Emission Inventory
from 2008 National Emission Inventory (NEI)
with Initial Screening EIs for PM2.5, NOx, SO2, VOC and NH3

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477

Lane County 2008 Emission Inventory for PM2.5 from the 2008 National Emission Inventory (NEI).

EI_sector	pollutant_code	description	emissions	uom	Oakridge	Annual	Winter
Agriculture - Crops & Livestock Dust	PM25-PRI	PM2.5 Primary (Filt + Cond)	30.07	TON	No	0.00	Insignificant
Commercial Cooking	PM25-PRI	PM2.5 Primary (Filt + Cond)	88.82	TON	Yes	0.10	Insignificant
Dust - Construction Dust	PM25-PRI	PM2.5 Primary (Filt + Cond)	178.52	TON	Yes	0.21	Insignificant
Dust - Paved Road Dust	PM25-PRI	PM2.5 Primary (Filt + Cond)	325.88	TON	Yes	3.70	Significant
Dust - Unpaved Road Dust	PM25-PRI	PM2.5 Primary (Filt + Cond)	1181.65	TON	No	0.00	Insignificant
Fires - Agricultural Field Burning	PM25-PRI	PM2.5 Primary (Filt + Cond)	1.20	TON	No	0.00	Insignificant
Fires - Prescribed Fires	PM25-PRI	PM2.5 Primary (Filt + Cond)	2246.15	TON	No	0.00	Insignificant
Fires - Wildfires	PM25-PRI	PM2.5 Primary (Filt + Cond)	2126.43	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Biomass	PM25-PRI	PM2.5 Primary (Filt + Cond)	74.91	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	PM25-PRI	PM2.5 Primary (Filt + Cond)	4.71	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Oil	PM25-PRI	PM2.5 Primary (Filt + Cond)	11.16	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Other	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.64	TON	No	0.00	Insignificant
Fuel Comb - Residential - Natural Gas	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.36	TON	No	0.00	Insignificant
Fuel Comb - Residential - Oil	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.92	TON	Yes	0.01	Insignificant
Fuel Comb - Residential - Other	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.03	TON	Yes	0.00	Insignificant
Fuel Comb - Residential - Wood	PM25-PRI	PM2.5 Primary (Filt + Cond)	1453.18	TON	Yes	16.50	Significant
Industrial Processes - Chemical Manuf	PM25-PRI	PM2.5 Primary (Filt + Cond)	577.47	TON	No	0.00	Insignificant
Industrial Processes - Mining	PM25-PRI	PM2.5 Primary (Filt + Cond)	50.83	TON	No	0.00	Insignificant
Industrial Processes - NEC	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.89	TON	No	0.00	Insignificant
Industrial Processes - Pulp & Paper	PM25-PRI	PM2.5 Primary (Filt + Cond)	368.91	TON	No	0.00	Insignificant
Industrial Processes - Storage and Transfer	PM25-PRI	PM2.5 Primary (Filt + Cond)	42.83	TON	No	0.00	Insignificant
Miscellaneous Non-Industrial NEC	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.07	TON	No	0.00	Insignificant
Mobile - Aircraft	PM25-PRI	PM2.5 Primary (Filt + Cond)	1.60	TON	Yes	0.02	Insignificant
Mobile - Locomotives	PM25-PRI	PM2.5 Primary (Filt + Cond)	40.09	TON	Yes	0.46	Significant
Mobile - Non-Road Equipment - Diesel	PM25-PRI	PM2.5 Primary (Filt + Cond)	88.25	TON	Yes	1.00	Insignificant
Mobile - Non-Road Equipment - Gasoline	PM25-PRI	PM2.5 Primary (Filt + Cond)	46.90	TON	Yes	0.53	Insignificant
Mobile - Non-Road Equipment - Other	PM25-PRI	PM2.5 Primary (Filt + Cond)	2.44	TON	Yes	0.03	Insignificant
Mobile - On-Road Diesel Heavy Duty Vehicles	PM25-PRI	PM2.5 Primary (Filt + Cond)	219.53	TON	Yes	4.12	Significant
Mobile - On-Road Diesel Light Duty Vehicles	PM25-PRI	PM2.5 Primary (Filt + Cond)	7.83	TON	Yes	0.15	Significant
Mobile - On-Road Gasoline Heavy Duty Vehicles	PM25-PRI	PM2.5 Primary (Filt + Cond)	6.25	TON	Yes	0.12	Significant
Mobile - On-Road Gasoline Light Duty Vehicles	PM25-PRI	PM2.5 Primary (Filt + Cond)	104.71	TON	Yes	1.97	Significant
Solvent - Industrial Surface Coating & Solvent Use	PM25-PRI	PM2.5 Primary (Filt + Cond)	12.60	TON	No	0.00	Insignificant
Waste Disposal	PM25-PRI	PM2.5 Primary (Filt + Cond)	31.82	TON	Yes	0.36	Significant
			9327.66			29.27	

Location	2000 Population	2000 Occupied HH
Lane County	322,959	130,453
Oakridge	3,148	1,345
Westfir	276	100
Other NAA	536	226
Oakridge-Westfir NAA Total	3,960	1,671

Location	2010 Population	2010 Occupied HH
Lane County	351,715	145,966
Oakridge	3,205	1,437
Westfir	253	114
Other NAA	536	226
Oakridge-Westfir NAA Total	3,994	1,777

Location	2000-2010 Difference	2000-2010 Difference
Lane County	28,756	15,513
Oakridge	57	92
Westfir	-23	14
Other NAA	0	0
Oakridge-Westfir NAA Total	34	106

Lane County emissions from: http://www.epa.gov/ttn/chief/net/2008inventory.html
Cities and county population and housing units from: http://www.pdx.edu/sites/www.pdx.edu.prc/files/2010_PL94_counties_updated.pdf

Vehicle Miles Traveled in 2008 Base Year	
Lane County	1,494,200,000
Oakridge-Westfir NAA	28,058,910

From Appendix C3, and Lane County VMT from: http://www.oregon.gov/ODOT/TD/TDATA/Pages/ata/tsm/vmtpage.aspx#Oregon_VMT_by_County

Lane County 2008 Emission Inventory for NOx from the 2008 National Emission Inventory (NEI).

EI_sector	pollutant_code	description	emissions	uom	Oakridge	Annual	Winter
Biogenics - Vegetation and soil	NOX	Nitrogen Oxides	288.20	TON	Yes	1.31	Insignificant
Commercial Cooking	NOX	Nitrogen Oxides	0.00	TON	Yes	0.00	Insignificant
Fires - Agricultural Field Burning	NOX	Nitrogen Oxides	0.40	TON	No	0.00	Insignificant
Fires - Prescribed Fires	NOX	Nitrogen Oxides	243.86	TON	No	0.00	Significant
Fires - Wildfires	NOX	Nitrogen Oxides	174.09	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Biomass	NOX	Nitrogen Oxides	102.33	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	NOX	Nitrogen Oxides	313.66	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Oil	NOX	Nitrogen Oxides	41.00	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Other	NOX	Nitrogen Oxides	0.70	TON	No	0.00	Insignificant
Fuel Comb - Residential - Natural Gas	NOX	Nitrogen Oxides	78.55	TON	No	0.00	Insignificant
Fuel Comb - Residential - Oil	NOX	Nitrogen Oxides	7.81	TON	Yes	0.09	Insignificant
Fuel Comb - Residential - Other	NOX	Nitrogen Oxides	8.59	TON	Yes	0.10	Insignificant
Fuel Comb - Residential - Wood	NOX	Nitrogen Oxides	189.93	TON	Yes	2.16	Significant
Industrial Processes - Chemical Manuf	NOX	Nitrogen Oxides	349.04	TON	No	0.00	Insignificant
Industrial Processes - Pulp & Paper	NOX	Nitrogen Oxides	784.24	TON	No	0.00	Insignificant
Miscellaneous Non-Industrial NEC	NOX	Nitrogen Oxides	1.05	TON	No	0.00	Significant
Mobile - Aircraft	NOX	Nitrogen Oxides	29.29	TON	Yes	0.33	Insignificant
Mobile - Locomotives	NOX	Nitrogen Oxides	1435.32	TON	Yes	16.30	Significant
Mobile - Non-Road Equipment - Diesel	NOX	Nitrogen Oxides	1118.08	TON	Yes	1.27	Insignificant
Mobile - Non-Road Equipment - Gasoline	NOX	Nitrogen Oxides	227.18	TON	Yes	0.26	Insignificant
Mobile - Non-Road Equipment - Other	NOX	Nitrogen Oxides	249.77	TON	Yes	0.28	Insignificant
Mobile - On-Road Diesel Heavy Duty Vehicles	NOX	Nitrogen Oxides	3282.93	TON	Yes	61.65	Significant
Mobile - On-Road Diesel Light Duty Vehicles	NOX	Nitrogen Oxides	83.36	TON	Yes	1.57	Significant
Mobile - On-Road Gasoline Heavy Duty Vehicles	NOX	Nitrogen Oxides	308.64	TON	Yes	5.80	Significant
Mobile - On-Road Gasoline Light Duty Vehicles	NOX	Nitrogen Oxides	4747.18	TON	Yes	89.15	Significant
Solvent - Industrial Surface Coating & Solvent Use	NOX	Nitrogen Oxides	4.71	TON	No	0.00	Insignificant
Waste Disposal	NOX	Nitrogen Oxides	0.00	TON	Yes	0.00	Insignificant
			14069.89			180.25	

Vehicle Miles Traveled in 2008 Base Year

Lane County	1,494,200,000
Oakridge-Westfir NAA	28,058,910

From Appendix C3, and Lane County VMT from: http://www.oregon.gov/ODOT/TD/TDATA/Pages/ata/tsm/vmtpage.aspx#Oregon_VMT_by_County

Location	2000 Population	2000 Occupied HH
Lane County	322,959	130,453
Oakridge	3,148	1,345
Westfir	276	100
Other NAA	536	226
Oakridge-Westfir NAA Total	3,960	1,671

Location	2010 Population	2010 Occupied HH
Lane County	351,715	145,966
Oakridge	3,205	1,437
Westfir	253	114
Other NAA	536	226
Oakridge-Westfir NAA Total	3,994	1,777

Location	2000-2010 Difference	2000-2010 Difference
Lane County	28,756	15,513
Oakridge	57	92
Westfir	-23	14
Other NAA	0	0
Oakridge-Westfir NAA Total	34	106

Lane County emissions from: http://www.epa.gov/ttn/chief/net/2008inventory.html
Cities and county population and housing units from: http://www.pdx.edu/sites/www.pdx.edu.prc/files/2010_PL94_counties_updated.pdf

Lane County 2008 Emission Inventory for SO2 from the 2008 National Emission Inventory (NEI).

EI_sector	pollutant_code	description	emissions	uom	Oakridge	Annual	Winter
Commercial Cooking	SO2	Sulfur Dioxide	0.000	TON	Yes	0.00	Insignificant
Fires - Agricultural Field Burning	SO2	Sulfur Dioxide	0.060	TON	No	0.00	Insignificant
Fires - Prescribed Fires	SO2	Sulfur Dioxide	165.379	TON	No	0.00	Significant
Fires - Wildfires	SO2	Sulfur Dioxide	141.096	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Biomass	SO2	Sulfur Dioxide	4.689	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	SO2	Sulfur Dioxide	1.090	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Oil	SO2	Sulfur Dioxide	233.900	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Other	SO2	Sulfur Dioxide	16.100	TON	No	0.00	Insignificant
Fuel Comb - Residential - Natural Gas	SO2	Sulfur Dioxide	0.501	TON	No	0.00	Insignificant
Fuel Comb - Residential - Oil	SO2	Sulfur Dioxide	18.474	TON	Yes	0.21	Insignificant
Fuel Comb - Residential - Other	SO2	Sulfur Dioxide	0.036	TON	Yes	0.00	Insignificant
Fuel Comb - Residential - Wood	SO2	Sulfur Dioxide	26.919	TON	Yes	0.31	Significant
Industrial Processes - Chemical Manuf	SO2	Sulfur Dioxide	38.780	TON	No	0.00	Insignificant
Industrial Processes - Pulp & Paper	SO2	Sulfur Dioxide	612.730	TON	No	0.00	Insignificant
Miscellaneous Non-Industrial NEC	SO2	Sulfur Dioxide	0.162	TON	Yes	0.00	Insignificant
Mobile - Aircraft	SO2	Sulfur Dioxide	4.703	TON	Yes	0.05	Insignificant
Mobile - Locomotives	SO2	Sulfur Dioxide	13.706	TON	Yes	0.16	Significant
Mobile - Non-Road Equipment - Diesel	SO2	Sulfur Dioxide	26.356	TON	Yes	0.03	Insignificant
Mobile - Non-Road Equipment - Gasoline	SO2	Sulfur Dioxide	1.373	TON	Yes	0.00	Insignificant
Mobile - Non-Road Equipment - Other	SO2	Sulfur Dioxide	0.674	TON	Yes	0.00	Insignificant
Mobile - On-Road Diesel Heavy Duty Vehicles	SO2	Sulfur Dioxide	75.267	TON	Yes	1.41	Significant
Mobile - On-Road Diesel Light Duty Vehicles	SO2	Sulfur Dioxide	2.656	TON	Yes	0.05	Significant
Mobile - On-Road Gasoline Heavy Duty Vehicles	SO2	Sulfur Dioxide	1.275	TON	Yes	0.02	Significant
Mobile - On-Road Gasoline Light Duty Vehicles	SO2	Sulfur Dioxide	24.174	TON	Yes	0.45	Significant
Solvent - Industrial Surface Coating & Solvent Use	SO2	Sulfur Dioxide	0.030	TON	No	0.00	Insignificant
Waste Disposal	SO2	Sulfur Dioxide	0.000	TON	Yes	0.00	Insignificant
			1410.13			2.70	

Vehicle Miles Traveled in 2008 Base Year

Lane County	1,494,200,000
Oakridge-Westfir NAA	28,058,910

From Appendix C3, and Lane County VMT from: http://www.oregon.gov/ODOT/TD/TDATA/Pages/ata/tsm/vmtpage.aspx#Oregon_VMT_by_County

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Westfir	-23	14
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Lane County emissions from: http://www.epa.gov/ttn/chief/net/2008inventory.html
Cities and county population and housing units from: http://www.pdx.edu/sites/www.pdx.edu.prc/files/2010_PL94_counties_updated.pdf

Lane County 2008 Emission Inventory for VOC from the 2008 National Emission Inventory (NEI).

EI_sector	pollutant_code	description	emissions	uom	Oakridge	Annual	Winter
Biogenics - Vegetation and soil	VOC	Volatile Organic Compounds	47248.165	TON	Yes	214.76	Insignificant
Bulk Gasoline Terminals	VOC	Volatile Organic Compounds	83.410	TON	No	0.00	Insignificant
Commercial Cooking	VOC	Volatile Organic Compounds	12.531	TON	Yes	0.00	Insignificant
Fires - Agricultural Field Burning	VOC	Volatile Organic Compounds	0.900	TON	No	0.00	Significant
Fires - Prescribed Fires	VOC	Volatile Organic Compounds	6374.260	TON	No	0.00	Insignificant
Fires - Wildfires	VOC	Volatile Organic Compounds	6150.084	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Biomass	VOC	Volatile Organic Compounds	7.400	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	VOC	Volatile Organic Compounds	3.610	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Oil	VOC	Volatile Organic Compounds	0.700	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Other	VOC	Volatile Organic Compounds	0.010	TON	No	0.00	Insignificant
Fuel Comb - Residential - Natural Gas	VOC	Volatile Organic Compounds	4.596	TON	No	0.00	Insignificant
Fuel Comb - Residential - Oil	VOC	Volatile Organic Compounds	0.304	TON	Yes	0.00	Insignificant
Fuel Comb - Residential - Other	VOC	Volatile Organic Compounds	0.334	TON	Yes	0.00	Insignificant
Fuel Comb - Residential - Wood	VOC	Volatile Organic Compounds	1663.316	TON	Yes	18.89	Significant
Gas Stations	VOC	Volatile Organic Compounds	1091.605	TON	Yes	20.50	Significant
Industrial Processes - Chemical Manuf	VOC	Volatile Organic Compounds	54.140	TON	No	0.00	Insignificant
Industrial Processes - Pulp & Paper	VOC	Volatile Organic Compounds	1312.234	TON	No	0.00	Insignificant
Industrial Processes - Storage and Transfer	VOC	Volatile Organic Compounds	70.522	TON	No	0.00	Insignificant
Miscellaneous Non-Industrial NEC	VOC	Volatile Organic Compounds	208.496	TON	No	0.00	Insignificant
Mobile - Aircraft	VOC	Volatile Organic Compounds	16.897	TON	Yes	0.19	Insignificant
Mobile - Locomotives	VOC	Volatile Organic Compounds	78.192	TON	Yes	0.89	Significant
Mobile - Non-Road Equipment - Diesel	VOC	Volatile Organic Compounds	113.714	TON	Yes	0.13	Insignificant
Mobile - Non-Road Equipment - Gasoline	VOC	Volatile Organic Compounds	1795.524	TON	Yes	2.04	Insignificant
Mobile - Non-Road Equipment - Other	VOC	Volatile Organic Compounds	64.321	TON	Yes	0.07	Insignificant
Mobile - On-Road Diesel Heavy Duty Vehicles	VOC	Volatile Organic Compounds	224.548	TON	Yes	4.22	Significant
Mobile - On-Road Diesel Light Duty Vehicles	VOC	Volatile Organic Compounds	14.007	TON	Yes	0.26	Significant
Mobile - On-Road Gasoline Heavy Duty Vehicles	VOC	Volatile Organic Compounds	228.721	TON	Yes	4.30	Significant
Mobile - On-Road Gasoline Light Duty Vehicles	VOC	Volatile Organic Compounds	3754.542	TON	Yes	70.50	Significant
Solvent - Consumer & Commercial Solvent Use	VOC	Volatile Organic Compounds	1612.909	TON	No	0.00	Insignificant
Solvent - Dry Cleaning	VOC	Volatile Organic Compounds	83.360	TON	No	0.00	Insignificant
Solvent - Industrial Surface Coating & Solvent Use	VOC	Volatile Organic Compounds	339.689	TON	No	0.00	Insignificant
Solvent - Non-Industrial Surface Coating	VOC	Volatile Organic Compounds	523.305	TON	No	0.00	Insignificant
Waste Disposal	VOC	Volatile Organic Compounds	14.375	TON	Yes	0.16	Insignificant
			73150.72			336.92	

Vehicle Miles Traveled in 2008 Base Year

Lane County	1,494,200,000
Oakridge-Westfir NAA	28,058,910

From Appendix C3, and Lane County VMT from: http://www.oregon.gov/ODOT/TD/TDATA/Pages/ata/tsm/vmtpage.aspx#Oregon_VMT_by_County

Location	2000 Population	2000 Occupied HH
Lane County	322,959	130,453
Oakridge	3,148	1,345
Westfir	276	100
Other NAA	536	226
Oakridge-Westfir NAA Total	3,960	1,671

Location	2010 Population	2010 Occupied HH
Lane County	351,715	145,966
Oakridge	3,205	1,437
Westfir	253	114
Other NAA	536	226
Oakridge-Westfir NAA Total	3,994	1,777

Location	2000-2010 Difference	2000-2010 Difference
Lane County	28,756	15,513
Oakridge	57	92
Westfir	-23	14
Other NAA	0	0
Oakridge-Westfir NAA Total	34	106

Lane County emissions from: http://www.epa.gov/ttn/chief/net/2008inventory.html
Cities and county population and housing units from: http://www.pdx.edu/sites/www.pdx.edu.prc/files/2010_PL94_counties_updated.pdf

Lane County 2008 Emission Inventory for NH3 from the 2008 National Emission Inventory (NEI).

EI_sector	pollutant_code	description	emissions	uom	Oakridge	Annual	Winter
Agriculture - Fertilizer Application	NH3	Ammonia	918.90	TON	No	0.00	Insignificant
Agriculture - Livestock Waste	NH3	Ammonia	651.83	TON	No	0.00	Insignificant
Fires - Prescribed Fires	NH3	Ammonia	443.43	TON	No	0.00	Insignificant
Fires - Wildfires	NH3	Ammonia	427.83	TON	No	0.00	Insignificant
Fuel Comb - Residential - Natural Gas	NH3	Ammonia	16.71	TON	No	0.00	Insignificant
Fuel Comb - Residential - Oil	NH3	Ammonia	0.43	TON	Yes	0.00	Insignificant
Fuel Comb - Residential - Other	NH3	Ammonia	0.03	TON	Yes	0.00	Insignificant
Fuel Comb - Residential - Wood	NH3	Ammonia	83.70	TON	Yes	0.95	Significant
Mobile - Locomotives	NH3	Ammonia	0.47	TON	Yes	0.01	Significant
Mobile - Non-Road Equipment - Diesel	NH3	Ammonia	0.98	TON	Yes	0.00	Insignificant
Mobile - Non-Road Equipment - Gasoline	NH3	Ammonia	0.74	TON	Yes	0.00	Insignificant
Mobile - On-Road Diesel Heavy Duty Vehicles	NH3	Ammonia	5.77	TON	Yes	0.11	Significant
Mobile - On-Road Diesel Light Duty Vehicles	NH3	Ammonia	0.37	TON	Yes	0.01	Significant
Mobile - On-Road Gasoline Heavy Duty Vehicles	NH3	Ammonia	4.53	TON	Yes	0.09	Significant
Mobile - On-Road Gasoline Light Duty Vehicles	NH3	Ammonia	122.95	TON	Yes	2.31	Significant
Waste Disposal	NH3	Ammonia	1.31	TON	Yes	0.01	Insignificant
			2679.99			3.49	

Vehicle Miles Traveled in 2008 Base Year

Lane County	1,494,200,000
Oakridge-Westfir NAA	28,058,910

From Appendix C3, and Lane County VMT from: http://www.oregon.gov/ODOT/TD/TDATA/Pages/ata/tsm/vmtpage.aspx#Oregon_VMT_by_County

Location	2000 Population	2000 Occupied HH
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Lane County emissions from: http://www.epa.gov/ttn/chief/net/2008inventory.html
Cities and county population and housing units from: http://www.pdx.edu/sites/www.pdx.edu.prc/files/2010_PL94_counties_updated.pdf

Appendix D: Emission Inventory

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area Emission Inventory and Forecast for 2008 Base Year and 2014 Attainment Year

October 2012

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477

Background

The 1990 Clean Air Act contains provisions on the required development of emission inventories for designated areas that failed or have failed in the past to meet the National Ambient Air Quality Standards (NAAQS). The Oakridge-Westfir Nonattainment Area (NAA) is a designated NAAQS $PM_{2.5}$ nonattainment area. This emission inventory is provided as a part of the State of Oregon revisions to its State Implementation Plan (SIP) to formulate a strategy to maintain the NAAQS.

The principal components for development and documentation for the 2014 Attainment Plan emission inventories have been addressed in this document, which includes stationary permitted point sources, stationary area (non-permitted) sources, non-road mobile sources (railroads), on-road mobile sources, and emissions summaries. Inventory years include a base year of 2008 and the 2014 attainment deadline year. The geographic boundary for each inventory is the Oakridge-Westfir NAA, as defined by the NAA boundary.

In this document the terms *annual*, *typical season day*, and *worst-case day* emissions are used to categorize the estimated emissions for a particular time period. The annual emissions are a total amount of emissions for the source category that occurred throughout the year, represented in tons per year (tpy). The typical season day emissions represent an average daily emission value occurring from November 1st through the end of February. This four month time period is considered to be the PM season, and is when the PM standard is usually violated. The worst-case day emissions are the highest daily emissions estimated for the PM season, and represent a day during the PM season when emissions generating activity is at its highest. For emission inventory purposes, the worst-case day is equivalent to the 98th-percentile design value (DV) day. Typical season day and worst-case day emissions are represented in pounds per day (lbs/day).

The 2008 National Emission Inventory (NEI) for Lane County was used as the starting point for calculating both $PM_{2.5}$ emissions and $PM_{2.5}$ precursor emissions for the Oakridge-Westfir $PM_{2.5}$ nonattainment area. The Lane County portion of the 2008 NEI is summarized in Appendix D-5, including emissions of $PM_{2.5}$, NOx, SO2, VOC and NH3. The initial Oakridge-Westfir emissions were estimated by applying appropriate emission allocation factors (e.g., relative population, housing, vehicle miles of travel, land area, etc.) to the Lane County $PM_{2.5}$ and precursor emission cateogries. The significant (and insignificant) source categories during the winter $PM_{2.5}$ problem season were identified in Appendix D-5.

Secondary particulate is an overall very minor contributor to the Oakridge $PM_{2.5}$ air pollution concentrations on worst winter days as described in the Speciation Studies in Appendix E and summarized in Table 8 of the Attainment Plan. For example, sulfates contribute only 1.1% and nitrates contribute only 0.4% on the top 25% high $PM_{2.5}$ concentration days. Rather, the major $PM_{2.5}$ contributor is organic carbon (88%), primarily from residential wood combustion.

Therefore, the emission inventory analysis focused in most detail on the significant $PM_{2.5}$ particulate sources during the winter season in Oakridge-Westfir, notably residential woodburning emissions from woodstoves, fireplaces and pellet stoves.

Executive Summary

This emission inventory consists of emission estimates from sources that emit $PM_{2.5}$ within the Oakridge-Westfir nonattainment area boundary. The emissions inventory data is essential in developing the attainment demonstration, as it helps identify the sources contributing to the air quality problem and the emission reduction strategies, once implemented, that reduce pollution levels below the standard. Sources of $PM_{2.5}$ in Oakridge include minor industry, on-road mobile sources (e.g., car and truck exhaust, road dust), railroads, and area sources (e.g., outdoor burning, woodstoves, and fireplaces).

Base Year Emission Inventory (2008)

The base year emission inventory is used as the starting point for the attainment demonstration. This inventory includes sources in the nonattainment area during the 2008 baseline year. The 2008 emission inventory is summarized in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	0.4	0.8	0.1%	0.1%
Oakridge Sand & Gravel: Cement plant	0.1	0.1	0.0%	0.0%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	42.3	7%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	158.9	174.8	30%	32%
Residential Wood Combustion: Certified Woodstove/Insert[2]	228.0	250.8	43%	45%
Pellet Stoves	6.7	7.4	1%	1%
All Other Stationary Area Sources	47.4	4.7	9%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	26.6	37.3	5%	7%
Re-Entrained Road Dust	12.1	27.8	2%	5%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
Total, All Sources, lbs/day	**525**	**552**		

(1) Worst-case day = Peak month production/20 workdays.
(2) Worst-case day = Peak Heating Degree Day

Table D-1: 2008 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.

The emissions inventory on worst winter days is of most interest since the $PM_{2.5}$ concentrations measured in Oakridge do not meet the current 24-hour $PM_{2.5}$ standard and the peak $PM_{2.5}$ concentrations occur on cold, stagnant days during the November-February wood-heating season. Residential wood-heating emissions (from certified and non-certified woodstoves, fireplaces, and pellet stoves) account for about 86% of the emissions on worst winter days, as illustrated in the following figure.

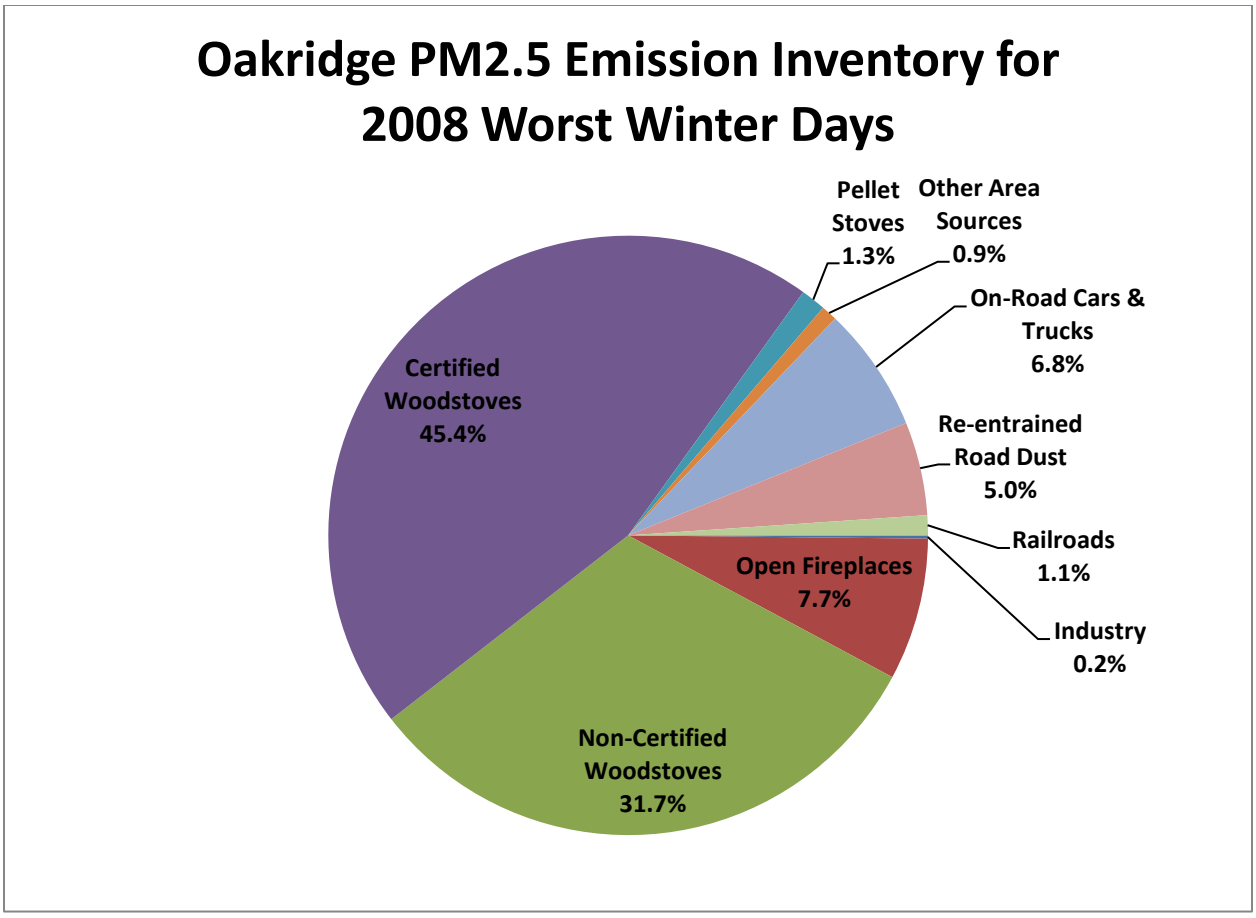


Figure D-1: **Oakridge $PM_{2.5}$ Emission Inventory for 2008 Worst Winter Days**

Residential Wood Combustion

Residential wood combustion (RWC) is a common way to heat homes in Oregon. To estimate emissions from wood burning, LRAPA conducted a survey for the 2009-2010 heating season in Oakridge-Westfir. The survey provided LRAPA with information on how many homes use various types of wood-heating devices, the amount of wood burned, and other information on wood-heating practices.

Mobile and Nonroad Sources

Road dust and tailpipe emissions of $PM_{2.5}$ from motor vehicles were calculated by Lane Council of Governments (LCOG) transportation staff by applying emission factors from the EPA MOVES computer program to total vehicle miles traveled in the nonattainment area. Estimated vehicle miles traveled are from previous transportation modeling by LCOG for the Oregon Department of Transportation. Emissions from railroads were provided by Union Pacific Railroad staff using the EPA NONROAD2008a emissions protocol.

Industrial Point Sources

LRAPA maintains data on industrial point source emissions in Lane County. The only operating industrial point sources within the Oakridge-Westfir area are two minor aggregate industry sources (rock crusher and concrete batch plant) operated by Oakridge Sand & Gravel.

Attainment Year Emission Inventory (2014)

The attainment year inventory is an estimation of emissions for the year that the area is expected to have attained the $PM_{2.5}$ standard. It includes projected emissions for the attainment year based on a number of different factors. Growth rates for population, employment, and VMT through 2014 were used to estimate 2014 emissions. LRAPA took credit for RWC emissions reductions as a result of the woodstove replacement project implemented during 2009-2012 that reduced the number of non-certified woodstoves accounted for in the 2008 emission inventory.

The attainment year emission inventory is based on the 2008 emissions inventory, estimated growth rates and the emission reduction strategies that have recently been put into effect. The emission reduction strategies primarily include the continued implementation (with specific strengthening revisions in some cases) of the existing control measures that have been effective in achieving the PM_{10} standards and the initial (1997) $PM_{2.5}$ standards on schedule. The key ongoing control strategies, which were in place prior to 2008, include:

- City ordinance to curtail burning during stagnant weather periods;
- City ordinance requiring the removal of a non-certified wood stoves upon sale of a home;
- City ordinance prohibiting the use of a non-certified wood stove in a residence; and
- Partnering in additional change-out programs to encourage removal of non-certified woodstoves.

The RWC emission reduction credits in the proposed $PM_{2.5}$ Attainment Plan are conservative. The calculated credits are based on:

- New woodstoves installed after 2008 are EPA certified Phase II equivalent, based on the Oakridge ordinances and the Oregon Heat Smart law;
- Existing uncertified woodstove replacements since 2008 are based on the 79 units documented by LRAPA-administered financial incentive programs; and
- The strengthened mandatory curtailment program during air pollution episodes forecasts a 30% reduction in wood burning on red advisory days.

There are several other RWC strategies in the proposed $PM_{2.5}$ Attainment Plan but no specific credits were taken for those strategies.

The 2014 emission inventory is summarized in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.1%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	3.7%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	29.6	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	106.1	81.7	22%	21%
Residential Wood Combustion: Certified Woodstove/Insert[2]	252.4	194.4	52%	51%
Pellet Stoves	7.3	8.0	1%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	15.7	22.2	3%	6%
Re-Entrained Road Dust	7.1	16.3	1%	4%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
Total, All Sources, lbs/day	**486**	**381**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table D-2: **2014 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.**

Comparison of 2008 to 2014 Emissions

The emission inventory shows an overall decrease in emissions for the attainment year (2014) based on the effectiveness of the emission control strategies.

The differences in the 2008 and 2014 emission inventories are the combination of increases due to growth factors and decreases due to emission control strategies. For example, motor vehicle emissions decreased overall due to progressively cleaner gasoline and diesel fuels and motor vehicles, but part of the emissions decrease was offset by gradual growth in traffic volumes. Industry emissions were conservatively increased to reflect operation at maximum capacity in 2014, but both industrial sources are minor so this did not have a major effect on the 2014 inventory. The most significant category is residential wood-heating; emissions were increased to reflect population growth during 2008-2014, decreased due to non-certified woodstove replacements with cleaner burning units during 2009-2012, and decreased due to improvements in the programs for curtailment during stagnant air episodes.

To review, the key long-term permanent RWC strategies have been:

- the woodstove change-out programs replacing uncertified woodstoves with cleaner burning and more efficient home heating units;
- the Oregon and EPA woodstove certification programs requiring any new woodstoves installed since 1986 to be certified woodstoves; and
- the Oakridge ordinance and Oregon Heat Smart law requiring removal of uncertified woodstoves upon home sale.

These programs have been critical to the significant improvement in Oakridge $PM_{2.5}$ concentrations during 2005-2011. In addition, the combined emission reduction of these programs will more than offset the growth in population and housing between 2008 and 2014, with a net RWC emission reduction of about 28 lb/day on typical season days and 31 lb/day on worst-case days.

The key short-term RWC strategy is a strengthened mandatory curtailment program to reduce fireplace and woodstove emissions by 30% on an average of 20 red days per year (based on the number of days above 30 $\mu g/m^3$ $PM_{2.5}$ during 2005-2011). This will reduce RWC emissions by 131 lb/day and reduce future $PM_{2.5}$ concentrations below the 35 $\mu g/m^3$ $PM_{2.5}$ standard on worst-case days.

Contingency Planning

The Oakridge $PM_{2.5}$ attainment plan must contain contingency measures that would be implemented in the event that the Oakridge nonattainment area fails to meet the standard on or after December 2014. The contingency measures are designed to correct the violation of the $PM_{2.5}$ standards and be implemented immediately. EPA requires that any contingency measures must equal one year equivalent of reasonable further progress (RFP). The RFP requirement in Oakridge would equal about one $\mu g/m^3$ of further reduction.

The Oakridge $PM_{2.5}$ attainment plan includes the following strategies as contingency strategies to fully meet the air quality standards, if it becomes clear that the strengthened ongoing strategies described above will not be sufficient to attain the $PM_{2.5}$ standards by 2014 and or to maintain compliance with the standards through 2024 and beyond:

- Stricter opacity limit, revising the current 40% opacity limit in the city ordinance to a more restrictive 20% limit, as has been done in some other northwest communities.
- Stricter green-yellow-red advisory program, with more yellow and red advisory days each winter.
- Further restrictions on city woodstove curtailment exemptions (for sole source, economic hardship).

The most quantifiable and most quickly implemented of these contingency measures would be further strengthening of the mandatory curtailment program by more consistent enforcement of the city curtailment ordinance and stricter criteria for expanding the number of yellow and red advisory days. If the standard is not met by 2014, the number of red curtailment days would be increased to an average of 30 days per year (based on the number of days above 25 $\mu g/m^3$ $PM_{2.5}$ during 2005-2011) and the frequency of curtailment enforcement (warnings and citations) would be increased accordingly in order to increase the effectiveness of the curtailment to 40% (or to 50% if necessary) on worst case days.

If the contingency plan is implemented, the mandatory curtailment program will be increased from an average of 20 days per year (based on 30 $\mu g/m^3$ $PM_{2.5}$ in the pre-2012 Oakridge

ordinance) to 30 days per year (based on 25 µg/m^3 $PM_{2.5}$ in the contingency plan). The contingency measures for stronger enforcement on more red advisory days is expected to increase the curtailment effectiveness.

- Using these contingency strategies to increase curtailment effectiveness to 40% is expected to reduce RWC emissions by 44 lb/day and further reduce $PM_{2.5}$ concentrations on worst case days.
- Using these contingency strategies to increase curtailment effectiveness to 50% is expected to reduce RWC emissions by 87 lb/day and further reduce $PM_{2.5}$ concentrations on worst case days.

Either of these contingency measures would more than achieve the one µg/m^3 target needed to meet the EPA RFP test.

If Oakridge meets the $PM_{2.5}$ standard by the EPA Clean Air Act 2014 deadline, the contingency plan will not need to be enacted. If Oakridge does not meet the $PM_{2.5}$ standard by the EPA Clean Air Act 2014 deadline, the contingency plan will be enacted by the beginning of the immediate next wood-heating season, November 15, 2015.

Introduction

Purpose of the Report

The $PM_{2.5}$ Nonattainment Area State Implementation Plan (SIP) emissions inventory for Oakridge-Westfir has been developed in response to requirements specified in the Clean Air Act Amendments of 1990 and in conformance to 40 CFR §51.1002(c).

The 1990 Clean Air Act contains provisions on the required development of emission inventories for designated areas that failed or have failed in the past to meet the National Ambient Air Quality Standards (NAAQS). The Oakridge-Westfir Nonattainment Area (NAA) is a designated NAAQS $PM_{2.5}$ nonattainment area. This emission inventory is provided as a part of the State of Oregon revisions to its State Implementation Plan (SIP) to formulate a strategy to maintain the NAAQS.

The U.S. Environmental Protection Agency (EPA) adopted revisions to the National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$ in September 2006. $PM_{2.5}$ is fine particulate matter two and a half microns and less in diameter.

On October 8, 2009, the Environmental Protection Agency (EPA) issued final area non-attainment designations for the 24-hour national air quality standards for fine particulate matter ($PM_{2.5}$). Oakridge was designated a non-attainment area in Oregon. Under the Clean Air Act, an area that violates the federal standards is designated as "nonattainment" and must adopt a plan with emission reduction measures to bring the area back into compliance. The area designated as non-attainment for $PM_{2.5}$ contains Oakridge, the small town of Westfir and surrounding area.

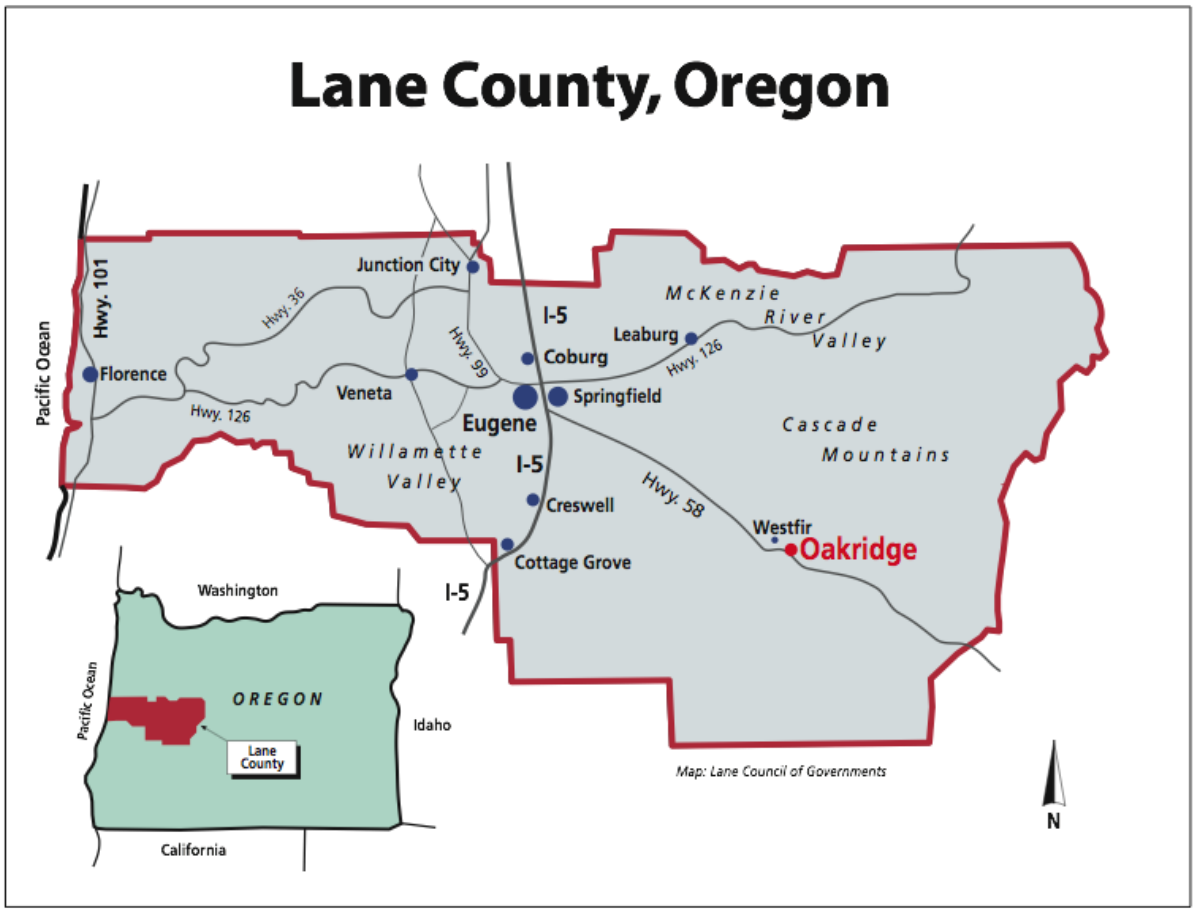
This document fulfills the EPA requirements for preparing the 2008 Base Year and 2014 Attainment Year emission inventories, as specified in the provisions of the 1990 CAAA, and EPA guidance documents. The purpose of this report is to establish baseline emissions for the Oakridge-Westfir NAA in 2008 and project emissions to 2014. These emissions are then used to determine whether the area will reach attainment by 2014. This determination is documented in the Oakridge $PM_{2.5}$ Attainment Plan, of which this is an appendix.

The principal components for development and documentation for the 2014 Attainment Plan emission inventories have been addressed in this document, which includes stationary permitted point sources, stationary area (non-permitted) sources, non-road mobile sources (railroads), on-road mobile sources, and emissions summaries. Inventory years include a base year of 2008 and the 2014 attainment deadline year. The geographic boundary for each inventory is the Oakridge-Westfir NAA, as defined by the NAA boundary.

Description of Inventory and Area Covered

The 2008 Base Year emission inventory and 2014 Attainment Year emission forecast cover $PM_{2.5}$ emissions for the Oakridge-Westfir NAA. Emissions are reported as annual, typical season day, and worst-case day. Typical season day emissions are the daily rate of emissions for the four-month PM season, defined as the period from the beginning of January through the end of February and beginning of November through the end of December. Worst-case day emissions represent the highest ambient $PM_{2.5}$ accumulations on a single day during the four-month PM season. Annual emissions are reported as tons per year (tpy), whereas typical season and worst-case day emissions are reported as lbs per day.

Oakridge, Oregon lies in an alluvial plain in the foothills at the southern end of the Willamette River valley. The city is in Lane County, Oregon, approximately 45 miles east-southeast of Eugene, and 28 miles west of Willamette Pass, the summit of the Cascade Mountain Range. The city limits of present-day Oakridge includes the historic City of Oakridge and, directly west, the area formerly known as Willamette City. Figure 2 shows the location of Oakridge in Lane



County.

Figure 2: Oakridge Location

The area of applicability for this attainment plan includes an area that contains the City of Oakridge and the small town of Westfir. Figure 3 shows the Oakridge-Westfir non-attainment area.

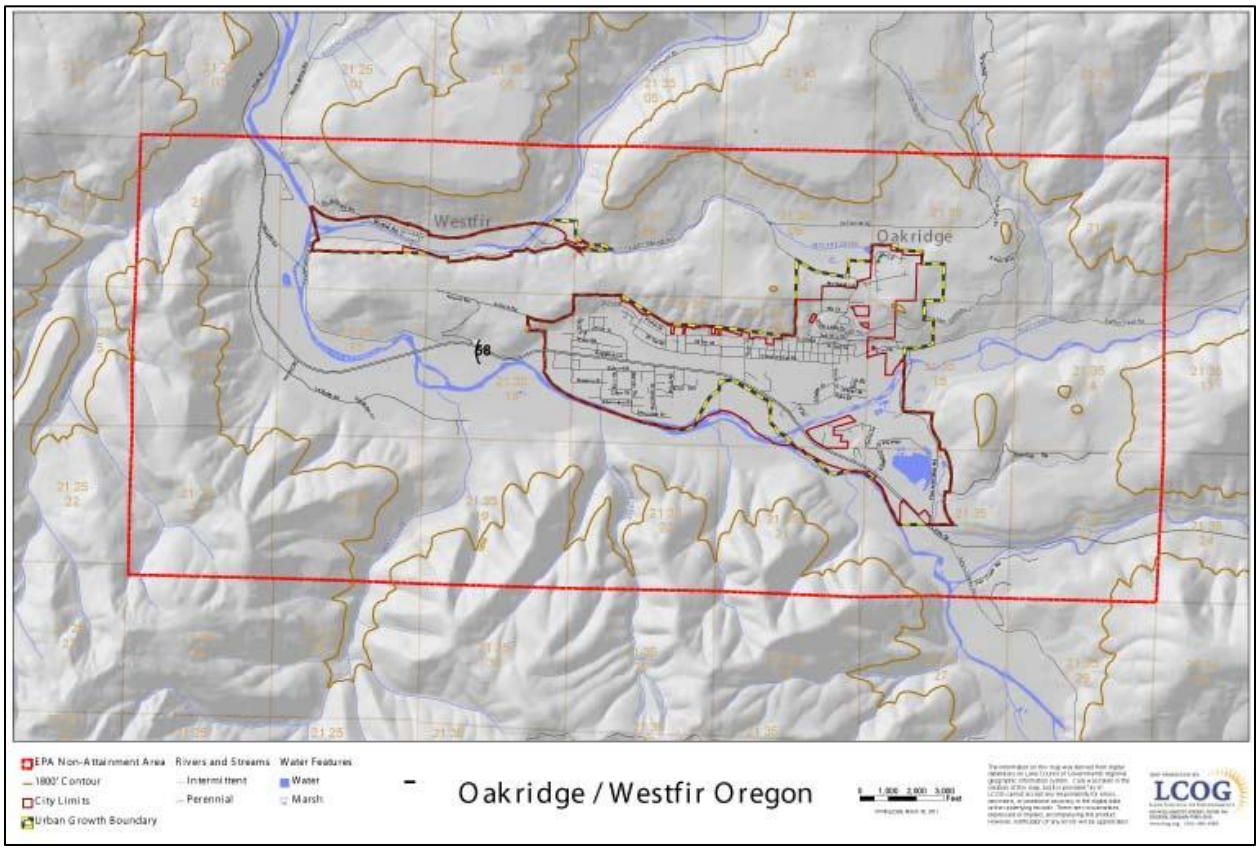


Figure 3: Nonattainment Area

The City of Oakridge is situated in a valley oriented east-west, through which flows the middle fork of the Willamette River. Elevation of the area ranges from 1100 feet at the lower (west) end to 1600 feet with areas of densest population situated between 1100 feet and 1200 feet. Mountains rise on the north and south sides to 1700 feet and 1600 feet, respectively.

Westfir is a very small (population 335) isolated rural mountain community that is located along the north fork of the Willamette River about 1 mile NW of Oakridge. Its elevation is about the same as Oakridge and it is surrounded by the same high mountains. Westfir and Oakridge are in separate steep sided river valleys separated by a 400-foot ridge. The Westfir valley is very narrow, only about 1/4 mile across at its widest point, while the Oakridge valley is about 1 mile across at its widest point.

Description of Emission Inventory Information Systems

The inventory has been assembled by the staff of the Lane Regional Air Protection Agency (LRAPA) with support from the staffs of the Lane Council of Governments (LCOG) and the Oregon Department of Environmental Quality ODEQ). Permitted point source emissions were drawn from the LRAPA permit source files and ODEQ emission factors. Residential wood combustion (RWC) emissions were calculated from LRAPA wood use surveys and EPA emission factors. Onroad emissions were calculated by LCOG using previous traffic modeling studies and the EPA MOVES emissions model. Railroad emissions were calculated by staff of the Union Pacific Railroad (UPRR) using UPRR data and EPA emissions factors. All other emissions were either modeled or inventoried by LRAPA staff specifically for this project.

Sources Not Inventoried

All significant sources of $PM_{2.5}$ in the Oakridge-Westfir NAA were considered for inclusion in the emission inventory. Sources were omitted for one of the following reasons: (1) point, area, non-road or mobile sources did not emit significant amounts of $PM_{2.5}$ annually or during the winter months; or (2) the activity did not occur within the Oakridge-Westfir NAA. The Lane County portion of the 2008 National Emission Inventory (NEI) was used as the initial base for the initial screening to identify significant source categories of PM, NOx, SO2, VOC and NH3 emissions in the Oakridge-Westfir area. The initial screening of estimated emissions in the Oakridge-Westfir area used relative population, housing, traffic volumes, acreage, industry locations, and other parameters. The Lane County and Oakridge-Westfir emissions of PM, NOx, SO2, VOC and NH3 are summarized in a series of tables by pollutant in Appendix D-5.

Guidance Documents

The inventory was conducted using applicable EPA procedure and guidance documents. Emission factors were taken from the EPA Procedures Document, the *Compilation of Air Pollutant Emission Factors*, hereinafter referred to as AP-42. Localized emission factors were used when documentation existed to support their accuracy. These and other information sources are cited in the text, as appropriate.

Contact Personnel for the Inventory

LRAPA staff, Merlyn Hough and Max Hueftle, performed most of the required source calculations. Josh Roll of the LCOG staff provided the vehicle miles travelled (VMT) and onroad emissions calculations.

Quality Assurance and Quality Control of the Inventory

LRAPA staff consulted with DEQ staff throughout the preparation of these emission inventories. Emissions from each of the categories (e.g., mobile source emission rates per mile) were compared to similar inventories for the Klamath Falls and Tacoma areas. PM emissions were compared to historical emission inventories and trends for the successful 1988-2010 Oakridge and Eugene-Springfield PM_{10} attainment planning and control strategies implementation. The Oakridge emission inventories were consistent with independent chemical speciation work on Oakridge PM filters and Positive Matrix Factorization (PMF) results by EPA Region 10 staff.

Summary of Emissions Data

Base Year Emission Inventory (2008)

The base year emission inventory is used as the starting point for the attainment demonstration. This inventory includes sources in the nonattainment area during the 2008 baseline year. The 2008 emission inventory is summarized in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	0.4	0.8	0.1%	0.1%
Oakridge Sand & Gravel: Concrete plant	0.1	0.1	0.0%	0.0%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	42.3	7%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	158.9	174.8	30%	32%
Residential Wood Combustion: Certified Woodstove/Insert[2]	228.0	250.8	43%	45%
Pellet Stoves	6.7	7.4	1%	1%
All Other Stationary Area Sources	47.4	4.7	9%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	26.6	37.3	5%	7%
Re-Entrained Road Dust	12.1	27.8	2%	5%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
Total, All Sources, lbs/day	**525**	**552**		

(1) Worst-case day = Peak month production/20 workdays.
(2) Worst-case day = Peak Heating Degree Day

Table D-1: 2008 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.

The emissions inventory on worst winter days is of most interest since the $PM_{2.5}$ concentrations measured in Oakridge do not meet the current 24-hour $PM_{2.5}$ standard and the peak $PM_{2.5}$ concentrations occur on cold, stagnant days during the November-February wood-heating season. Residential wood-heating emissions (from certified and non-certified woodstoves, fireplaces, and pellet stoves) account for about 86% of the emissions on worst winter days, as illustrated in the following figure.

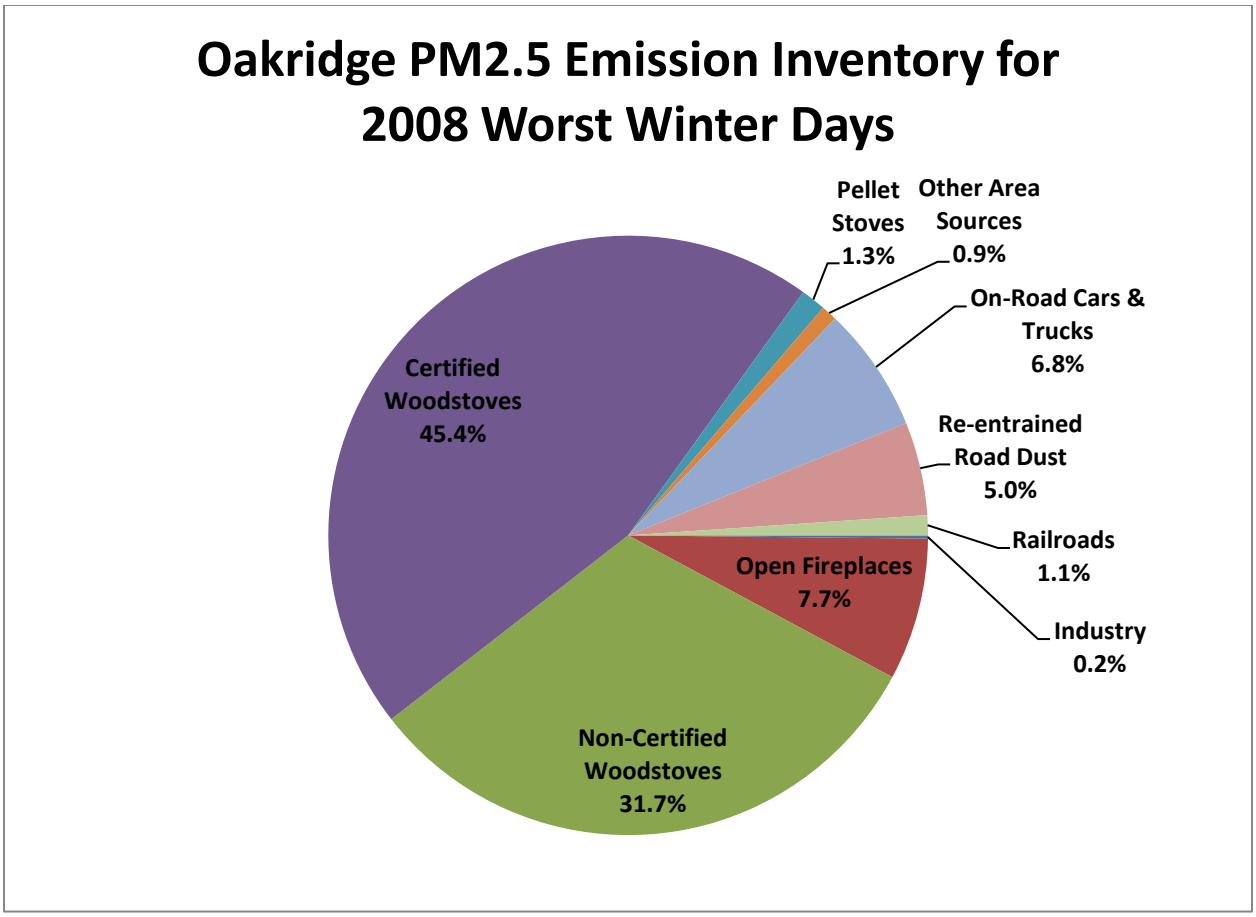


Figure D-1: **Oakridge $PM_{2.5}$ Emission Inventory for 2008 Worst Winter Days**

Industrial Point Sources

LRAPA maintains data on industrial point source emissions in Lane County. The two existing industrial sources in the Oakridge-Westfir area are minor industrial sources of $PM_{2.5}$ emissions. The facilities are a portable rock crusher and a ready-mix concrete plant owned and operated by Oakridge Sand & Gravel.

These two minor sources together emit less than one ton per year of $PM_{2.5}$ emissions and contribute less than 1% to the base year and future year emission inventories. These two minor sources are well below the LRAPA significant emission rate (SER) for $PM_{2.5}$ of 10 tons per year.

The air pollution control technologies installed on these sources are the standards for the industry and meet RACT requirements. The rock crusher has water-spray controls and the concrete plant has baghouse controls. Actual production rates, maximum production capacities, actual emissions, and maximum potential emissions are summarized in Appendix D-1. Emission factors are based on the ODEQ Emission Factors for Asphalt and Aggregate

Industries (AQ-EF06) which are derived from EPA AP-42. A copy of AQ-EF06 is included in Appendix D-1.

The typical season day emissions for these two facilities during the base year were based on average actual production rates and calculated emissions during the months of November-February in recent years (2008-2011). The worst-case day emissions for these two facilities during the base year on based on actual production rates and calculated emissions during the highest production month during November-February in recent years (2008-2011); for the rock crusher, the peak winter month was January 2011; for the ready-mix concrete plant, the peak winter month was November 2009.

[The future year (2014) emissions for these two facilities are based on the maximum allowable production rates identified in the facility permit applications and the LRAPA-issued permits. The typical season day emissions are based on the annual maximum production capacity and the worst-day emissions are based on the daily maximum production capacity. The rock crusher has a production capacity of 3,600 tons per day (potential $PM_{2.5}$ emissions of 4 lb/day) and 300,000 tons per year (potential $PM_{2.5}$ emissions of 360 lb/year). The ready-mix concrete plant has a production capacity of 480 cubic yards per day (potential $PM_{2.5}$ emissions of 14 lb/day) and 30,000 cubic yards per year (potential $PM_{2.5}$ emissions of 90 lb/year).]

Residential Wood Combustion

Residential wood combustion (RWC) is a common way to heat homes in Oregon. To estimate emissions from wood burning, LRAPA conducted a survey for the 2009-2010 heating season in Oakridge-Westfir. The survey provided LRAPA with information on how many homes use various types of wood-heating devices, the amount of wood burned, and other information on wood-heating practices. The Oakridge wood use is summarized in the following table.

Woodburning Device	Base Year Wood Fuel Use Survey (Households)	Base Year Wood Fuel Use (tons/HH)	Base Year Wood Fuel Use (tons/year)
Oakridge NAA			
21-04-008-100 Fireplace without Insert	123	1.6	195.6
21-04-008-320 Certified Non-Cat Wood-Stove	256	3.0	770.6
21-04-008-330 Certified Cat Wood-Stove	64	3.0	192.6
21-04-008-310 Conv Wood Stove	111	3.0	334.1
21-04-008-230 Fireplace Insert Cert Catalyst	28	3.0	84.3
21-04-008-220 Fireplace Insert Cert Non-Cat	112	3.0	337.1
21-04-008-210 Fireplace Insert Conv.	96	3.0	289.0
21-04-008-400 Exempt Pellet Stove	228	1.2	264.5
21-04-008-510 Central Furnace	0	0.0	0.0
Total	1,018		2,468

Table D-1a: **Oakridge Base Year Residential Wood Use Survey Results.**

The survey report, data, and additional RWC emission calculation details are included at the end of Appendix D-2 in a series of tables of RWC 2008 emissions of $PM_{2.5}$ (and NOx, SO2, VOC and NH3).

Other Area Sources

The only other area source category with potential significant emissions is backyard burning. Backyard burning is banned in Lane County for fire safety reasons during the June-September fire season and is banned in Oakridge for air quality reasons during November-February. There are 1,756 households in the Oakridge-Westfir nonattainment area. The LRAPA survey indicates that 28% of the households (about 492 households) burn yard debris (weighted average of 3 cubic yards per household) during the Fall and Spring months. The yard debris is a mix of leaves and brush with an estimated average density of 312.5 pounds per cubic yard using conversion factors (250-375 lb/yard) from OAR 340-097-0110. AP-42 emission factors are 17-38 lb/ton, or an average of 27.5 lb/ton. The total amount of yard debris burned is calculated to be 230.6 tons per year with $PM_{2.5}$ emissions of 3.2 tons per year. Typical season days emissions

are estimated to be 47.4 lb/day on the approximately 135 days per year during the Spring and Fall burning seasons . Although backyard burning is banned during November-February, LRAPA and Oakridge occasionally receive complaints of backyard burning on banned days, so backyard burning emissions are conservatively estimated at 10% (4.7 lb/day) on worst-case days during November-February.

Mobile and Nonroad Sources

Road dust and tailpipe emissions of $PM_{2.5}$ from motor vehicles were calculated by Lane Council of Governments (LCOG) transportation staff by applying emission factors from the EPA MOVES computer program to total vehicle miles traveled in the nonattainment area. Estimated vehicle miles traveled are from previous transportation modeling by LCOG for the Oregon Department of Transportation. A copy of the LCOG report is included as Appendix D-3.

Emissions from railroads were provided by Union Pacific Railroad staff using the EPA NONROAD2008a emissions protocol. The UPRR report is included as Appendix D-4. Fuel consumption information was submitted by UPRR to LRAPA as Confidential Business Information so some of the report is not included in the appendix. Contact LRAPA or UPRR if additional details or calculations are needed for verification.

Other non-road mobile sources were categorized by LRAPA as insignificant in Oakridge-Westfir during the $PM_{2.5}$ winter season as summarized in Appendix D-5.

Attainment Year Emission Inventory (2014)

The attainment year inventory is an estimation of emissions for the year that the area is expected to have attained the $PM_{2.5}$ standard. It includes projected emissions for the attainment year based on a number of different factors. Growth rates for population, employment, and VMT through 2014 were used to estimate 2014 emissions. LRAPA took credit for RWC emissions reductions as a result of the woodstove replacement project implemented during 2009-2012 that reduced the number of non-certified woodstoves accounted for in the 2008 emission inventory.

The attainment year emission inventory is based on 2008 emissions inventory, estimated growth rates and the emission reduction strategies that have recently been put into effect. The emission reduction strategies primarily include the continued implementation (with specific strengthening revisions in some cases) of the existing control measures that have been effective in achieving the PM_{10} standards and the initial (1997) $PM_{2.5}$ standards on schedule. The key ongoing control strategies, which were in place prior to 2008, include:

- City ordinance to curtail burning during stagnant weather periods;
- City ordinance requiring the removal of a non-certified wood stoves upon sale of a home;
- City ordinance prohibiting the use of a non-certified wood stove in a residence; and
- Partnering in additional change-out programs to encourage removal of non-certified woodstoves.

The RWC emission reduction credits in the proposed $PM_{2.5}$ Attainment Plan are conservative. The calculated credits are based on:

- New woodstoves installed after 2008 are EPA certified Phase II equivalent, based on the Oakridge ordinances and the Oregon Heat Smart law;
- Existing uncertified woodstove replacements since 2008 are based on the 79 units documented by LRAPA-administered financial incentive programs; and
- The strengthened mandatory curtailment program during air pollution episodes forecasts a 30% reduction in wood burning on red advisory days.

There are several other RWC strategies in the proposed $PM_{2.5}$ Attainment Plan but no specific credits were taken for those strategies.

Economic Factors

The economy in Oakridge has shifted from logging-based industries to a more recreation-oriented model. The decline in the harvesting and processing of timber has left Oakridge with no industrial employer or businesses that support the lumber industry. In the 1990's, the population in Oakridge declined sharply as jobs disappeared. Current census figures show only modest growth of 1.8% between 2000 and 2010, with the current population at 3,205. Within the civilian labor force, 16% were unemployed in 2010 and 21.7% of all families had incomes below the poverty level. The low cost of living has attracted low-income and unemployed people to Oakridge.

The recreation industry has picked up in Oakridge, with mountain biking being very popular. A hostel, brew pub, and other small businesses have opened to support the visitors attracted to the area. Despite the recent business growth, few jobs have been created. Population and employment in Oakridge are expected to increase only modestly over the next 20 years. The population estimate for the year 2025 is 4,000. Any new employment has been assigned to the potential development of the Oakridge Industrial Park.

Growth Rates

Growth is expected to be low to moderate in the Oakridge-Westfir area through 2014. Population, housing, and employment forecasts are expected to increase gradually. VMT growth is based on the previous transportation modeling by LCOG in the Highway 58 corridor.

The 2014 emission inventory is summarized in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.1%
Oakridge Sand & Gravel: Concrete plant	4.3	14.0	0.9%	3.7%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	29.6	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	106.1	81.7	22%	21%
Residential Wood Combustion: Certified Woodstove/Insert[2]	252.4	194.4	52%	51%
Pellet Stoves	7.3	8.0	1%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	15.7	22.2	3%	6%
Re-Entrained Road Dust	7.1	16.3	1%	4%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
Total, All Sources, lbs/day	**486**	**381**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table D-2: **2014 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.**

Residential wood combustion continues to be the major emission source category in 2014. The Oakridge 2014 wood use, after applying growth factors and woodstove replacements, is summarized in the following table.

Woodburning Device	2014 Wood Fuel Use (Households)	2014 Wood Fuel Use (tons/HH)	2014 Wood Fuel Use (tons/year)
Oakridge NAA			
21-04-008-100 Fireplace without Insert	123	1.6	195.6
21-04-008-320 Certified Non-Cat Wood-Stove	298	3.0	879.4
21-04-008-330 Certified Cat Wood-Stove	64	3.0	188.9
21-04-008-310 Conv Wood Stove	65	3.0	191.8
21-04-008-230 Fireplace Insert Cert Catalyst	28	3.0	82.6
21-04-008-220 Fireplace Insert Cert Non-Cat	130	3.0	383.6
21-04-008-210 Fireplace Insert Conv.	76	3.0	224.3
21-04-008-400 Exempt Pellet Stove	247	1.2	286.5
21-04-008-510 Central Furnace	0	0.0	0.0
Total	1,031		2,433

Table D-2a: **Oakridge 2014 Projected Residential Wood Use.**

For example, comparing Tables D-1a and D-2a, the number of wood burning households and amount of wood burned increased in 2008-2014 due to population and housing growth, but the number of conventional (uncertified) woodstoves and fireplace inserts decreased due to units replaced with woodstove replacement incentives during 2009-2012 as verified by LRAPA. Additional RWC emission calculation details are included at the end of Appendix D-2 in a series of tables (Tables 3 through 12) of RWC 2014 emissions of $PM_{2.5}$ (and NOx, SO2, VOC and NH3).

Comparison of 2008 to 2014 Emissions

The emission inventory shows an overall decrease in emissions for the attainment year (2014) based on the effectiveness of the emission control strategies.

The differences in the 2008 and 2014 emission inventories are the combination of increases due to growth factors and decreases due to emission control strategies. For example, motor vehicle emissions decreased overall due to progressively cleaner gasoline and diesel fuels and

motor vehicles, but part of the emissions decrease was offset by gradual growth in traffic volumes.

Industry emissions were conservatively increased to reflect operation at maximum capacity in 2014, but both industrial sources are minor so this did not have a major effect on the 2014 inventory. The future year (2014) emissions for these two facilities are based on the maximum allowable production rates identified in the facility permit applications and the LRAPA-issued permits. The typical season day emissions are based on the annual maximum production capacity and the worst-day emissions are based on the daily maximum production capacity. The rock crusher has a production capacity of 3,600 tons per day (potential $PM_{2.5}$ emissions of 4 lb/day) and 300,000 tons per year (potential $PM_{2.5}$ emissions of 360 lb/year). The ready-mix concrete plant has a production capacity of 480 cubic yards per day (potential $PM_{2.5}$ emissions of 14 lb/day) and 30,000 cubic yards per year (potential $PM_{2.5}$ emissions of 90 lb/year).

The most significant category is residential wood-heating; emissions were increased to reflect population growth during 2008-2014, decreased due to non-certified woodstove replacements with cleaner burning units during 2009-2012, and decreased due to improvements in the programs for curtailment during stagnant air episodes.

In order to illustrate the RWC emission reductions from the key strategies, it is helpful to compare the 2014 emission inventories with (Table D-2 above) and without (Table D-3 below) the strengthened mandatory curtailment program on worst-case days, and to compare both of these tables to the 2008 emission inventory in Table D-1.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	0.7%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	2.5%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	42.3	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	106.1	116.7	22%	21%
Residential Wood Combustion: Certified Woodstove/Insert[2]	252.4	277.7	52%	50%
Pellet Stoves	7.3	8.0	1%	1%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	15.7	22.2	3%	4%
Re-Entrained Road Dust	7.1	16.3	1%	3%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
Total, All Sources, lbs/day	**486**	**512**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table D-3: **2014 Estimated Worst-Case Day $PM_{2.5}$ Emissions without Mandatory Curtailment.**

To review, the key long-term permanent RWC strategies have been:

- the woodstove change-out programs replacing uncertified woodstoves with cleaner burning and more efficient home heating units;
- the Oregon and EPA woodstove certification programs requiring any new woodstoves installed since 1986 to be certified woodstoves; and
- the Oakridge ordinance and Oregon Heat Smart law requiring removal of uncertified woodstoves upon home sale.

These programs have been critical to the significant improvement in Oakridge $PM_{2.5}$ concentrations during 2005-2011. In addition, the combined emission reduction of these programs will more than offset the growth in population and housing between 2008 and 2014, with a net RWC emission reduction of about 28 lb/day on typical season days and 31 lb/day on worst-case days (comparing the fireplace, woodstove and pellet stove emissions in Tables D-1 and D-3).

The key short-term RWC strategy is a strengthened mandatory curtailment program to reduce fireplace and woodstove emissions by 30% on an average of 20 red days per year (based on the number of days above 30 $\mu g/m^3$ $PM_{2.5}$ during 2005-2011). This will reduce RWC emissions by 131 lb/day (comparing the fireplace and woodstove emissions in Tables D-2 and D-3) and reduce future $PM_{2.5}$ concentrations below the 35 $\mu g/m^3$ $PM_{2.5}$ standard on worst-case days as outlined in Appendix H.

Contingency Planning

The Oakridge $PM_{2.5}$ attainment plan must contain contingency measures that would be implemented in the event that the Oakridge nonattainment area fails to meet the standard on or after December 2014. The contingency measures are designed to correct the violation of the $PM_{2.5}$ standards and be implemented immediately. EPA requires that any contingency measures must equal one year equivalent of reasonable further progress (RFP).

In Oakridge, the worst-day $PM_{2.5}$ concentrations need to be reduced by about one microgram per cubic meter ($\mu g/m^3$) per year in order to meet the $PM_{2.5}$ standard by 2014 (i.e., reduced from 39.5 $\mu g/m^3$ in the 2006-2010 baseline period to 35 $\mu g/m^3$ by the 2014 attainment date). Therefore the RFP requirement in Oakridge would equal about one $\mu g/m^3$ of further reduction.

The Oakridge $PM_{2.5}$ attainment plan includes the following strategies as contingency strategies to fully meet the air quality standards, if it becomes clear that the strengthened ongoing strategies described above will not be sufficient to attain the $PM_{2.5}$ standards by 2014 and or to maintain compliance with the standards through 2024 and beyond:

- Stricter opacity limit, revising the current 40% opacity limit in the city ordinance to a more restrictive 20% limit, as has been done in some other northwest communities.
- Stricter green-yellow-red advisory program, with more yellow and red advisory days each winter.

- Further restrictions on city woodstove curtailment exemptions (for sole source, economic hardship).

The most quantifiable and most quickly implemented of these contingency measures would be further strengthening of the mandatory curtailment program by more consistent enforcement of the city curtailment ordinance and stricter criteria for expanding the number of yellow and red advisory days. If the standard is not met by 2014, the number of red curtailment days would be increased to an average of 30 days per year (based on the number of days above 25 $\mu g/m^3$ $PM_{2.5}$ during 2005-2011) and the frequency of curtailment enforcement (warnings and citations) would be increased accordingly in order to increase the effectiveness of the curtailment to 40% (or to 50% if necessary) on worst case days.

If curtailment was increased to 40% on 30 days per year, the 2014 RWC emissions would be reduced as outlined in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.2%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	4.2%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	25.4	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	106.1	70.0	22%	21%
Residential Wood Combustion: Certified Woodstove/Insert[2]	252.4	166.6	52%	49%
Pellet Stoves	7.3	8.0	1%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	15.7	22.2	3%	7%
Re-Entrained Road Dust	7.1	16.3	1%	5%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
Total, All Sources, lbs/day	**486**	**337**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table D-5: 2014 Estimated Worst-Case Day $PM_{2.5}$ Emissions with 40% Curtailment.

If curtailment was increased to 50% on 30 days per year, the 2014 RWC emissions would be reduced as outlined in the following table.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.4%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	4.8%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	21.2	8%	7%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	106.1	58.4	22%	20%
Residential Wood Combustion: Certified Woodstove/Insert[2]	252.4	138.8	52%	47%
Pellet Stoves	7.3	8.0	1%	3%
All Other Stationary Area Sources	47.4	4.7	10%	2%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	15.7	22.2	3%	8%
Re-Entrained Road Dust	7.1	16.3	1%	6%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
Total, All Sources, lbs/day	**486**	**294**		

(1) Worst-case day = Permitted hourly (x24) operating capacity
(2) Worst-case day = Peak Heating Degree Day

Table D-6: 2014 Estimated Worst-Case Day $PM_{2.5}$ Emissions with 50% Curtailment.

If the contingency plan is implemented, the mandatory curtailment program will be increased from an average of 20 days per year (based on 30 µg/m^3 $PM_{2.5}$ in the pre-2012 Oakridge ordinance) to 30 days per year (based on 25 µg/m^3 $PM_{2.5}$ in the contingency plan). The contingency measures for stronger enforcement on more red advisory days is expected to increase the curtailment effectiveness.

- Using these contingency strategies to increase curtailment effectiveness to 40% is expected to reduce RWC emissions by 44 lb/day and further reduce $PM_{2.5}$ concentrations on worst case days.
- Using these contingency strategies to increase curtailment effectiveness to 50% is expected to reduce RWC emissions by 87 lb/day and further reduce $PM_{2.5}$ concentrations on worst case days.

Either of these contingency measures would more than achieve the one µg/m^3 target needed to meet the EPA RFP test.

If Oakridge meets the $PM_{2.5}$ standard by the EPA Clean Air Act 2014 deadline, the contingency plan will not need to be enacted. If Oakridge does not meet the $PM_{2.5}$ standard by the EPA Clean Air Act 2014 deadline, the contingency plan will be enacted by the beginning of the immediate next wood-heating season, November 15, 2015.

Appendix D-1
Industrial Point Sources Emission Inventory

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477

Hot Mix Asphalt Plants – Particulate Matter:

Type	Particulate Matter Controls	Pounds of pollutant per ton of product[1]		
		PM	PM_{10}	$PM_{2.5}$
Batch Mix	Uncontrolled	32	4.5	0.29
	Venturi or wet scrubber	0.14	0.034	0.018
	Baghouse	0.042	0.027	0.025
Drum Mix	Uncontrolled	28	6.5	1.6
	Venturi or wet scrubber	0.045	0.025	0.021
	Baghouse	0.033	0.023	0.022

Hot Mix Asphalt Plants – Gaseous Pollutants:

Type	Fuel	Pounds of pollutant per ton of product[2]			
		SO_2	NO_x	CO	VOC
Batch Mix	Natural Gas	0.0046	0.025	0.40/0.1[3]	0.0082
	No. 2 fuel oil	0.088	0.12/0.08[3]	0.40/0.1[3]	0.0082
	No. 6 fuel oil	0.088	0.12	0.40	0.036
Drum Mix	Natural Gas	0.0034	0.026	0.13/0.1[3]	0.032
	No. 2 fuel oil	0.011	0.055	0.13/0.1[3]	0.032
	Waste oil	0.058	0.055	0.13/0.1[3]	0.032

Rock crushers

Type of control	Pounds of pollutant per ton of rock crushed[4]		
	PM	PM_{10}	$PM_{2.5}$
Uncontrolled	0.25	0.0125	0.00075
Water Spray	0.04	0.02	0.0012[5]

Ready-mix concrete plants

Type of control	Pounds of pollutant per cubic yard of concrete[5]		
	PM	PM_{10}	$PM_{2.5}$
Uncontrolled	0.2	0.102	0.03
Baghouse	0.02	0.02	0.0059[5]

[1] These factors are from AP-42 Tables 11.1-1 and 11.1-2. These factors should not be used if there is source specific emissions data available.
[2] These factors are from AP-42 Tables 11.1-3 through 11.1-4. These factors should not be used if there is source specific emissions data available.
[3] The first value represents emissions from sources without routine tuning of the burner. The second value can be used for sources that have a routine burner tuning schedule.
[4] These are DEQ factors.
[5] EPA PM calculator applying percentage of $PM_{2.5}$ to PM_{10} emission factor
[6] The uncontrolled emission factor is from AP-42 Table 11.12-2. The controlled factors are DEQ factors.

Oakridge Sand and Gravel
Permit No. 202814

Rock Crushing

Year: 2008	Rock Crushed	PM	PM10	PM2.5
Month	(Tons)	(pounds)	(pounds)	(pounds)
January	-	-	-	-
February	-	-	-	-
March	40,028	1,601	801	48.0
April	28,787	1,151	576	34.5
May	-	-	-	-
June	-	-	-	-
July	-	-	-	-
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-
November	-	-	-	-
December	-	-	-	-
TOTAL	68,815	2,753	1,376	83

Year: 2009
Zero (0) tons

Year: 2010
Zero (0) tons

Year: 2011	Rock Crushed	PM	PM10	PM2.5
Month	(Tons)	(pounds)	(pounds)	(pounds)
January	13,600	544	272	16.3
February	10,200	408	204	12.2
March	-	-	-	-
April	-	-	-	-
May	-	-	-	-
June	-	-	-	-
July	-	-	-	-
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-
November	-	-	-	-
December		-	-	-
TOTAL	23,800	952	476	29

	Production	PM	PM10	PM2.5
Maximum	Tons	(pounds)	(pounds)	(pounds)
Hourly*	150	6	3	0
Daily	3,600	144	72	4
Annual	300,000	12,000	6,000	360

*Hourly production capacity of 150 tons/hr is from ACDP application

Emission Factors (rock crushers, waterspray control)**

PM	0.04	lb/ton
PM10	0.02	lb/ton
PM2.5	0.0012	lb/ton

**Reference = ODEQ AQ-EF06, Emission Factors Asphalt and Aggregate Industries

Oakridge Sand and Gravel
Permit No. 206125

Ready-Mix Concrete

Year: 2009	Concrete	PM	PM10	PM2.5
Month	(Cubic Yards)	(pounds)	(pounds)	(pounds)
January	92	1.84	1.8	0.5
February	31	0.62	0.6	0.2
March	113	2.26	2.3	0.7
April	69	1.38	1.4	0.4
May	23	0.46	0.5	0.1
June	369	7.38	7.4	2.2
July	95	1.9	1.9	0.6
August	139	2.78	2.8	0.8
September	77	1.54	1.5	0.5
October	50	1	1.0	0.3
November	95	1.9	1.9	0.6
December	6	0.12	0.1	0.0
TOTAL	1,159	23	23	7

Year: 2010	Concrete	PM	PM10	PM2.5
Month	(Cubic Yards)	(pounds)	(pounds)	(pounds)
January	28	0.56	0.6	0.2
February	25	0.5	0.5	0.1
March	42	0.84	0.8	0.2
April	31	0.62	0.6	0.2
May	19	0.38	0.4	0.1
June	27	0.54	0.5	0.2
July	27	0.54	0.5	0.2
August	52	1.04	1.0	0.3
September	14	0.27	0.3	0.1
October	17	0.34	0.3	0.1
November	26	0.52	0.5	0.2
December	-	0	0.0	-
TOTAL	307.5	6.2	6.2	1.8

Year: 2011	Concrete	PM	PM10	PM2.5
Month	(Cubic Yards)	(pounds)	(pounds)	(pounds)
January	7	0.14	0.1	0.0
February	17	0.34	0.3	0.1
March	21	0.42	0.4	0.1
April	15	0.3	0.3	0.1
May	38	0.76	0.8	0.2
June	83	1.66	1.7	0.5
July	26	0.52	0.5	0.2
August	8	0.16	0.2	0.0
September	7	0.14	0.1	0.0
October	-	0	0.0	-
November	-	0	0.0	-
December	-	0	0.0	-
TOTAL	222	4	4	1

	Production	PM	PM10	PM2.5
Maximum	Cubic Yards	(pounds)	(pounds)	(pounds)
Hourly*	20	0.4	0.4	0.1
Daily	480	10	10	2.8
Annual	30,000	600	600	177

*Hourly production capacity of 20 cubic yards/hr is from ACDP application

Emission Factors (ready-mix concrete, controlled by baghouse)**

PM	0.02	lb/cu yd
PM10	0.02	lb/cu yd
PM2.5	0.0059	lb/cu yd

**Reference = ODEQ AQ-EF06, Emission Factors Asphalt and Aggregate Industries (AP-42 derived)

Oakridge Sand and Gravel
Permit No. 206125

Combined Emissions from Rock Crushing and Ready-Mix Concrete Production

Year: 2008	PM	PM10	PM2.5	
Month	(pounds)	(pounds)	(pounds)	
January	92.0	1.8	1.8	
February	31.0	0.6	0.6	
March	1,714.1	802.8	50.3	includes rock production
April	1,220.5	577.1	35.9	includes rock production
May	23.0	0.5	0.5	
June	369.0	7.4	7.4	
July	95.0	1.9	1.9	
August	139.0	2.8	2.8	
September	77.0	1.5	1.5	
October	50.0	1.0	1.0	
November	95.0	1.9	1.9	
December	6.0	0.1	0.1	
TOTAL	3,911.6	1,399.5	105.8	

Facility does not have 2008 Ready Mix production so assume 2008 is equal to 2009 for Ready Mix

Year: 2009	PM	PM10	PM2.5
Month	(pounds)	(pounds)	(pounds)
January	92	1.84	1.8
February	31	0.62	0.6
March	113	2.26	2.3
April	69	1.38	1.4
May	23	0.46	0.5
June	369	7.38	7.4
July	95	1.9	1.9
August	139	2.78	2.8
September	77	1.54	1.5
October	50	1	1.0
November	95	1.9	1.9
December	6	0.12	0.1
TOTAL	1159	23.18	23.2

Year: 2010	PM	PM10	PM2.5
Month	(pounds)	(pounds)	(pounds)
January	28	0.56	0.6
February	25	0.5	0.5
March	42	0.84	0.8
April	31	0.62	0.6
May	19	0.38	0.4
June	27	0.54	0.5
July	27	0.54	0.5
August	52	1.04	1.0
September	13.5	0.27	0.3
October	17	0.34	0.3
November	26	0.52	0.5
December	0	0	0.0
TOTAL	307.5	6.15	6.2

Year: 2011	PM	PM10	PM2.5	
Month	(pounds)	(pounds)	(pounds)	
January	551	272.14	16.5	includes rock production
February	425	204.34	12.6	includes rock production
March	21	0.42	0.4	
April	15	0.3	0.3	
May	38	0.76	0.8	
June	83	1.66	1.7	
July	26	0.52	0.5	
August	8	0.16	0.2	
September	7	0.14	0.1	
October	0	0	0.0	
November	0	0	0.0	
December	0	0	0.0	
TOTAL	222	4.44	4.4	

	PM	PM10	PM2.5
Maximum	(pounds)	(pounds)	(pounds)
Hourly*	6	3	0.3
Daily	154	82	7.2
Annual	12,600	6,600	537

*Hourly production capacities are from ACDP application

Appendix D-2
Residential Wood Combustion Survey

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477

SURVEY OF OAKRIDGE AND WESTFIR RESIDENTS CONDUCTED FOR LANE REGIONAL AIR PROTECTION AGENCY

August, 2010

ADVANCED MARKETING
RESEARCH INC.

P.O. Box 5244 · Eugene, OR 97405 · Phone/Fax 541-345-6600 · www.advancedmarketingresearch.com

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EXECUTIVE SUMMARY

RESIDENCE (Q2)
87% of respondents live in Oakridge, 13% in Westfir.

LIVE INSIDE OR OUTSIDE OAKRIDGE CITY LIMITS (Q3)
77% of the Oakridge residents surveyed live inside city limits, down from 85% in 2005. 23% live outside city limits.

WOOD-BURNING DEVICES (Q4)
38% of respondents have a wood stove or fireplace with insert. 13% have a pellet stove. 7% have an open fireplace. 46% have no wood-burning devices. There have been no significant changes since 2005.

PELLET CONSUMPTION (Q5)
Although statistically there are not more people with pellet stoves than there were in 2005 (39 currently compared with 26 in 2005), those with pellet stoves are burning more bags of pellets per burning season than they were in 2005. Currently 17% burn one to twenty-nine bags, compared with 34% in 2005. And currently 44% burn over sixty bags, compared with 23% in 2005.

EPA CERTIFIED STOVES (Q6)
69% believe that their wood stove or fireplace with insert is EPA certified as "clean burning" (less than twenty-five years old). 15% say their stove in *not* EPA certified. 16% are unsure if their stove is certified. There have been no significant changes since 2005.

FREQUENCY OF BURNING WOOD (Q7)
Of those with a wood stove, fireplace with insert, or open fireplace (n=135), 48% burn wood daily in the winter months (down from 61% in 2005). 19% burn several times a week, 10% burn several times a month, and 10% burn less often than once a month. 13% never burn wood in these devices.

CONSUMPTION OF WOOD: OPEN FIREPLACE (Q8)
Of those with an open fireplace (n=22), 50% do not burn wood in their open fireplace, 32% burn one to two cords, and 19% burn three to five cords of wood per winter.

CONSUMPTION OF WOOD: WOOD STOVE (Q9)
Of those with a wood stove or fireplace with insert (n=117), 13% do not burn wood in it, 2% burn less than one cord, 43% burn one to two cords, and 43% burn over two cords of wood per winter. There have been no significant changes since 2005.

HOW IS WOOD STORED? (Q10)
The vast majority of wood (92%) is stored covered and dry. There have been no significant changes since 2005.

AGING OF WOOD (Q11)
66% of those burning wood (n=135) use wood that has aged for a year or more (down from 79% in 2005). 17% use wood that has aged for seven to eleven months. 7% use wood that has aged for six months or less. 12% are unsure how long their wood has aged when they burn it.

SOURCES OF HEAT (Q12)
For 33% of those who burn wood (not including pellets), their wood-burning device is the only heat source for their residence. 67% have an alternate source of heat. There have been no significant changes since 2005.

HOME HEATING EXEMPTION (Q13)
21% of Oakridge residents who burn wood (n=116) currently have a home wood heating exemption from the City of Oakridge, while 72% do not. 8% are unsure.

AWARENESS OF WOOD HEATING ADVISORY PROGRAM (Q14)
84% of respondents (down from 95% in 2005) are aware of the Home Wood Heating Advisory Program with its red, yellow, and green advisory system. 16% are unaware of the program.

ADVISORY PHONE CALLS (Q15-Q17)
47% of respondents receive occasional phone calls notifying them of whether or not they should burn wood based on air quality in their community (down from 80% in 2005). 51% do not receive such phone calls (up from 20% in 2005).

Of those not receiving calls (n=160), 81% don't know why; they have never been called (up from 63% in 2005). 7% say they don't know why; the calls just stopped. 7% don't burn wood. 4% asked to be removed from the list (down from 22% in 2005).

SHOULD THE CALL PROGRAM CONTINUE? (Q18-Q19)
56% of respondents feel that the notification call program is a useful program that should continue. 21% do not feel it should continue (down from 34% in 2005). 23% are unsure (up from 12% in 2005).

Those who do not feel the program is useful or are unsure (n=138) gave the following reasons: "We don't burn wood" (20%), "the calls are ineffective; some have to burn to keep warm" (20%), "it is unnecessary" (9%), and "unfamiliar with the program" (9%).

FOLLOWING THE ADVISORY (Q20)
Of those who receive advisory calls (n=146), 19% said that in general, the notification call program causes them to follow the wood burning advisory more often than they would without it. 2% said they follow the advisory less often than they would without the notification system. 39% report no change in following the advisory. 39% said "not applicable," they don't burn wood (down from 51% in 2005).

It should be noted that the wording of this question changed from 2005: "This year, did you follow the wood burning advisory more often, less often, or the same as in past years?" to the current wording: "In general, does the notification call program cause you to follow the wood burning advisory more often, less often, or the same as you would without it?"

AWARENESS OF AIR QUALITY (Q21)
Of those who receive advisory calls (n=146), 53% feel that the telephone advisory program has made them more aware of air quality in their community (up from 38% in 2005). 1% feel that they are less aware of air quality. 45% feel there is no difference in their awareness (down from 59% in 2005).

BACKYARD BURNING (Q22-Q24)
28% of respondents conduct backyard burning of yard trimmings at their residence; 72% do not.

Of those who do backyard burning (n=88), 82% do it once per backyard burning season. 14% burn once a month and 3% burn once a week.

Of those who do backyard burning (n=88), the majority (58%) burn one to five cubic yards per burning season. 19% burn less than one cubic yard, and 18% burn more than five cubic yards. 5% are unsure of how much they burn.

INTERNET ACCESS AT HOME (Q25)
69% of respondents have internet access at home (up from 36% in 2005); 30% do not.

SURVEY OF OAKRIDGE AND WESTFIR RESIDENTS FOR L.R.A.P.A.

August, 2010

PURPOSE OF THE STUDY

The purpose of this study is to assist LRAPA in measuring awareness and effectiveness of the Oakridge Home Wood Heating Telephone Advisory Program.

METHODOLOGY

Advanced Marketing Research was hired to conduct the research project in order to obtain unbiased and statistically valid results.

Using questions proposed by LRAPA, Advanced Marketing Research designed a questionnaire instrument to be administered by telephone. Using a random list of residents living in Oakridge and Westfir as a sampling frame, 312 interviews were completed. Telephone interviews were conducted between August 13 and August 22, 2010.

Proper data analysis techniques were employed by Advanced Marketing Research to avoid introducing unnecessary error and bias into the study.

QUOTAS OBSERVED

The gender and age quotas below were targeted in the data collection process.

Males	48% to 52%
Females	48% to 52%
Age 65+	28% Maximum

RESPONSE RATE

Of the 397 qualified respondents reached by telephone, 312 interviews were completed, for a response rate of 79%. The overall breakdown of numbers dialed is as follows:

Refusals	85
Disconnects	124
Wrong Numbers	22
Language Barrier	0
Spanish Language Barrier	0
Business Numbers	4
Fax	1
No Answer	98
Answering Machine	223
Busy Signal	3
Call Backs	18
No Qualified Respondent	6
Completed Interviews	312
Total Numbers Dialed	896

TESTS FOR DIFFERENCES BETWEEN PROPORTIONS

When looking at the data tables, differences between percentage amounts can be misleading, and statistical tests must be conducted to determine if the differences are statistically significant. The computer makes these calculations for us, and the results are occasional plus or minus signs at the bottom of certain cells. These indicate that those answers are more different from everybody else's answers than could be expected due to chance, given the sample sizes involved. Plus signs are used if the group picks that answer *more* often than everyone else; minus signs if it is *less* than everyone else. The number of plus or minus signs indicates the level of statistical significance. One means the 90% level, two the 95% level, and three the 99% level. For example, two plus signs would mean that you can be 95% sure that the people represented by that group really would pick that answer more often than the people represented by the rest of the sample. It should be noted that this test can only be done for banner columns that contain at least 30 people. Because of this requirement, it is possible that the test will be done for some banner columns on a table and not for others.

NOTES ON CHI SQUARE

The chi square value and its associated probability are printed beneath the first column in each banner heading. The probability (p=.xxx) indicates the probability that the heading and row variables are *not* related is .xxx. For example, a .05 probability of not being related means a 95 percent chance of being related.

BOUND ON ERROR

	SAMPLE SIZE		Bound on Error at
SEX	Frequency	Percent	95% Confidence Level
Male	154	49%	7.2%
Female	158	51%	7.1%
AGE			
18-34	30	10%	16.4%
35-44	27	9%	--
45-54	66	21%	11.1%
55-64	103	33%	8.9%
65+	86	28%	9.7%
INCOME			
Under $15,000	49	16%	12.8%
$15,000-$24,999	55	18%	12.1%
$25,000-$34,999	51	16%	12.6%
$35,000-$49,999	52	17%	12.5%
$50,000 and Up	50	16%	12.7%
TOTAL	312	100%	5.0%*

* What this means is that we are 95% certain that the mean response of the entire population of Oakridge and Westfir lies within (plus or minus) 5.0% of the survey response. Oakridge has 1526 households and Westfir has 100 households.

DEMOGRAPHIC BREAKDOWN BY YEAR

SEX	2010	2005
Male	49%	50%
Female	51%	50%
AGE		
18-24	4%	4%
25-34	6%	7%
35-44	9%	14%
45-54	21%	26%
55-64	33%	25%
65+	28%	24%
INCOME		
Under $15,000	16%	22%
$15,000-$24,999	18%	33%
$25,000-$34,999	16%	17%
$35,000-$49,999	17%	8%
$50,000 and Up	16%	9%
YEARS IN COMMUNITY		
Under one year	3%	5%
1-5 years	15%	19%
6-10 years	17%	9%
Over 10 years	65%	67%
OWN OR RENT?		
Own	83%	83%
Rent	16%	16%
DWELLING TYPE		
Single Family	77%	79%
Mobile Home	19%	13%
Apartment	3%	4%
Duplex	1%	3%

MINIMUM DIFFERENCE IN PERCENTAGE POINTS REQUIRED FOR STATISTICAL SIGNIFICANCE IN COMPARISON OF REPORTED PERCENTAGES FOR SUBGROUPS WITH 95% CONFIDENCE

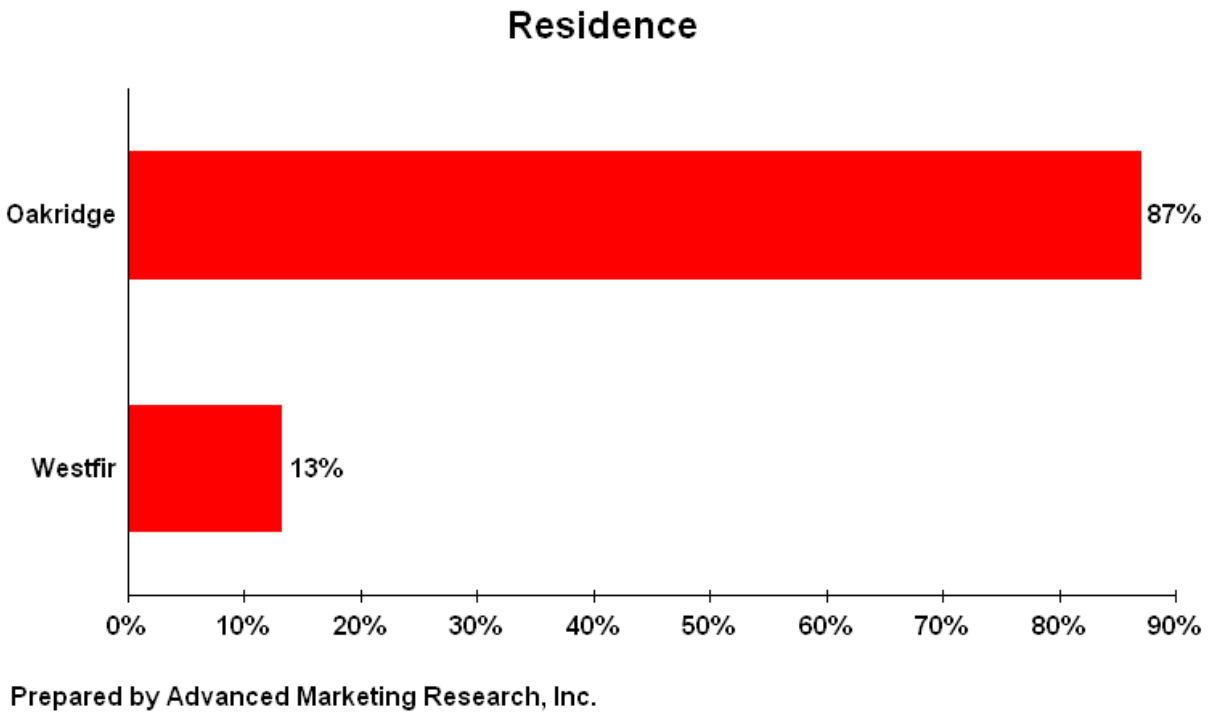
Subsample	50	100	150	200	250	300	350	400	450	500	600
50	20%	17%	16%	15%	15%	15%	15%	15%	15%	15%	15%
100		14%	13%	12%	12%	11%	11%	11%	11%	11%	11%
150			11%	11%	10%	10%	10%	9%	9%	9%	9%
200				10%	9%	9%	9%	8%	8%	8%	8%
250					9%	8%	8%	8%	8%	8%	7%
300						8%	8%	7%	7%	7%	7%
350							7%	7%	7%	7%	6%
400								7%	7%	7%	6%
450									7%	6%	6%
500										6%	6%
600											6%

Minimums are for reported percentages near 50%. When much smaller or much larger percentages are reported, a slightly smaller minimum is required.

ANALYSIS OF DATA

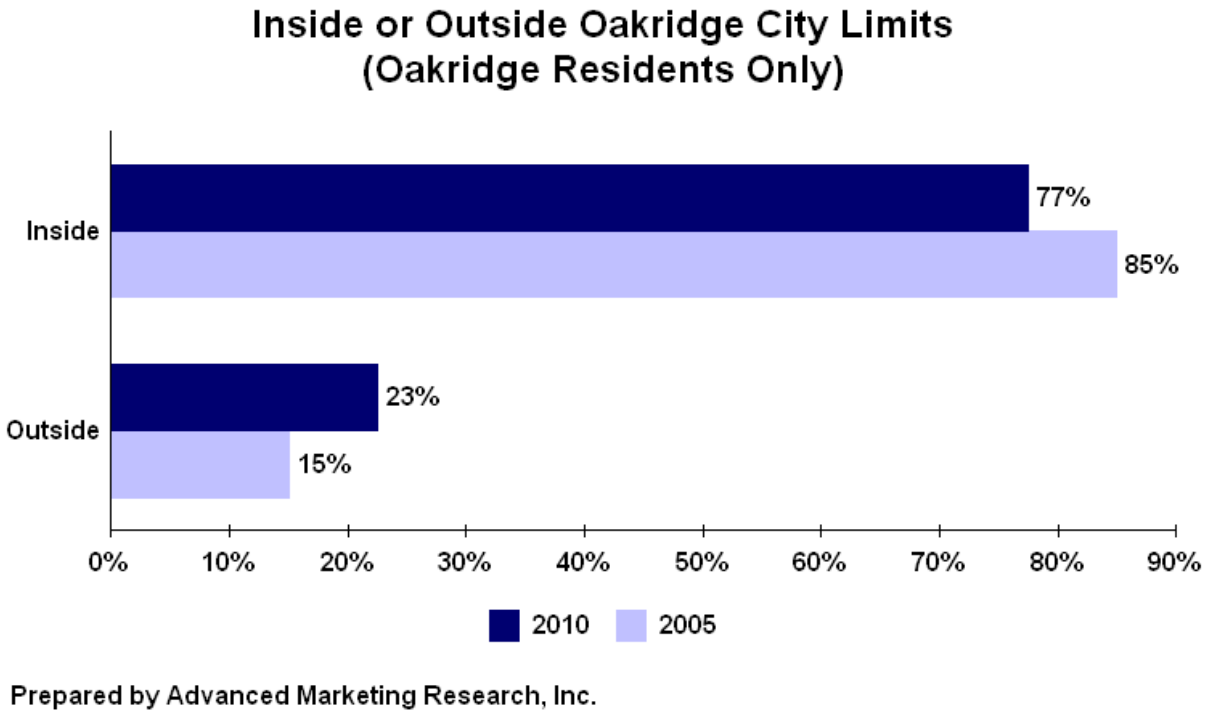
RESIDENCE (Q2)

87% of respondents live in Oakridge, 13% in Westfir.



LIVE INSIDE OR OUTSIDE OAKRIDGE CITY LIMITS (Q3)

77% of the Oakridge residents surveyed live inside city limits, down from 85% in 2005. 23% live outside city limits.

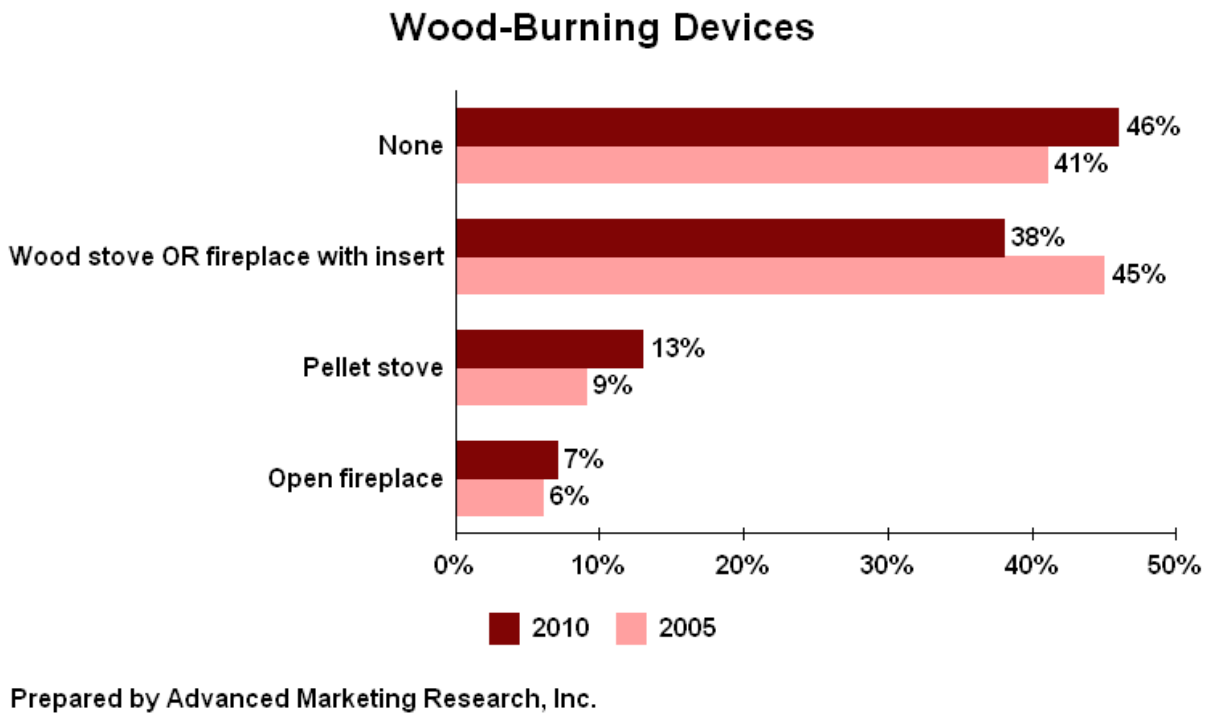


Demographic Differences

Oakridge residents with no wood burning devices are more likely than others to live inside city limits. Oakridge residents with wood stoves are more likely than others to live outside city limits.

WOOD-BURNING DEVICES (Q4)

38% of respondents have a wood stove or fireplace with insert. 13% have a pellet stove. 7% have an open fireplace. 46% have no wood-burning devices. There have been no significant changes since 2005.



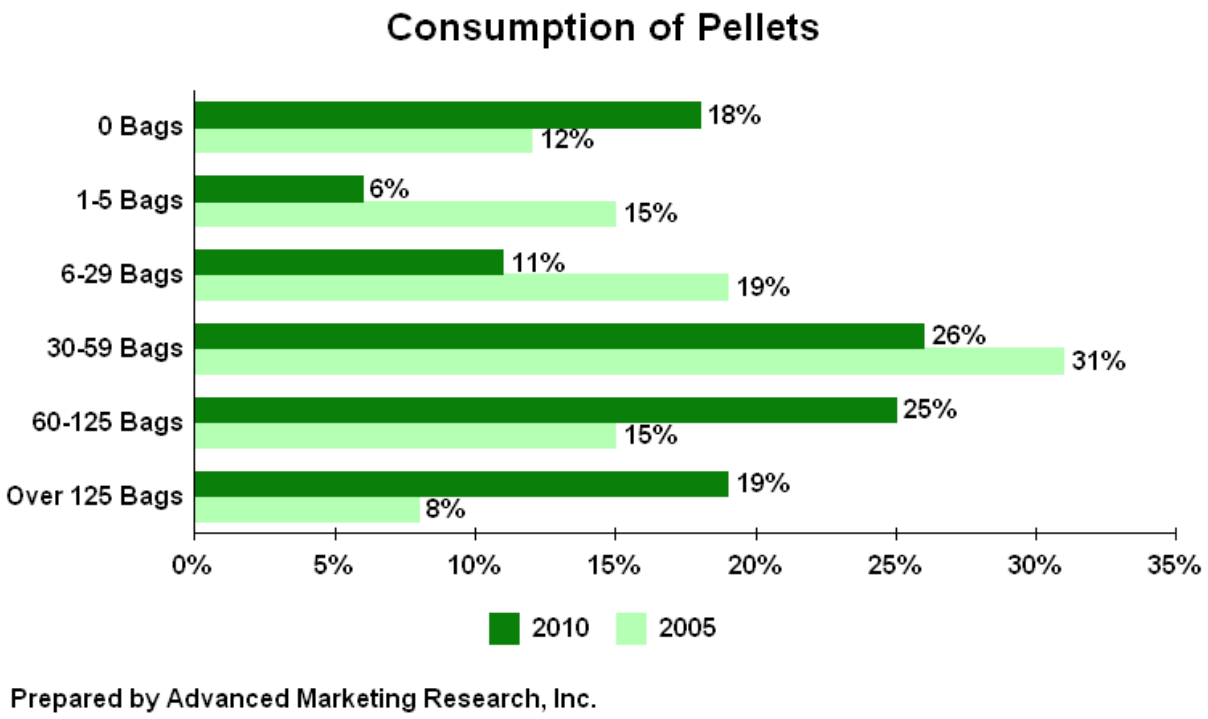
Demographic Differences

Oakridge residents not living within city limits and those respondents living in single family dwellings are more likely than others to have a wood stove or fireplace with insert.

Oakridge residents living inside city limits, renters, and those living in mobile homes are more likely than others to have *no* wood-burning devices.

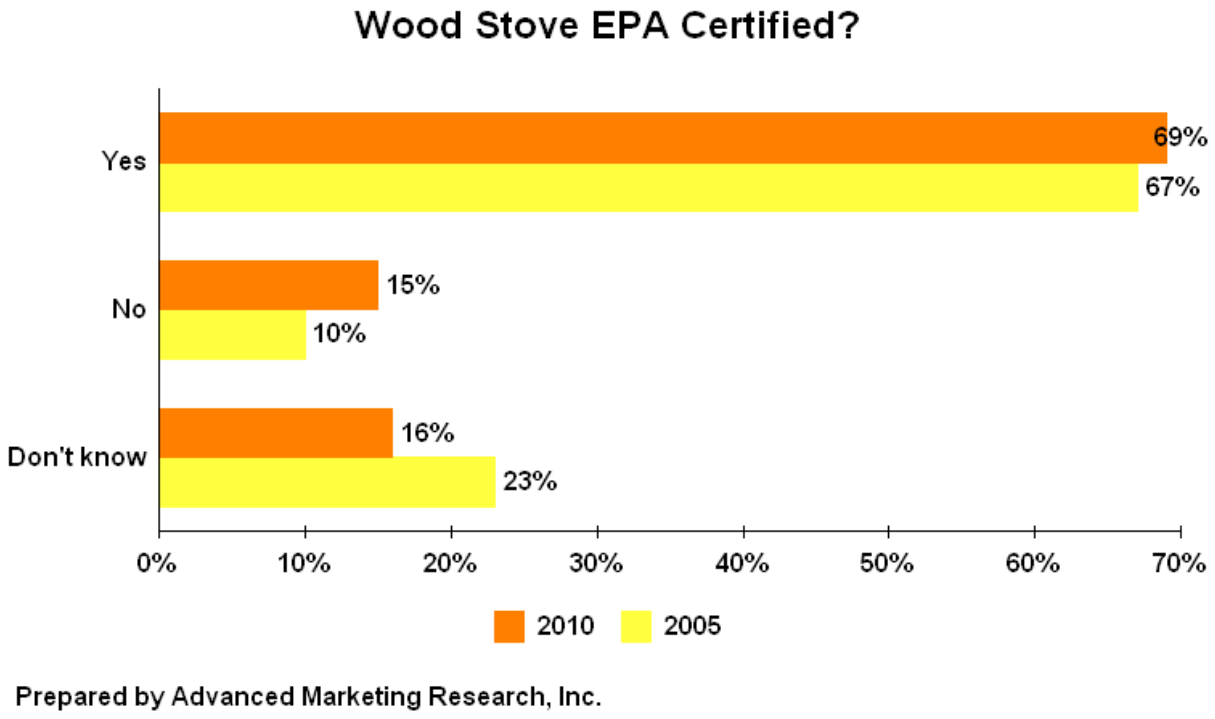
PELLET CONSUMPTION (Q5)

Although statistically there are not more people with pellet stoves than there were in 2005 (39 currently compared with 26 in 2005), those with pellet stoves are burning more bags of pellets per burning season than they were in 2005. Currently 17% burn one to twenty-nine bags, compared with 34% in 2005. And currently 44% burn over sixty bags, compared with 23% in 2005.



EPA CERTIFIED STOVES (Q6)

69% believe that their wood stove or fireplace with insert is EPA certified as "clean burning" (less than twenty-five years old). 15% say their stove in *not* EPA certified. 16% are unsure if their stove is certified. There have been no significant changes since 2005.

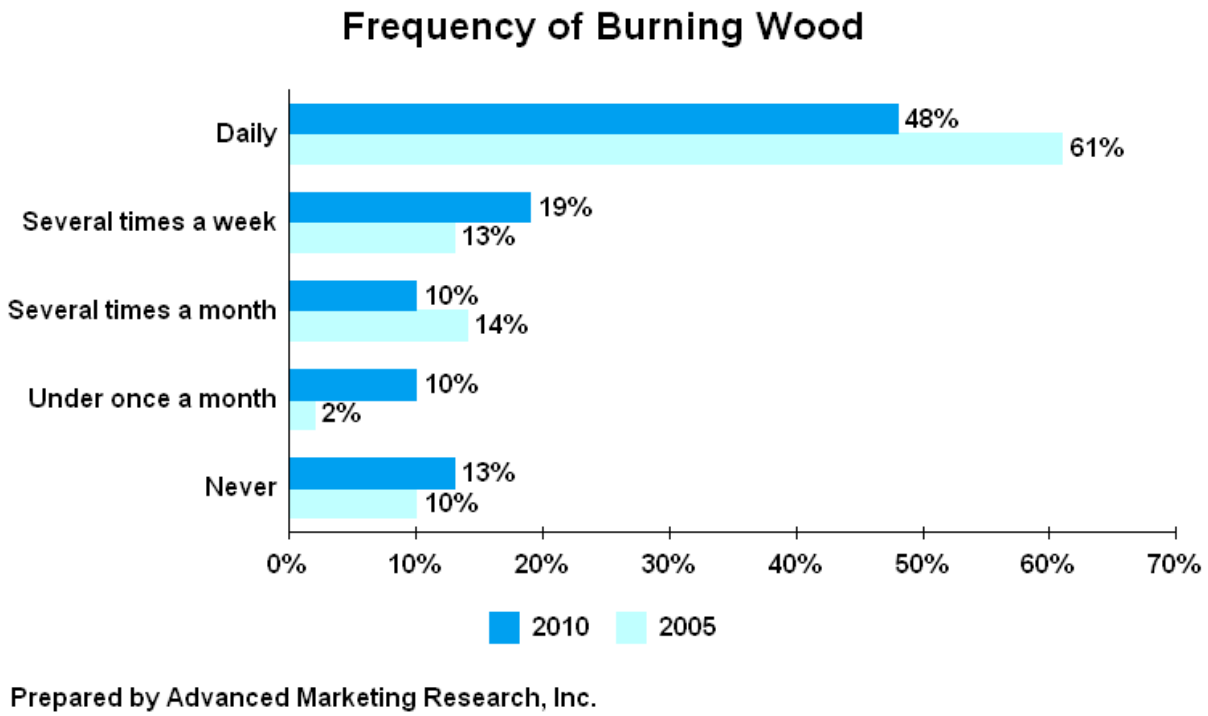


Demographic Differences

35 to 54 year-olds are more likely than others to say their wood stove *is* EPA certified.

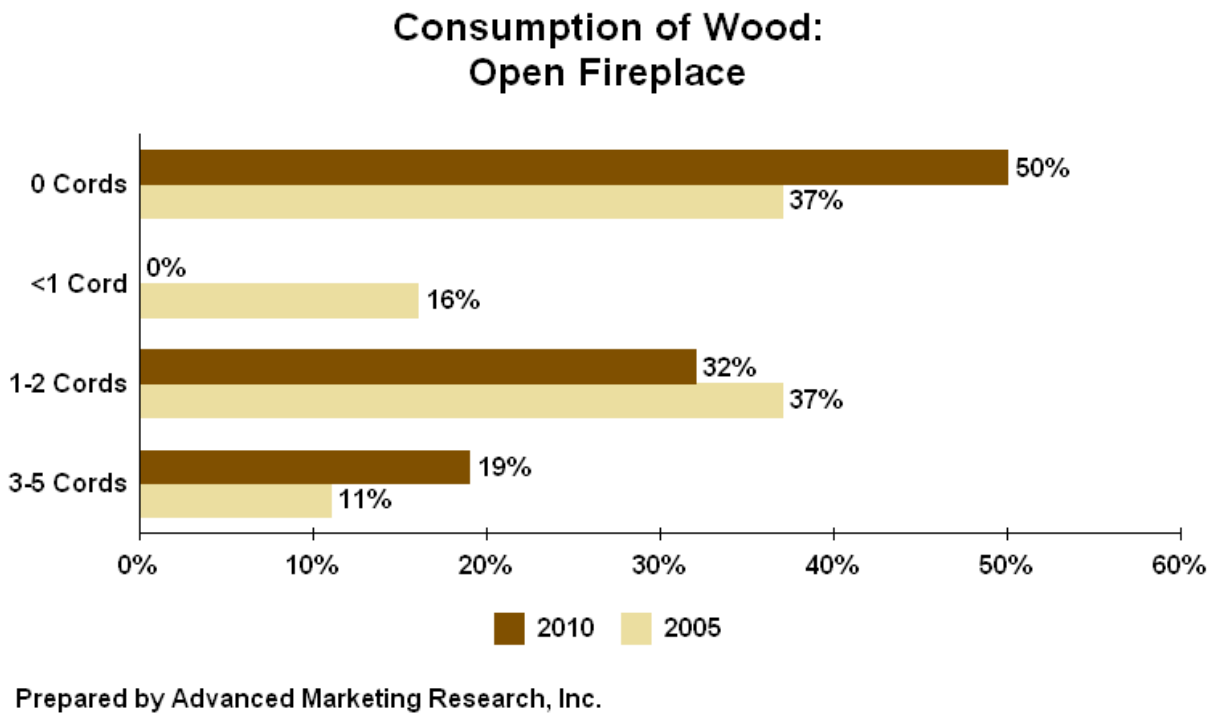
FREQUENCY OF BURNING WOOD (Q7)

Of those with a wood stove, fireplace with insert, or open fireplace (n=135), 48% burn wood daily in the winter months (down from 61% in 2005). 19% burn several times a week, 10% burn several times a month, and 10% burn less often than once a month. 13% never burn wood in these devices.



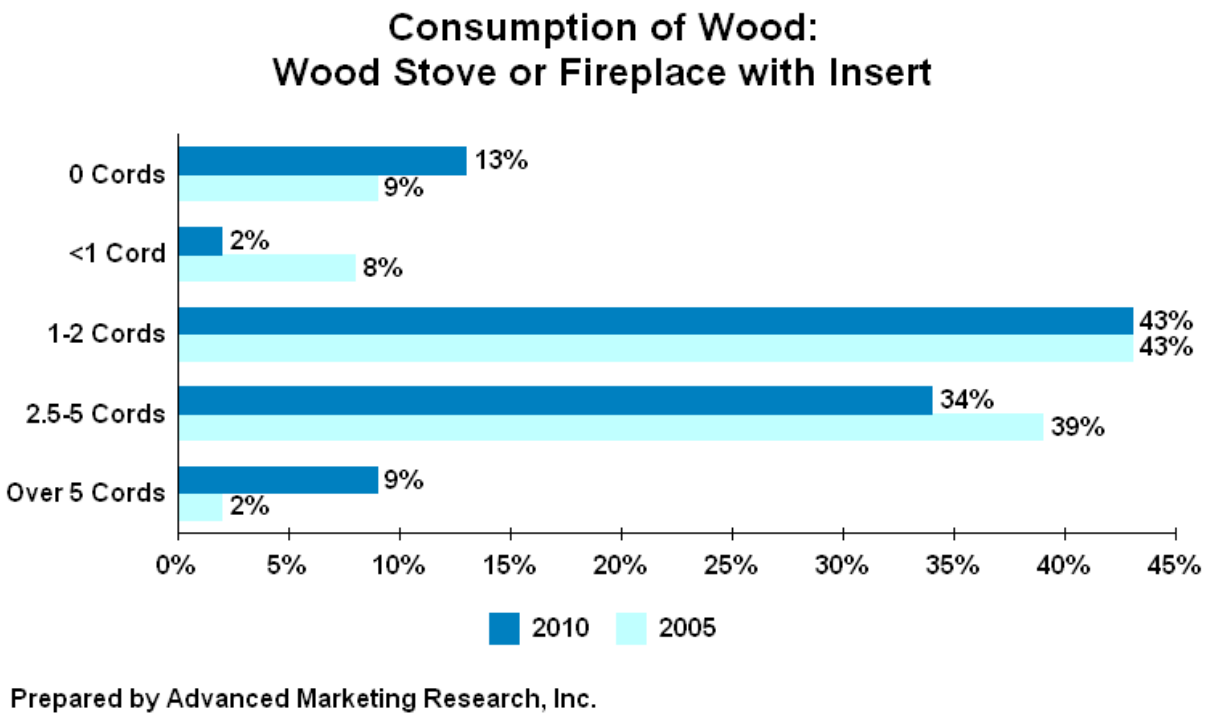
CONSUMPTION OF WOOD: OPEN FIREPLACE (Q8)

Of those with an open fireplace (n=22), 50% do not burn wood in their open fireplace, 32% burn one to two cords, and 19% burn three to five cords of wood per winter.



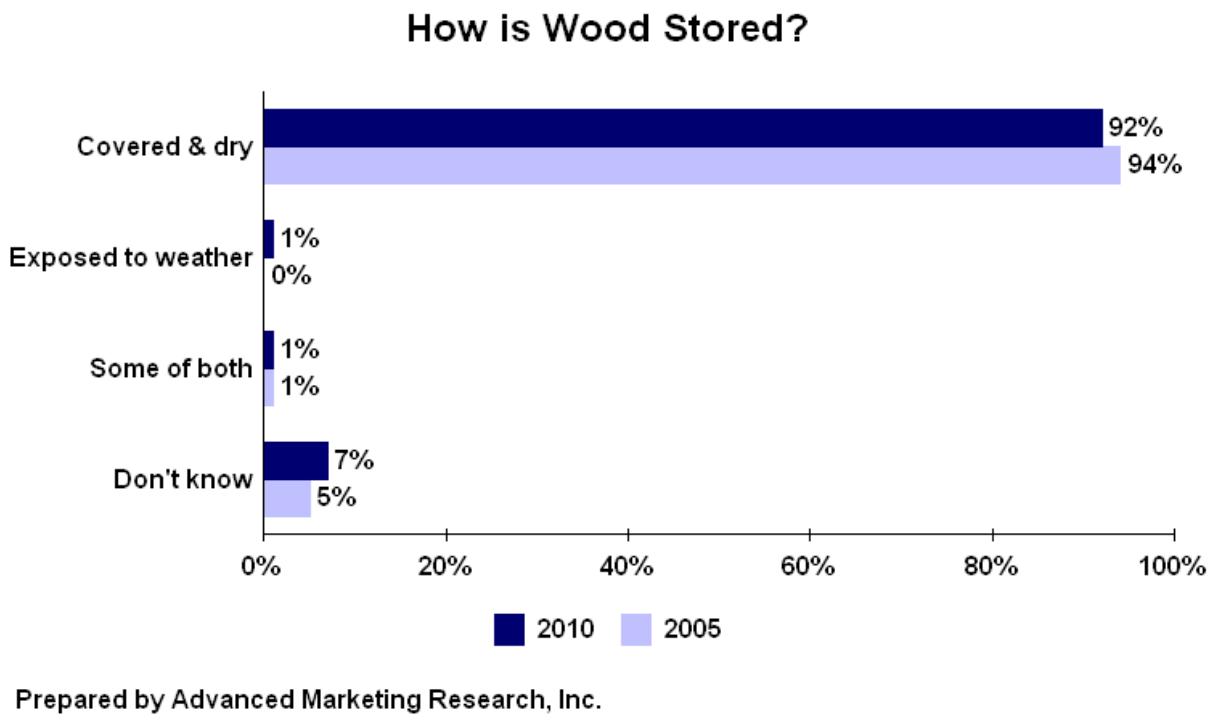
CONSUMPTION OF WOOD: WOOD STOVE (Q9)

Of those with a wood stove or fireplace with insert (n=117), 13% do not burn wood in it, 2% burn less than one cord, 43% burn one to two cords, and 43% burn over two cords of wood per winter. There have been no significant changes since 2005.



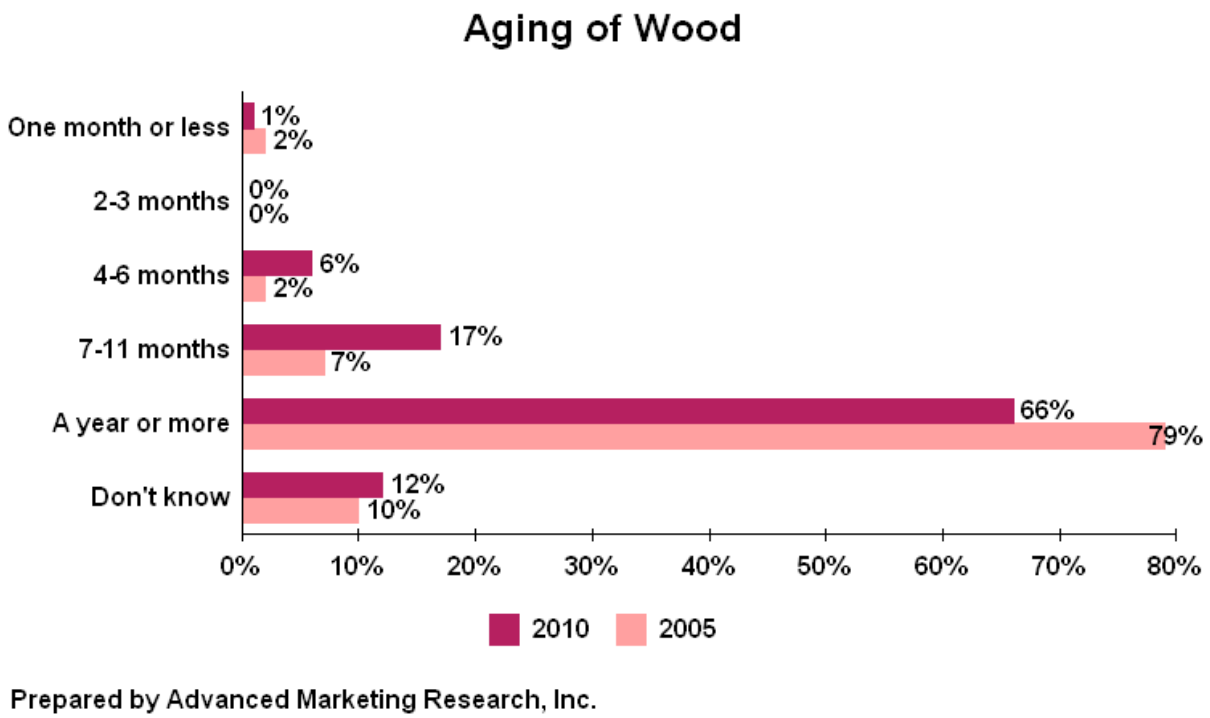
HOW IS WOOD STORED? (Q10)

The vast majority of wood (92%) is stored covered and dry. There have been no significant changes since 2005.



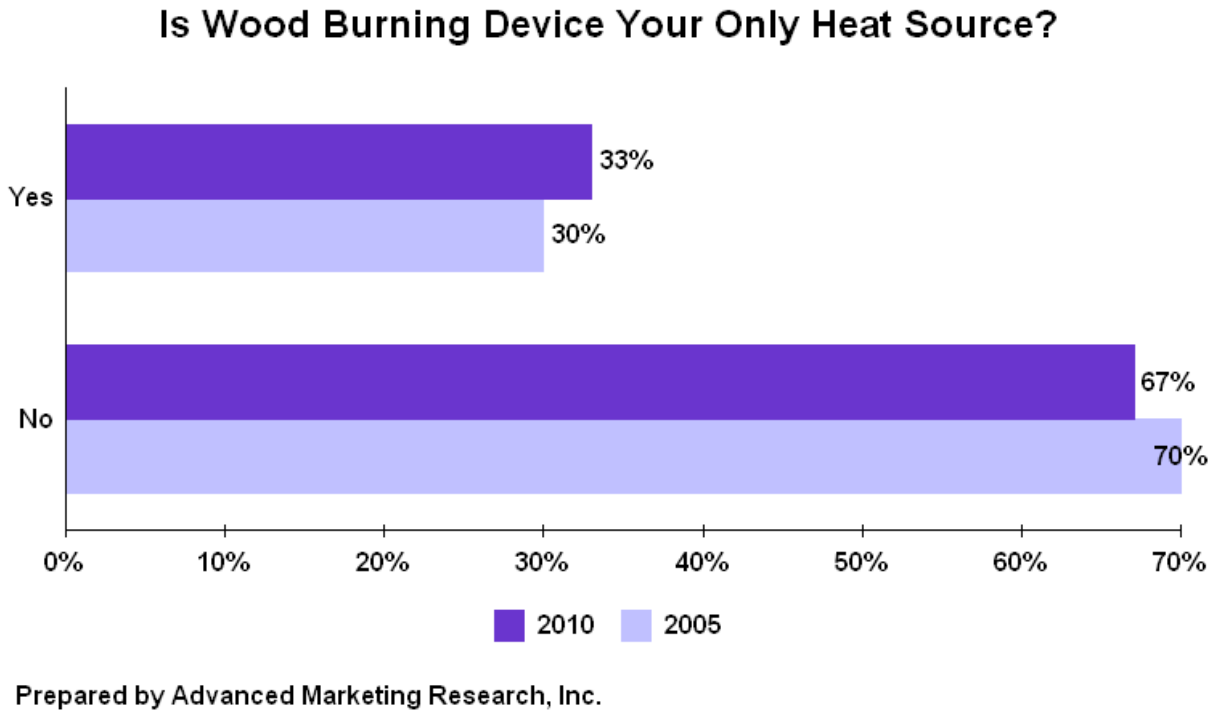
AGING OF WOOD (Q11)

66% of those burning wood (n=135) use wood that has aged for a year or more (down from 79% in 2005). 17% use wood that has aged for seven to eleven months. 7% use wood that has aged for six months or less. 12% are unsure how long their wood has aged when they burn it.



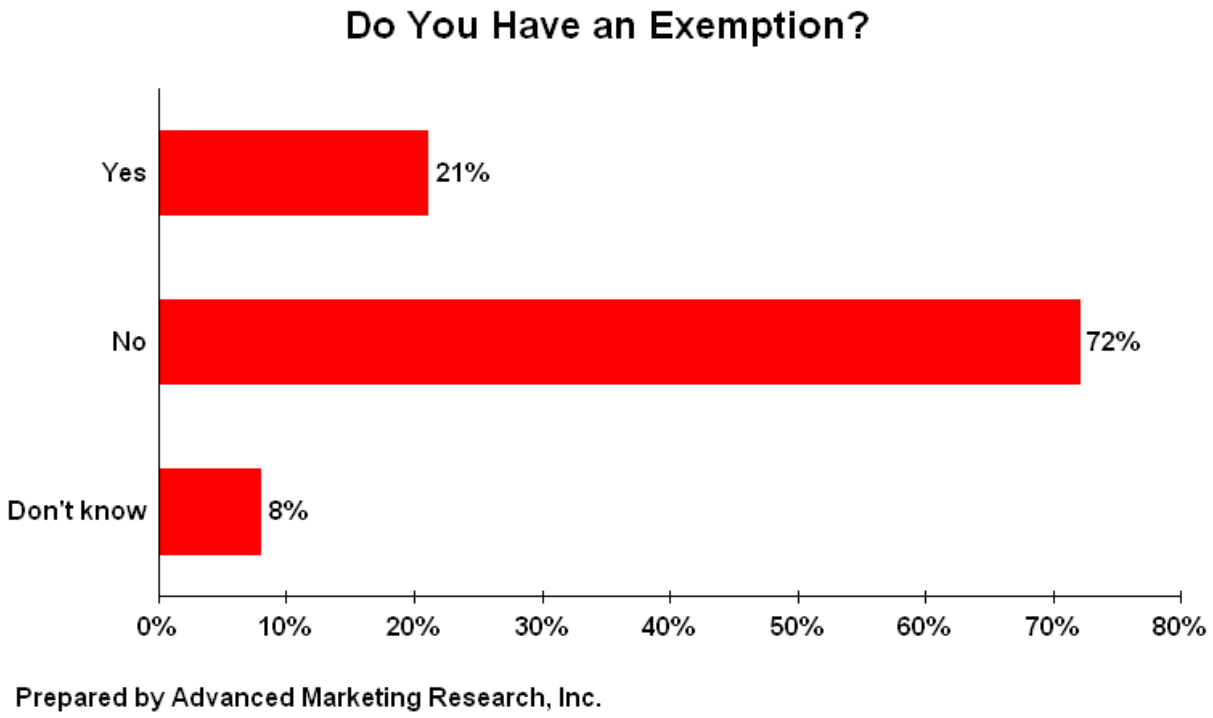
SOURCES OF HEAT (Q12)

For 33% of those who burn wood (not including pellets), their wood-burning device is the only heat source for their residence. 67% have an alternate source of heat. There have been no significant changes since 2005.



HOME HEATING EXEMPTION (Q13)

21% of Oakridge residents who burn wood (n=116) currently have a home wood heating exemption from the City of Oakridge, while 72% do not. 8% are unsure.

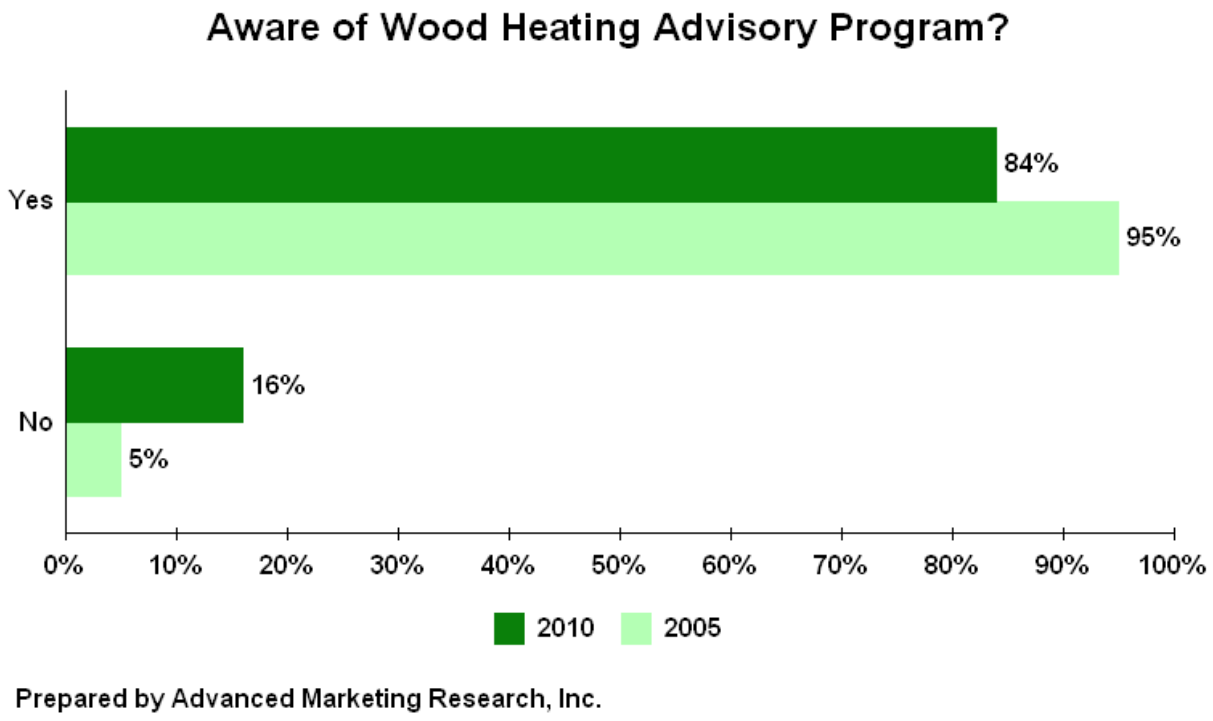


Demographic Differences

Those with internet access at home are less likely than others to have a home wood heating exemption.

AWARENESS OF WOOD HEATING ADVISORY PROGRAM (Q14)

84% of respondents (down from 95% in 2005) are aware of the Home Wood Heating Advisory Program with its red, yellow, and green advisory system. 16% are unaware of the program.



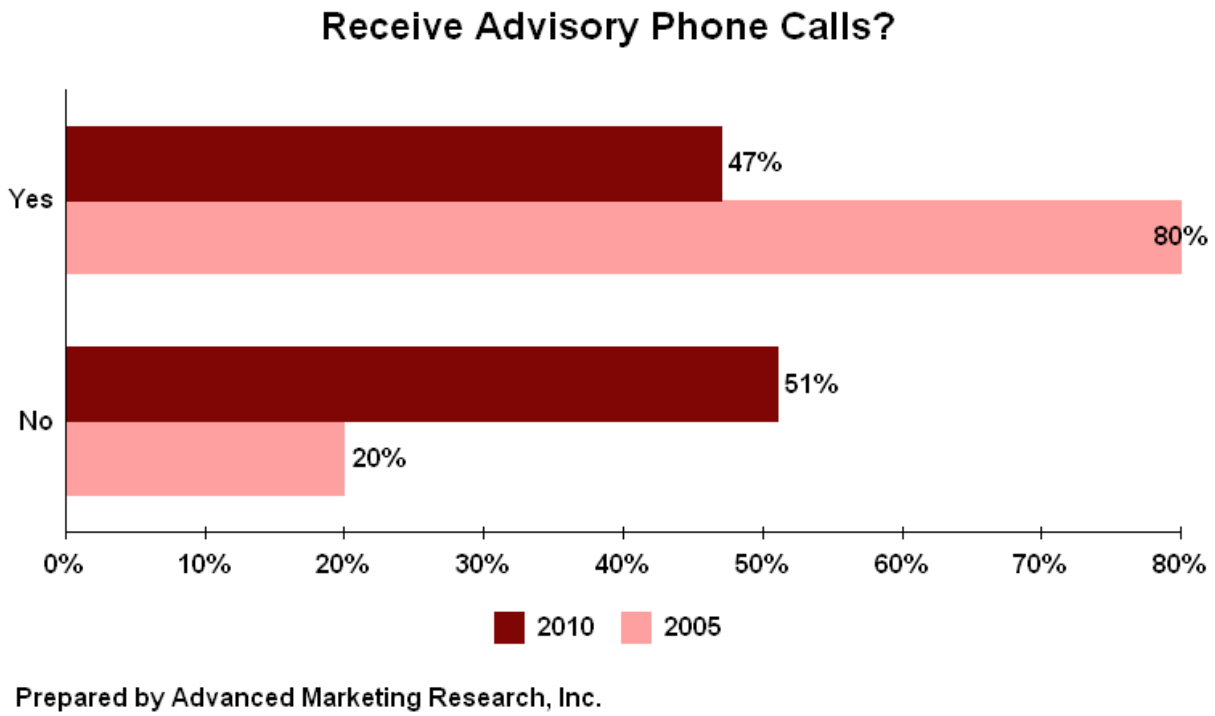
Demographic Differences

Females, 55 to 64 year-olds, those living in single-family dwellings, those with internet access at home, and those who have lived in the area for more than ten years are more likely than others to be aware of the program. Males, 18 to 34 year-olds, those without internet access at home, and those living in the area for five years or less are more likely than others to be unaware of the program.

ADVISORY PHONE CALLS (Q15-Q17)

47% of respondents receive occasional phone calls notifying them of whether or not they should burn wood based on air quality in their community (down from 80% in 2005). 51% do not receive such phone calls (up from 20% in 2005).

Of those not receiving calls (n=160), 81% don't know why; they have never been called (up from 63% in 2005). 7% say they don't know why; the calls just stopped. 7% don't burn wood. 4% asked to be removed from the list (down from 22% in 2005).



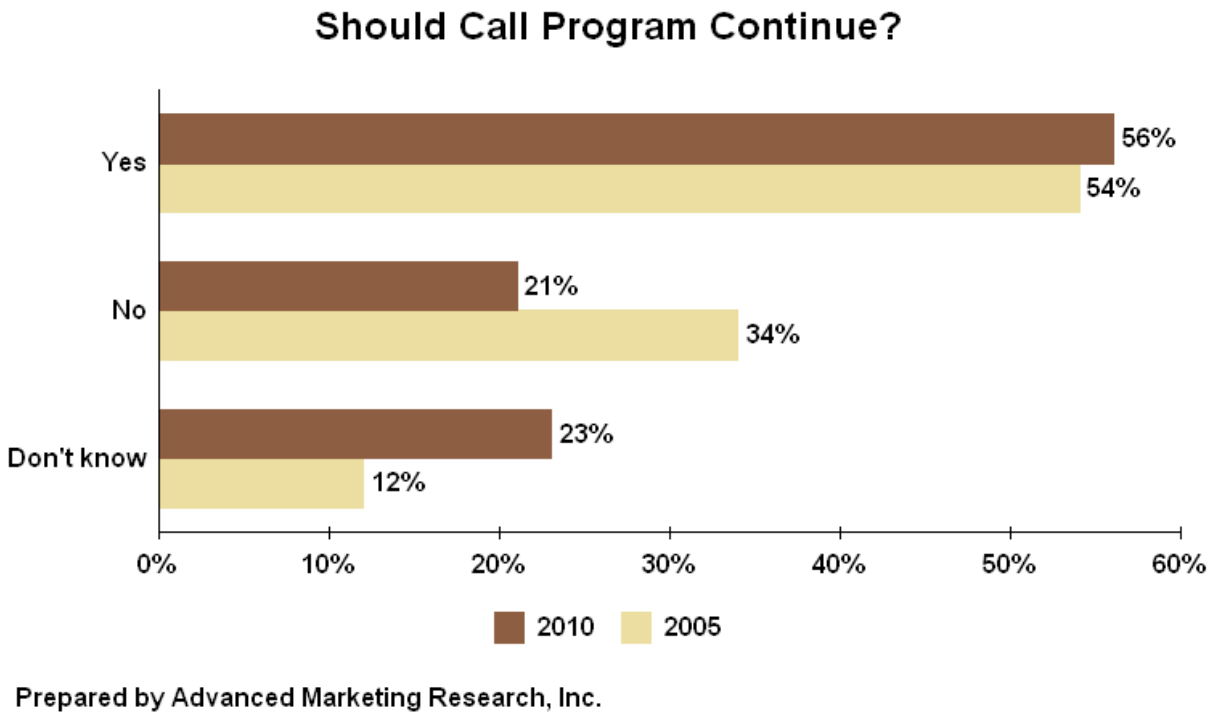
Demographic Differences

35 to 54 year-olds, those earning $35,000 to $49,999, Oakridge residents living inside city limits, Oakridge residents, and residents of over ten years are more likely than others to receive advisory phone calls.

SHOULD THE CALL PROGRAM CONTINUE? (Q18-Q19)

56% of respondents feel that the notification call program is a useful program that should continue. 21% do not feel it should continue (down from 34% in 2005). 23% are unsure (up from 12% in 2005).

Those who do not feel the program is useful or are unsure (n=138) gave the following reasons: "We don't burn wood" (20%), "the calls are ineffective; some have to burn to keep warm" (20%), "it is unnecessary" (9%), and "unfamiliar with the program" (9%). (For responses less than 9%, see Table 19. For verbatim comments, see Table 19V.)



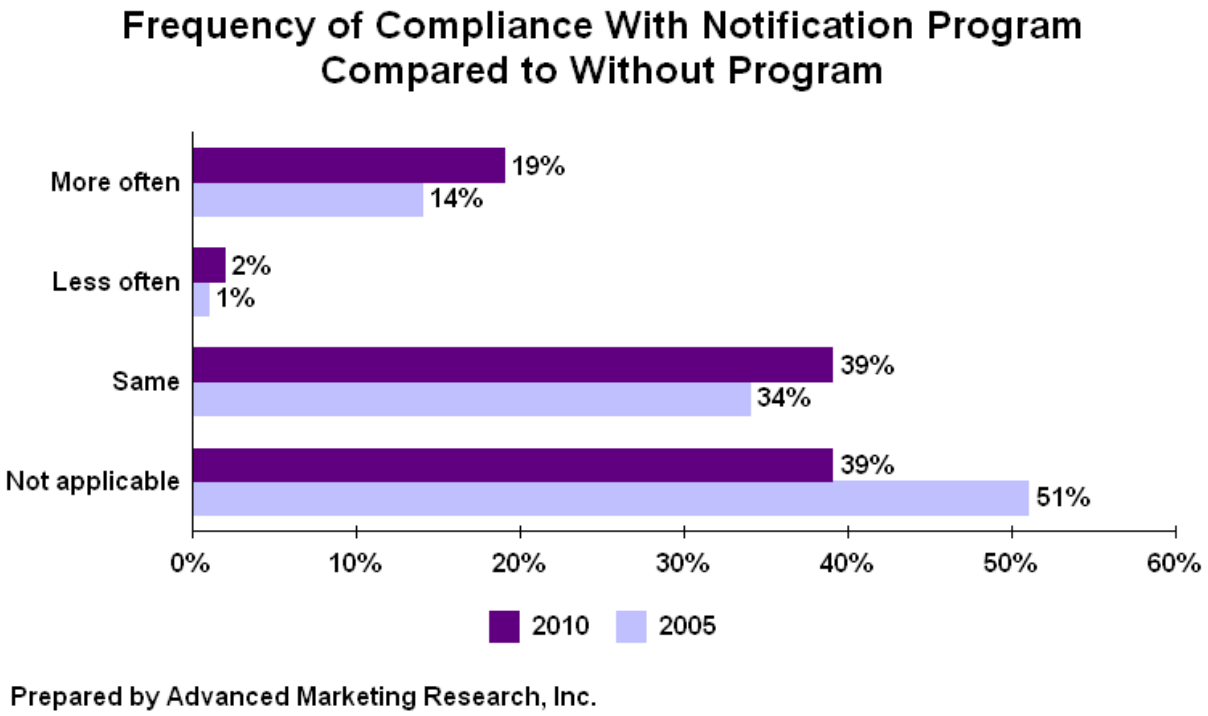
Demographic Differences

Those who have lived in the community for more than ten years are more likely than others to feel the program should continue. Oakridge residents living outside city limits are more likely than others to feel the program should *not* continue.

FOLLOWING THE ADVISORY (Q20)

Of those who receive advisory calls (n=146), 19% said that in general, the notification call program causes them to follow the wood burning advisory more often than they would without it. 2% said they follow the advisory less often than they would without the notification system. 39% report no change in following the advisory. 39% said "not applicable," they don't burn wood (down from 51% in 2005).

It should be noted that the wording of this question changed from 2005: "This year, did you follow the wood burning advisory more often, less often, or the same as in past years?" to the current wording: "In general, does the notification call program cause you to follow the wood burning advisory more often, less often, or the same as you would without it?"

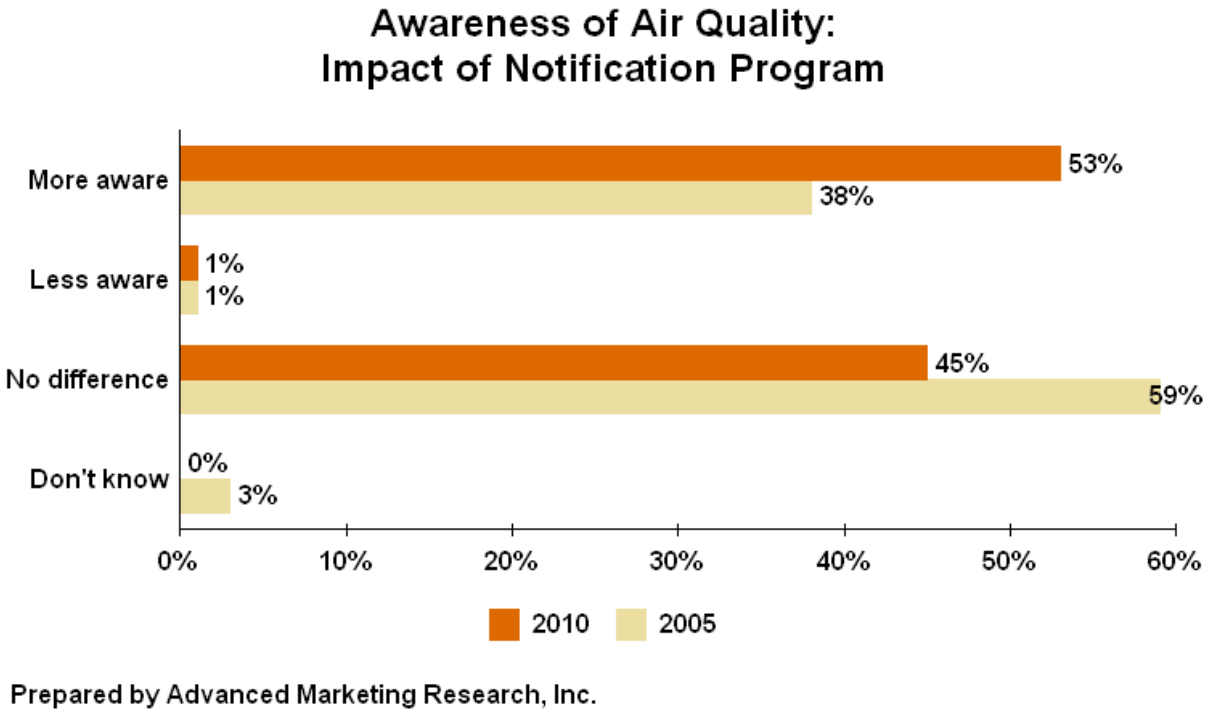


Demographic Differences

Those with wood stoves are more likely than others to say they are following the advisory the same as they would without the notification system. Those for who wood is the only source of heat are more likely than others to say they are following the advisory more often than they would without the notification system.

AWARENESS OF AIR QUALITY (Q21)

Of those who receive advisory calls (n=146), 53% feel that the telephone advisory program has made them more aware of air quality in their community (up from 38% in 2005). 1% feel that they are less aware of air quality. 45% feel there is no difference in their awareness (down from 59% in 2005).

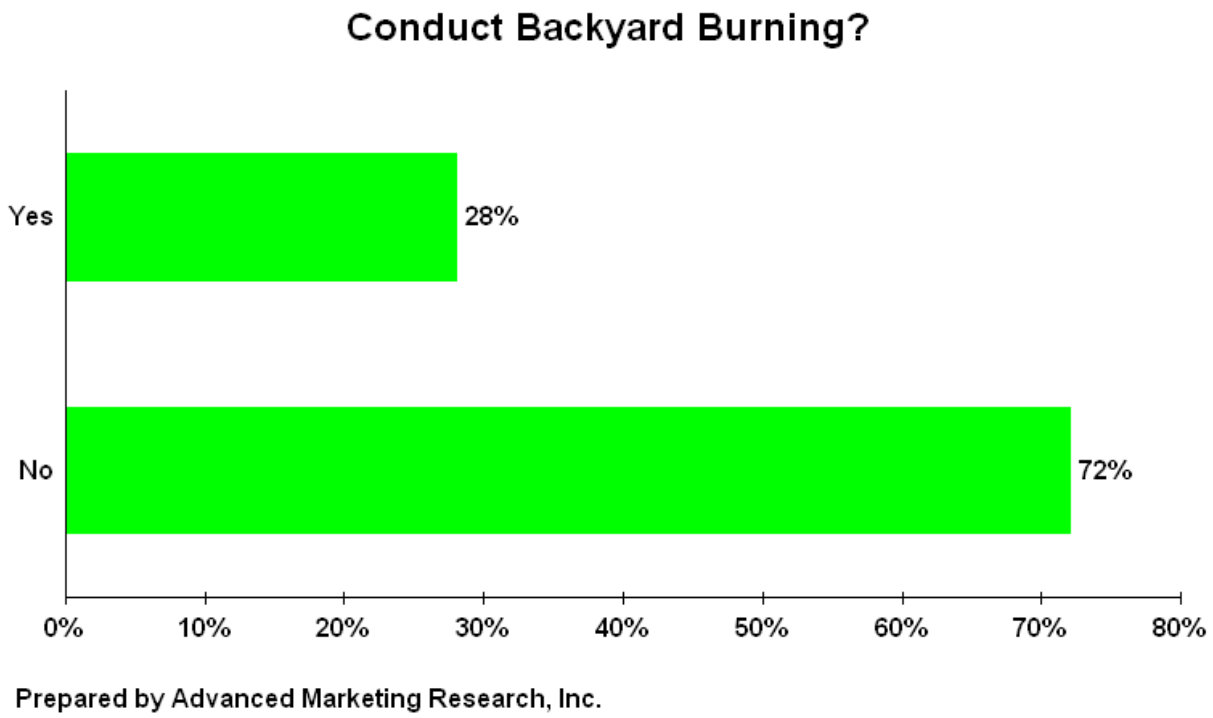


BACKYARD BURNING (Q22-Q24)

28% of respondents conduct backyard burning of yard trimmings at their residence; 72% do not.

Of those who do backyard burning (n=88), 82% do it once per backyard burning season. 14% burn once a month and 3% burn once a week.

Of those who do backyard burning (n=88), the majority (58%) burn one to five cubic yards per burning season. 19% burn less than one cubic yard, and 18% burn more than five cubic yards. 5% are unsure of how much they burn.

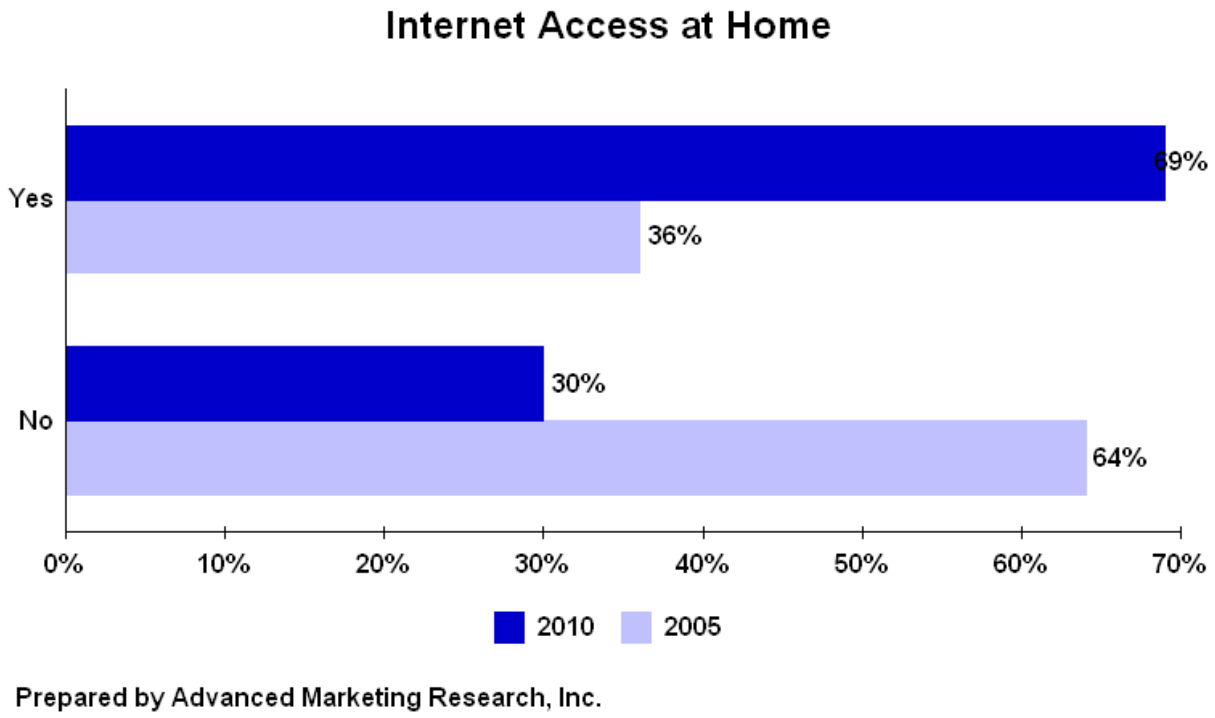


Demographic Differences

35 to 54 year-olds and Oakridge residents living outside city limits are more likely than others to do backyard burning.

INTERNET ACCESS AT HOME (Q25)

69% of respondents have internet access at home (up from 36% in 2005); 30% do not.



Demographic Differences

Females and those earning over $35,000 are more likely than others to have internet access at home. Males, seniors, Oakridge residents living inside city limits, and those earning under $15,000 are less likely than others to have internet access at home.

DATA TABLES

QUESTIONNAIRE INSTRUMENT

Table 2: Do you live in Oakridge zip code 97463 or Westfir zip code 97492?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Oakridge 97463 - CONTINUE	271 87%	24 100%	83 100% +++	9 100%	69 85%	17 100%	14 74%
Westfir 97492 - CONTINUE	41 13%	0 0%	0 0%	0 0%	12 15%	0 0%	5 26%
Chi Square			0.00 .999			5.02 .081	

Prepared by Advanced Marketing Research, Inc.

Table 3: Do you live inside or outside Oakridge city limits?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	271	24	83	9	69	17	14
Inside	210 77%	21 88%	48 58% ---	6 67%	47 68% --	9 53%	9 64%
Outside	61 23%	3 13%	35 42% +++	3 33%	22 32% ++	8 47%	5 36%
Don't know/Refused	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			7.19 .027			1.38 .501	

Prepared by Advanced Marketing Research, Inc.

Table 4: Do you currently have an open fireplace, a pellet stove, a wood stove, or a fireplace with insert? (MULTIPLE RESPONSES POSSIBLE; CODE ALL THAT APPLY)

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
None	143 46%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Wood stove OR fireplace with insert	117 38%	23 96%	69 83% +++	8 89%	81 100% +++	17 100%	19 100%
Pellet stove	39 13%	0 0%	4 5% --	0 0%	4 5% --	0 0%	1 5%
Open fireplace (no insert)	22 7%	2 8%	17 20% +++	1 11%	0 0%	3 18%	1 5%
Chi Square			3.75 .710			12.82 .046	

Prepared by Advanced Marketing Research, Inc.

Table 5: Approximately how many bags of pellet fuel did you burn during the last heating season (October 2009 through April 2010)? (ONE BAG = 50 POUNDS) (ROUND TO THE NEAREST WHOLE BAG) **(HIT "ENTER" IF "DON'T KNOW")**

Number of bags of pellets burned

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	39	0	4	0	4	0	1
0	7 18%	0 0%	2 50%	0 0%	2 50%	0 0%	1 100%
1	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
2	1 3%	0 0%	1 25%	0 0%	1 25%	0 0%	0 0%
12	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
13	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
20	2 5%	0 0%	1 25%	0 0%	1 25%	0 0%	0 0%
30	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
40	2 5%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
50	7 18%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
75	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
80	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
100	5 13%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
120	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
125	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
150	4 10%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
160	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
180	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
200	1 3%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%

(continued)

Table 5: Approximately how many bags of pellet fuel did you burn during the last heating season (October 2009 through April 2010)? (ONE BAG = 50 POUNDS) (ROUND TO THE NEAREST WHOLE BAG) **(HIT "ENTER" IF "DON'T KNOW")**

Number of bags of pellets burned

(continued)

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	39	0	4	0	4	0	1
Minimum	0	0	0	0	0	0	0
Maximum	200	0	20	0	20	0	0
Mean	66	0	6	0	6	0	0
S.D.	59	0	10	0	10	0	0
S.E.	9	0	5	0	5	0	0

Table 6: To the best of your knowledge, is your (wood stove AND/OR fireplace with insert) EPA certified as "clean burning" (less than 25 years old)? (MULTIPLE RESPONSES POSSIBLE, IF MULTIPLE DEVICES) (EPA=Environmental Protection Agency)

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	117	23	69	8	81	17	19
Yes	81 69%	18 78%	43 62% -	8 100%	81 100% +++	0 0%	0 0%
No	17 15%	3 13%	14 20% ++	0 0%	0 0%	17 100%	0 0%
Don't know/Refused	19 16%	2 9%	12 17%	0 0%	0 0%	0 0%	19 100%
Chi Square			6.01 .199			234.00 .001	

Prepared by Advanced Marketing Research, Inc.

Table 7: During the winter months, do you burn wood: daily, several times a week, several times a month, less than once a month, or never?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	135	24	83	9	81	17	19
Daily	65 48%	18 75%	31 37% ---	5 56%	46 57% ++	8 47%	7 37%
Several times a week	26 19%	4 17%	18 22%	2 22%	16 20%	2 12%	6 32%
Several times a month	13 10%	2 8%	10 12%	0 0%	7 9%	2 12%	2 11%
Less than once a month	14 10%	0 0%	12 14% ++	0 0%	6 7%	4 24%	1 5%
Never	17 13%	0 0%	12 14%	2 22%	6 7% --	1 6%	3 16%
Don't know/Refused	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			16.16 .040			8.97 .345	

Prepared by Advanced Marketing Research, Inc.

Table 8: Approximately how many cords of wood did you burn in your open fireplace during the last heating season (October 2009 through April 2010)? (ONE DECIMAL ALLOWED; e.g., 2.5) **(HIT "ENTER" IF DON'T KNOW)**

Number of cords burned in open fireplace

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	22	2	17	1	0	3	1
0	11	0	8	1	0	2	0
	50%	0%	47%	100%	0%	67%	0%
1	6	0	6	0	0	1	0
	27%	0%	35%	0%	0%	33%	0%
2	1	1	0	0	0	0	1
	5%	50%	0%	0%	0%	0%	100%
3	3	1	2	0	0	0	0
	14%	50%	12%	0%	0%	0%	0%
5	1	0	1	0	0	0	0
	5%	0%	6%	0%	0%	0%	0%
Minimum	0	2	0	0	0	0	2
Maximum	5	3	5	0	0	1	2
Mean	1	3	1	0	0	0	2
S.D.	1	1	1	0	0	1	0
S.E.	0	1	0	0	0	0	0

Table 9: Approximately how many cords of wood did you burn in your (wood stove AND/OR fireplace with insert) during the last heating season (October 2009 through April 2010)? (ONE DECIMAL ALLOWED; e.g., 2.5) (**HIT "ENTER" IF DON'T KNOW)**

Number of cords burned in wood stove and/or fireplace with insert

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	117	23	69	8	81	17	19
0	15	0	13	1	9	3	3
	13%	0%	19%	13%	11%	18%	16%
0.5	1	0	1	0	0	1	0
	1%	0%	1%	0%	0%	6%	0%
0.75	1	0	1	0	1	0	0
	1%	0%	1%	0%	1%	0%	0%
1	26	4	19	0	15	5	6
	22%	17%	28%	0%	19%	29%	32%
1.5	1	0	1	0	1	0	0
	1%	0%	1%	0%	1%	0%	0%
2	23	4	12	2	16	2	5
	20%	17%	17%	25%	20%	12%	26%
3	20	5	8	3	17	0	3
	17%	22%	12%	38%	21%	0%	16%
3.5	1	0	1	0	1	0	0
	1%	0%	1%	0%	1%	0%	0%
4	14	8	4	0	8	4	2
	12%	35%	6%	0%	10%	24%	11%
5	5	0	2	2	5	0	0
	4%	0%	3%	25%	6%	0%	0%
6	4	1	3	0	3	1	0
	3%	4%	4%	0%	4%	6%	0%
8	2	1	0	0	2	0	0
	2%	4%	0%	0%	2%	0%	0%
9	2	0	2	0	1	1	0
	2%	0%	3%	0%	1%	6%	0%
10	2	0	2	0	2	0	0
	2%	0%	3%	0%	2%	0%	0%
Minimum	0	1	0	0	0	0	0
Maximum	10	8	10	5	10	9	4
Mean	3	3	2	3	3	2	2
S.D.	2	2	2	2	2	2	1
S.E.	0	0	0	1	0	1	0

Table 10: In general, is your wood supply covered and dry, or exposed to wet weather?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	135	24	83	9	81	17	19
Covered and dry	124 92%	24 100%	75 90%	8 89%	79 98% +++	17 100%	16 84%
Exposed to weather	1 1%	0 0%	1 1%	0 0%	1 1%	0 0%	0 0%
Some of both	1 1%	0 0%	1 1%	0 0%	0 0%	0 0%	1 5%
Don't know/Refused	9 7%	0 0%	6 7%	1 11%	1 1% ---	0 0%	2 11%
Chi Square			3.02 .806			11.62 .071	

Prepared by Advanced Marketing Research, Inc.

Table 11: In general, how long has your wood aged when you use it? (MULTIPLE RESPONSES POSSIBLE)

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	135	24	83	9	81	17	19
One month or less	1 1%	0 0%	1 1%	0 0%	1 1%	0 0%	0 0%
2-3 months	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
4-6 months	8 6%	2 8%	5 6%	1 11%	6 7%	1 6%	0 0%
7-11 months	23 17%	5 21%	17 20%	0 0%	15 19%	2 12%	5 26%
A year or more	89 66%	17 71%	50 60% -	7 78%	55 68%	13 76%	11 58%
Don't know/Refused	16 12%	0 0%	10 12%	2 22%	5 6% --	1 6%	3 16%
Chi Square			6.83 .555			5.31 .724	

Prepared by Advanced Marketing Research, Inc.

Table 12: Is a wood burning device the only heat source for your residence? (PELLETS ARE NOT CONSIDERED WOOD)

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	135	24	83	9	81	17	19
Yes	45 33%	19 79%	18 22% ---	3 33%	32 40% +	5 29%	6 32%
No	90 67%	5 21%	65 78% +++	6 67%	49 60% -	12 71%	13 68%
Don't know/Refused	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			27.23 .001			0.88 .645	

Prepared by Advanced Marketing Research, Inc.

Table 13: Do you currently have a home wood heating exemption from the City of Oakridge?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	116	24	83	9	69	17	14
Yes	24 21%	24 100%	0 0%	0 0%	18 26% +	3 18%	2 14%
No	83 72%	0 0%	83 100% +++	0 0%	43 62% ---	14 82%	12 86%
Don't know/Refused	9 8%	0 0%	0 0%	9 100%	8 12% +	0 0%	0 0%
Chi Square			232.00 .001			6.01 .199	

Prepared by Advanced Marketing Research, Inc.

Table 14: Are you aware of the Home Wood Heating Advisory Program with its RED, YELLOW, and GREEN advisory system?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Yes	262 84%	22 92%	71 86%	6 67%	66 81%	17 100%	13 68%
No	47 15%	2 8%	12 14%	3 33%	15 19%	0 0%	6 32%
Don't know/Refused	3 1%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			3.28 .512			6.13 .189	

Prepared by Advanced Marketing Research, Inc.

Table 15: Do you receive occasional phone calls notifying you of whether or not you should burn wood based on air quality in your community?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Yes	146 47%	16 67%	49 59% +++	4 44%	42 52%	13 76%	10 53%
No	160 51%	7 29%	34 41% --	5 56%	39 48%	3 18%	8 42%
Don't know/Refused	6 2%	1 4%	0 0%	0 0%	0 0%	1 6%	1 5%
Chi Square			5.66 .226			9.15 .057	

Prepared by Advanced Marketing Research, Inc.

Table 16: Do you know why you are not receiving notification calls?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	160	7	34	5	39	3	8
I don't know - they have never called	130 81%	6 86%	30 88%	4 80%	37 95% ++	2 67%	7 88%
I don't know - they stopped calling (not because I told them to)	11 7%	0 0%	1 3%	1 20%	1 3%	0 0%	0 0%
I don't burn wood	11 7%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
I told them to stop calling	6 4%	0 0%	3 9% +	0 0%	0 0%	1 33%	1 13%
Just moved here	1 1%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Have an exemption	1 1%	1 14%	0 0%	0 0%	1 3% +	0 0%	0 0%
Chi Square			9.94 .446			10.28 .416	

Table 18: Do you feel that the notification call program is a useful program that should continue?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Yes	174 56%	17 71%	47 57%	3 33%	46 57%	9 53%	11 58%
No	66 21%	2 8%	21 25%	2 22%	15 19%	5 29%	3 16%
Don't know/Refused	72 23%	5 21%	15 18%	4 44%	20 25%	3 18%	5 26%
Chi Square			6.88 .143			1.41 .842	

Prepared by Advanced Marketing Research, Inc.

Table 20: In general, does the notification call program cause you to follow the wood burning advisory more often, less often, or the same as you would without it?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	146	16	49	4	42	13	10
More often	28 19%	5 31%	15 31% ++	2 50%	12 29% +	3 23%	3 30%
Less often	3 2%	0 0%	2 4%	0 0%	2 5%	0 0%	0 0%
The same	57 39%	10 63%	26 53% ++	2 50%	24 57% +++	8 62%	6 60%
Not applicable (don't burn wood)	57 39%	1 6%	6 12% ---	0 0%	4 10% ---	2 15%	1 10%
Don't know/Refused	1 1%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			2.33 .969			1.59 .991	

Prepared by Advanced Marketing Research, Inc.

Table 21: Has the notification call program made you more aware of air quality in your community, less aware, or no difference in awareness?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	146	16	49	4	42	13	10
More aware	78 53%	9 56%	27 55%	3 75%	24 57%	5 38%	7 70%
Less aware	2 1%	0 0%	1 2%	0 0%	1 2%	0 0%	0 0%
No difference	66 45%	7 44%	21 43%	1 25%	17 40%	8 62%	3 30%
Don't know/Refused	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			0.96 .915			3.12 .538	

Prepared by Advanced Marketing Research, Inc.

Table 22: Do you conduct backyard burning of yard trimmings at your residence?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Yes	88 28%	6 25%	34 41% +++	3 33%	29 36% +	6 35%	6 32%
No	224 72%	18 75%	49 59% ---	6 67%	52 64% -	11 65%	13 68%
Don't know/Refused	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			2.09 .351			0.12 .941	

Prepared by Advanced Marketing Research, Inc.

Table 23: How often do you do backyard burning of yard trimmings: daily, once a week, once a month, or once per backyard burning season?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	88	6	34	3	29	6	6
Daily	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Once a week	3 3%	0 0%	1 3%	0 0%	0 0%	1 17%	0 0%
Once a month	12 14%	0 0%	5 15%	0 0%	3 10%	0 0%	2 33%
Once per backyard burning season	72 82%	6 100%	28 82%	3 100%	25 86%	5 83%	4 67%
Don't know/Refused	1 1%	0 0%	0 0%	0 0%	1 3%	0 0%	0 0%
Mean S.D.	3.8 0.5	4.0 0.0	3.8 0.5	4.0 0.0	3.9 0.3	3.7 0.8	3.7 0.5
Chi Square			1.85 .933			9.49 .148	

Prepared by Advanced Marketing Research, Inc.

Table 24: How much do you burn in one backyard burning season: less than one cubic yard, one to five cubic yards, or more than five cubic yards?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	88	6	34	3	29	6	6
Less than one cubic yard	17 19%	1 17%	6 18%	2 67%	6 21%	2 33%	1 17%
One to five cubic yards	51 58%	4 67%	20 59%	1 33%	15 52%	3 50%	4 67%
More than five cubic yards	16 18%	1 17%	7 21%	0 0%	6 21%	1 17%	1 17%
Don't know/Refused	4 5%	0 0%	1 3%	0 0%	2 7%	0 0%	0 0%
Mean S.D.	2.0 0.6	2.0 0.6	2.0 0.6	1.3 0.6	2.0 0.7	1.8 0.8	2.0 0.6
Chi Square			4.53 .606			1.57 .954	

Prepared by Advanced Marketing Research, Inc.

Table 25: Do you have internet access AT HOME?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Yes	216 69%	12 50%	64 77% +	5 56%	55 68%	12 71%	14 74%
No	93 30%	12 50%	19 23%	3 33%	26 32%	5 29%	5 26%
Don't know/Refused	3 1%	0 0%	0 0%	1 11%	0 0%	0 0%	0 0%
Chi Square			18.85 .001			0.26 .992	

Prepared by Advanced Marketing Research, Inc.

Table 26: How long have you lived in your community?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Less than one year	8 3%	0 0%	2 2%	0 0%	1 1%	0 0%	1 5%
1-5 years	48 15%	3 13%	10 12%	1 11%	12 15%	1 6%	4 21%
6-10 years	52 17%	0 0%	13 16%	1 11%	11 14%	1 6%	3 16%
Over ten years	202 65%	21 88%	57 69%	7 78%	56 69%	15 88%	11 58%
Don't know/Refused	2 1%	0 0%	1 1%	0 0%	1 1%	0 0%	0 0%
Chi Square			5.92 .656			5.70 .681	

Prepared by Advanced Marketing Research, Inc.

Table 27: Do you own or rent your residence?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Own	259 83%	19 79%	73 88%	7 78%	73 90% ++	15 88%	15 79%
Rent	51 16%	4 17%	9 11%	2 22%	7 9% --	2 12%	4 21%
Don't know/Refused	2 1%	1 4%	1 1%	0 0%	1 1%	0 0%	0 0%
Chi Square			2.49 .647			2.80 .591	

Prepared by Advanced Marketing Research, Inc.

Table 28: Is your residence a: single family home, mobile home, townhouse, condominium, duplex, apartment, or something else?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Single family	240 77%	22 92%	73 88% +++	9 100%	72 89% +++	16 94%	15 79%
Mobile home	58 19%	2 8%	8 10% --	0 0%	7 9% ---	1 6%	4 21%
Apartment	10 3%	0 0%	1 1%	0 0%	1 1%	0 0%	0 0%
Duplex	3 1%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Don't know/Refused	1 0%	0 0%	1 1% +	0 0%	1 1% +	0 0%	0 0%
Chi Square			1.82 .986			3.83 .872	

Table 30: Has your home been weatherized within the last five years?

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Yes	143 46%	11 46%	38 46%	3 33%	44 54% +	6 35%	6 32%
No	151 48%	12 50%	41 49%	5 56%	31 38% --	11 65%	13 68%
Don't know/Refused	18 6%	1 4%	4 5%	1 11%	6 7%	0 0%	0 0%
Chi Square			1.03 .905			9.29 .054	

Prepared by Advanced Marketing Research, Inc.

Table 31: Please tell me when I read the category that contains your age:

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
18-24	12 4%	1 4%	3 4%	1 11%	2 2%	0 0%	2 11%
25-34	18 6%	0 0%	4 5%	1 11%	4 5%	0 0%	2 11%
35-44	27 9%	5 21%	6 7%	0 0%	10 12%	0 0%	0 0%
45-54	66 21%	3 13%	23 28% +	3 33%	24 30% ++	2 12%	4 21%
55-64	103 33%	11 46%	29 35%	2 22%	21 26%	10 59%	9 47%
65 or older	86 28%	4 17%	18 22%	2 22%	20 25%	5 29%	2 11%
REFUSED - DO NOT READ	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Chi Square			11.04 .355			19.22 .038	

Prepared by Advanced Marketing Research, Inc.

Table 32: Please tell me when I read the category that contains your household's annual income, before taxes:

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Under $15,000	49 16%	4 17%	12 14%	0 0%	9 11%	4 24%	4 21%
$15,000 - $24,999	55 18%	6 25%	10 12%	2 22%	13 16%	3 18%	3 16%
$25,000 - $34,999	51 16%	2 8%	14 17%	1 11%	9 11%	3 18%	4 21%
$35,000 - $49,999	52 17%	8 33%	14 17%	1 11%	17 21%	3 18%	5 26%
$50,000 or more	50 16%	2 8%	20 24% ++	2 22%	18 22% +	4 24%	2 11%
DON'T KNOW/REFUSED - DO NOT READ	55 18%	2 8%	13 16%	3 33%	15 19%	0 0%	1 5%
Chi Square			12.52 .252			9.67 .470	

Prepared by Advanced Marketing Research, Inc.

Table 33: THANK YOU FOR YOUR TIME! Hang up and record: Gender:

		HAVE EXEMPTION?			CERTIFIED STOVE?		
	Total	Yes	No	Don't Know	Yes	No	Don't Know
	312	24	83	9	81	17	19
Male	154	12	31	4	35	7	7
	49%	50%	37%	44%	43%	41%	37%
			--				
Female	158	12	52	5	46	10	12
	51%	50%	63%	56%	57%	59%	63%
			++				
Chi Square			1.30			0.26	
			.522			.878	

Prepared by Advanced Marketing Research, Inc.

Table 1. 2008 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	0.4	0.8	0.1%	0.1%
Oakridge Sand & Gravel: Cement plant	0.1	0.1	0.0%	0.0%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	42.3	7%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	158.9	174.8	30%	32%
Residential Wood Combustion: Certified Woodstove/Insert[2]	228.0	250.8	43%	45%
Pellet Stoves	6.7	7.4	1%	1%
All Other Stationary Area Sources	47.4	4.7	9%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	26.6	37.3	5%	7%
Re-Entrained Road Dust	12.1	27.8	2%	5%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	1%
	---	---		
Total, All Sources, lbs/day	**525**	**552**		

(1) Worst-case day = Peak month production/20 workdays.

(2) Worst-case day = Peak Heating Degree Day

Updated, MLH 5/23/12

Table 2. 2014 Estimated Typical Season Day and Worst-Case Day $PM_{2.5}$ Emissions.

	-- lbs/per day --		Percent of Total NAA Emissions	
	Typical Season Day	Worst-Case Day	Typical Season Day	Worst-Case Day
Permitted Point Sources[1]				
Oakridge Sand & Gravel: Rock crushing operation	1.7	4.0	0.4%	1.1%
Oakridge Sand & Gravel: Cement plant	4.3	14.0	0.9%	3.7%
Stationary Area Sources				
Residential Wood Combustion: Fireplace[2]	38.5	29.6	8%	8%
Residential Wood Combustion: Non-Certified Woodstove/Insert[2]	106.1	81.7	22%	21%
Residential Wood Combustion: Certified Woodstove/Insert[2]	252.4	194.4	52%	51%
Pellet Stoves	7.3	8.0	1%	2%
All Other Stationary Area Sources	47.4	4.7	10%	1%
On-Road Sources				
On-Road: Exhaust, Brake, Tire	15.7	22.2	3%	6%
Re-Entrained Road Dust	7.1	16.3	1%	4%
Nonroad Sources				
Union Pacific Railroad	6.0	6.0	1%	2%
	---	---		
Total, All Sources, lbs/day	**486**	**381**		

(1) Worst-case day = Permitted hourly (x24) operating capacity

(2) Worst-case day = Peak Heating Degree Day

Updated, MLH 5/23/12

Table 3. Oakridge NAA 2008 Residential Wood Combustion $PM_{2.5}$
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	$PM_{2.5}$ Emissions			(9)
					Annual	PM Season		Worst Case
Woodburning Device	Base Year Wood Fuel Use (tons/yr)	$PM_{2.5}$ EF (lbs/ton)	Relative HDD	Activity (days/wk)	(6) Annual (tons/yr)	(7) Typical Day (lb/day)	(8) Worst Case Day (lb/day)	Day Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	23.6	1.10	7	2.3	38	42	42
21-04-008-320 Certified Non-Cat Wood-Stove	770.6	19.6	1.10	7	7.6	126	138	138
21-04-008-330 Certified Cat Wood-Stove	192.6	20.4	1.10	7	2.0	33	36	36
21-04-008-310 Conv Wood Stove	334.1	30.6	1.10	7	5.1	85	94	94
21-04-008-230 Fireplace Insert Cert Catalyst	84.3	20.4	1.10	7	0.9	14	16	16
21-04-008-220 Fireplace Insert Cert Non-Cat	337.1	19.6	1.10	7	3.3	55	61	61
21-04-008-210 Fireplace Insert Conv.	289.0	30.6	1.10	7	4.4	74	81	81
21-04-008-400 Exempt Pellet Stove	264.5	3.1	1.10	7	0.4	7	7	7
21-04-008-510 Central Furnace	0.0	27.6	1.10	7	0.0	0	0	0
Total	2,467.7				25.9	432	475	**475**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge and 2008 Klamath Falls Wood Burning Survey Results.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion PM2.5 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	23.6	1
2104008210	30.6	1
2104008220	19.6	1
2104008230	20.4	1
2104008310	30.6	1
2104008320	19.6	1
2104008330	20.4	1
2104008400	3.06	3
2104008510	27.6	3
2104008610	27.6	3
2104008700	23.6	3
2104009000	28.4	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011.

Table 3-a. Oakridge NAA 2008 Residential Wood Combustion Household Survey
and PM2.5 Area Source Emissions From Residential Wood Heating

(1)	(2)	(2)	(2)	(3)	(4)	(4)	(4)	(5)	$PM_{2.5}$ Emissions			(9)
									Annual	PM Season		Worst Case
Woodburning Device	Base Year Wood Fuel Use Survey (Households)	Base Year Wood Fuel Use (tons/HH)	Base Year Wood Fuel Use (tons/year)	$PM_{2.5}$ EF (lbs/ton)	Average Heating Degree Days (HDD)	Peak Heating Degree Days (HDD)	Relative HDD	Activity (days/wk)	(6) Annual (tons/yr)	(7) Typical Day (lb/day)	(8) Worst Case Day (lb/day)	Day Advisory Controlled (lbs/day)
Oakridge NAA												
21-04-008-100 Fireplace without Insert	123	1.6	195.6	23.6	26	28	1.10	7	2.3	38	42	42
21-04-008-320 Certified Non-Cat Wood-Stove	256	3.0	770.6	19.6	26	28	1.10	7	7.6	126	138	138
21-04-008-330 Certified Cat Wood-Stove	64	3.0	192.6	20.4	26	28	1.10	7	2.0	33	36	36
21-04-008-310 Conv Wood Stove	111	3.0	334.1	30.6	26	28	1.10	7	5.1	85	94	94
21-04-008-230 Fireplace Insert Cert Catalyst	28	3.0	84.3	20.4	26	28	1.10	7	0.9	14	16	16
21-04-008-220 Fireplace Insert Cert Non-Cat	112	3.0	337.1	19.6	26	28	1.10	7	3.3	55	61	61
21-04-008-210 Fireplace Insert Conv.	96	3.0	289.0	30.6	26	28	1.10	7	4.4	74	81	81
21-04-008-400 Exempt Pellet Stove	228	1.2	264.5	3.1	26	28	1.10	7	0.4	7	7	7
21-04-008-510 Central Furnace	0	0.0	0.0	27.6	26	28	1.10	7	0.0	0	0	0
Total	1,018		2,468						25.9	432	475	**475**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge and 2008 Klamath Falls Wood Burning Survey Results.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion PM2.5 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	23.6	1
2104008210	30.6	1
2104008220	19.6	1
2104008230	20.4	1
2104008310	30.6	1
2104008320	19.6	1
2104008330	20.4	1
2104008400	3.06	3
2104008510	27.6	3
2104008610	27.6	3
2104008700	23.6	3
2104009000	28.4	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

(Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011.

Table 4. Oakridge NAA 2014 Residential Wood Combustion $PM_{2.5}$
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	$PM_{2.5}$ Emissions			(9)
					Annual	PM Season		Worst Case
Woodburning Device	2014 Wood Fuel Use (tons/yr)	$PM_{2.5}$ EF (lbs/ton)	Relative HDD	Activity (days/wk)	(6) Annual (tons/yr)	(7) Typical Day (lb/day)	(8) Worst Case Day (lb/day)	Day 30% Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	23.6	1.10	7	2.3	38	42	30
21-04-008-320 Certified Non-Cat Wood-Stove	879.4	19.6	1.10	7	8.6	144	158	111
21-04-008-330 Certified Cat Wood-Stove	188.9	20.4	1.10	7	1.9	32	35	25
21-04-008-310 Conv Wood Stove	191.8	30.6	1.10	7	2.9	49	54	38
21-04-008-230 Fireplace Insert Cert Catalyst	82.6	20.4	1.10	7	0.8	14	15	11
21-04-008-220 Fireplace Insert Cert Non-Cat	383.6	19.6	1.10	7	3.8	63	69	48
21-04-008-210 Fireplace Insert Conv.	224.3	30.6	1.10	7	3.4	57	63	44
21-04-008-400 Exempt Pellet Stove	286.5	3.1	1.10	7	0.4	7	8	8
21-04-008-510 Central Furnace	0.0	27.6	1.10	7	0.0	0	0	0
Total	2,432.7				24.3	404	445	**314**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge Wood Burning Survey Results and subsequent heating unit replacements verified by LRAPA.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion PM2.5 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	23.6	1
2104008210	30.6	1
2104008220	19.6	1
2104008230	20.4	1
2104008310	30.6	1
2104008320	19.6	1
2104008330	20.4	1
2104008400	3.06	3
2104008510	27.6	3
2104008610	27.6	3
2104008700	23.6	3
2104009000	28.4	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011 increased by 30% compliance after 2012 strategy implementation.

Table 4-a. Oakridge NAA 2014 Residential Wood Combustion PM2.5
Area Source Emissions From Residential Wood Heating

(1) Woodburning Device	(2) 2014 Wood Fuel Use (Households)	(2) 2014 Wood Fuel Use (tons/HH)	(2) 2014 Wood Fuel Use (tons/year)	(3) $PM_{2.5}$ EF (lbs/ton)	(4) Average Heating Degree Days (HDD)	(4) Peak 2% Heating Degree Days (HDD)	(4) Relative HDD	(5) Activity (days/wk)	$PM_{2.5}$ Emissions Annual (6) Annual (tons/yr)	PM Season (7) Typical Day (lb/day)	PM Season (8) Worst Case Day (lb/day)	(9) Worst Case Day 30% Advisory Controlled (lbs/day)
Oakridge NAA												
21-04-008-100 Fireplace without Insert	123	1.6	195.6	23.6	26	28	1.10	7	2.3	38	42	30
21-04-008-320 Certified Non-Cat Wood-Stove	298	3.0	879.4	19.6	26	28	1.10	7	8.6	144	158	111
21-04-008-330 Certified Cat Wood-Stove	64	3.0	188.9	20.4	26	28	1.10	7	1.9	32	35	25
21-04-008-310 Conv Wood Stove	65	3.0	191.8	30.6	26	28	1.10	7	2.9	49	54	38
21-04-008-230 Fireplace Insert Cert Catalyst	28	3.0	82.6	20.4	26	28	1.10	7	0.8	14	15	11
21-04-008-220 Fireplace Insert Cert Non-Cat	130	3.0	383.6	19.6	26	28	1.10	7	3.8	63	69	48
21-04-008-210 Fireplace Insert Conv.	76	3.0	224.3	30.6	26	28	1.10	7	3.4	57	63	44
21-04-008-400 Exempt Pellet Stove	247	1.2	286.5	3.1	26	28	1.10	7	0.4	7	8	8
21-04-008-510 Central Furnace	0	0.0	0.0	27.6	26	28	1.10	7	0.0	0	0	0
Total	1,031		2,433						24.3	404	445	**314**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge Wood Burning Survey Results and subsequent heating unit replacements verified by LRAPA.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion PM2.5 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	23.6	1
2104008210	30.6	1
2104008220	19.6	1
2104008230	20.4	1
2104008310	30.6	1
2104008320	19.6	1
2104008330	20.4	1
2104008400	3.06	3
2104008510	27.6	3
2104008610	27.6	3
2104008700	23.6	3
2104009000	28.4	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =
(Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.
8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011 increased by 30% compliance after 2012 strategy implementation.

Table 5. Oakridge NAA 2008 Residential Wood Combustion NOx
Area Source Emissions From Residential Wood Heating

(1) Woodburning Device	(2) Base Year Wood Fuel Use (tons/yr)	(3) NOx EF (lbs/ton)	(4) Relative HDD	(5) Activity (days/wk)	NOx Emissions Annual (6) Annual (tons/yr)	NOx Emissions PM Season (7) Typical Day (lb/day)	NOx Emissions PM Season (8) Worst Case Day (lb/day)	(9) Worst Case Day Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	2.6	1.10	7	0.3	4	5	5
21-04-008-320 Certified Non-Cat Wood-Stove	770.6	2.3	1.10	7	0.9	15	16	16
21-04-008-330 Certified Cat Wood-Stove	192.6	2.0	1.10	7	0.2	3	4	4
21-04-008-310 Conv Wood Stove	334.1	2.8	1.10	7	0.5	8	9	9
21-04-008-230 Fireplace Insert Cert Catalyst	84.3	2.0	1.10	7	0.1	1	2	2
21-04-008-220 Fireplace Insert Cert Non-Cat	337.1	2.3	1.10	7	0.4	6	7	7
21-04-008-210 Fireplace Insert Conv.	289.0	2.8	1.10	7	0.4	7	7	7
21-04-008-400 Exempt Pellet Stove	264.5	3.8	1.10	7	0.5	8	9	9
21-04-008-510 Central Furnace	0.0	1.8	1.10	7	0.0	0	0	0
Total	2,467.7				3.2	53	58	**58**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge and 2008 Klamath Falls Wood Burning Survey Results.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion NOx emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	2.6	1
2104008210	2.8	1
2104008220	2.3	3
2104008230	2.0	1
2104008310	2.8	1
2104008320	2.3	3
2104008330	2.0	1
2104008400	3.8	3
2104008510	1.8	3
2104008610	1.8	3
2104008700	2.6	1
2104009000	7.7	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011.

Table 6. Oakridge NAA 2014 Residential Wood Combustion NOx
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	NOx Emissions			(9)
					Annual	PM Season		Worst Case
					(6)	(7)	(8)	Day 30%
Woodburning Device	2014 Wood Fuel Use (tons/yr)	NOx EF (lbs/ton)	Relative HDD	Activity (days/wk)	Annual (tons/yr)	Typical Day (lb/day)	Worst Case Day (lb/day)	Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	2.6	1.10	7	0.3	4	5	3
21-04-008-320 Certified Non-Cat Wood-Stove	879.4	2.3	1.10	7	1.0	17	18	13
21-04-008-330 Certified Cat Wood-Stove	188.9	2.0	1.10	7	0.2	3	3	2
21-04-008-310 Conv Wood Stove	191.8	2.8	1.10	7	0.3	4	5	3
21-04-008-230 Fireplace Insert Cert Catalyst	82.6	2.0	1.10	7	0.1	1	2	1
21-04-008-220 Fireplace Insert Cert Non-Cat	383.6	2.3	1.10	7	0.4	7	8	6
21-04-008-210 Fireplace Insert Conv.	224.3	2.8	1.10	7	0.3	5	6	4
21-04-008-400 Exempt Pellet Stove	286.5	3.8	1.10	7	0.5	9	10	10
21-04-008-510 Central Furnace	0.0	1.8	1.10	7	0.0	0	0	0
Total	2,432.7				3.1	52	57	**43**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge Wood Burning Survey Results and subsequent heating unit replacements verified by LRAPA.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion NOx emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	2.6	1
2104008210	2.8	1
2104008220	2.3	3
2104008230	2.0	1
2104008310	2.8	1
2104008320	2.3	3
2104008330	2.0	1
2104008400	3.8	3
2104008510	1.8	3
2104008610	1.8	3
2104008700	2.6	1
2104009000	7.7	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011 increased by 30% compliance after 2012 strategy implementation.

Table 7. Oakridge NAA 2008 Residential Wood Combustion SO2
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	SO2 Emissions			(9)
					Annual	PM Season		Worst Case
					(6)	(7)	(8)	Day
Woodburning Device	Base Year Wood Fuel Use (tons/yr)	SO2 EF (lbs/ton)	Relative HDD	Activity (days/wk)	Annual (tons/yr)	Typical Day (lb/day)	Worst Case Day (lb/day)	Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	0.4	1.10	7	0.0	1	1	1
21-04-008-320 Certified Non-Cat Wood-Stove	770.6	0.4	1.10	7	0.2	3	3	3
21-04-008-330 Certified Cat Wood-Stove	192.6	0.4	1.10	7	0.0	1	1	1
21-04-008-310 Conv Wood Stove	334.1	0.4	1.10	7	0.1	1	1	1
21-04-008-230 Fireplace Insert Cert Catalyst	84.3	0.4	1.10	7	0.0	0	0	0
21-04-008-220 Fireplace Insert Cert Non-Cat	337.1	0.4	1.10	7	0.1	1	1	1
21-04-008-210 Fireplace Insert Conv.	289.0	0.4	1.10	7	0.1	1	1	1
21-04-008-400 Exempt Pellet Stove	264.5	0.3	1.10	7	0.0	1	1	1
21-04-008-510 Central Furnace	0.0	2.0	1.10	7	0.0	0	0	0
Total	2,467.7				0.5	8	9	**9**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge and 2008 Klamath Falls Wood Burning Survey Results.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion SO2 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	0.4	1
2104008210	0.4	1
2104008220	0.4	3
2104008230	0.4	1
2104008310	0.4	1
2104008320	0.4	3
2104008330	0.4	1
2104008400	0.32	3
2104008510	2.03	3
2104008610	2.03	3
2104008700	0.4	1
2104009000	unknown	--

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011.

Table 8. Oakridge NAA 2014 Residential Wood Combustion SO2
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	SO2 Emissions			(9)
					Annual	PM Season		Worst Case
					(6)	(7)	(8)	Day 30%
Woodburning Device	2014 Wood Fuel Use (tons/yr)	SO2 EF (lbs/ton)	Relative HDD	Activity (days/wk)	Annual (tons/yr)	Typical Day (lb/day)	Worst Case Day (lb/day)	Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	0.4	1.10	7	0.0	1	1	1
21-04-008-320 Certified Non-Cat Wood-Stove	879.4	0.4	1.10	7	0.2	3	3	2
21-04-008-330 Certified Cat Wood-Stove	188.9	0.4	1.10	7	0.0	1	1	0
21-04-008-310 Conv Wood Stove	191.8	0.4	1.10	7	0.0	1	1	0
21-04-008-230 Fireplace Insert Cert Catalyst	82.6	0.4	1.10	7	0.0	0	0	0
21-04-008-220 Fireplace Insert Cert Non-Cat	383.6	0.4	1.10	7	0.1	1	1	1
21-04-008-210 Fireplace Insert Conv.	224.3	0.4	1.10	7	0.0	1	1	1
21-04-008-400 Exempt Pellet Stove	286.5	0.3	1.10	7	0.0	1	1	1
21-04-008-510 Central Furnace	0.0	2.0	1.10	7	0.0	0	0	0
Total	2,432.7				0.5	8	9	**6**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge Wood Burning Survey Results and subsequent heating unit replacements verified by LRAPA.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion SO2 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	0.4	1
2104008210	0.4	1
2104008220	0.4	3
2104008230	0.4	1
2104008310	0.4	1
2104008320	0.4	3
2104008330	0.4	1
2104008400	0.32	3
2104008510	2.03	3
2104008610	2.03	3
2104008700	0.4	1
2104009000	unknown	--

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011 increased by 30% compliance after 2012 strategy implementation.

Table 9. Oakridge NAA 2008 Residential Wood Combustion VOC
Area Source Emissions From Residential Wood Heating

(1) Woodburning Device	(2) Base Year Wood Fuel Use (tons/yr)	(3) VOC EF (lbs/ton)	(4) Relative HDD	(5) Activity (days/wk)	VOC Emissions Annual (6) Annual (tons/yr)	VOC Emissions PM Season (7) Typical Day (lb/day)	VOC Emissions PM Season (8) Worst Case Day (lb/day)	(9) Worst Case Day Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	18.9	1.10	7	1.8	31	34	34
21-04-008-320 Certified Non-Cat Wood-Stove	770.6	12.0	1.10	7	4.6	77	85	85
21-04-008-330 Certified Cat Wood-Stove	192.6	15.0	1.10	7	1.4	24	26	26
21-04-008-310 Conv Wood Stove	334.1	53.0	1.10	7	8.9	148	162	162
21-04-008-230 Fireplace Insert Cert Catalyst	84.3	15.0	1.10	7	0.6	11	12	12
21-04-008-220 Fireplace Insert Cert Non-Cat	337.1	12.0	1.10	7	2.0	34	37	37
21-04-008-210 Fireplace Insert Conv.	289.0	53.0	1.10	7	7.7	128	140	140
21-04-008-400 Exempt Pellet Stove	264.5	0.0	1.10	7	0.0	0	0	0
21-04-008-510 Central Furnace	0.0	11.7	1.10	7	0.0	0	0	0
Total	2,467.7				27.1	451	497	**497**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge and 2008 Klamath Falls Wood Burning Survey Results.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion VOC emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	18.9	1
2104008210	53	1
2104008220	12	3
2104008230	15	1
2104008310	53	1
2104008320	12	3
2104008330	15	1
2104008400	0.041	3
2104008510	11.7	3
2104008610	11.7	3
2104008700	18.9	1
2104009000	39.56	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011.

Table 10. Oakridge NAA 2014 Residential Wood Combustion VOC
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	VOC Emissions			(9)
					Annual	PM Season		Worst Case
	2014				(6)	(7)	(8)	Day 30%
Woodburning Device	Wood Fuel Use (tons/yr)	VOC EF (lbs/ton)	Relative HDD	Activity (days/wk)	Annual (tons/yr)	Typical Day (lb/day)	Worst Case Day (lb/day)	Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	18.9	1.10	7	1.8	31	34	24
21-04-008-320 Certified Non-Cat Wood-Stove	879.4	12.0	1.10	7	5.3	88	97	68
21-04-008-330 Certified Cat Wood-Stove	188.9	15.0	1.10	7	1.4	24	26	18
21-04-008-310 Conv Wood Stove	191.8	53.0	1.10	7	5.1	85	93	65
21-04-008-230 Fireplace Insert Cert Catalyst	82.6	15.0	1.10	7	0.6	10	11	8
21-04-008-220 Fireplace Insert Cert Non-Cat	383.6	12.0	1.10	7	2.3	38	42	30
21-04-008-210 Fireplace Insert Conv.	224.3	53.0	1.10	7	5.9	99	109	76
21-04-008-400 Exempt Pellet Stove	286.5	0.0	1.10	7	0.0	0	0	0
21-04-008-510 Central Furnace	0.0	11.7	1.10	7	0.0	0	0	0
Total	2,432.7				22.5	375	412	**289**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge Wood Burning Survey Results and subsequent heating unit replacements verified by LRAPA.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion VOC emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	18.9	1
2104008210	53	1
2104008220	12	3
2104008230	15	1
2104008310	53	1
2104008320	12	3
2104008330	15	1
2104008400	0.041	3
2104008510	11.7	3
2104008610	11.7	3
2104008700	18.9	1
2104009000	39.56	2

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011 increased by 30% compliance after 2012 strategy implementation.

Table 11. Oakridge NAA 2008 Residential Wood Combustion NH3
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	NH3 Emissions			(9)
					Annual	PM Season		Worst Case
					(6)	(7)	(8)	Day
Woodburning Device	Base Year Wood Fuel Use (tons/yr)	NH3 EF (lbs/ton)	Relative HDD	Activity (days/wk)	Annual (tons/yr)	Typical Day (lb/day)	Worst Case Day (lb/day)	Advisory Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	1.8	1.10	7	0.2	3	3	3
21-04-008-320 Certified Non-Cat Wood-Stove	770.6	0.9	1.10	7	0.3	6	6	6
21-04-008-330 Certified Cat Wood-Stove	192.6	0.9	1.10	7	0.1	1	2	2
21-04-008-310 Conv Wood Stove	334.1	1.7	1.10	7	0.3	5	5	5
21-04-008-230 Fireplace Insert Cert Catalyst	84.3	0.9	1.10	7	0.0	1	1	1
21-04-008-220 Fireplace Insert Cert Non-Cat	337.1	0.9	1.10	7	0.2	3	3	3
21-04-008-210 Fireplace Insert Conv.	289.0	1.7	1.10	7	0.2	4	5	5
21-04-008-400 Exempt Pellet Stove	264.5	0.3	1.10	7	0.0	1	1	1
21-04-008-510 Central Furnace	0.0	1.8	1.10	7	0.0	0	0	0
Total	2,467.7				1.4	23	25	**25**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge and 2008 Klamath Falls Wood Burning Survey Results.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion NH3 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	1.8	1
2104008210	1.7	1
2104008220	0.9	3
2104008230	0.9	1
2104008310	1.7	1
2104008320	0.9	3
2104008330	0.9	1
2104008400	0.3	3
2104008510	1.8	3
2104008610	1.8	3
2104008700	1.8	1
2104009000	unknown	--

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011.

Table 12. Oakridge NAA 2014 Residential Wood Combustion NH3
Area Source Emissions From Residential Wood Heating

(1)	(2)	(3)	(4)	(5)	NH3 Emissions			(9)
					Annual	PM Season		Worst Case
	2014				(6)	(7)	(8)	Day 30%
Woodburning	Wood Fuel	NH3				Typical	Worst Case	Advisory
Device	Use (tons/yr)	EF (lbs/ton)	Relative HDD	Activity (days/wk)	Annual (tons/yr)	Day (lb/day)	Day (lb/day)	Controlled (lbs/day)
Oakridge NAA								
21-04-008-100 Fireplace without Insert	195.6	1.8	1.10	7	0.2	3	3	2
21-04-008-320 Certified Non-Cat Wood-Stove	879.4	0.9	1.10	7	0.4	7	7	5
21-04-008-330 Certified Cat Wood-Stove	188.9	0.9	1.10	7	0.1	1	2	1
21-04-008-310 Conv Wood Stove	191.8	1.7	1.10	7	0.2	3	3	2
21-04-008-230 Fireplace Insert Cert Catalyst	82.6	0.9	1.10	7	0.0	1	1	0
21-04-008-220 Fireplace Insert Cert Non-Cat	383.6	0.9	1.10	7	0.2	3	3	2
21-04-008-210 Fireplace Insert Conv.	224.3	1.7	1.10	7	0.2	3	3	2
21-04-008-400 Exempt Pellet Stove	286.5	0.3	1.10	7	0.0	1	1	1
21-04-008-510 Central Furnace	0.0	1.8	1.10	7	0.0	0	0	0
Total	2,432.7				1.3	21	23	**16**

Notes:

1) Woodburning Device categories are from the 2010 Oakridge Wood Burning Survey Results and subsequent heating unit replacements verified by LRAPA.
2) Woodburning Fuel Use estimates are from the 2010 Oakridge Wood Burning Survey Results.
3) Residential Wood Combustion NH3 emission factors and references:

scc	factor, lb/ton fuel burned	Reference
2104008100	1.8	1
2104008210	1.7	1
2104008220	0.9	3
2104008230	0.9	1
2104008310	1.7	1
2104008320	0.9	3
2104008330	0.9	1
2104008400	0.3	3
2104008510	1.8	3
2104008610	1.8	3
2104008700	1.8	1
2104009000	unknown	--

Reference 1: US EPA. Documentation For The 2002 Base Year National Emission Inventory For Hazardous Air Pollutants
Reference 2: Li, Victor S., and Rosenthal, Steven. "Content and emissions characteristics of Artificial Wax Firelogs." Paper presented at the 15th International Emission Inventory Conference. New Orleans, Lousiana. May 15th-18th, 2006.
Reference 3: Houck, James E., Eagle, Brian N. Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA. December 19, 2006.

4) Heating Degree Days calculated from LRAPA meteorological monitoring site at Willamette Activity Center (WAC) in Oakridge.
5) Klamath Falls and Oakridge survey results indicate activity occurs throughout the week.
6) Annual emissions [tons/year] = (2010 Survey Wood Fuel Use [tons/year] * emission factor [lbs/ton]) / 2000 [lbs/ton].
7) Typical PM_{10} Season Day Emissions [lbs/day] =

   (Annual Emissions [tons/year] * 2000 [lbs/ton]) / (120 heating days per season) without a weight for day of week fuel burned.

8) Worst Case Day Emissions [lbs/day] typical season day * worst-case day multiplier (based on peak/average HDD).

(9) Advisory controlled emissions based on woodburning curtailment compliance surveys during 2007-2011 increased by 30% compliance after 2012 strategy implementation.

Appendix D-3
Transportation Sources Emission Inventory

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477

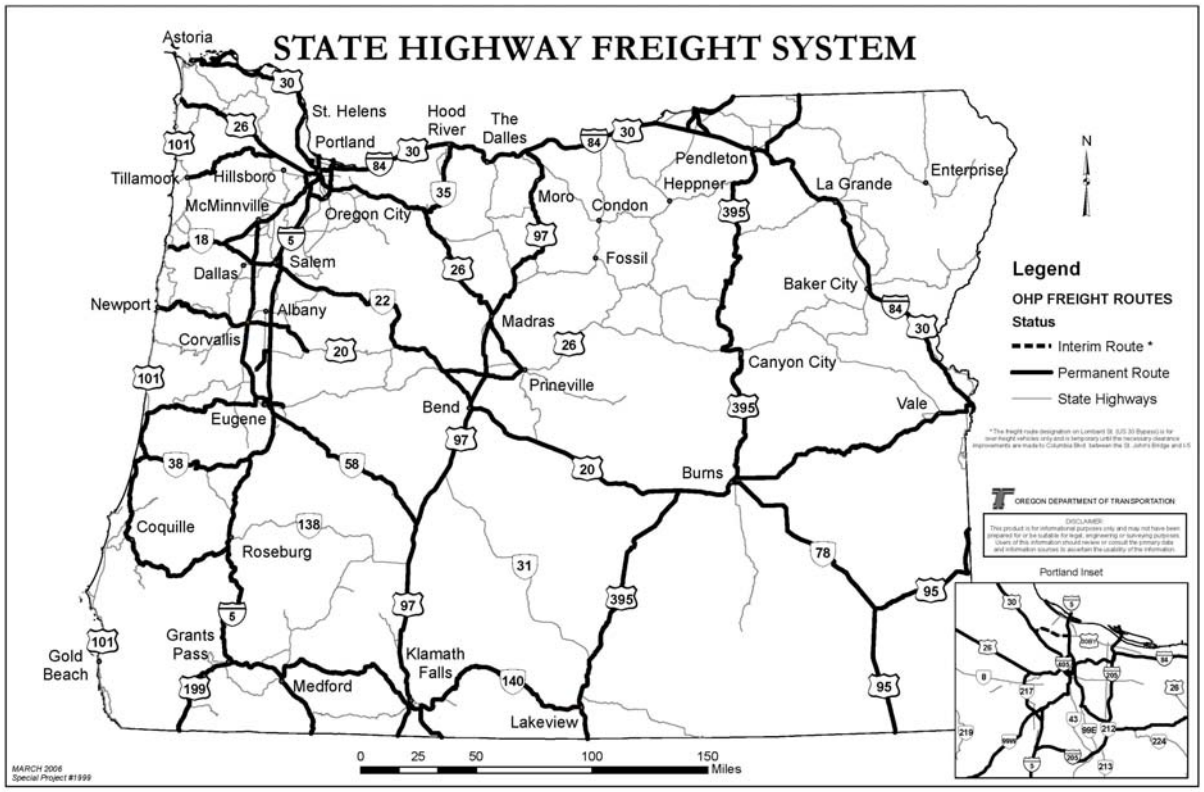
Subject: Westfir-Oakridge PM 2.5 Emissions Report
Date: 3/23/2012
Author: Josh Roll – LCOG Transportation and Land Use Planner
Email: jroll@lcog.org
Phone: 541-682-2454

Section 1

Introduction

The Lane Council of Governments has been tasked with determining the Fine Particle matter emissions (PM2.5) from transportation sources for the Westfir-Oakridge non-attainment area in Lane County for Lane Regional Air Protection Agency (LRAPA). The City of Oakridge is located in Lane County, approximately 40 miles east of the Eugene-Springfield Metropolitan Area. The Middle Fork of the Willamette River creates the southern edge of Oakridge. Salmon Creek serves as the eastern boundary of the study area, and flows southwest through the city, merging with the Middle Fork. The City of Westfir is located roughly 1 mile north of Oakridge. Highway 58 in Oakridge is an area of both high automobile and freight traffic with Highway 58 classified as a state freight route (See figure 1.1). Using two primary forecasting tools, a simplified 4-step travel demand model and the Environmental Protection Agency's (EPA) model Motor Vehicle Emission Simulator (MOVES), LCOG completed the analysis detailed in this report.

Figure 1.1



Section 2

Travel Demand Estimation

With support and direction from the Oregon Department of Transportation, LCOG deployed the Oregon Small Urban Model (OSUM). OSUM uses travel behavior relationships estimated on travel survey data from approximately 3,200 two-day household activity surveys administered over eight rural counties throughout Oregon. The model also uses household and employment land use information and external traffic counts to inform its travel demand estimation process. OSUM represents the state of the practice for travel demand modeling for small urban communities in Oregon.

Currently land use assumptions regarding households and employment relate to a base year of 2002 and a future year of 2025. Updating the land use information was not deemed necessary at this time and instead the desired forecast years, 2008, 2014, and 2024, were interpolated using linear interpolation. It was necessary to account for seasonal variation of travel in the study area from external sources. This was done by updating the external traffic flow inputs with observed highway counts for two cordon locations that reflected the particular month in which the traffic counts were collected. Tables 2.1 through 2.4 below detail the differences between seasons (months) of each forecast year. The cordon counts and their seasonal adjustments are based on observed seasonal variation recorded by ODOT permanent automatic traffic recorder (ATR) stations.[1] Figure 2.1 below shows the locations of each external cordon point. This approach assumes all local traffic remains stable and only external traffic flows fluctuate according to season.

Travel demand was forecast at the hourly level because the emissions calculation process requires hourly VMT in order to apply the hourly emissions rates correctly due to the sensitivity of the emissions rates to temperature at which the travel activity is occurring. See Figure 2.2 for an example of hourly variation of VMT for a selected month and year.

[1] ODOT Permanent Automatic Traffic Recorder Station Trend Summaries: http://www.oregon.gov/ODOT/TD/TDATA/tsm/docs/2002_ATR.pdf

Figure 2.1

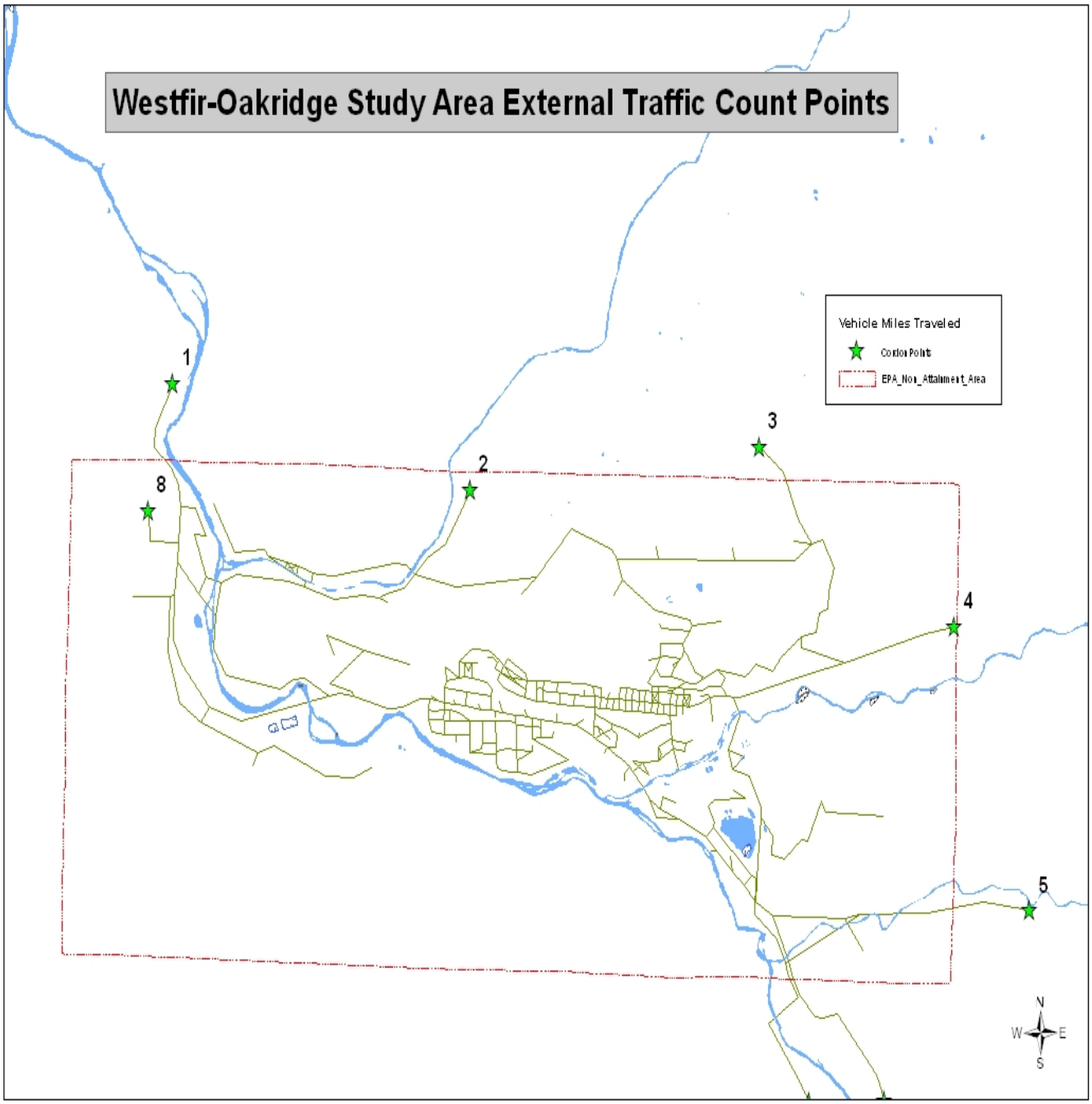

Westfir-Oakridge Study Area External Traffic Count Points
Vehicle Miles Traveled
Cordon Points
EPA_Non_Attainment_Area
1
2
3
4
5
8
N
W
E
S

Figure 2.2

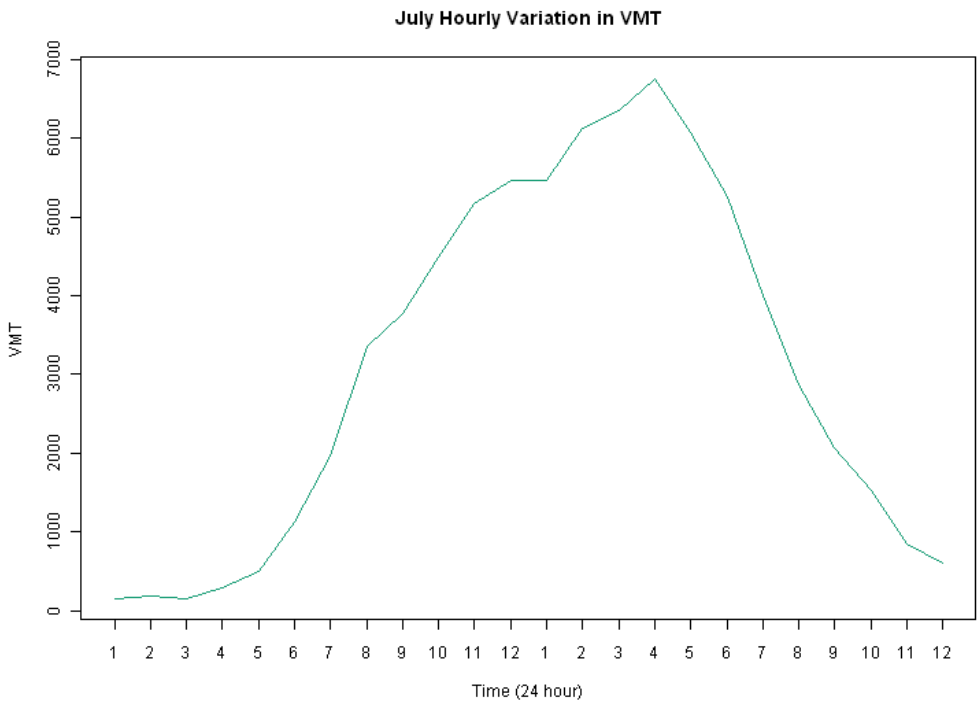


Table 2.1

	April				
CountPoint	**2002**	**2008**	**2014**	**2024**	**2025**
1	3588	3857	4125	4572	4616.1
2	300	300	300	300	300
3	490	490	490	490	490
4	150	150	150	150	150
5	2622	2799	2975	3269	3298.2
6	320	320	320	320	320
7	180	180	180	180	180
8	120	120	120	120	120

Table 2.2

	July				
CountPoint	**2002**	**2008**	**2014**	**2024**	**2025**
1	5980	6427	6874	7619	7693.5
2	300	300	300	300	300
3	490	490	490	490	490
4	150	150	150	150	150
5	4370	4664	4958	5448	5497
6	320	320	320	320	320
7	180	180	180	180	180
8	120	120	120	120	120

Table 2.3

	September				
CountPoint	**2002**	**2008**	**2014**	**2024**	**2025**
1	5616	6036	6456	7156	7225.2
2	300	300	300	300	300
3	490	490	490	490	490
4	150	150	150	150	150
5	4104	4381	4657	5117	5162.4
6	320	320	320	320	320
7	180	180	180	180	180
8	120	120	120	120	120

Table 2.4

	December				
CountPoint	**2002**	**2008**	**2014**	**2024**	**2025**
1	3172	3410	3647	4042	4080.9
2	300	300	300	300	300
3	490	490	490	490	490
4	150	150	150	150	150
5	2318	2474	2630	2890	2915.8
6	320	320	320	320	320
7	180	180	180	180	180
8	120	120	120	120	120

It was necessary to account for weekend travel differently than weekday travel because observed highway counts demonstrated higher volumes on those days, likely due to weekend recreation travel. It was also necessary to adjust the weekend travel according to the season, since the weekend travel in each season varies. Using traffic counts from the ATR weekday and weekend differences were observed and a weekend factor was calculated. Because the weekend versus weekday difference was observed on the Highway 58 facility we assume that local road traffic remains stable throughout the week and the weekend therefore the adjustment factor is only applied to the travel activity associated with the highway facility traversing the study area. The figures in Table 2.5 describe just how different highway travel is on the weekends, with up to 92% (the winter factor) more travel being observed on those days versus weekdays.

Table 2.5

Season	**Weekend Factor**
Spring	1.68
Summer	1.63
Fall	1.46
Winter	1.92

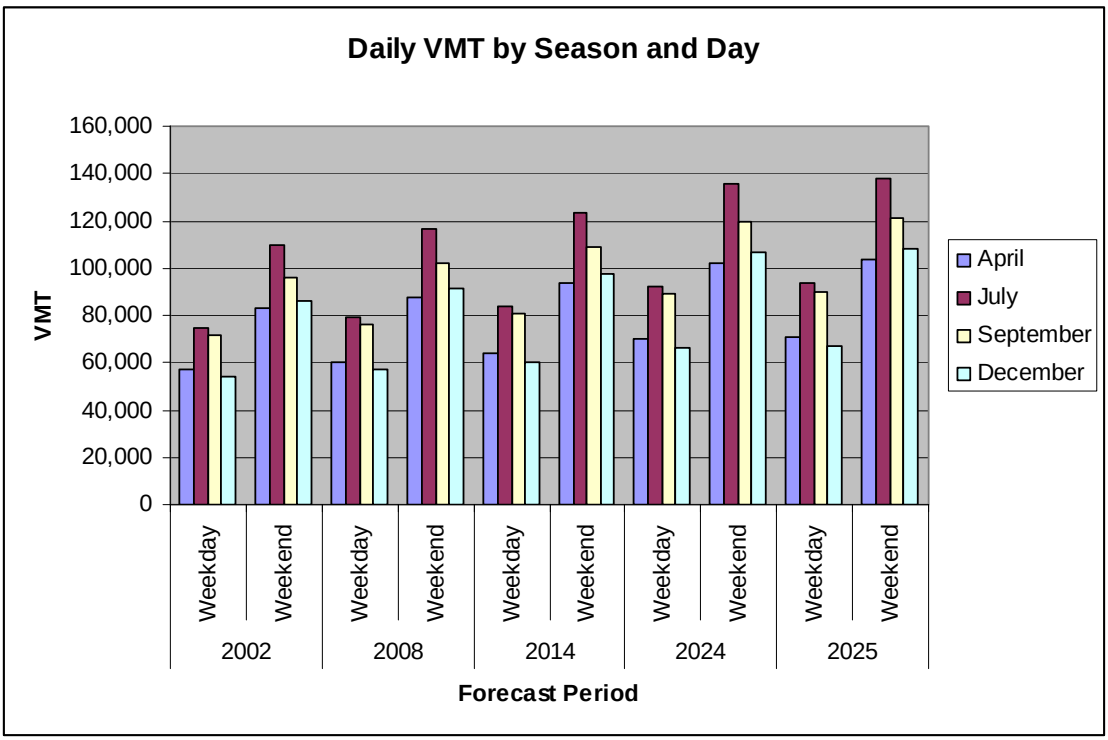
Table 2.6 and Figure 2.3 detail the VMT calculated for each of the forecast years and seasons including the weekday and weekend values. As expected the summer and fall travel activity is higher, again most likely due recreational travel. Also, a significant amount of travel occurs

during the weekend. Instead of calculating travel activity for each month it was deemed reasonable to calculate one month of activity per season and factor up the values. Using an assumed 65 days of weekday travel per season and 26 days of weekend travel, an annual VMT was calculated which is also displayed in Table 2.6.

Table 2.6

Daily and Annual VMT by Month										
	2002		2008		2014		2024		2025	
Month	**Weekday**	**Weekend**	**Weekday**	**Weekend**	**Weekday**	**Weekend**	**Weekday**	**Weekend**	**Weekday**	**Weekend**
April	56,802	82,767	60,205	87,857	63,922	93,386	70,036	102,462	71,051	103,760
July	74,538	109,337	79,188	116,298	84,167	123,719	92,408	135,988	93,643	137,611
September	71,822	96,030	76,310	102,131	81,084	108,607	89,022	119,346	90,198	120,780
December	53,714	86,109	56,902	91,390	60,409	97,167	66,164	106,610	67,134	107,918
Total Annual	26,427,322		28,058,910		29,817,705		32,720,530		33,153,430	

Figure 2.3



Additionally, Table 2.7 and Table 2.8 detail the VMT on Highway 58 versus the local roads for both the weekdays and the weekends. As can be observed from the tables, weekend and weekday travel on local roads remains stable while the travel on Highway 58 facilities is higher, more so on weekends especially in July and September calculations.

Table 2.7

Weekday Daily and Annual VMT by Month for Highway 58 vs. Local Roads										
	2002		2008		2014		2024		2025	
Month	Hwy	NonHwy	Hwy	NonHwy	Hwy	NonHwy	Hwy	NonHwy	Hwy	NonHwy
April	38,184	18,619	40,665	19,539	43,328	20,594	47,685	22,351	48,102	22,949
July	55,236	19,302	58,904	20,284	62,782	21,385	69,175	23,234	69,791	23,851
September	52,628	19,194	56,131	20,179	59,833	21,251	65,922	23,100	66,483	23,715
December	35,212	18,503	37,487	19,416	39,954	20,456	43,963	22,201	44,331	22,802
Total Annual	11,781,856	4,915,126	12,557,187	5,162,161	13,383,317	5,439,535	14,738,375	5,907,598	14,866,014	6,065,602

Table 2.8

Weekend Daily and Annual VMT by Month for Highway 58 vs. Local Roads										
	2002		2008		2014		2024		2025	
Month	Hwy	NonHwy	Hwy	NonHwy	Hwy	NonHwy	Hwy	NonHwy	Hwy	NonHwy
April	64,149	18,619	68,318	19,539	72,792	20,594	80,111	22,351	80,811	22,949
July	90,035	19,302	96,014	20,284	102,335	21,385	112,755	23,234	113,760	23,851
September	76,836	19,194	81,952	20,179	87,356	21,251	96,246	23,100	97,066	23,715
December	67,606	18,503	71,974	19,416	76,711	20,456	84,409	22,201	85,116	22,802
Total Annual	7,764,290	1,966,050	8,274,698	2,064,864	8,819,040	2,175,814	9,711,519	2,363,039	9,795,573	2,426,241

Section 3

Emissions Estimation

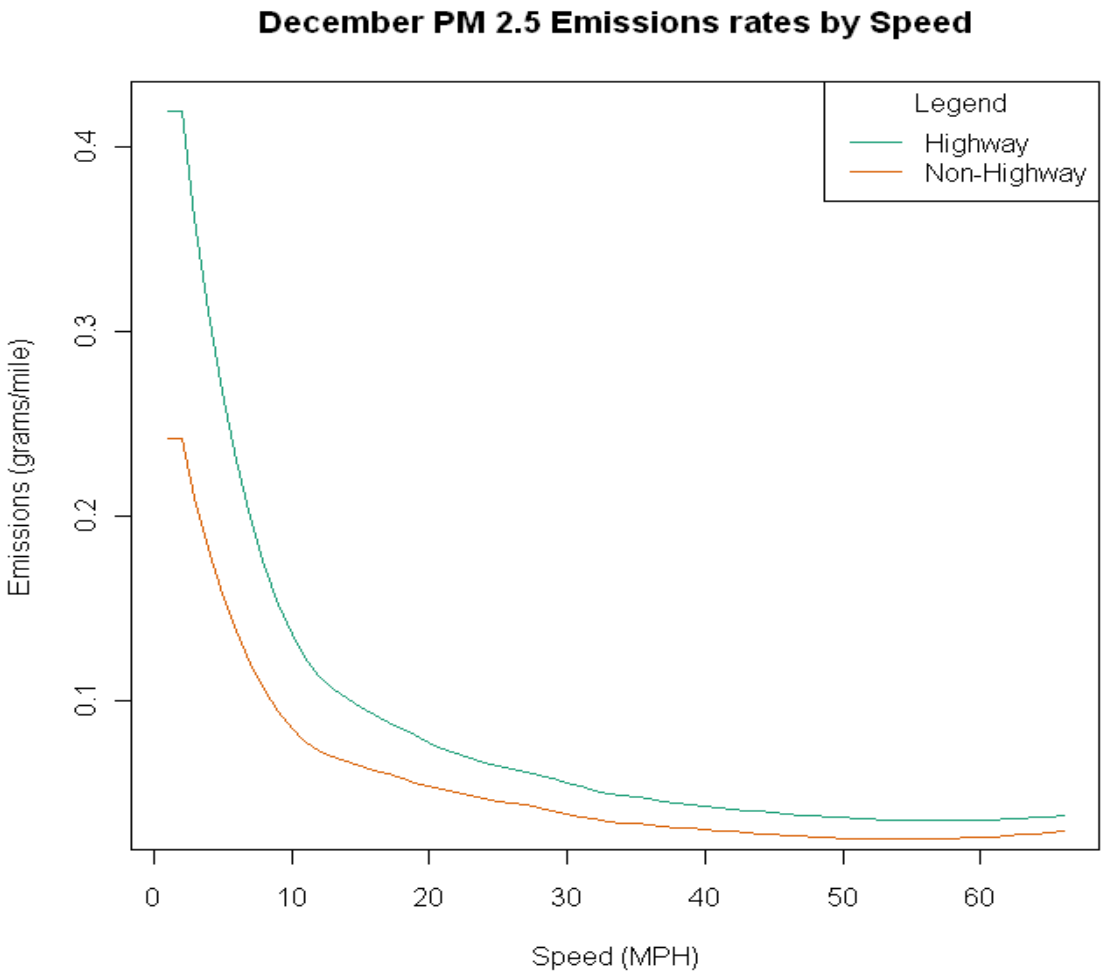
MOVES represents the latest in mobile source emissions forecasting (EPA 2010). The MOVES model incorporates input data that include vehicle fleet composition, traffic activities, fuel information and meteorology parameters and conducts modal-based emissions calculations using a set of model functions. Based on the resulting modal-based vehicle emission rates, emission inventories or emission factors are then generated for the desired geographic scale (macro, meso or micro scales) as well as temporal resolution (year, day and hour). For our purposes the emission factor approach was selected that computes emission rates by Source Bins defined to represent unique combinations of vehicle class, model year group, vehicle weight, engine size, and technology, and fuel types. (EPA 2002, 2007) The temporal resolution selected reflects emissions rates computed at the hourly level as per EPA's Technical Guidance for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity (EPA 2010). Using this approach requires a post process that is explained in detail below.

Using fuel formulation, fleet age distribution, meteorological information, fleet population, and VMT by vehicle type, MOVES estimates emissions for PM 2.5 source bins or each of the forecast periods.[2] The source bins are parsed categories of vehicle type, fuel type, and model year. Two types of outputs make up the bulk of what MOVES computes for emissions analysis, distance rates and vehicle rates. Distance rates are grams per mile emission rates for PM 2.5 pollutants based on speed for each source bin. Speed does not vary significantly between forecast periods, since the growth in vehicle traffic does not cause enough congestion to reduce traffic flow to less than free flow speeds. Nevertheless, speed has a considerable impact on emissions as detailed in Figure 3.1. This figure details composite PM2.5 emissions factors computed through MOVES for highway and non-highway facilities. The emissions are 'composite' because they represent the sum of all the different vehicle types' emissions rates weighted by their respective percentage assumed to be a part of the fleet mix for highway and non-highway traffic. Table 3.1 details these assumed fleet mix for our study area. Appendix A details all of the emission rate curves for each year and each vehicle type for gasoline and diesel vehicles separately. The future emission rates are substantially lower then the base year scenarios (2002 and 2008) due to technology improvements in the fleet for all vehicles. This can be most readily observed in the diesel vehicles, but is also seen in the gasoline vehicles.

Vehicle rates outputs are emission rates for the selected pollutants by vehicle type for non running emissions (crankcase start exhaust, crankcase extended idle exhaust, and extended idle exhaust). These rates are applied to the vehicle population in order to calculate idling emissions. The assumed vehicle populations are details in Appendix B and show very small amounts of growth overall between forecast periods**.**

[2] These inputs can be obtained upon request from LCOG, see contact info above.

Figure 3.1


December PM 2.5 Emissions rates by Speed
Legend
Highway
Non-Highway
Emissions (grams/mile)
0.1
0.2
0.3
0.4
0
10
20
30
40
50
60
Speed (MPH)

Assumptions of fleet composition for highway facilities came from an ODOT Automated Travel Data sensor located on Highway-58 less than a half mile east of the study area. Non-highway fleet mix assumptions come from national fleet mix values for 2009 because the break down for Lane County at the level of type of fuel consumed and vehicle type is not available. Since the highway facilities are assumed to have much more heavy duty truck traffic the respective emissions rates are also much higher.

Table 3.1

MOVES Vehicle Type	Description	Fuel	Hwy 58 %	Local %
11	Motor Cycle	Gas	0.00%	0.43%
21	Passenger Car	Gas	20.90%	52.83%
21	Passenger Car	Diesel	0.10%	0.21%
31	Passenger Truck	Gas	44.90%	27.92%
31	Passenger Truck	Diesel	0.50%	0.28%
32	Commercial Truck	Gas	3.40%	8.86%
32	Commercial Truck	Diesel	0.20%	0.57%
41	Intercity Bus	Diesel	0.10%	0.04%
42	Transit Bus	Diesel	0.00%	0.00%
43	School Bus	Diesel	0.60%	0.29%
51	Refuse Truck	Diesel	0.00%	0.07%
52	Single Short Haul	Gas	7.50%	1.00%
52	Single Short Haul	Diesel	17.60%	2.34%
53	Single Long Haul	Gas	0.50%	0.06%
53	Single Long Haul	Diesel	1.10%	0.14%
61	Combo Short Haul	Diesel	1.50%	2.84%
62	Combo Long Haul	Diesel	1.10%	2.11%

Section 4

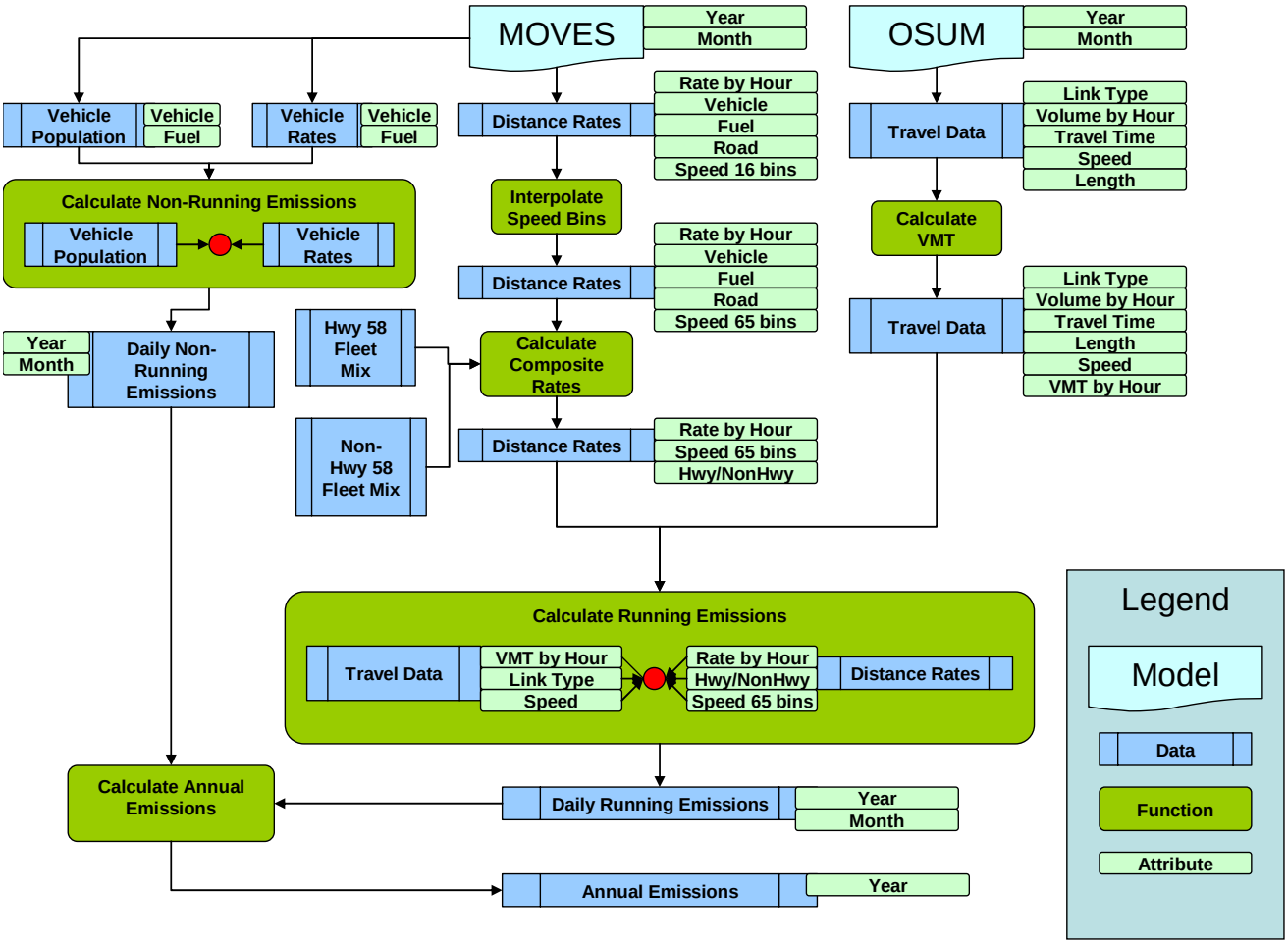
Methodology Discussion

Combining the results from the OSUM travel model and emissions rates from the MOVES emissions model was done using a post process developed using the R statistical program, an open source scripting language. The process uses the MOVES outputs and combines them with travel activity data from the OSUM model. Figure 4.1 below lays out the basic flow of this process including the inputs to both models and the post process. EPA MOVES Technical Guidance(EPA 2010) specifies that hourly rates be used for SIP analysis therefore emission rates and travel activity were broken into these temporal bins . To calculate emissions factors, MOVES model requires local inputs to account for the vehicle population, fuel specifications, local weather data (meteorological) and the vehicle age distribution. Fuel specifications detail the relevant aspects of gasoline and diesel fuels used by vehicles such as sulfur content and ethanol content. MOVES defaults for fuels specifications were used for all scenarios and seasons. The vehicle age distributions impacts the assumed efficiency of vehicles and can have a dramatic impact on the emissions rates since an older fleet has a much less efficient emissions profile(again see Appendix B for emission rate curves comparisons between years). This distribution was gleaned from registration data for 2008 and is assumed not to change for the

base and future years. In other words, if in the base year we assume that 2% of the fleet is 25 years old then in the future we make the same assumption though a vehicle that's 25 years old in 2025 will be much more efficient than a car that's 25 years old in 2002 but this will be reflected in the emissions output.

The household and employment inputs for the OSUM model are described in detail in Appendix C while the external traffic inputs are described in Tables 2.1 through 2.4 above. For the land use information for interim years 2008, 2014, and 2024, linear interpolation was used to compute households and employment by TAZ. This process was assessed as reasonable given the work that would be needed to forecast those years through a land use allocation modeling process.

Figure 4.1



Section 5

Results

Table 5.1 details summary results of the PM 2.5 analysis for the Westfir-Oakridge area. Both daily and annual computations are shown for total emissions (lbs.). The seasonal variation is reflected in the VMT (Table 2.6 above) but due to higher emissions rates in the winter from colder average temperatures, daily emissions remain relatively stable across forecast seasons. Due to overall fleet efficiency gains and technology improvements, daily and annual emissions drop considerably even though VMT (Table 5.2 and Figure 5.1) continues to increase into the future albeit marginally.

Table 5.1

Total Daily and Annual Emissions(lbs.) by Month										
	2002		2008		2014		2024		2025	
Month	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
April	31.1	41.7	22.4	29.9	13.2	17.3	7.0	8.9	6.9	8.6
July	31.5	44.5	22.7	32.0	12.8	17.9	6.1	8.3	6.0	7.9
September	32.4	41.7	23.3	30.0	13.3	16.9	6.6	8.1	6.4	7.8
December	37.9	52.5	27.2	37.3	16.7	22.2	9.5	12.2	9.3	11.8
Total Annual	12,503.0		8,986.7		5,228.4		2,699.4		2,642.8	

Table 5.2

Year	Total Annual VMT
2002	26,427,322
2008	28,058,910
2014	29,817,705
2024	32,720,530
2025	33,153,430

Figure 5.1

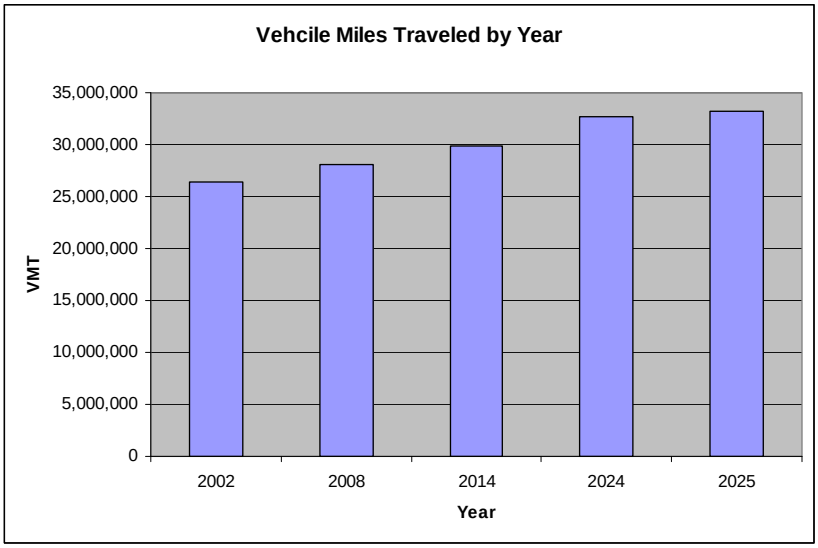
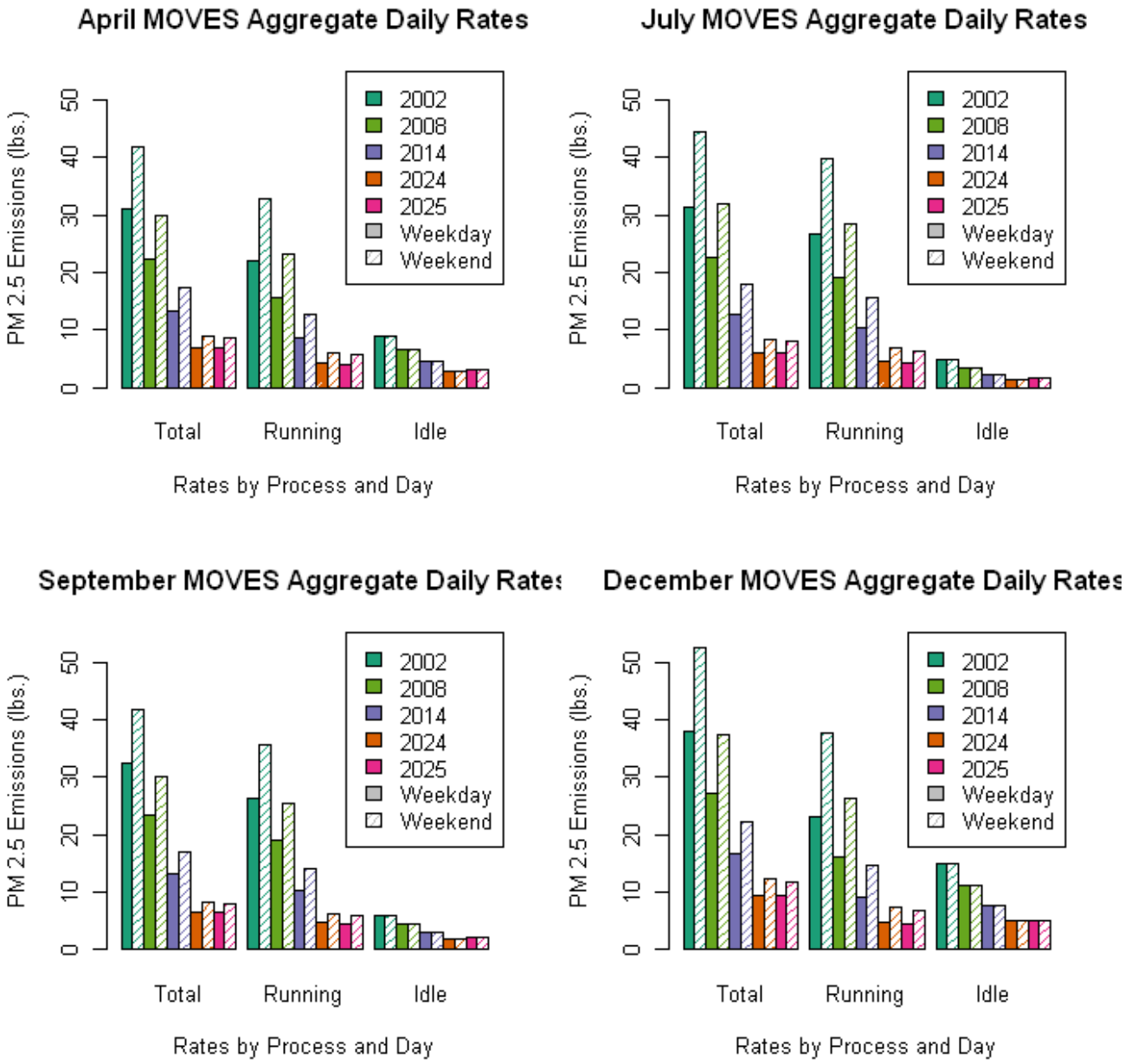


Figure 5.2 details the decrease in daily rates for total, running, and idling emissions across the forecast periods. As the fleet advances into the future PM 2.5 rates for all months and both weekday and weekend decrease significantly by the forecast horizon year 2025.

Figure 5.2



In order to get an idea of the relative contribution of emissions by vehicle type and fuel type the daily emissions were broken out by these source bin categories. Tables 5.3 and 5.4 and their accompanying charts in figure 5.3 and 5.4 show total and percentage total daily weekday emissions for the month of April broken out by source bin. All other months' charts and can be found in Appendix D. As demonstrated in the graph single-short haul remains the largest emitter of PM2.5 running emissions with gasoline passenger trucks following closely by 2025.
Idling emissions are dominated by passenger cars and trucks because the analysis assumes little dwell time for fright traffic.

Table 5.3

	Weekday					
April	SourceBin	2002	2008	2014	2024	2025
	ComboLongHaul.Diesel	2.99617	2.09202	1.03961	0.30600	0.27289
	ComboLongHaul.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	ComboShortHaul.Diesel	3.54258	2.42672	1.13820	0.33139	0.29758
	ComboShortHaul.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	ComTruck.Diesel	0.21391	0.15464	0.09651	0.03392	0.03220
	ComTruck.Gas	0.31865	0.23696	0.17397	0.15749	0.15702
	InterBus.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	InterBus.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	MotorCycle.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	MotorCycle.Gas	0.00686	0.00714	0.00752	0.00818	0.00839
	MotorHome.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	MotorHome.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	PassCar.Diesel	0.04262	0.02514	0.00907	0.00229	0.00227
	PassCar.Gas	1.38698	1.02815	0.78180	0.67225	0.67801
	PassTruck.Diesel	0.23895	0.17303	0.08700	0.02743	0.02380
	PassTruck.Gas	2.41393	1.69855	1.14632	1.03820	1.01324
	RefuseTruck.Diesel	0.04355	0.03157	0.01508	0.00489	0.00458
	RefuseTruck.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	SchoolBus.Diesel	0.33939	0.25773	0.12604	0.04415	0.04057
	SchoolBus.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	SingleLongHaul.Diesel	0.59367	0.45212	0.26481	0.09887	0.08716
	SingleLongHaul.Gas	0.06726	0.02578	0.01293	0.01052	0.00950
	SingleShortHaul.Diesel	9.28105	6.87804	3.70139	1.31253	1.17970
	SingleShortHaul.Gas	0.78418	0.32147	0.17350	0.15053	0.14480
	TransitBus.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	TransitBus.Gas	0.00000	0.00000	0.00000	0.00000	0.00000

Figure 5.3

	Weekday					
April		2002	2008	2014	2024	2025
	ComboLongHaul.Diesel	0.13454	0.13233	0.11849	0.07288	0.06906
	ComboLongHaul.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	ComboShortHaul.Diesel	0.15908	0.15350	0.12973	0.07893	0.07530
	ComboShortHaul.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	ComTruck.Diesel	0.00961	0.00978	0.01100	0.00808	0.00815
	ComTruck.Gas	0.01431	0.01499	0.01983	0.03751	0.03973
	InterBus.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	InterBus.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	MotorCycle.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	MotorCycle.Gas	0.00031	0.00045	0.00086	0.00195	0.00212
	MotorHome.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	MotorHome.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	PassCar.Diesel	0.00191	0.00159	0.00103	0.00055	0.00057
	PassCar.Gas	0.06228	0.06504	0.08911	0.16011	0.17157
	PassTruck.Diesel	0.01073	0.01095	0.00992	0.00653	0.00602
	PassTruck.Gas	0.10840	0.10744	0.13065	0.24727	0.25641
	RefuseTruck.Diesel	0.00196	0.00200	0.00172	0.00116	0.00116
	RefuseTruck.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	SchoolBus.Diesel	0.01524	0.01630	0.01437	0.01051	0.01027
	SchoolBus.Gas	0.00000	0.00000	0.00000	0.00000	0.00000
	SingleLongHaul.Diesel	0.02666	0.02860	0.03018	0.02355	0.02206
	SingleLongHaul.Gas	0.00302	0.00163	0.00147	0.00250	0.00240
	SingleShortHaul.Diesel	0.41676	0.43507	0.42187	0.31261	0.29853
	SingleShortHaul.Gas	0.03521	0.02033	0.01977	0.03585	0.03664
	TransitBus.Diesel	0.00000	0.00000	0.00000	0.00000	0.00000
	TransitBus.Gas	0.00000	0.00000	0.00000	0.00000	0.00000

Figure 5.3

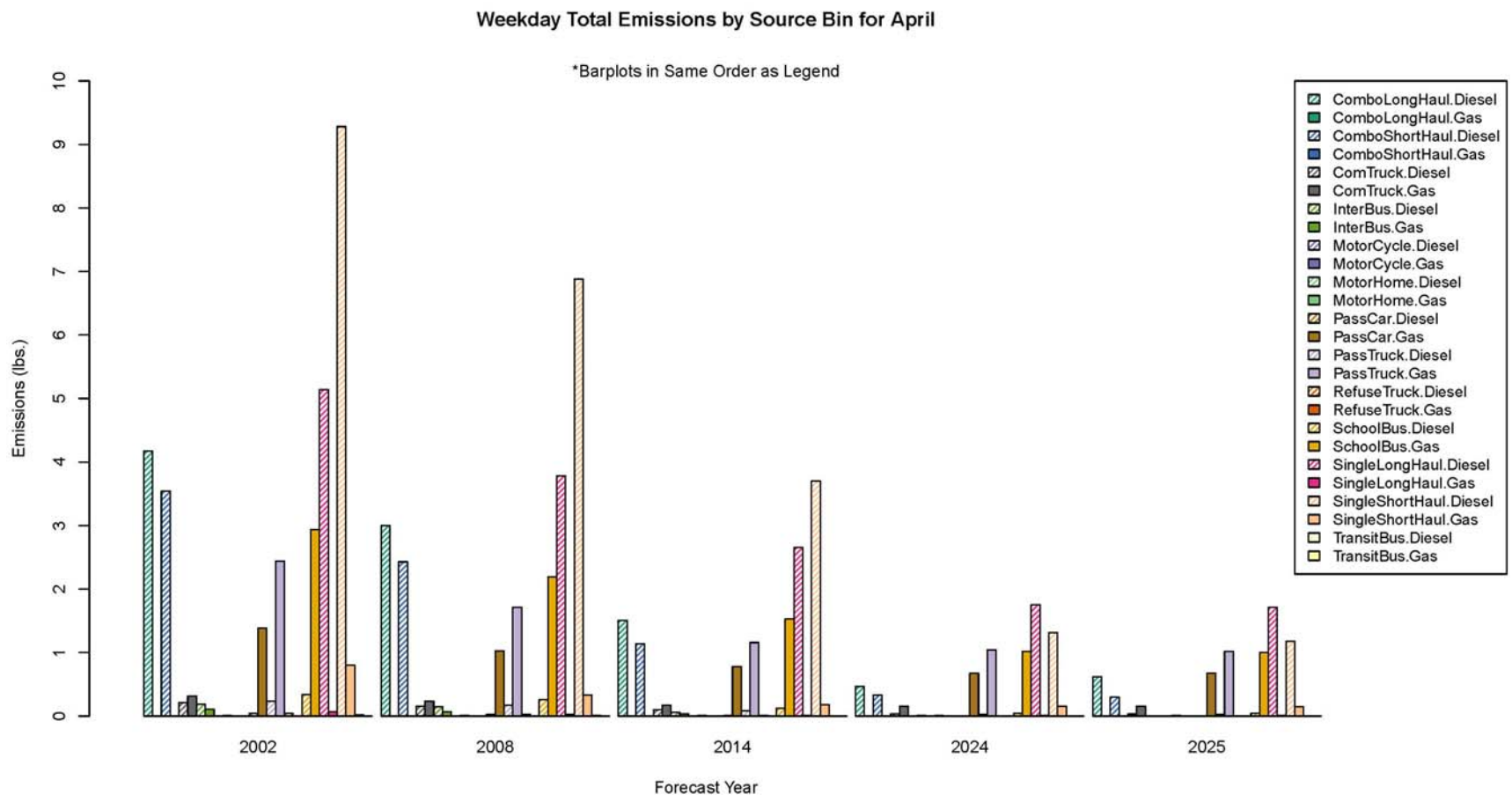
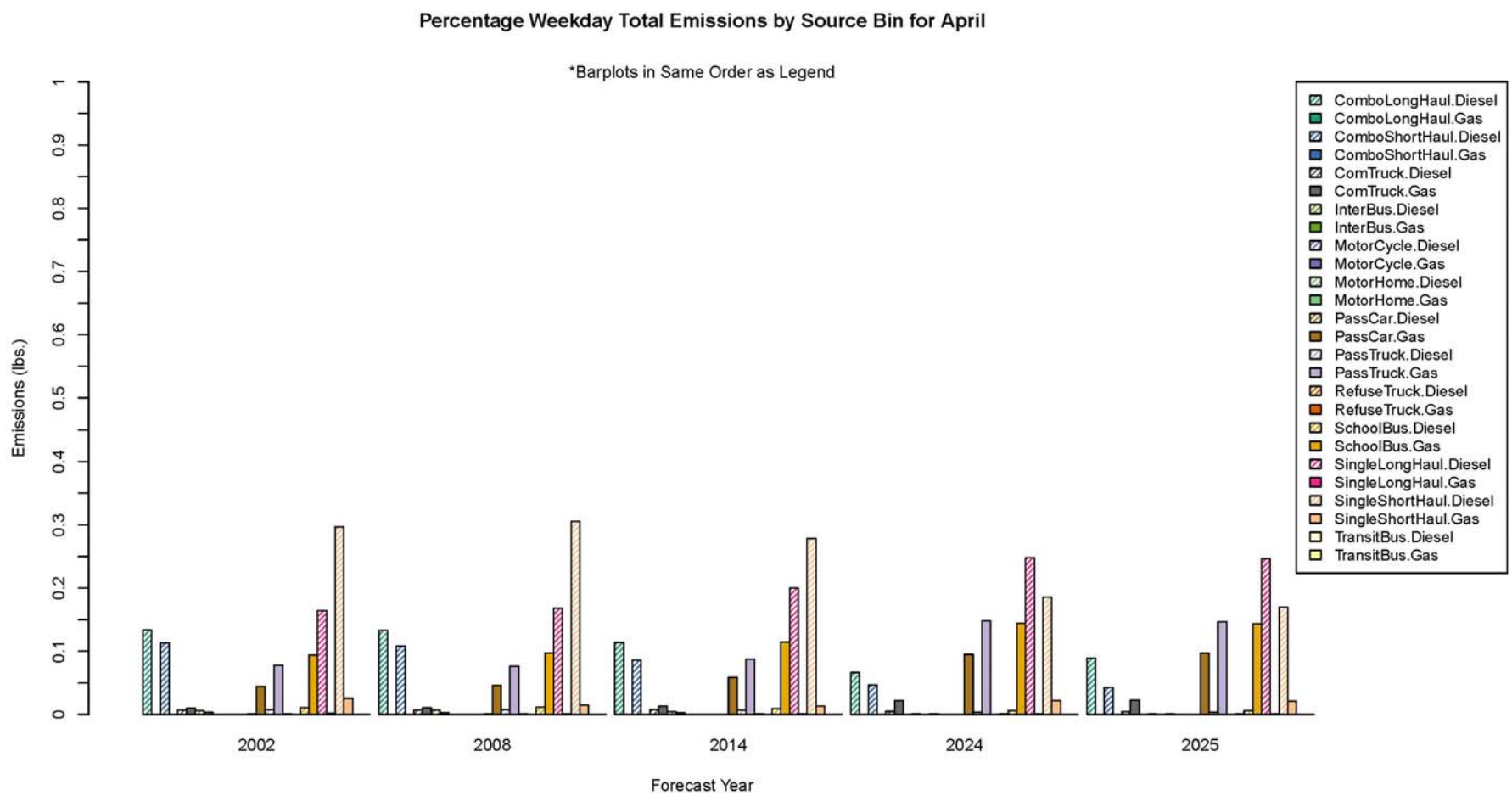

Weekday Total Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
5
6
7
8
9
10
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

Figure 5.4


Percentage Weekday Total Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

If the emission source bins are aggregated the results for weekday total emissions can be observed in table 5.4 and figure 5.5 below. Due to the heavy flow of diesel freight traffic diesel remains the largest emitter of PM2.5 into the future though its share does decrease even though its proportion of travel remains stable.

Figure 5.4

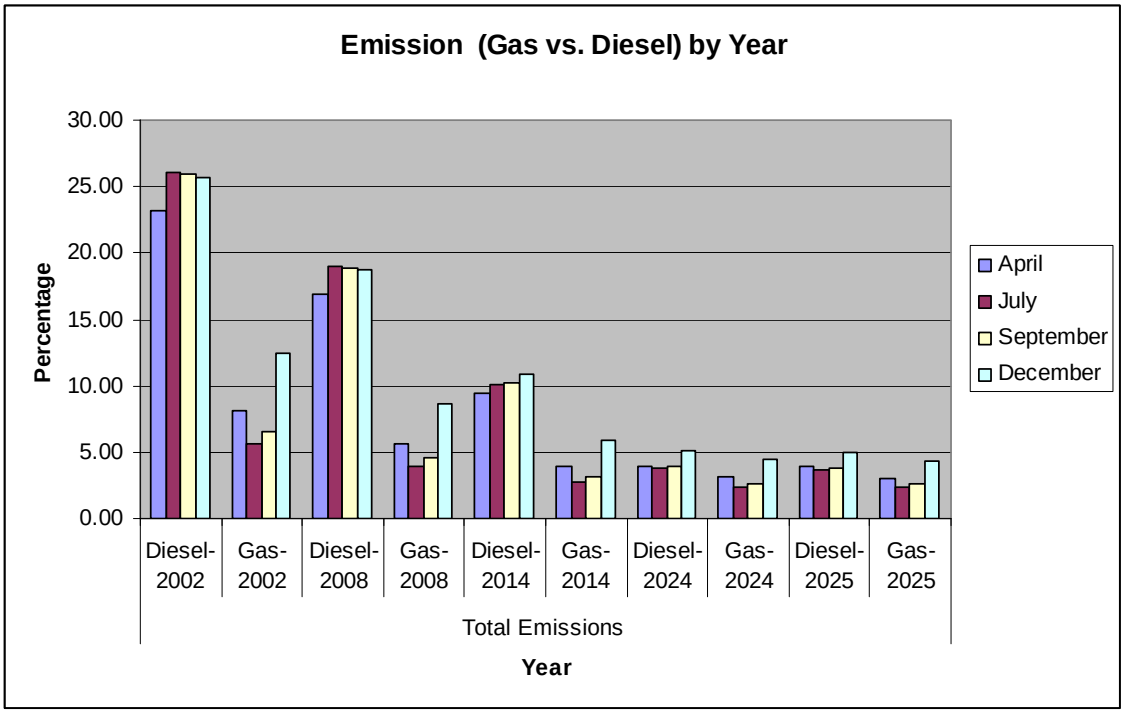
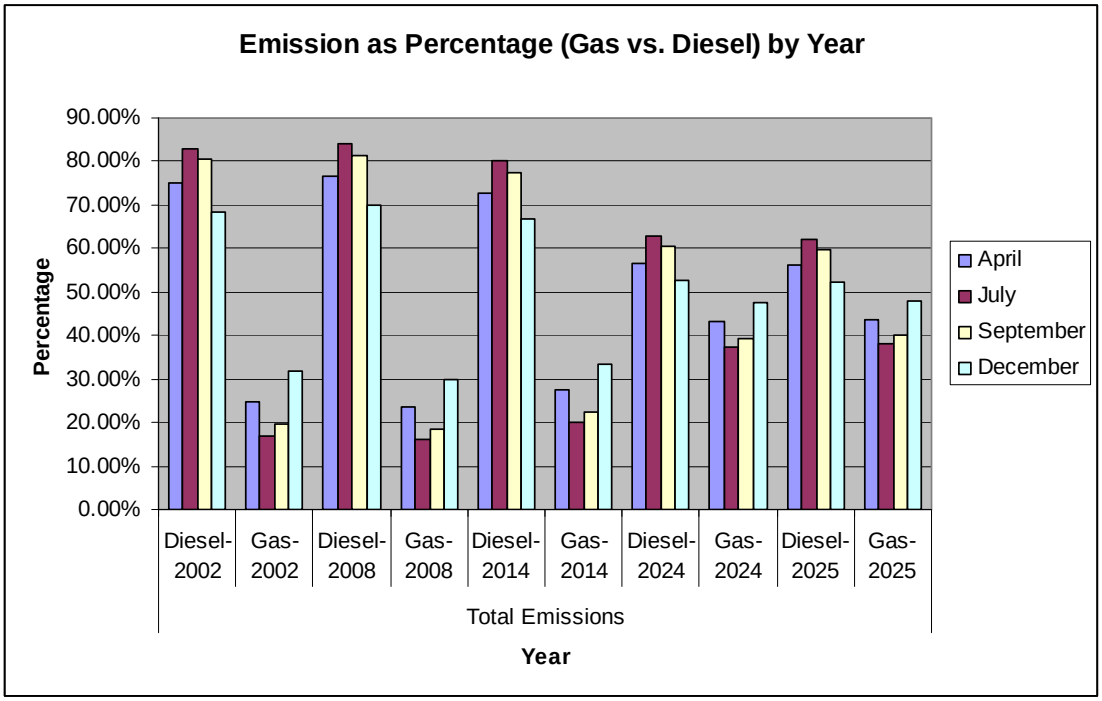


Figure 5.5



Sources

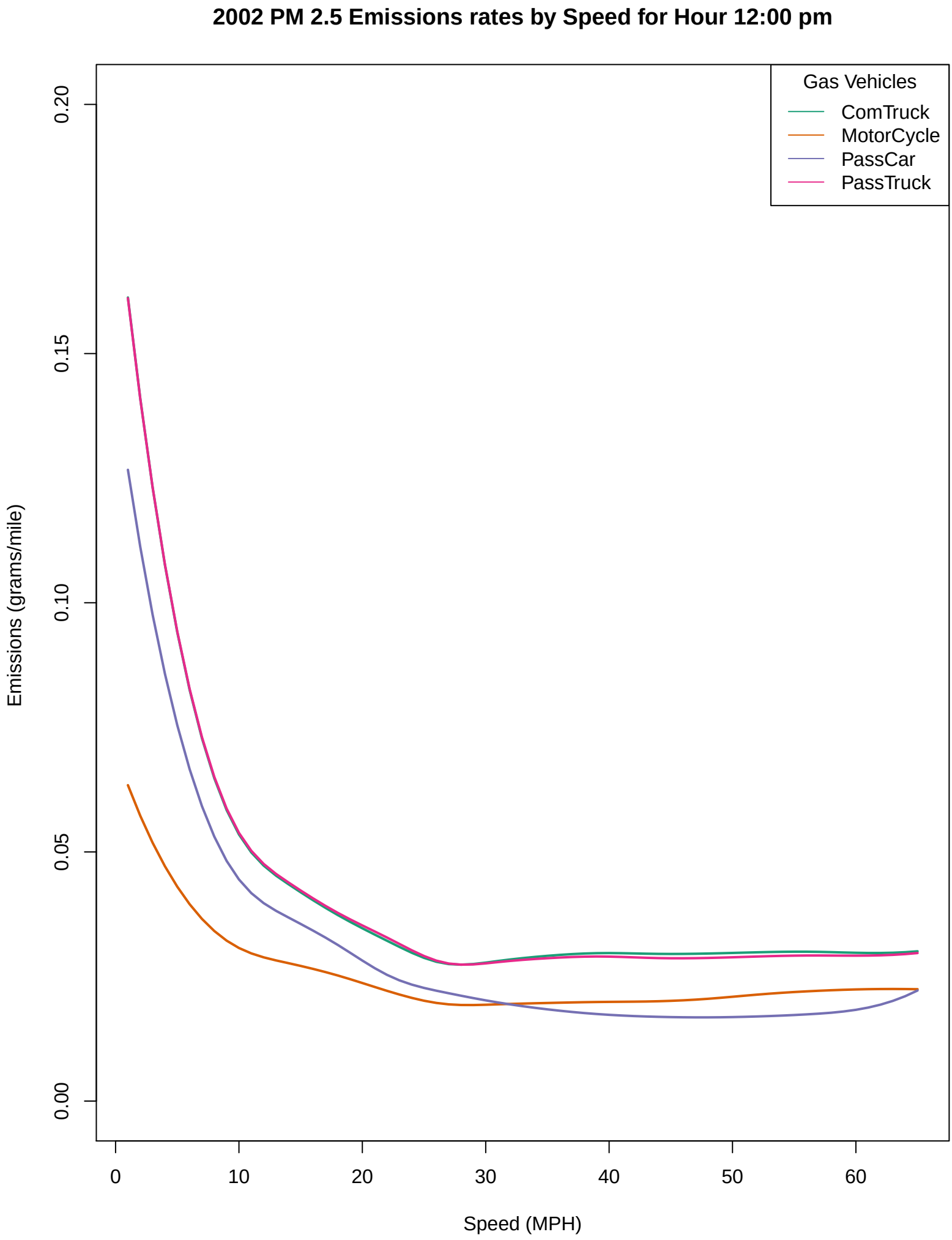
1. USEPA. Motor Vehicle Emission Simulator (MOVES) Publication EPA-420-B-10-036, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, 2010.

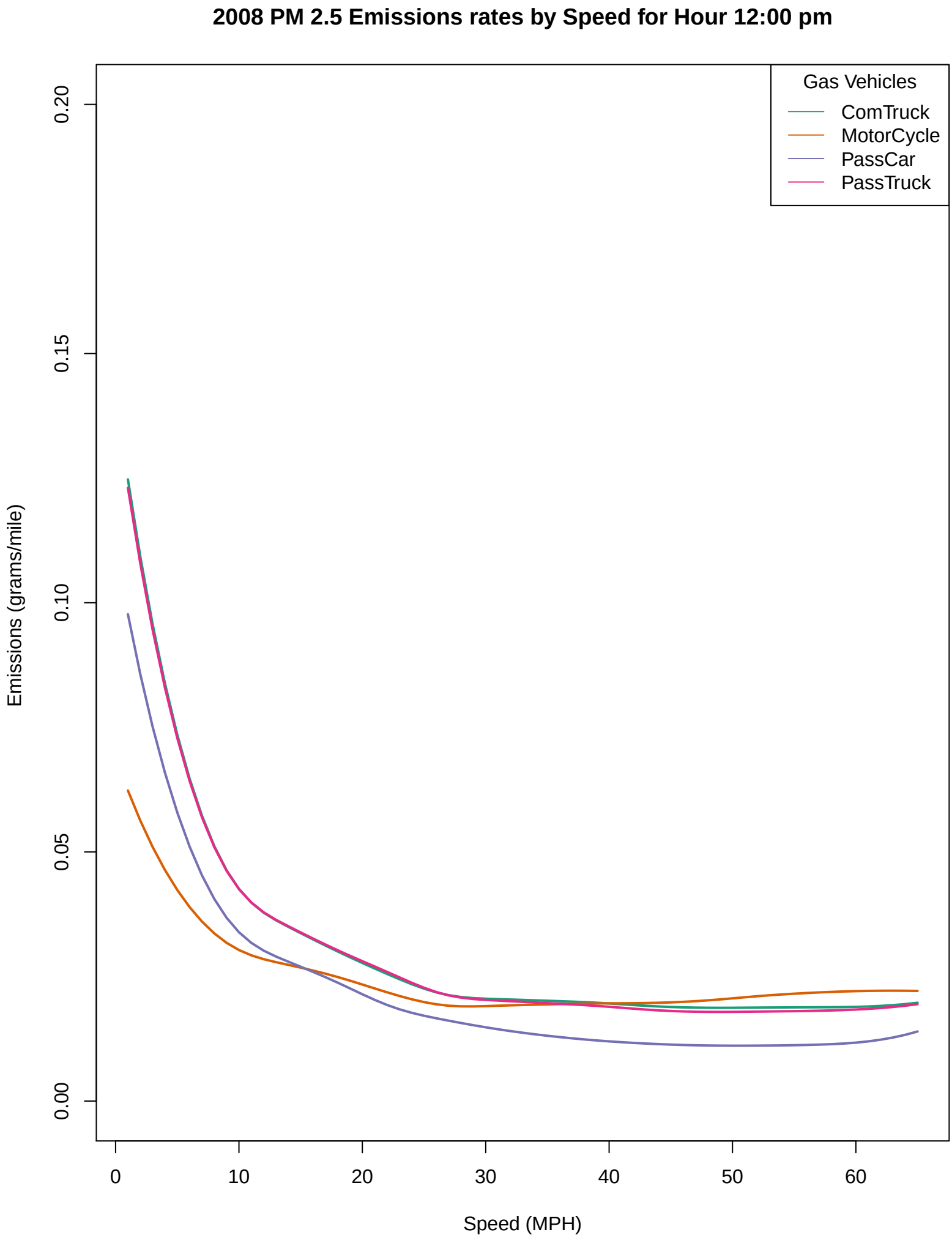
2. USEPA. *Draft Design and Implementation Plan for EPA's Multi-Scale Motor Vehicle and Equipment Emission System (MOVES).* Publication EPA420-P-02-006, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, 2002.

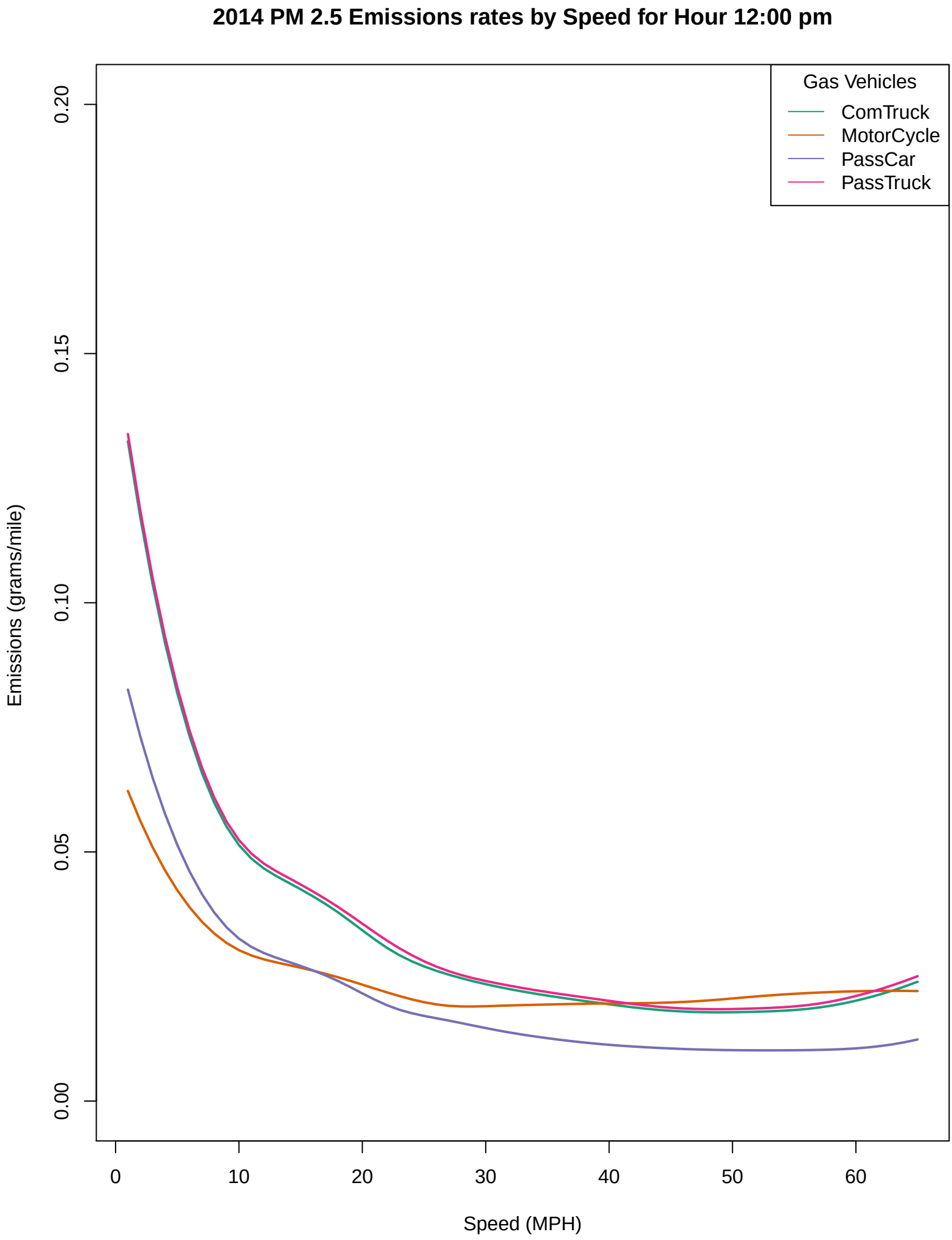
3. USEPA. *Motor Vehicle Emission Simulator Highway Vehicle Implementation (MOVES-HVI) Demonstration Version: Software Design and Reference Manual Draft*. Publication EPA420-P-07-001, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, 2007.

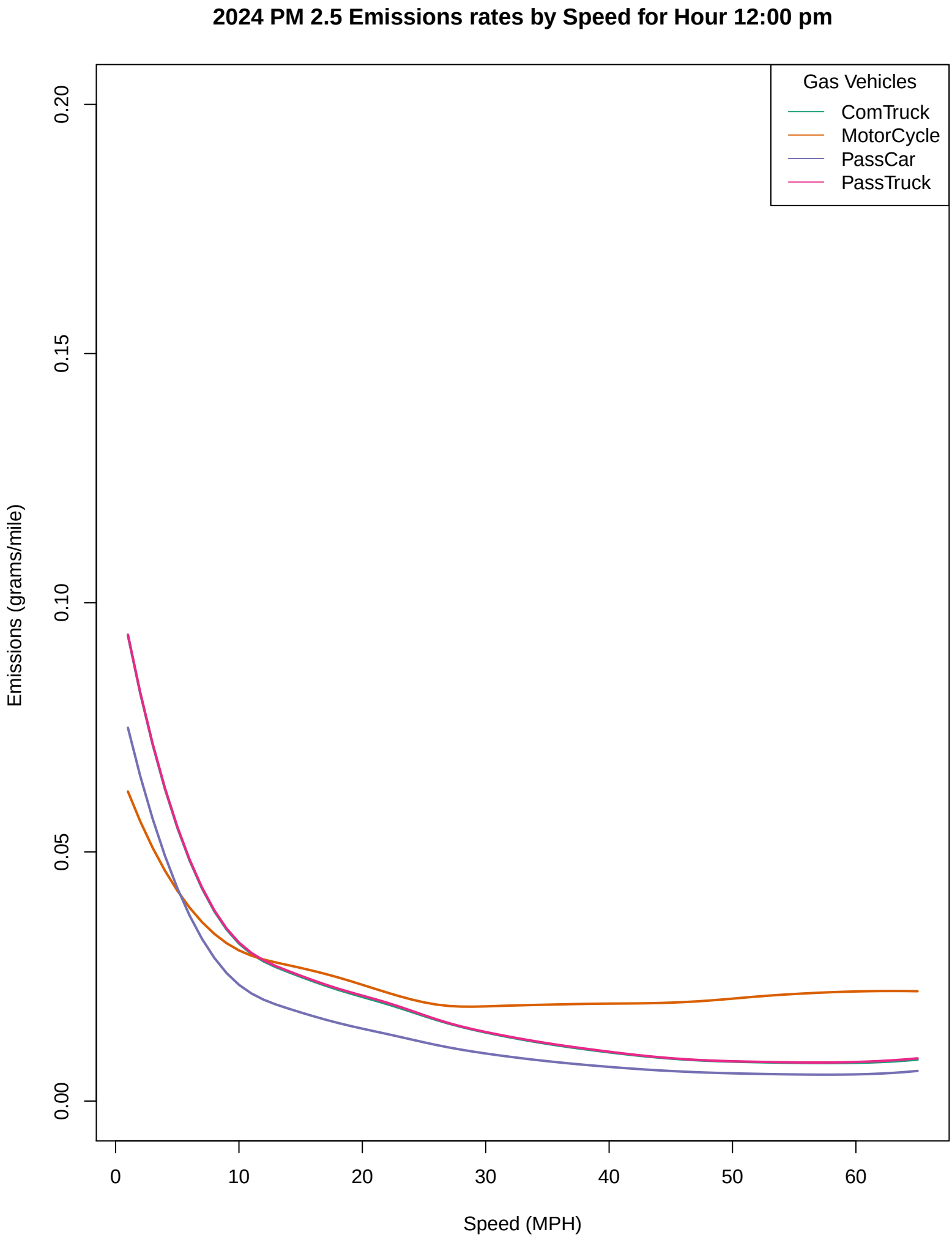
4. USEPA. Technical guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity. Publication EPA-420-B-10-023, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, 2010

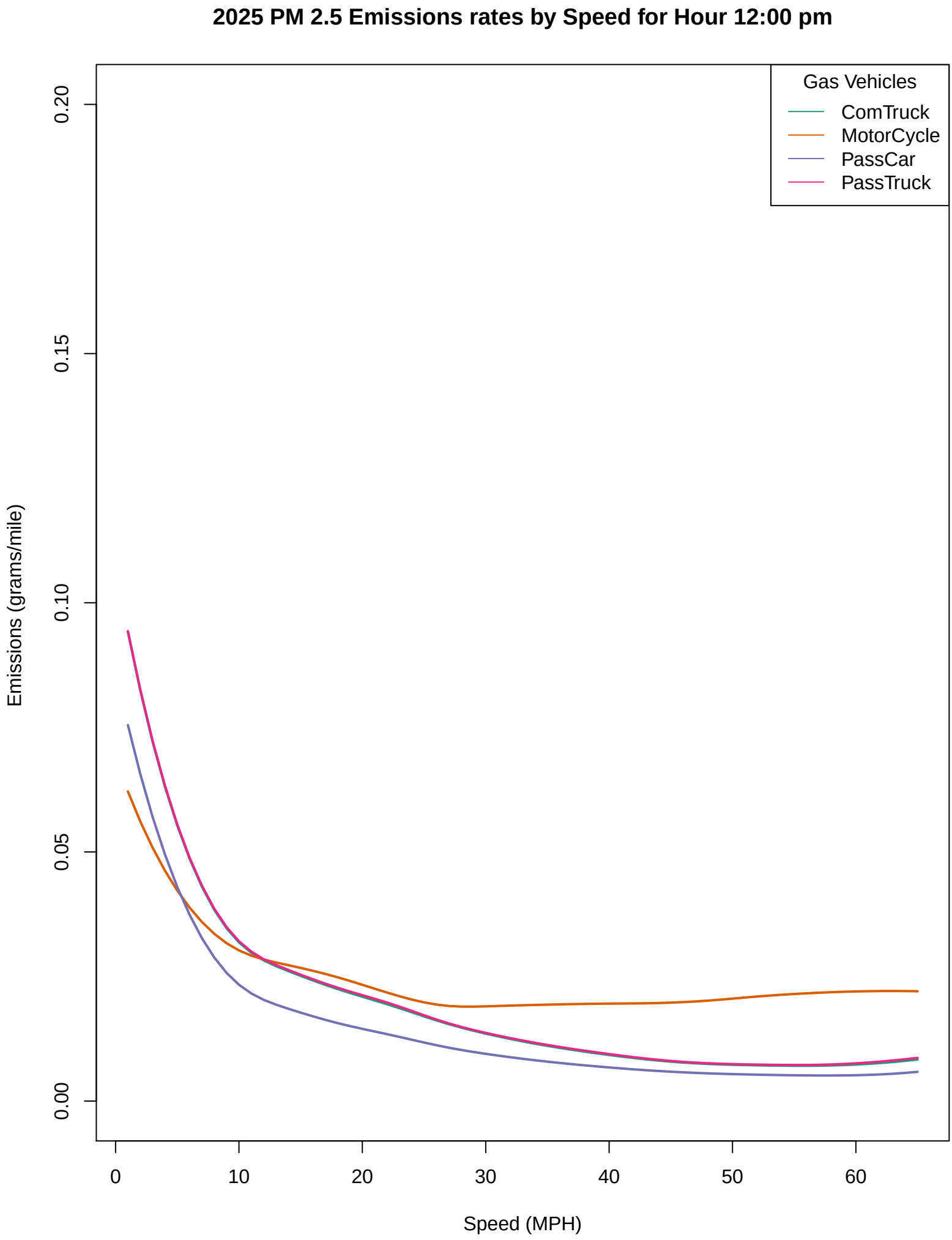
Appendix A
Emission Rate Curves

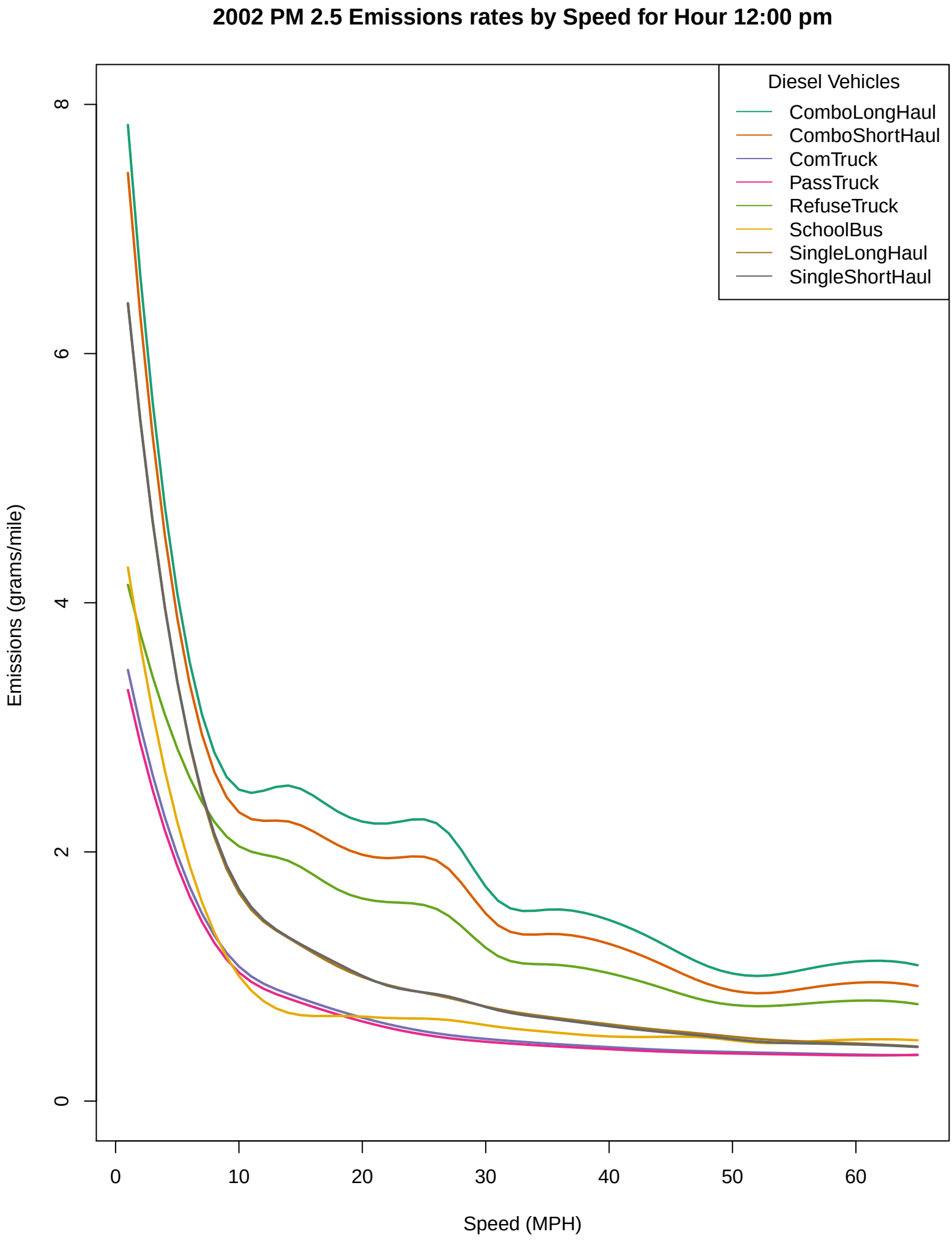

2002 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Gas Vehicles
ComTruck
MotorCycle
PassCar
PassTruck
Emissions (grams/mile)
0.00
0.05
0.10
0.15
0.20
0
10
20
30
40
50
60
Speed (MPH)

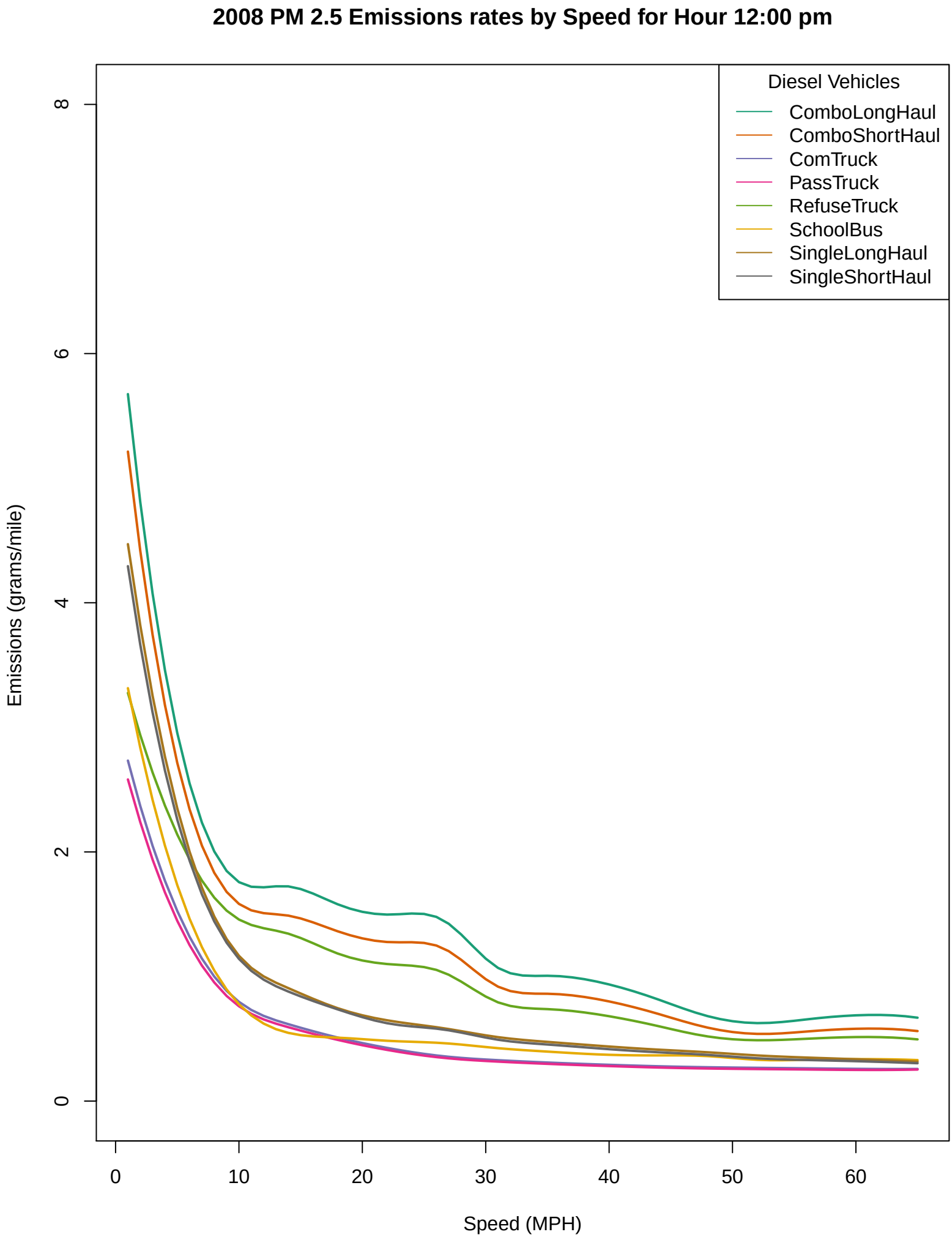

2008 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Gas Vehicles
ComTruck
MotorCycle
PassCar
PassTruck
Emissions (grams/mile)
0.00
0.05
0.10
0.15
0.20
0
10
20
30
40
50
60
Speed (MPH)

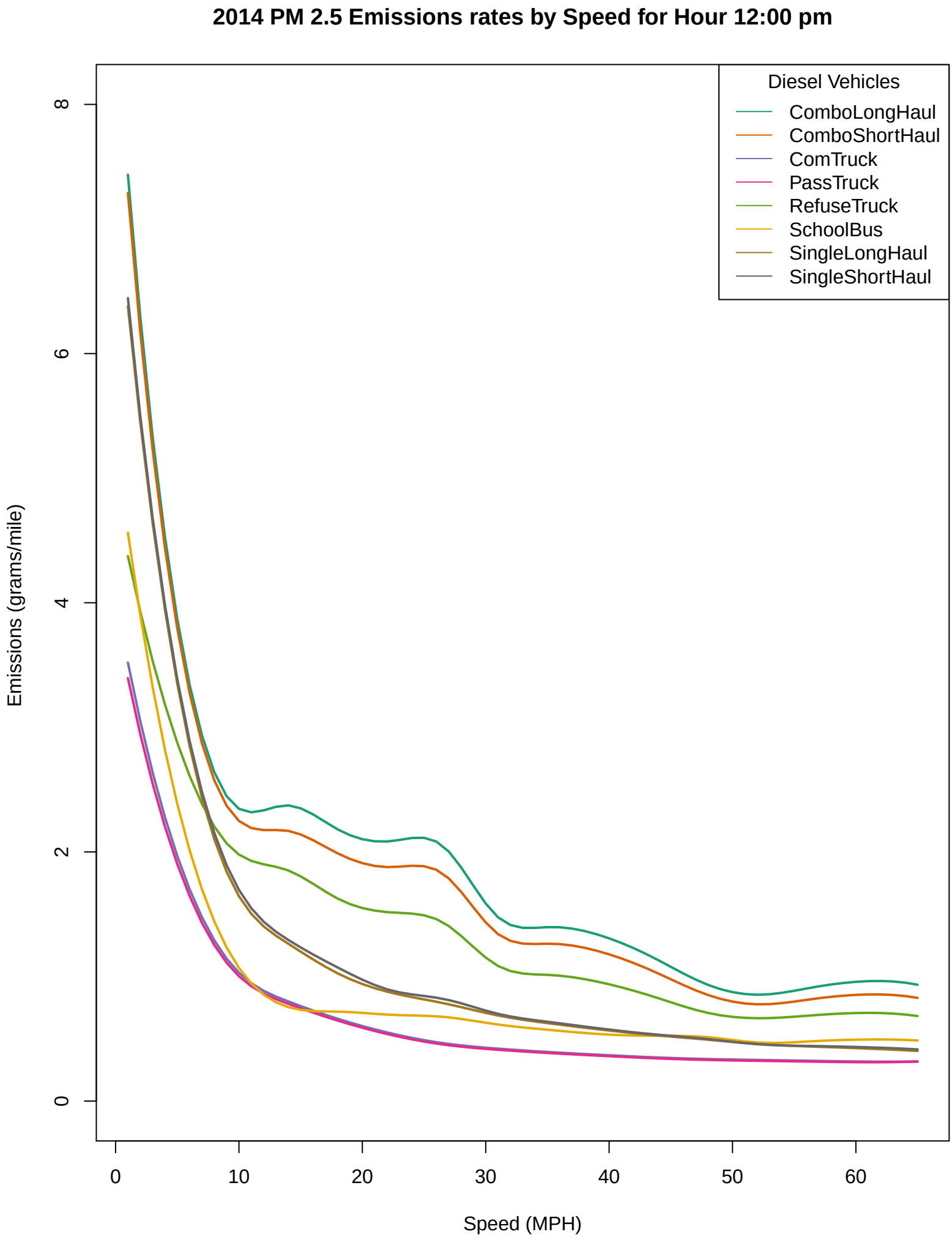

2014 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Gas Vehicles
ComTruck
MotorCycle
PassCar
PassTruck
Emissions (grams/mile)
0.00
0.05
0.10
0.15
0.20
0
10
20
30
40
50
60
Speed (MPH)

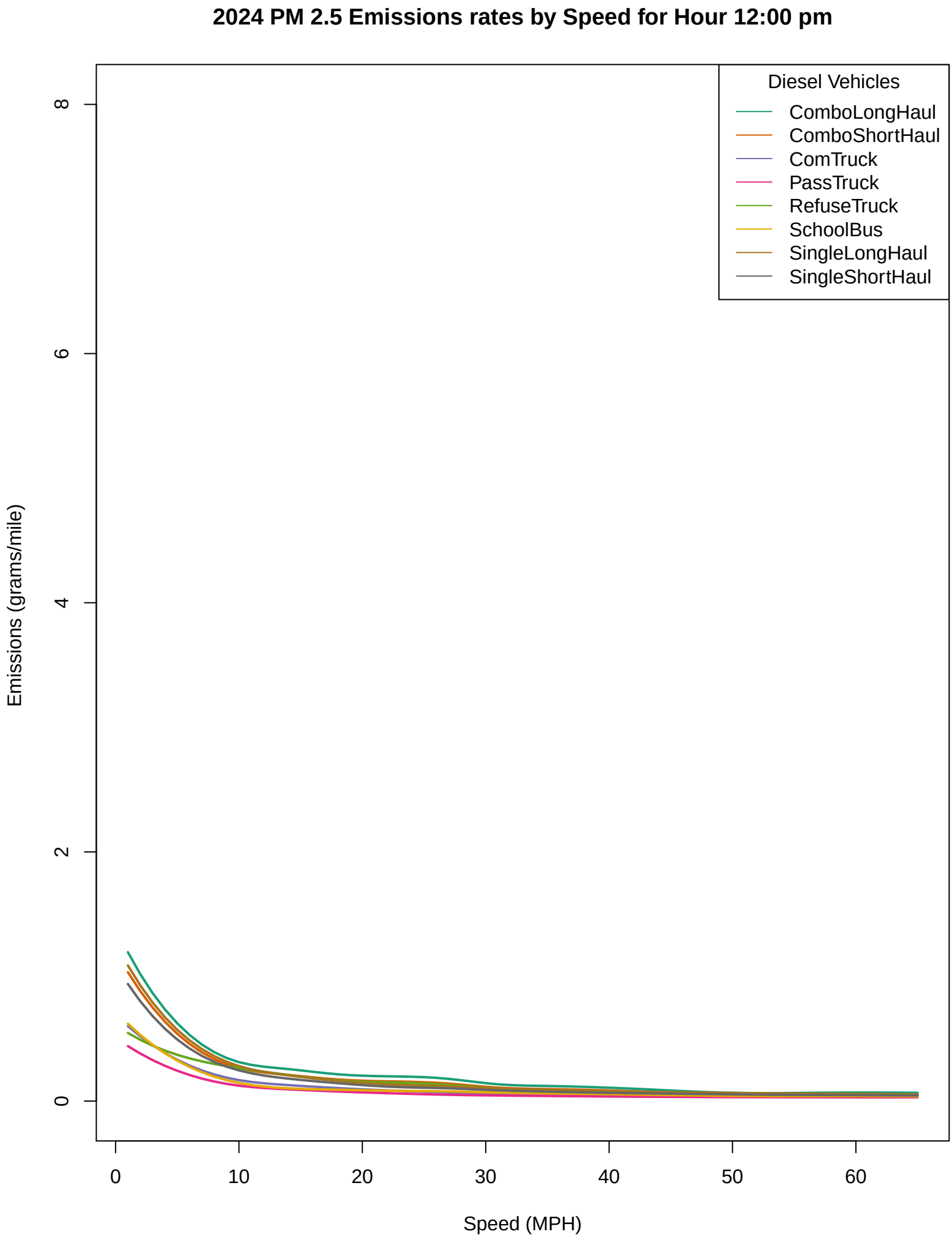

2024 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Gas Vehicles
ComTruck
MotorCycle
PassCar
PassTruck
Emissions (grams/mile)
0.00
0.05
0.10
0.15
0.20
0
10
20
30
40
50
60
Speed (MPH)

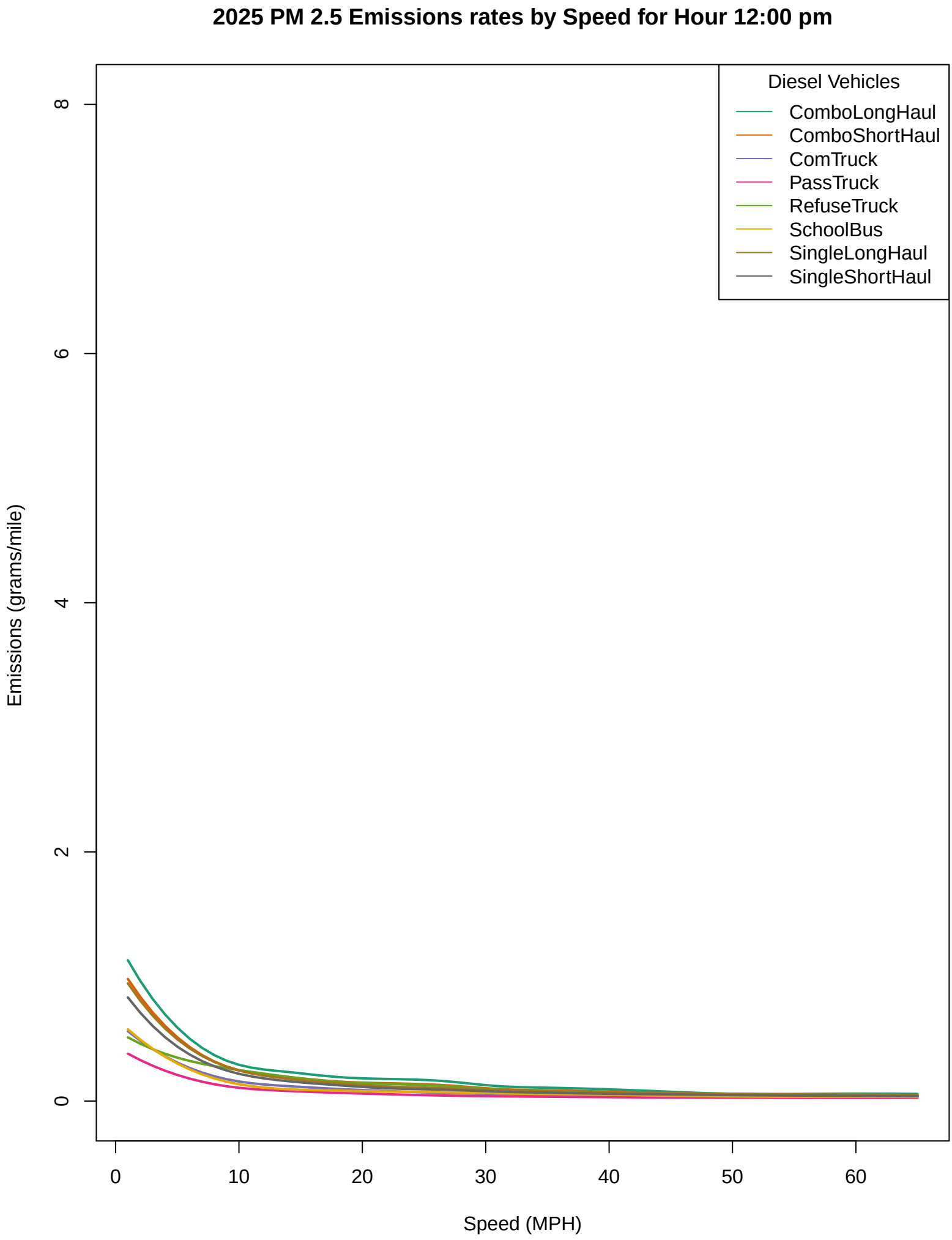

2025 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Gas Vehicles
ComTruck
MotorCycle
PassCar
PassTruck
Emissions (grams/mile)
0.00
0.05
0.10
0.15
0.20
0
10
20
30
40
50
60
Speed (MPH)


2002 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Diesel Vehicles
ComboLongHaul
ComboShortHaul
ComTruck
PassTruck
RefuseTruck
SchoolBus
SingleLongHaul
SingleShortHaul
Emissions (grams/mile)
0
2
4
6
8
0
10
20
30
40
50
60
Speed (MPH)


2008 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Diesel Vehicles
ComboLongHaul
ComboShortHaul
ComTruck
PassTruck
RefuseTruck
SchoolBus
SingleLongHaul
SingleShortHaul
Emissions (grams/mile)
0
2
4
6
8
0
10
20
30
40
50
60
Speed (MPH)


2014 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Diesel Vehicles
ComboLongHaul
ComboShortHaul
ComTruck
PassTruck
RefuseTruck
SchoolBus
SingleLongHaul
SingleShortHaul
Emissions (grams/mile)
0
2
4
6
8
0
10
20
30
40
50
60
Speed (MPH)


2024 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Diesel Vehicles
ComboLongHaul
ComboShortHaul
ComTruck
PassTruck
RefuseTruck
SchoolBus
SingleLongHaul
SingleShortHaul
Emissions (grams/mile)
0
2
4
6
8
0
10
20
30
40
50
60
Speed (MPH)


2025 PM 2.5 Emissions rates by Speed for Hour 12:00 pm
Diesel Vehicles
ComboLongHaul
ComboShortHaul
ComTruck
PassTruck
RefuseTruck
SchoolBus
SingleLongHaul
SingleShortHaul
Emissions (grams/mile)
0
2
4
6
8
0
10
20
30
40
50
60
Speed (MPH)

Appendix B
Vehicle Population

Year	MOVES Source Type	Population	Vehicle Description
2002	21	1487	Passenger Car
2002	31	1949	Passenger Truck
2002	32	10	Light Commercial Truck
2002	11	197	Motorcycle
2002	41	0	Intercity Bus
2002	42	0	Transit Bus
2002	43	5	School Bus
2002	51	5	Refuse Truck
2002	52	10	Single Unit Short Haul Truck
2002	53	10	Single Unit Long Haul truck
2002	54	0	Motor Home
2002	61	10	Combination Short Haul Truck
2002	62	10	Combination Long Haul Truck
2008	21	1634	Passenger Car
2008	31	2114	Passenger Truck
2008	32	10	Light Commercial Truck
2008	11	214	Motorcycle
2008	41	0	Intercity Bus
2008	42	0	Transit Bus
2008	43	5	School Bus
2008	51	5	Refuse Truck
2008	52	10	Single Unit Short Haul Truck
2008	53	10	Single Unit Long Haul truck
2008	54	0	Motor Home
2008	61	10	Combination Short Haul Truck
2008	62	10	Combination Long Haul Truck
2014	21	1886	Passenger Car
2014	31	2472	Passenger Truck
2014	32	12	Light Commercial Truck
2014	11	250	Motorcycle
2014	41	0	Intercity Bus
2014	42	0	Transit Bus
2014	43	6	School Bus
2014	51	6	Refuse Truck
2014	52	12	Single Unit Short Haul Truck
2014	53	12	Single Unit Long Haul truck
2014	54	0	Motor Home
2014	61	12	Combination Short Haul Truck
2014	62	12	Combination Long Haul Truck
2024	21	2096	Passenger Car
2024	31	2747	Passenger Truck
2024	32	13	Light Commercial Truck
2024	11	278	Motorcycle
2024	41	0	Intercity Bus

2024	42	0	Transit Bus
2024	43	6	School Bus
2024	51	6	Refuse Truck
2024	52	13	Single Unit Short Haul Truck
2024	53	13	Single Unit Long Haul truck
2024	54	0	Motor Home
2024	61	13	Combination Short Haul Truck
2024	62	13	Combination Long Haul Truck
2025	21	2117	Passenger Car
2025	31	2775	Passenger Truck
2025	32	13	Light Commercial Truck
2025	11	281	Motorcycle
2025	41	0	Intercity Bus
2025	42	0	Transit Bus
2025	43	6	School Bus
2025	51	6	Refuse Truck
2025	52	13	Single Unit Short Haul Truck
2025	53	13	Single Unit Long Haul truck
2025	54	0	Motor Home
2025	61	13	Combination Short Haul Truck
2025	62	13	Combination Long Haul Truck

Appendix C
Household and Employment Assumptions

2025 Oakridge Household and Employment TAZ Allocation Assumptions

TO: Clair Van Bloom, LCOG
Bud Reiff, LCOG

COPIES: Lisa Nell, ODOT
Kevin Urban, City of Oakridge
Frank Angelo, Angelo Eaton & Associates
Kathi Wiederhold, LCOG

FROM: Steve Perone

DATE: June 11, 2004 (revised)

The purpose of this memorandum is to summarize recommendations for TAZ allocation of 20-year household and employment growth in the cities of Oakridge and Westfir. These data will be used as inputs in LCOG's 2025 travel demand forecasts for the build and no-build alternative concepts, as part of the Oakridge Oregon 58 Refinement Plan. The recommendations outlined are based on the population, housing unit and employment forecasts prepared by LCOG and summarized below.

2025 Housing Unit Growth

The following table summarizes existing and future forecast population and housing units for Oakridge and Westfir.

2025 HOUSING AND POPULATION ASSUMPTIONS

Oakridge Population and Housing Units	
2025 Population based on preliminary coordinated population projections	4,000
Average Household Size as assumed in TSP	2.28
Number of 2025 Households	1,754
Assume 5% Vacancy Rate	92
Total 2025 Housing Units	1,846
Total 2002 Housing Units	1,778
2002-2025 Future Housing Units	68
Westfir Population and Housing Units	
2025 Population based on preliminary coordinated population projections	410

2025 HOUSING AND POPULATION ASSUMPTIONS

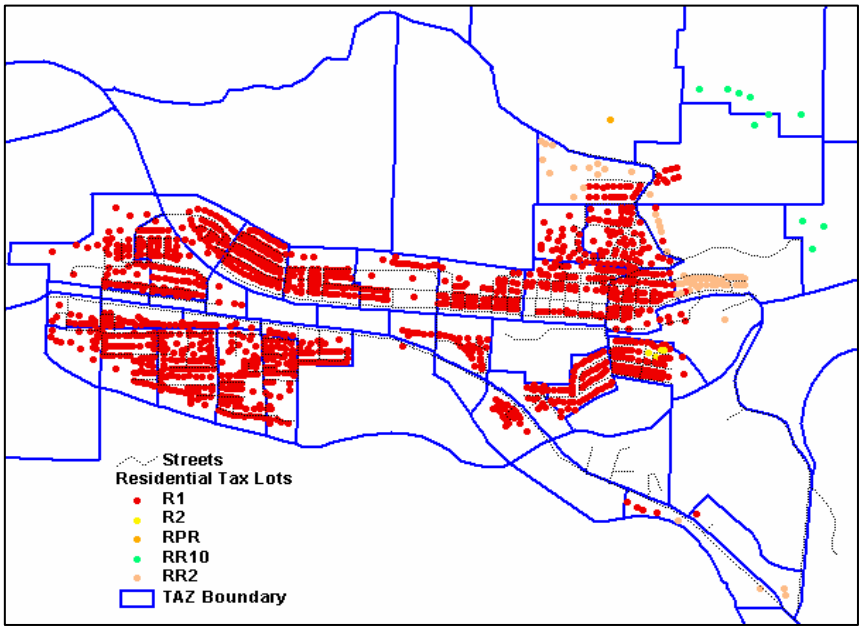
Average Household Size	2.5
Number of 2025 Households	164
Assume 5% Vacancy Rate	9
Total 2025 Housing Units	173
Total 2002 Housing Units	131
2002-2025 Future Housing Units	42

The forecast projects 68 additional housing units in Oakridge and 42 in Westfir in the year 2025, for a total increase of 110 housing units.

2025 Oakridge Housing Unit TAZ Allocation

The following methods and associated steps were utilized to prepare 2025 housing unit estimates by TAZ in the City of Oakridge. The future housing unit estimates will be used to estimate total households by TAZ for travel demand modeling based on average vacancy rates and household size.

1). LCOG's 2002 Regional Land Information Database (RLID) housing unit estimates were compared by TAZ with the number of residential tax lots[1]. Tax lots by TAZ were calculated using the centroid of the tax lot as illustrated in the following figure:



Residential Tax Lots by TAZ

[1] LCOG's Geographic Information System tax lot database was used for this purpose.

2). Using the delta derived in step one (Tax lots - HH Units), all TAZ's with a delta greater than or equal to 10 were selected. This step identifies TAZ's with undeveloped or underdeveloped residential parcels that may see residential growth in the forecasting period. This resulted in a selection of 10 TAZ as follows:

OAKRIDE TRANSPORATION ANALYSIS ZONES IDENTIFIED FOR HOUSEHOLD GROWTH

TAZ	2002 Total RLID Household Units	Total Number of Tax Lots	DELTA	DELTA %
20	1	11	10	6%
22	25	33	10	6%
21	21	45	27	16%
24	2	25	23	14%
23	49	62	16	9%
53	74	84	20	12%
39	63	79	22	13%
27	74	79	13	8%
62	58	63	12	7%
61	92	98	16	9%
TOTAL	459	579	169	100%

In addition to the TAZ's identified above, TAZ id #54 was identified as a candidate for future residential growth based on the number of large subdividable parcels. The allocation assumes that TAZ 54 will receive approximately 9 percent or 6 of the future forecasted housing units.

3). Assigned forecasted future housing units to each TAZ in the group based on the delta percent of the total. The allocation was performed after manually allocating growth to TAZ 54 as described in step 2. The following table presents the *additional* new housing units by TAZ for the year 2025:

OAKRIDE TRANSPORATION ANALYSIS HOUSING UNIT GROWTH

TAZ	DELTA	% of total	New 2025 Housing Units
20	10	6%	3[2]
22	10	6%	4
21	27	16%	10
24	23	14%	9
23	16	9%	6
53	20	12%	7
39	22	13%	8
27	13	8%	5
62	12	7%	4
61	16	9%	6
Subtotal	169	100%	62
54	-	-	6
Total	-	-	**68**

2025 Westfir Housing Unit TAZ Allocation

Forecast 2025 housing unit growth in Westfir is assumed and allocated in proportion to the 2002 RLID estimate. The following table summarizes 2025 Westfir housing unit assumptions:

WESTFIR TRANSPORATION ANALYSIS HOUSING UNIT GROWTH

	Housing Units		
TAZ	2002	**New 2025**	2025 Total
66	45	15	60
67	79	27	106
Total	124[3]	42	166

[2] Rounded down to maintain forecast year control total

[3] Excludes small portion of Westfir in TAZ 50 (assume that is the difference in total housing units 131 vs. 124)

WESTFIR TRANSPORATION ANALYSIS HOUSING UNIT GROWTH

	Housing Units

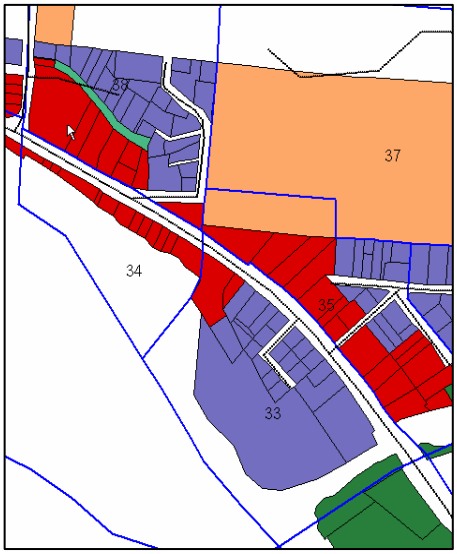
2025 Employment

The majority of employment growth in the City of Oakridge is assumed to occur as part of the development of the Oakridge Industrial Park. The following table summarizes existing and future forecast employment and associated assumptions:

2025 EMPLOYMENT PROJECTION AND ASSUMPTIONS

Oakridge Employment	
2002 Estimated Covered Employment	710
Annual Average Population Growth Rate 2003 to 2025	0.23%
TSP Assumption 3 - 2025 Non-manufacturing employment will grow consistent with population growth.	749
2002 - 2025 Future Non-manufacturing Employment Growth	39
TSP Assumption 2 - Manufacturing will grow by 350 employees	350
2002 - 2025 Total Future Employment Growth	389
Westfir Employment	
2002 Estimated Covered Employment	14
2025 Total Future Employment - No Change	14

All of the manufacturing employment increase will be assigned to the Oakridge Industrial Park, TAZ number 14. Non-manufacturing employment growth is assumed to occur along Oregon 58 east of Crestview in TAZ's 33-35 and 38, as displayed in the figure below:



Oakridge TAZ's Identified for Non-Manufacturing Employment Growth

The following table presents employment growth by TAZ:

OAKRIDGE TAZ EMPLOYMENT GROWTH BY TAZ

TAZ	2025 Employment Growth
33	9
34	10
35	10
38	10
Total	39

That ratio between retail and service employment will be assumed consistent with existing proportions.

Summary

The assumptions outlined above will provide the project team the ability to analyze travel demand impacts that include modest population growth, focused commercial enhancements along Highway 58 in Oakridge and successful economic development

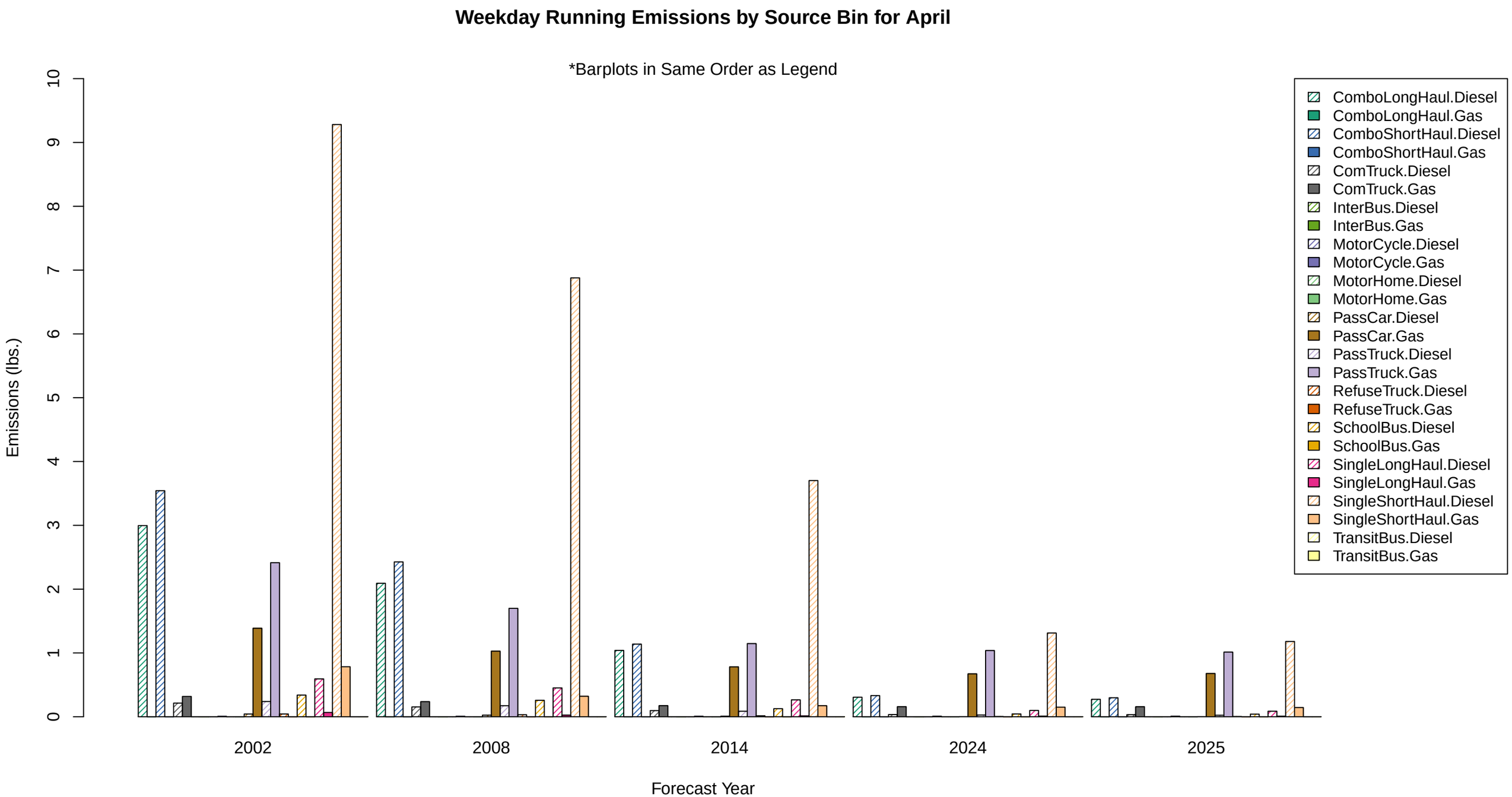
associated with development of the industrial park. The assumptions outlined above should be used to prepare the future year TAZ based socioeconomic inputs for to support travel demand forecasting for development of the refinement plan.

Please contact me directly if you have any questions or concerns about assumptions detailed in this memorandum.

associated with development of the industrial park. The assumptions outlined above should be used to prepare the future year TAZ based socioeconomic inputs for to support travel demand forecasting for development of the refinement plan.

Please contact me directly if you have any questions or concerns about assumptions detailed in this memorandum.

Appendix D
Emissions by Source Bin (& %)


Weekday Running Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
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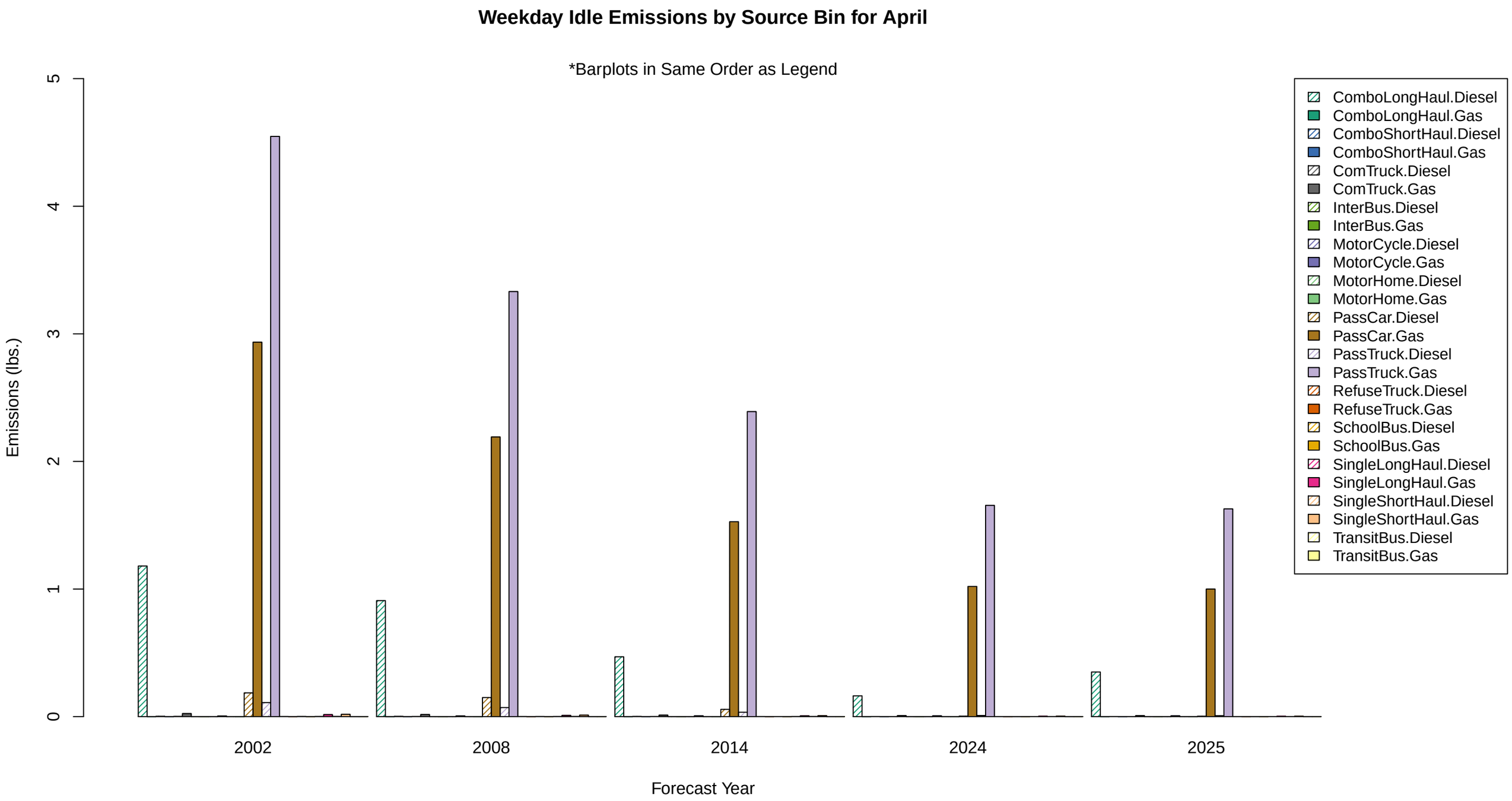
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekday Idle Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
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2002
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2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
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MotorHome.Diesel
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SingleShortHaul.Gas
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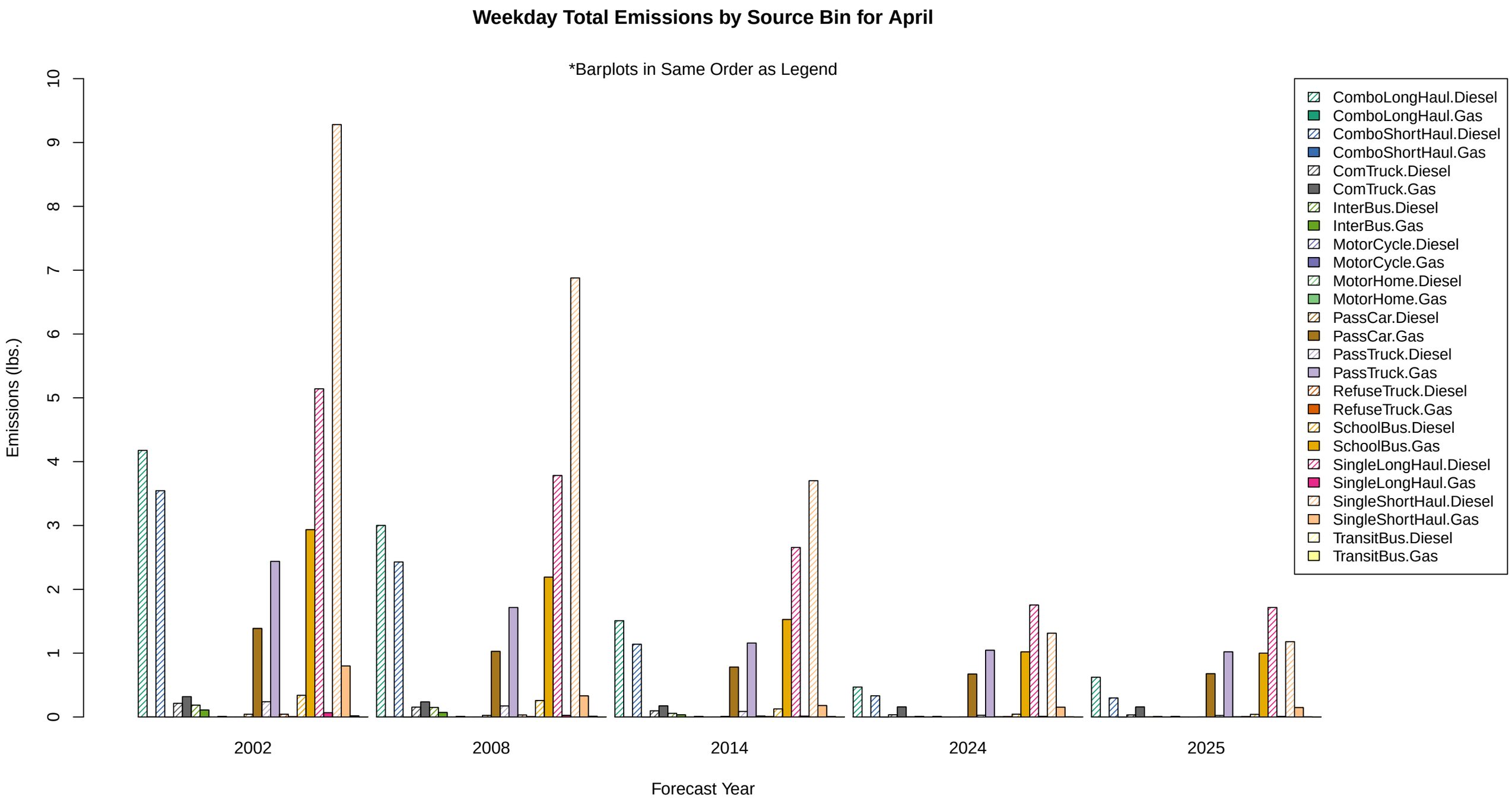
Weekday Total Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
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RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
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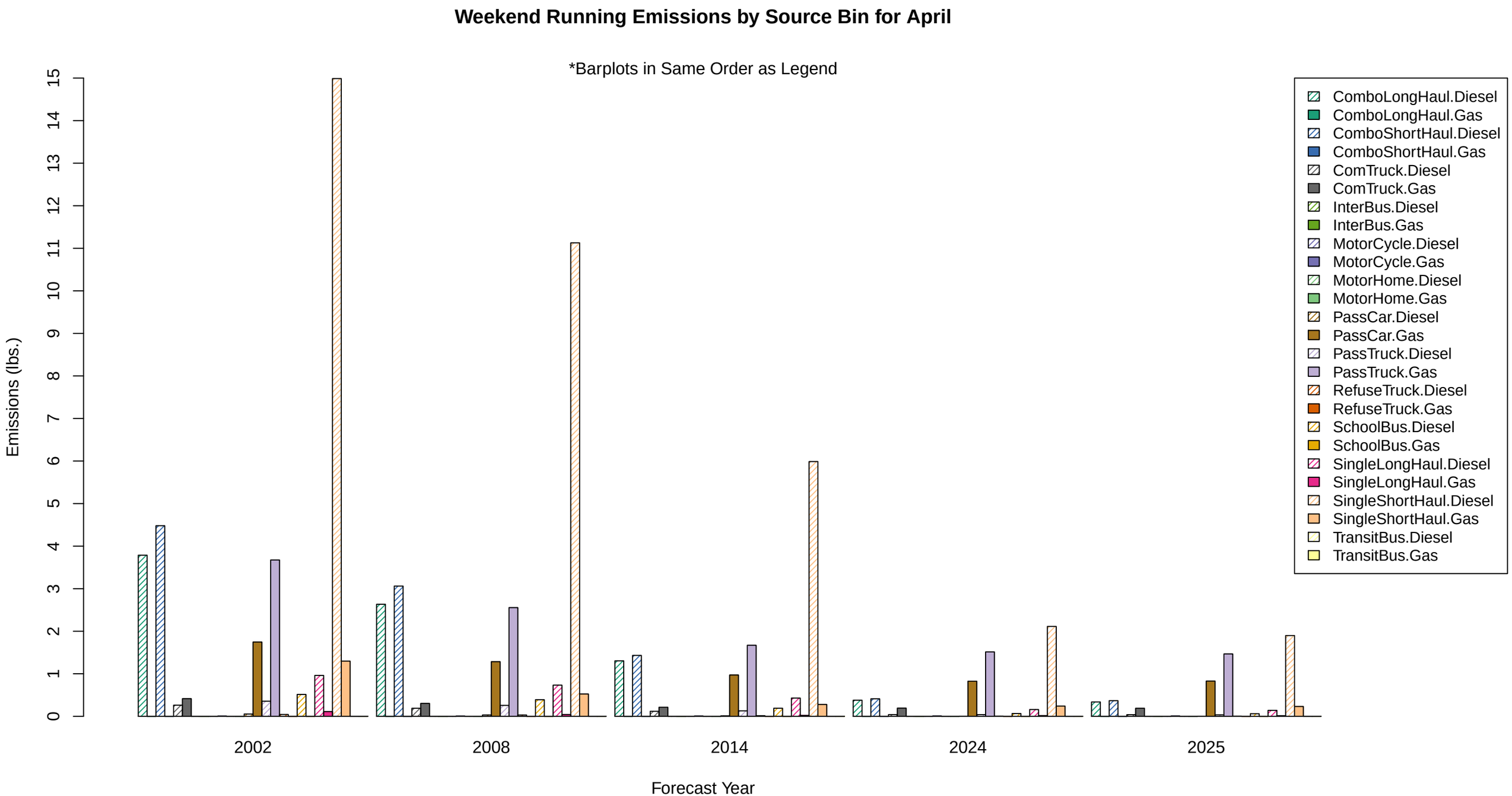
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekend Running Emissions by Source Bin for April
*Barplots in Same Order as Legend
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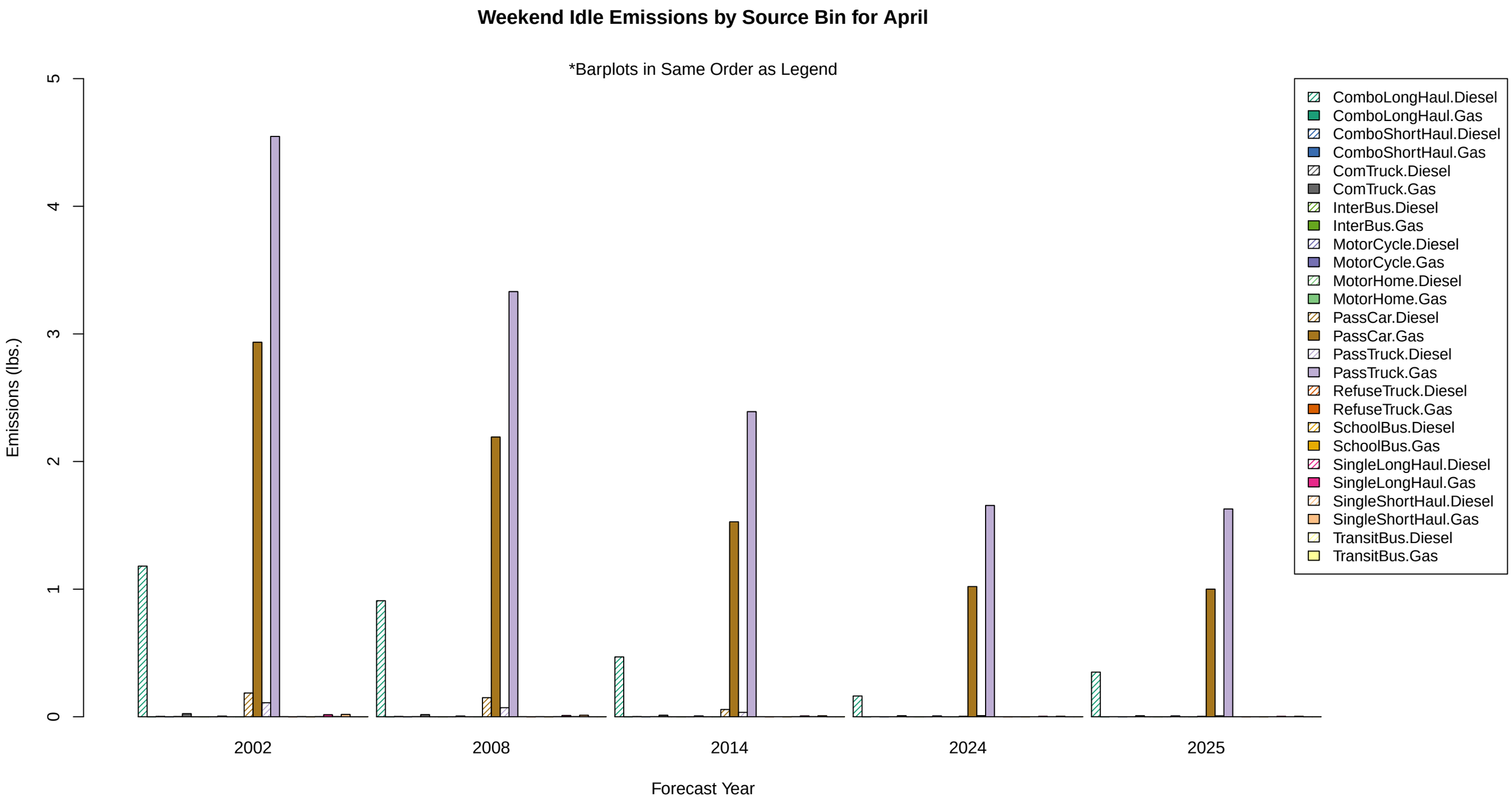
TransitBus.Gas


Weekend Idle Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
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SingleShortHaul.Gas
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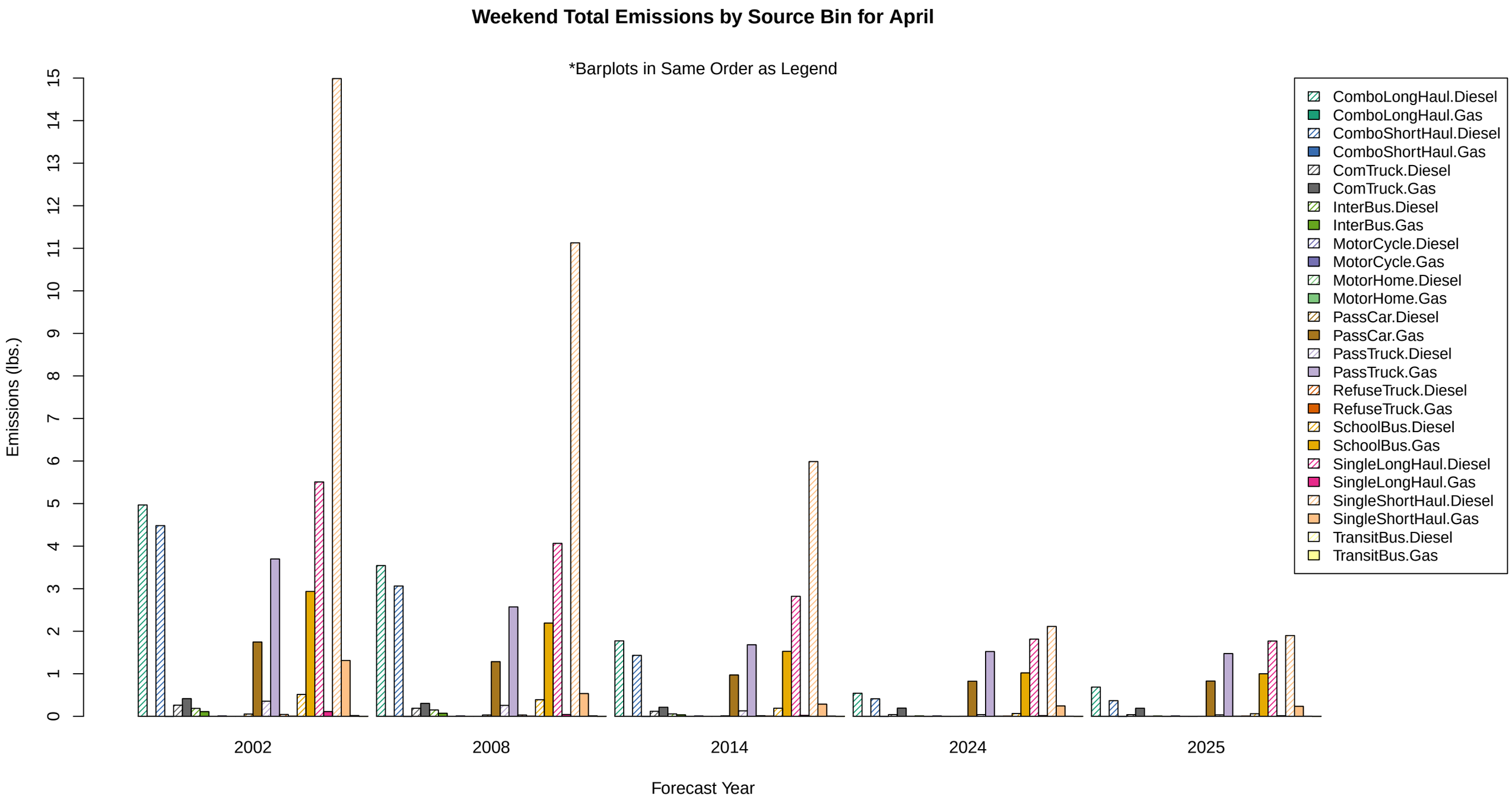
TransitBus.Gas


Weekend Total Emissions by Source Bin for April
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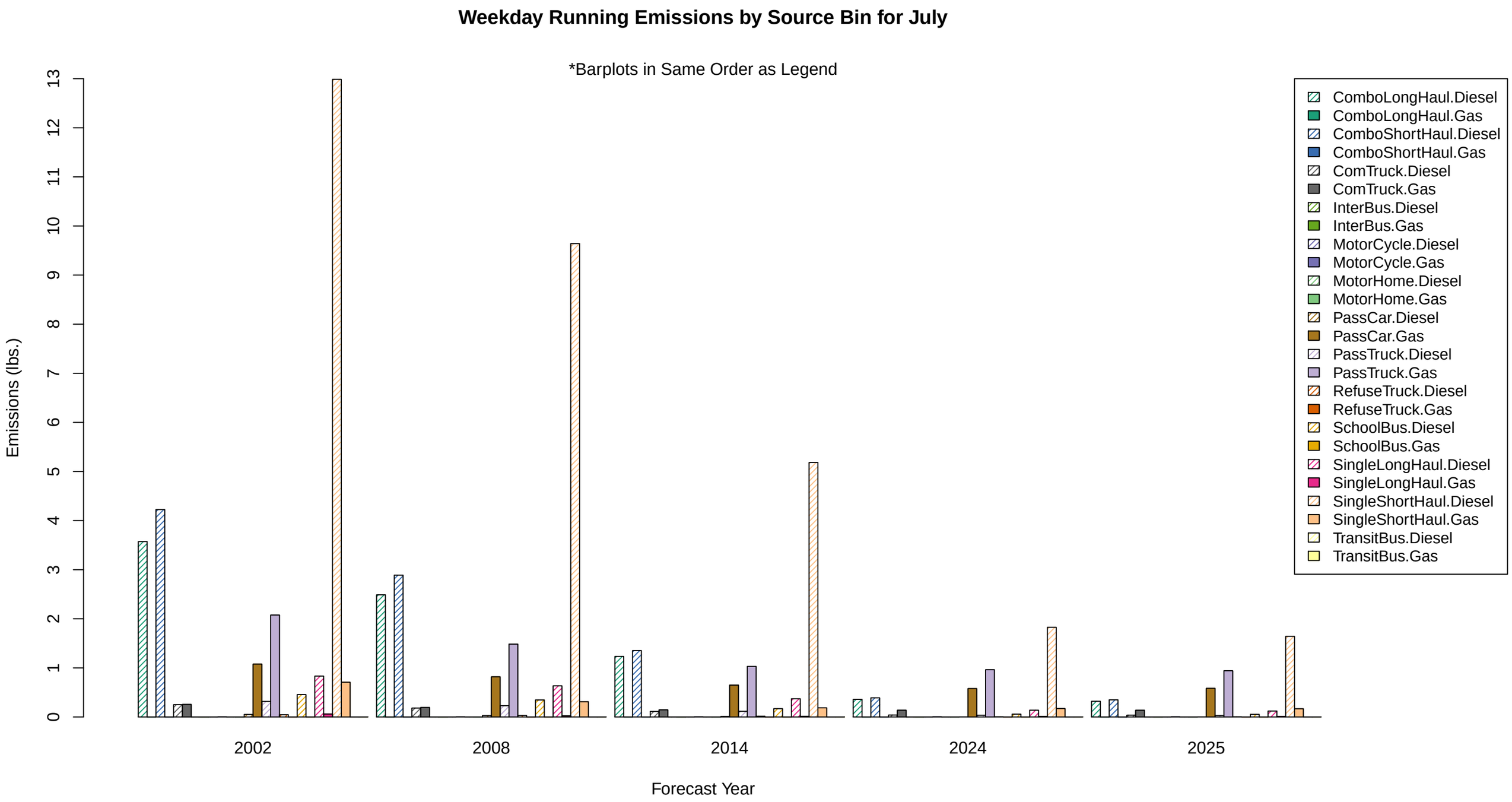
Weekday Running Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
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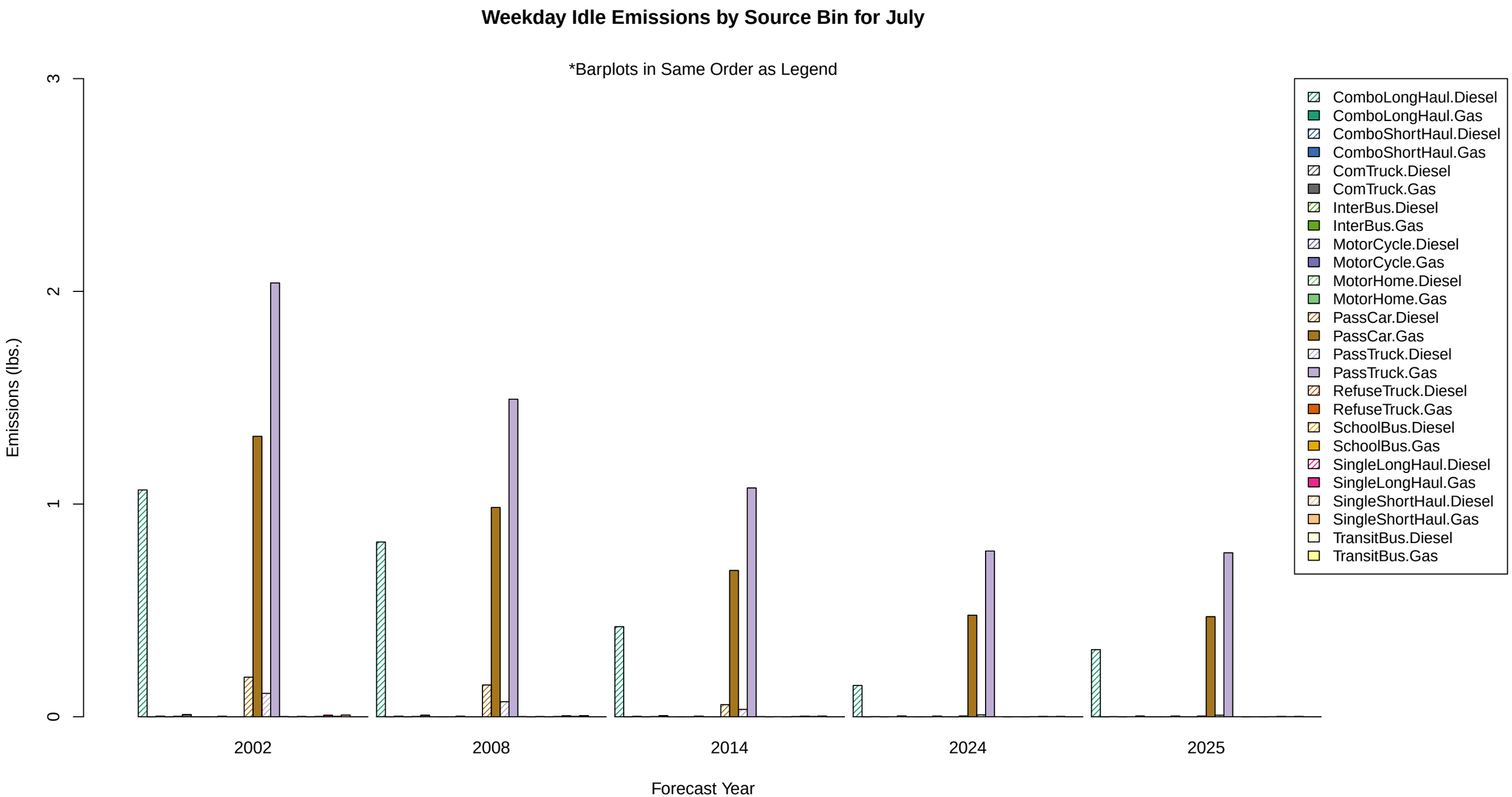
Weekday Idle Emissions by Source Bin for July
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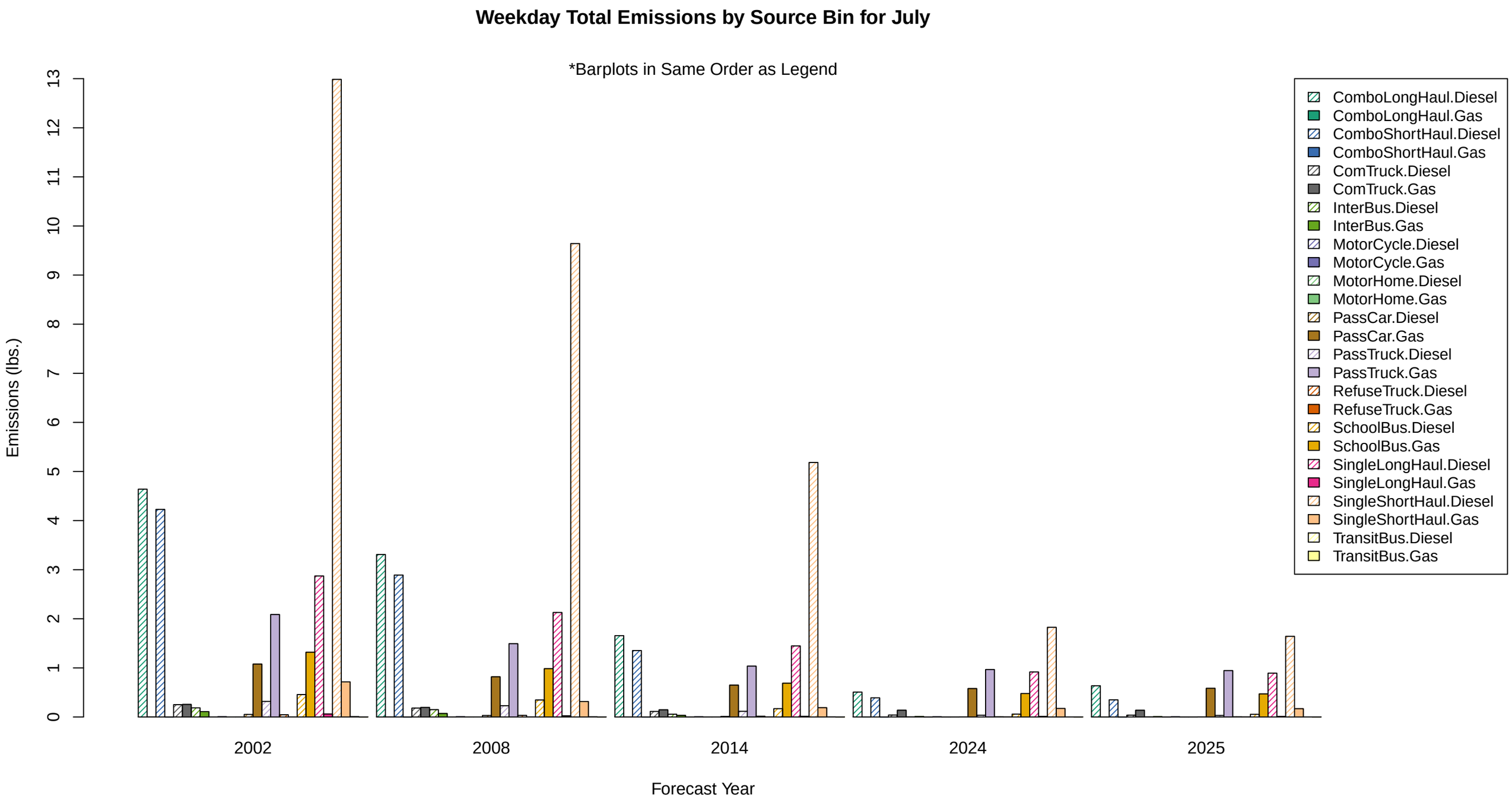
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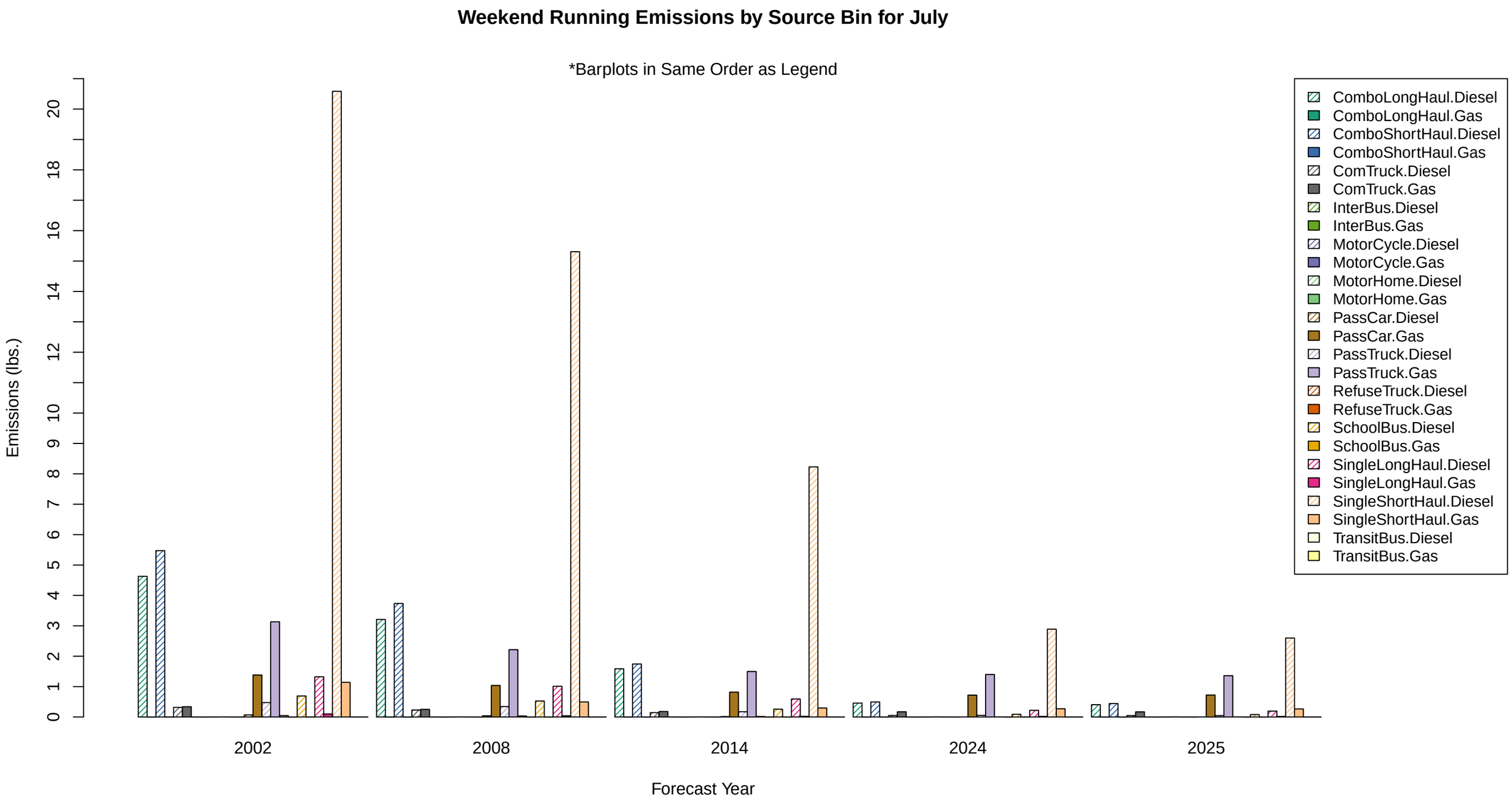
Weekend Running Emissions by Source Bin for July
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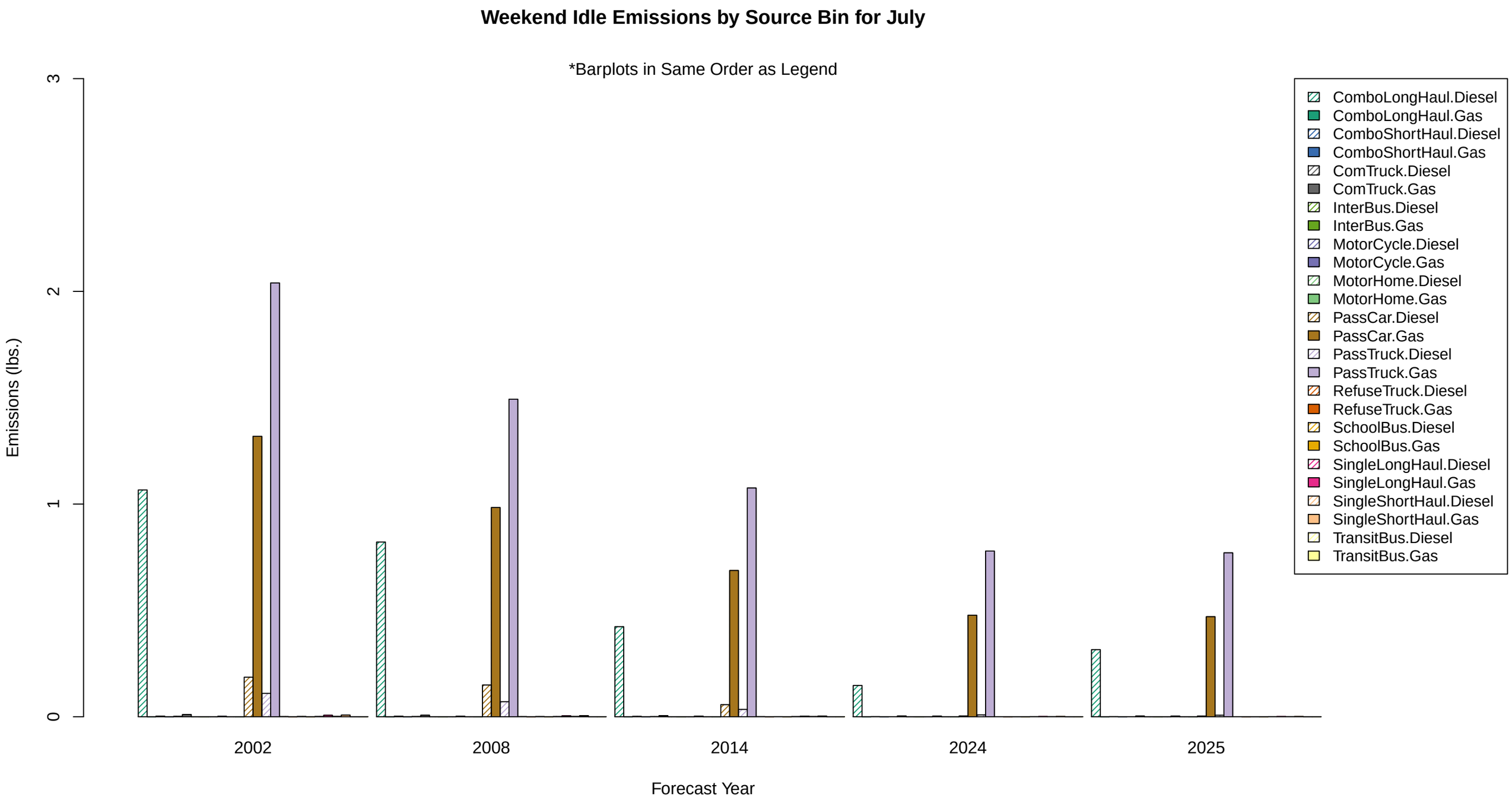
Weekend Idle Emissions by Source Bin for July
*Barplots in Same Order as Legend
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Forecast Year
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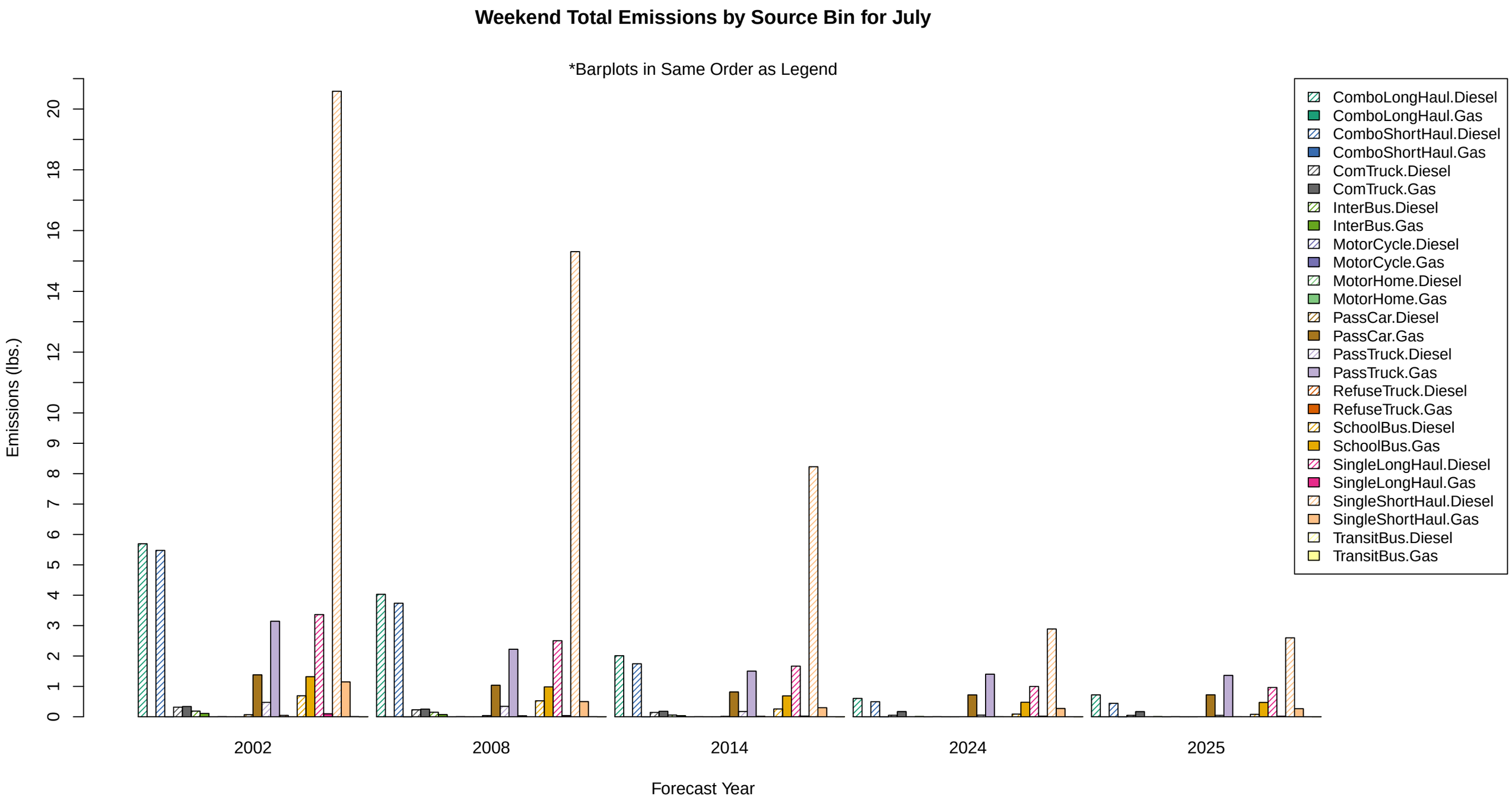
Weekend Total Emissions by Source Bin for July
*Barplots in Same Order as Legend
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MotorCycle.Gas
MotorHome.Diesel
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PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
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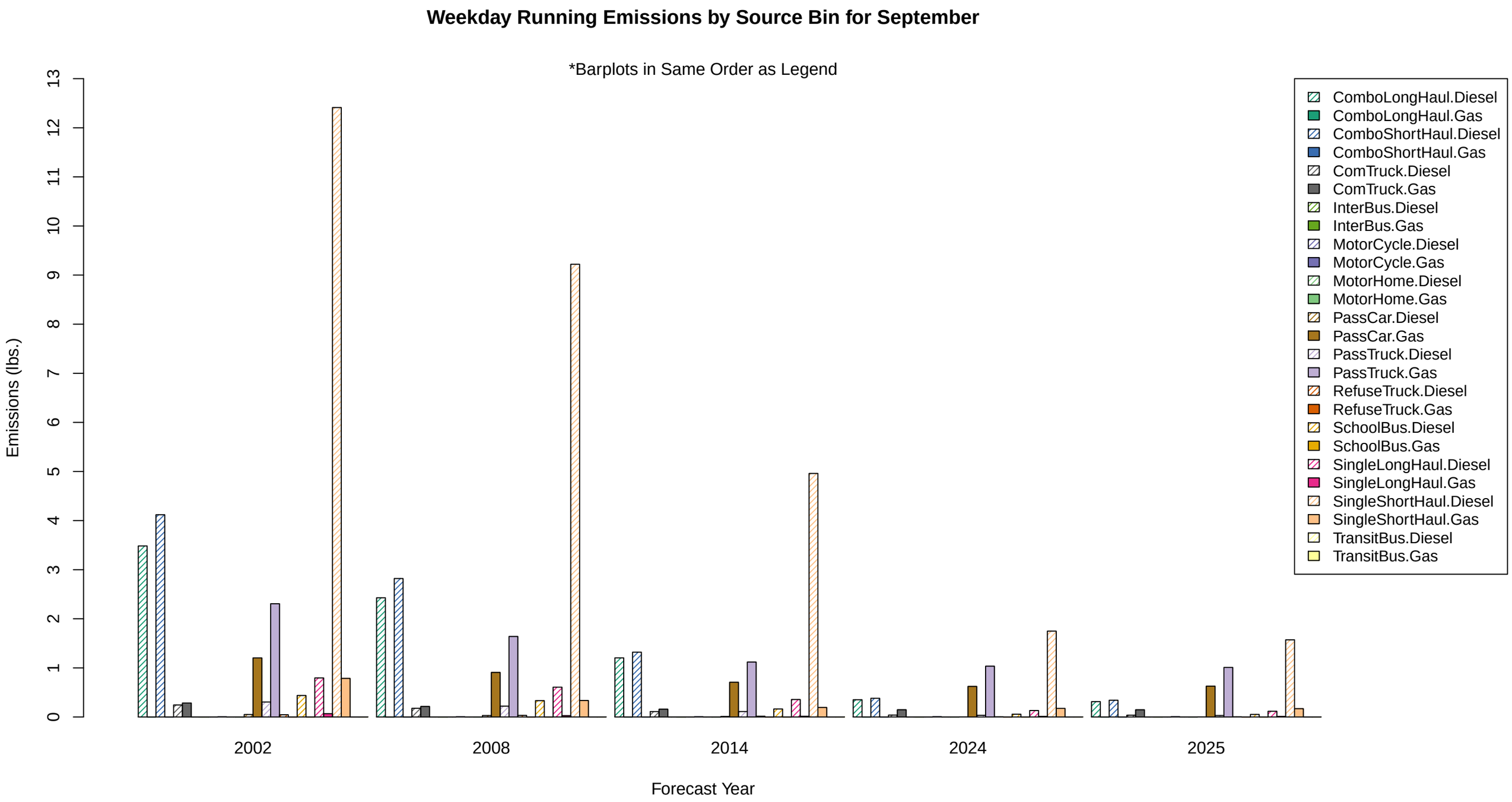
Weekday Running Emissions by Source Bin for September
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Emissions (lbs.)
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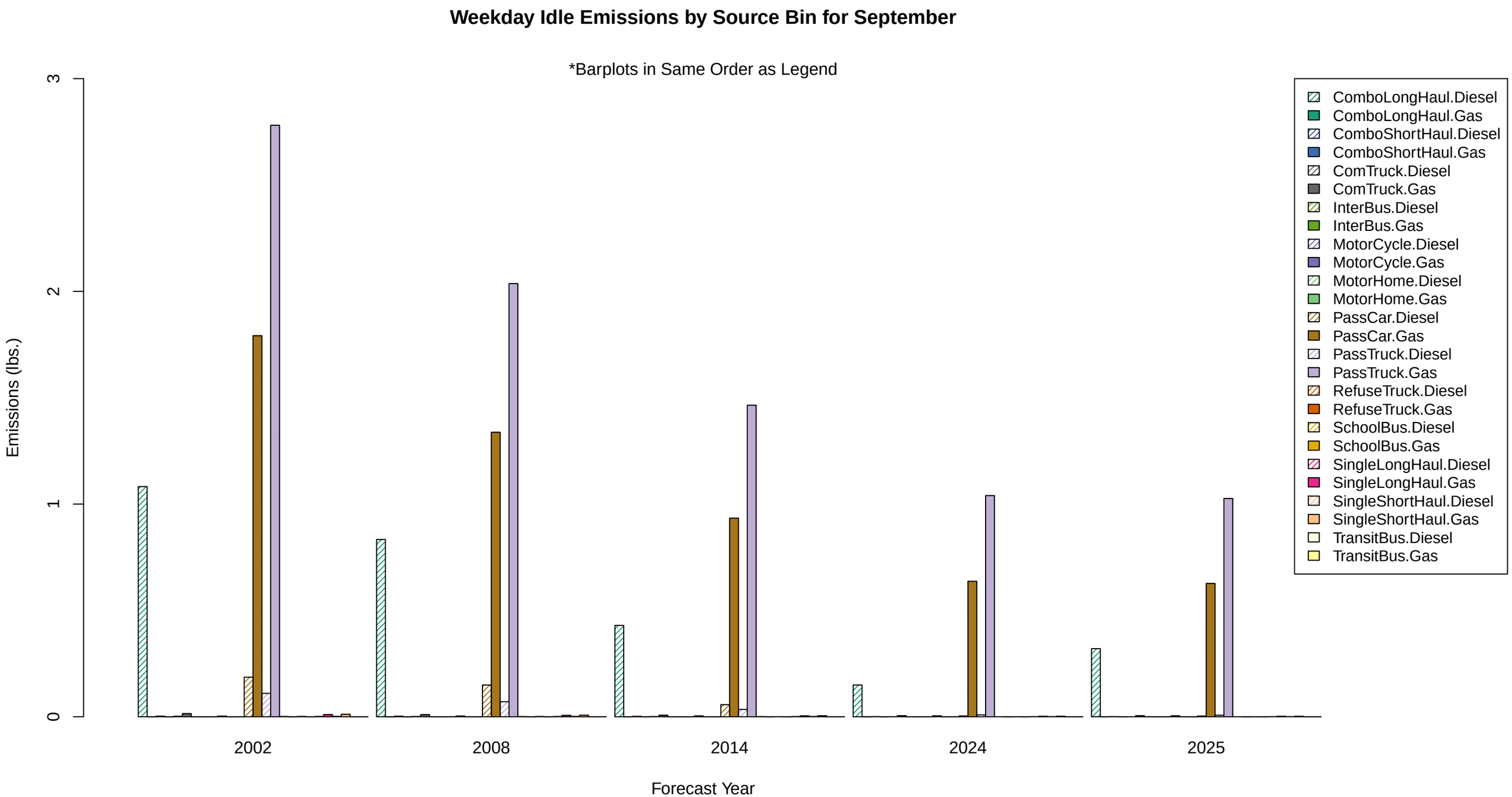
Weekday Idle Emissions by Source Bin for September
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Forecast Year
ComboLongHaul.Diesel
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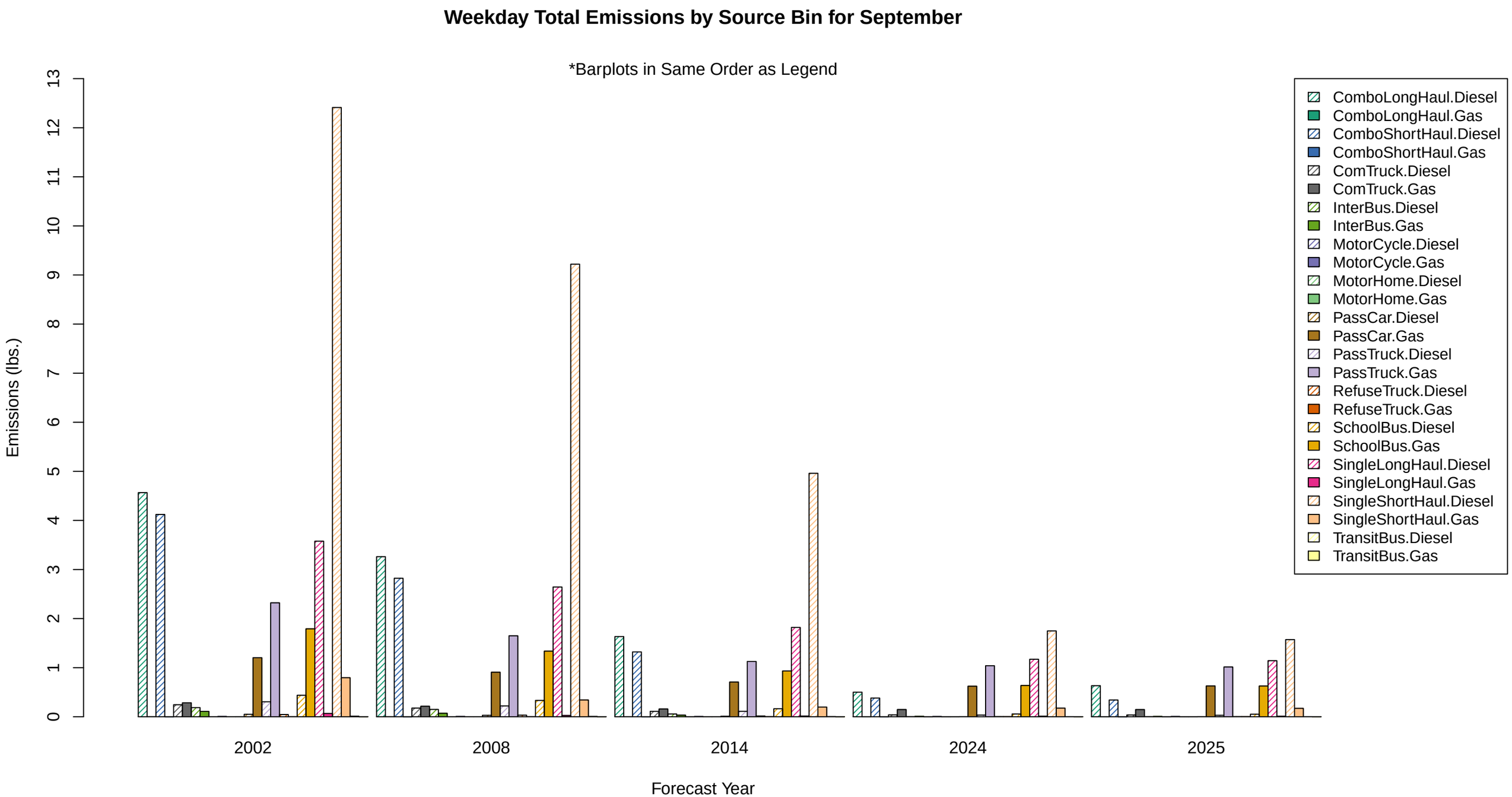
Weekday Total Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
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ComboLongHaul.Diesel
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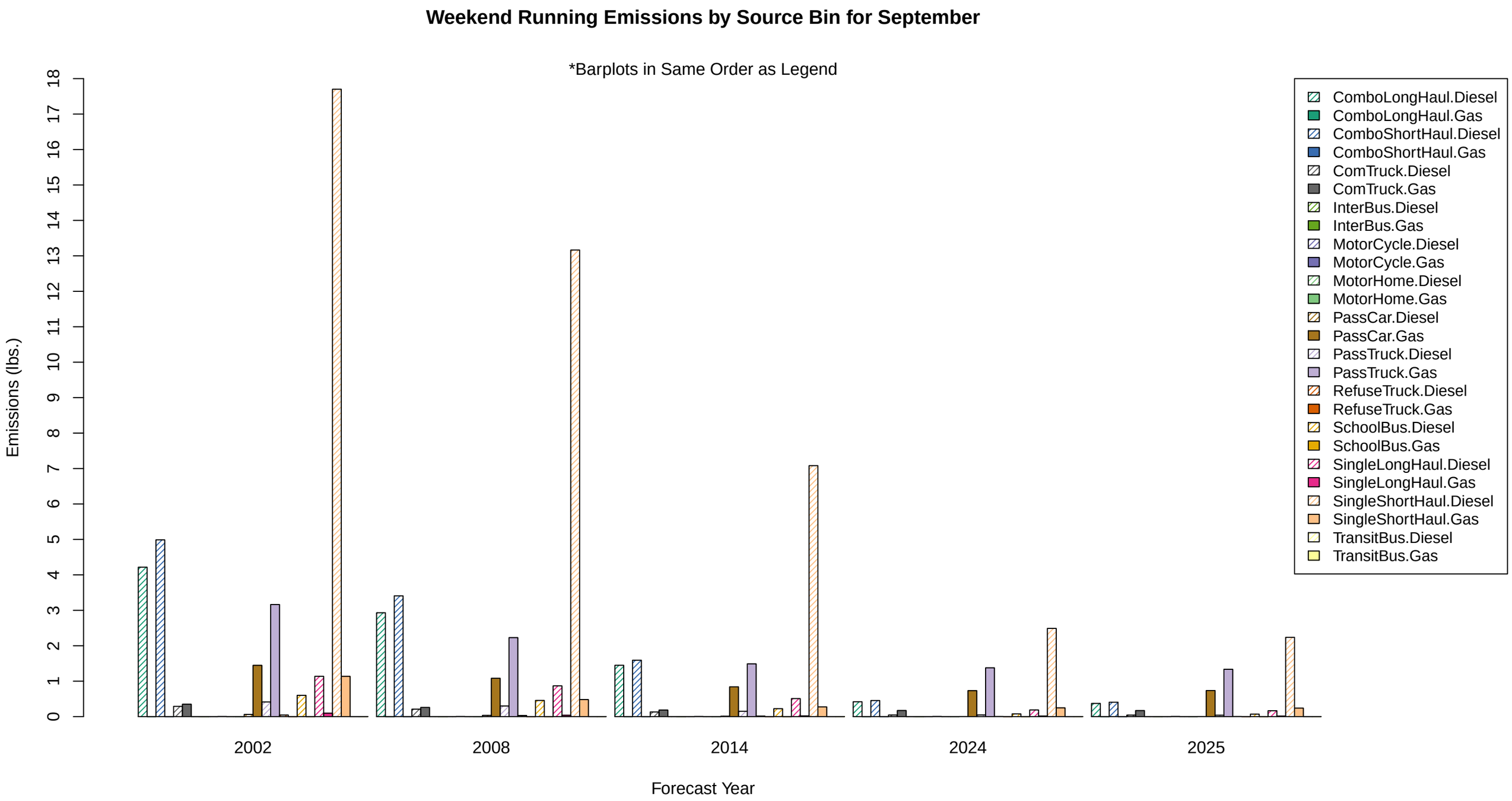
Weekend Running Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
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PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
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SchoolBus.Gas
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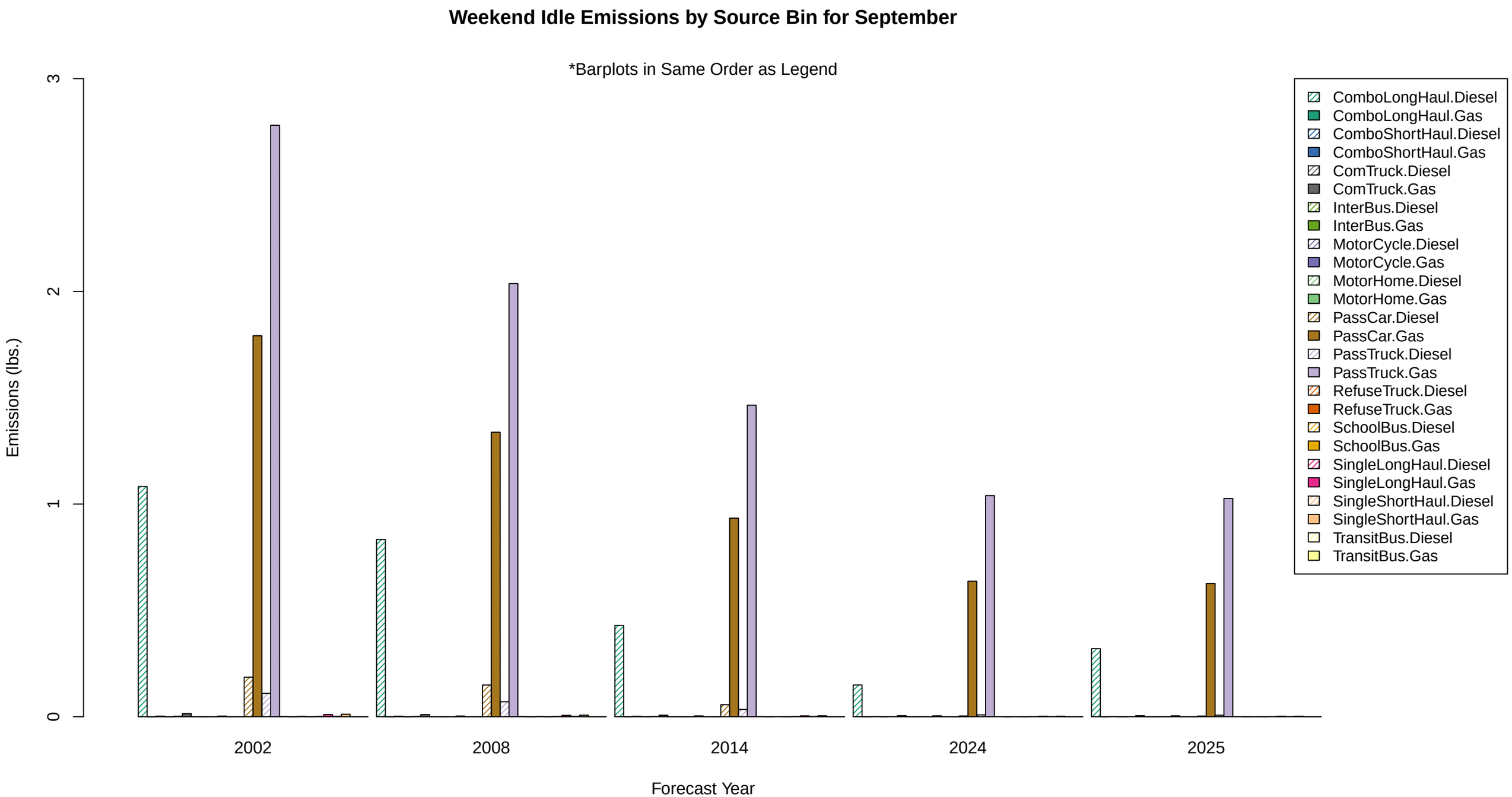
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas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2025
Forecast Year
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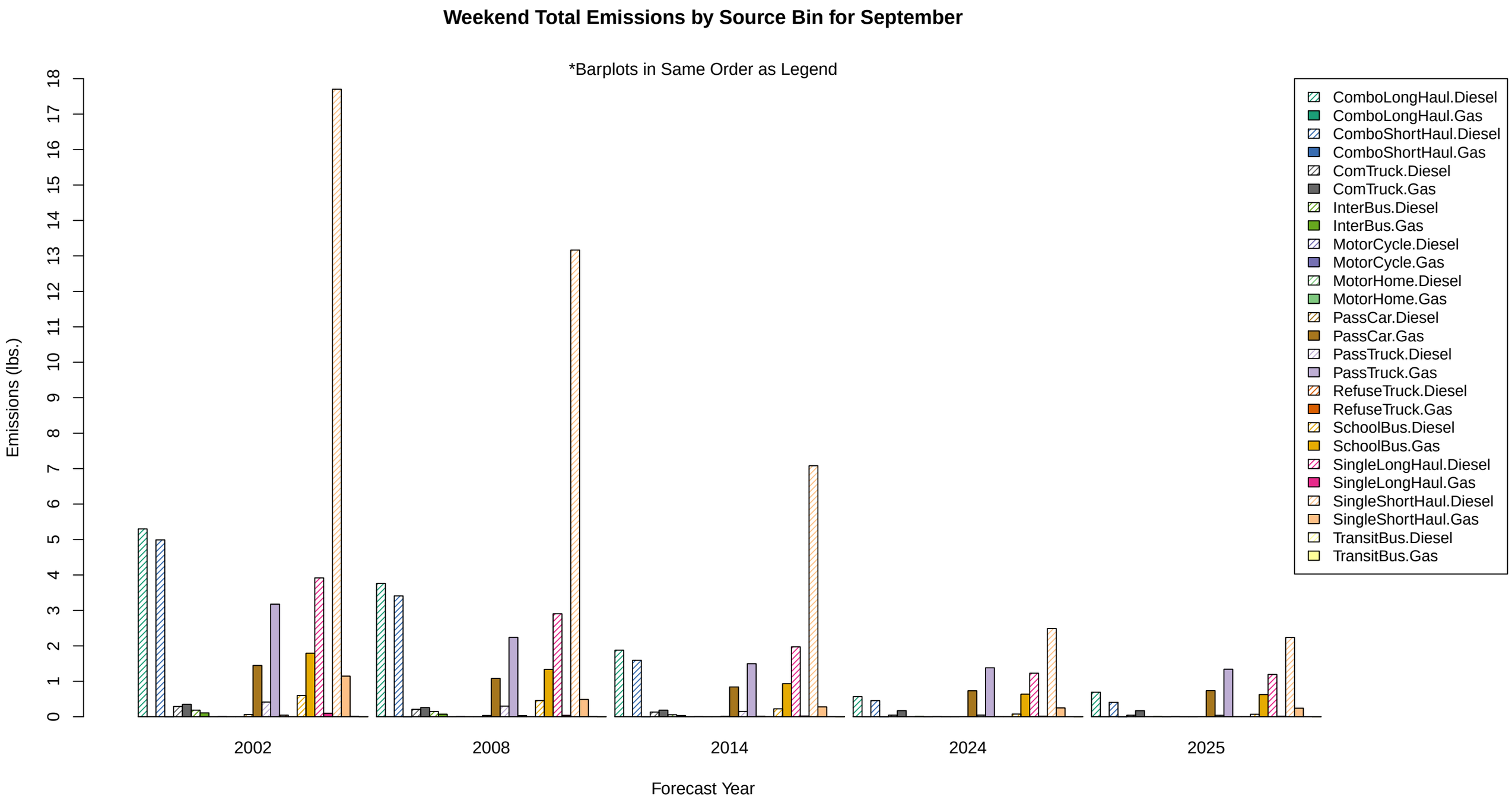
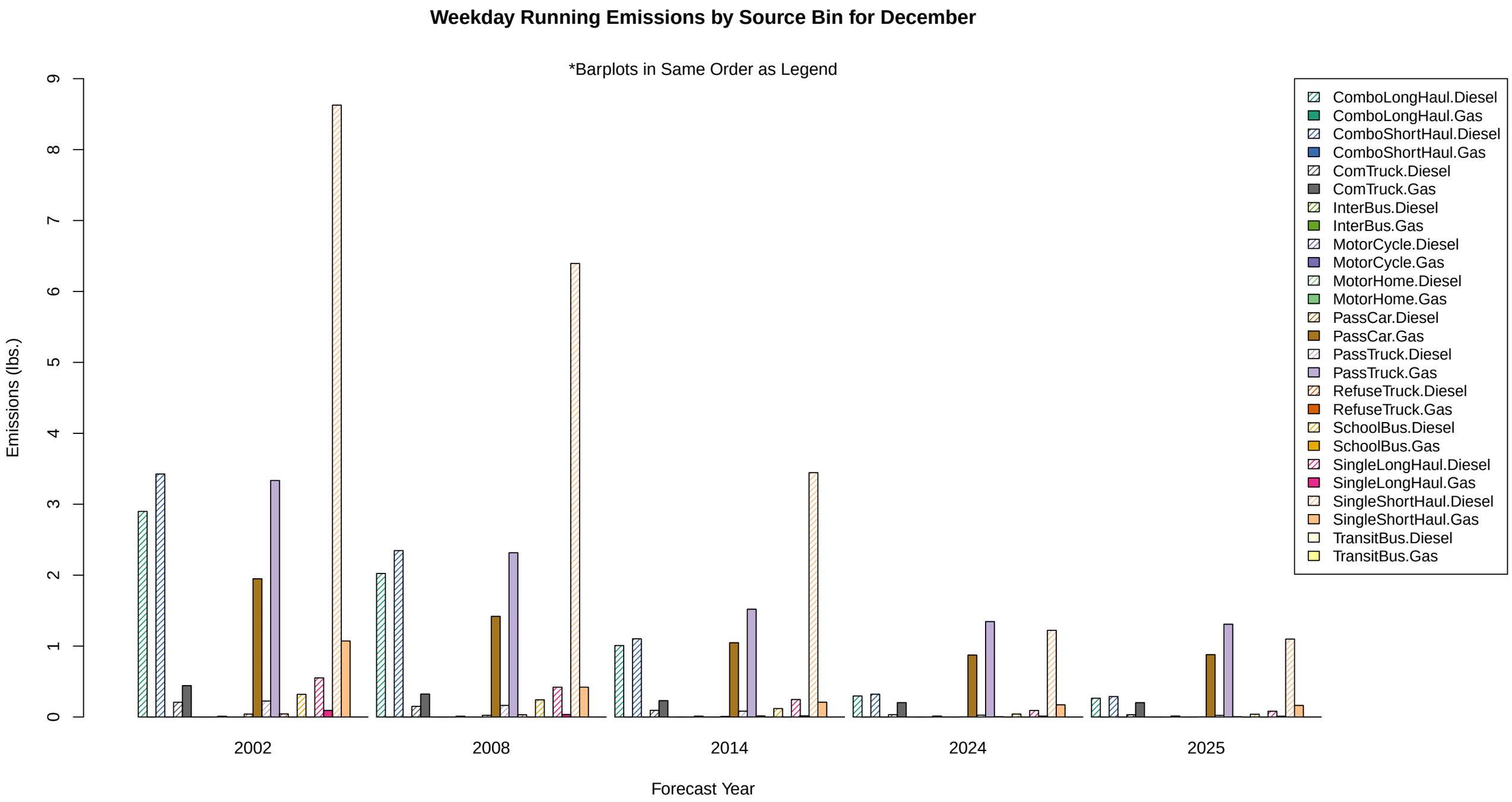
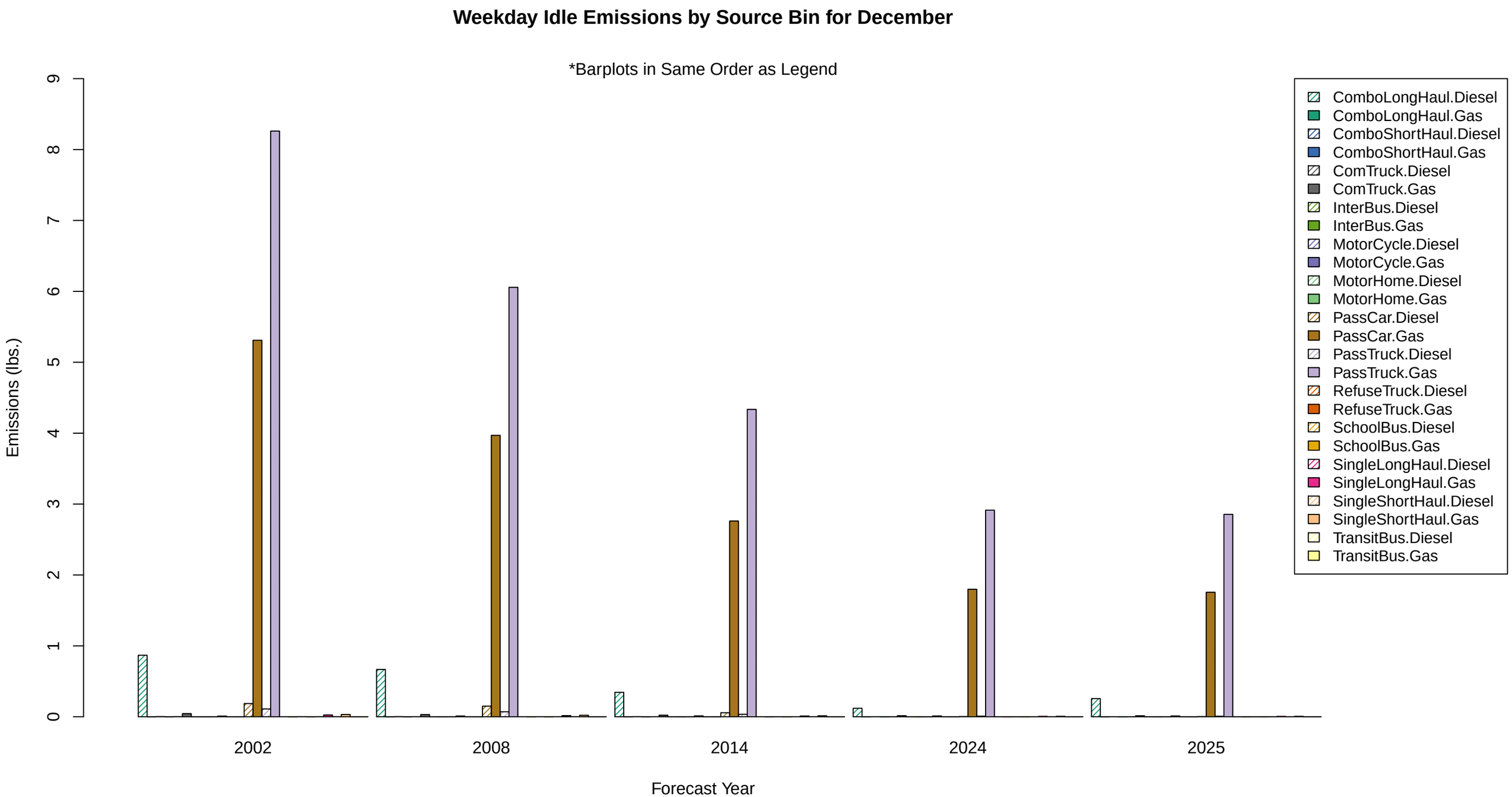
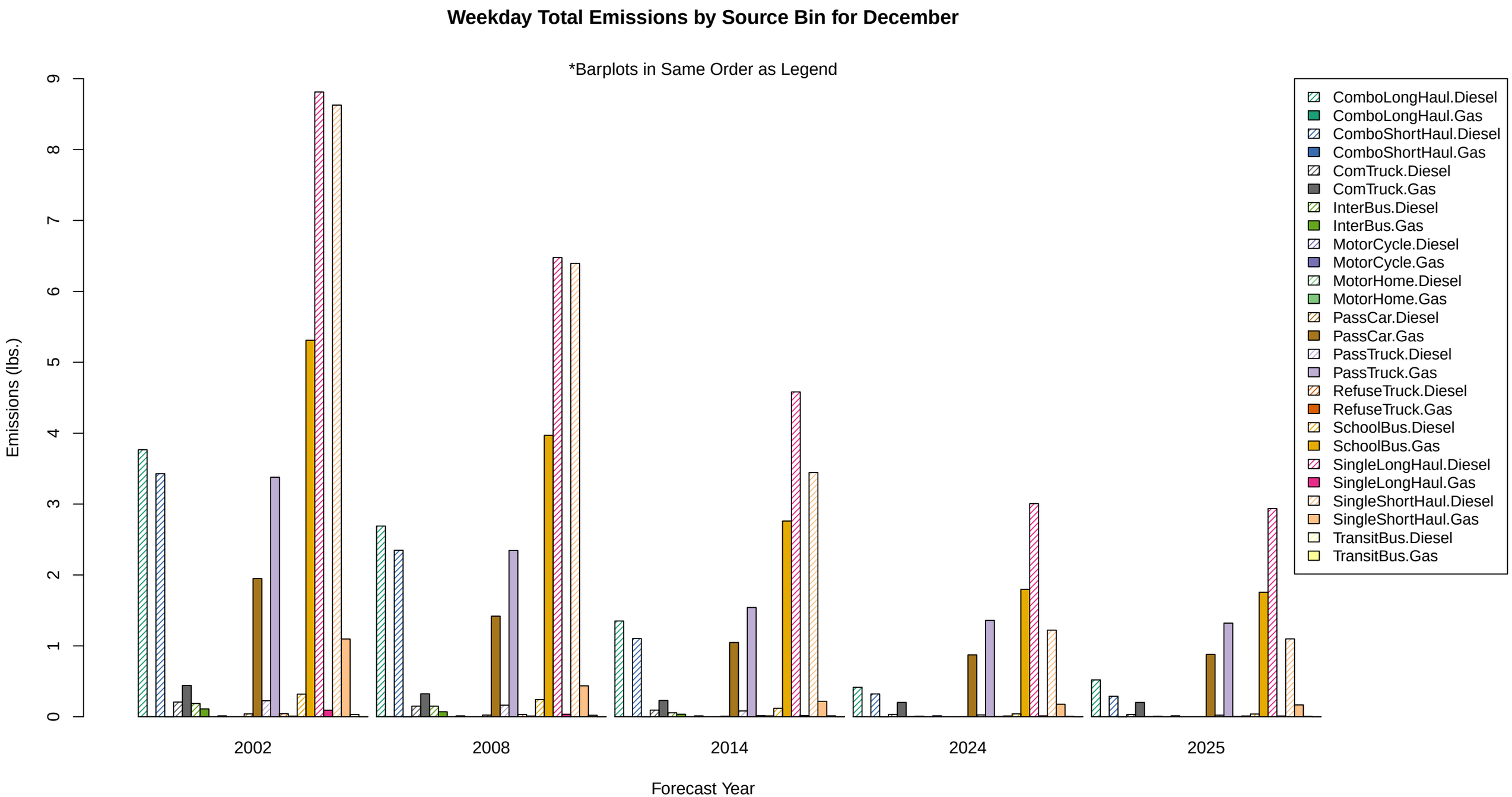
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekend Total Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekday Running Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
5
6
7
8
9
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekday Idle Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
5
6
7
8
9
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekday Total Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
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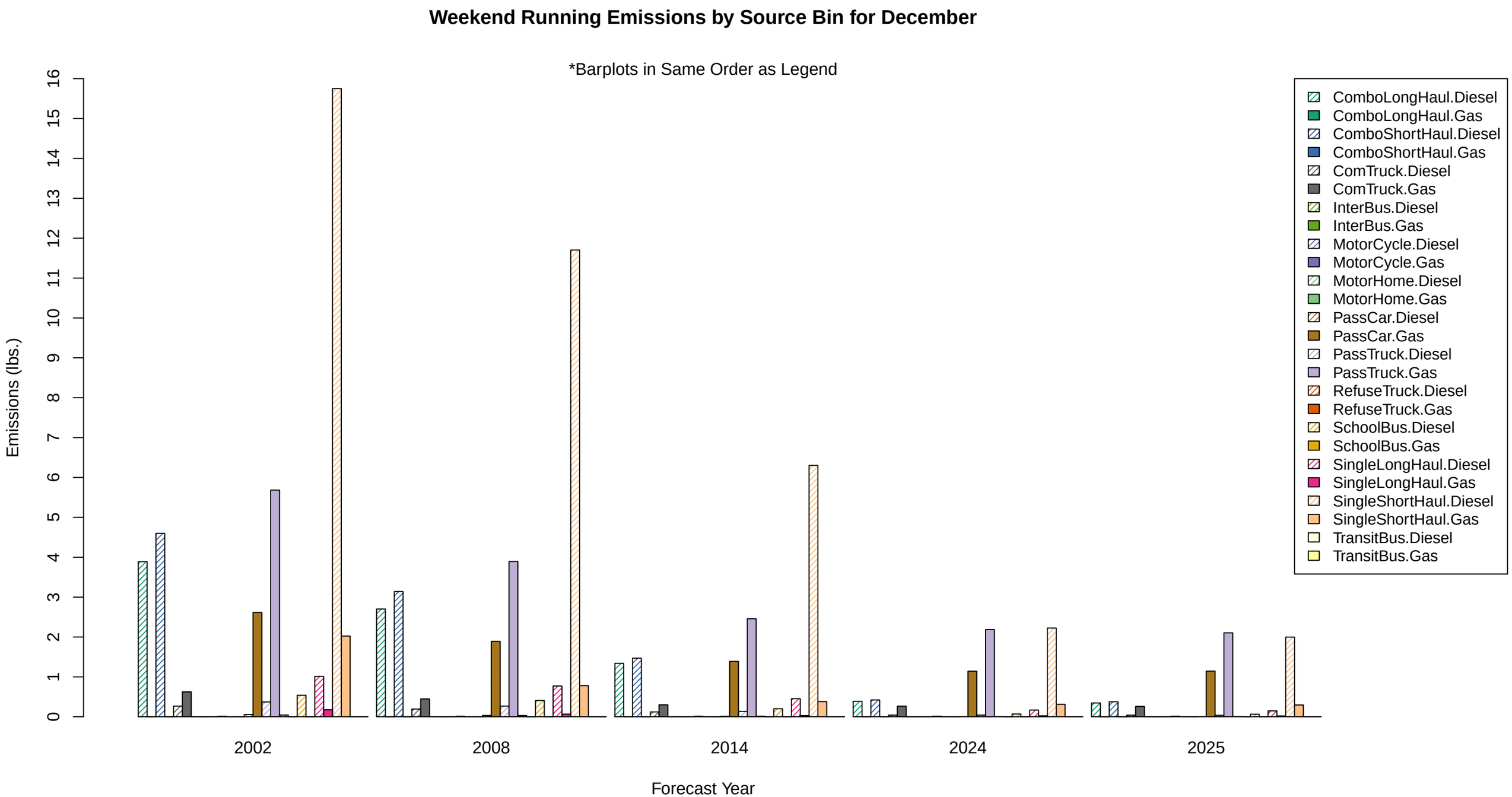
6
7
8
9
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Weekend Running Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
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6
7
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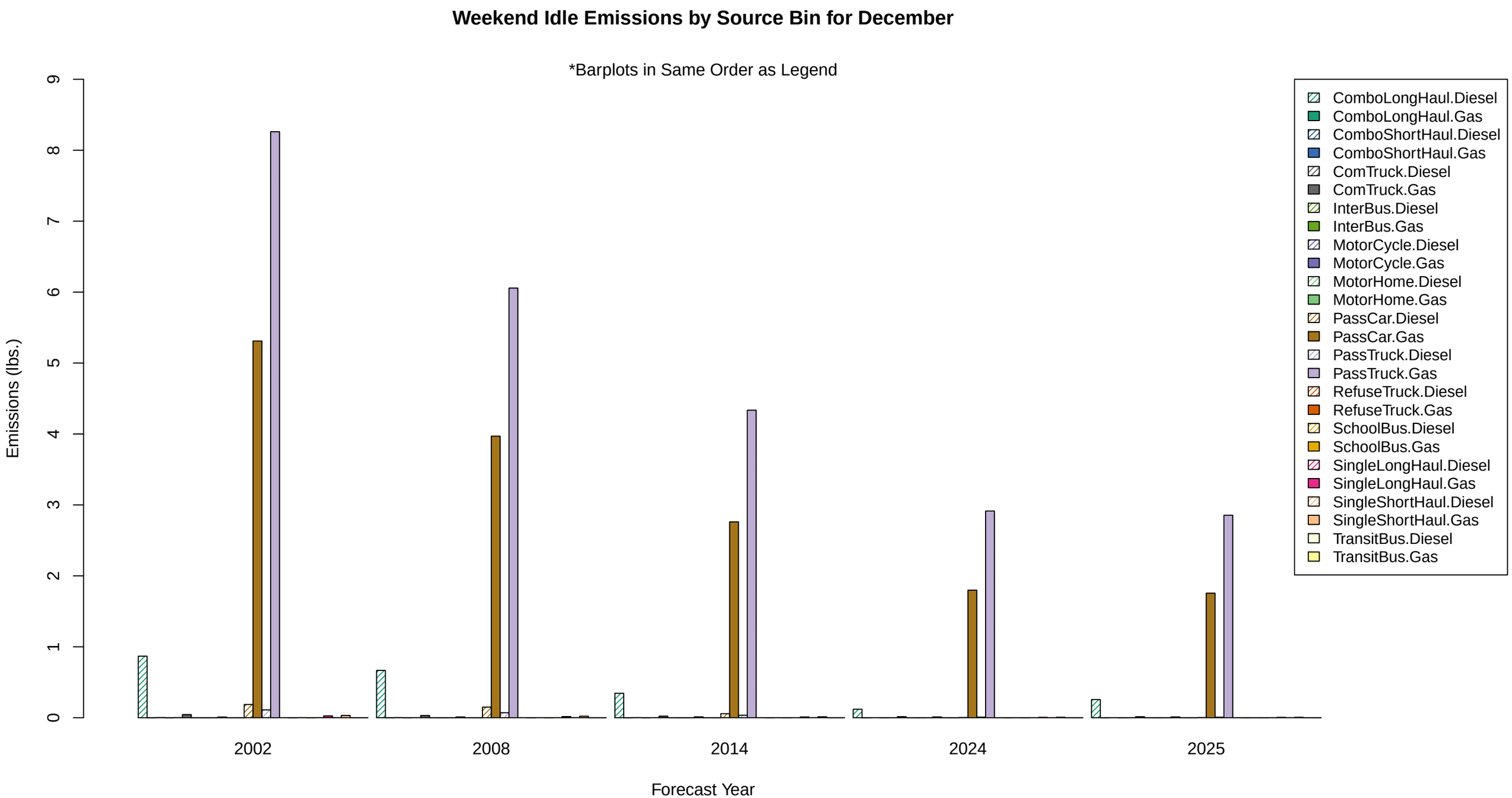
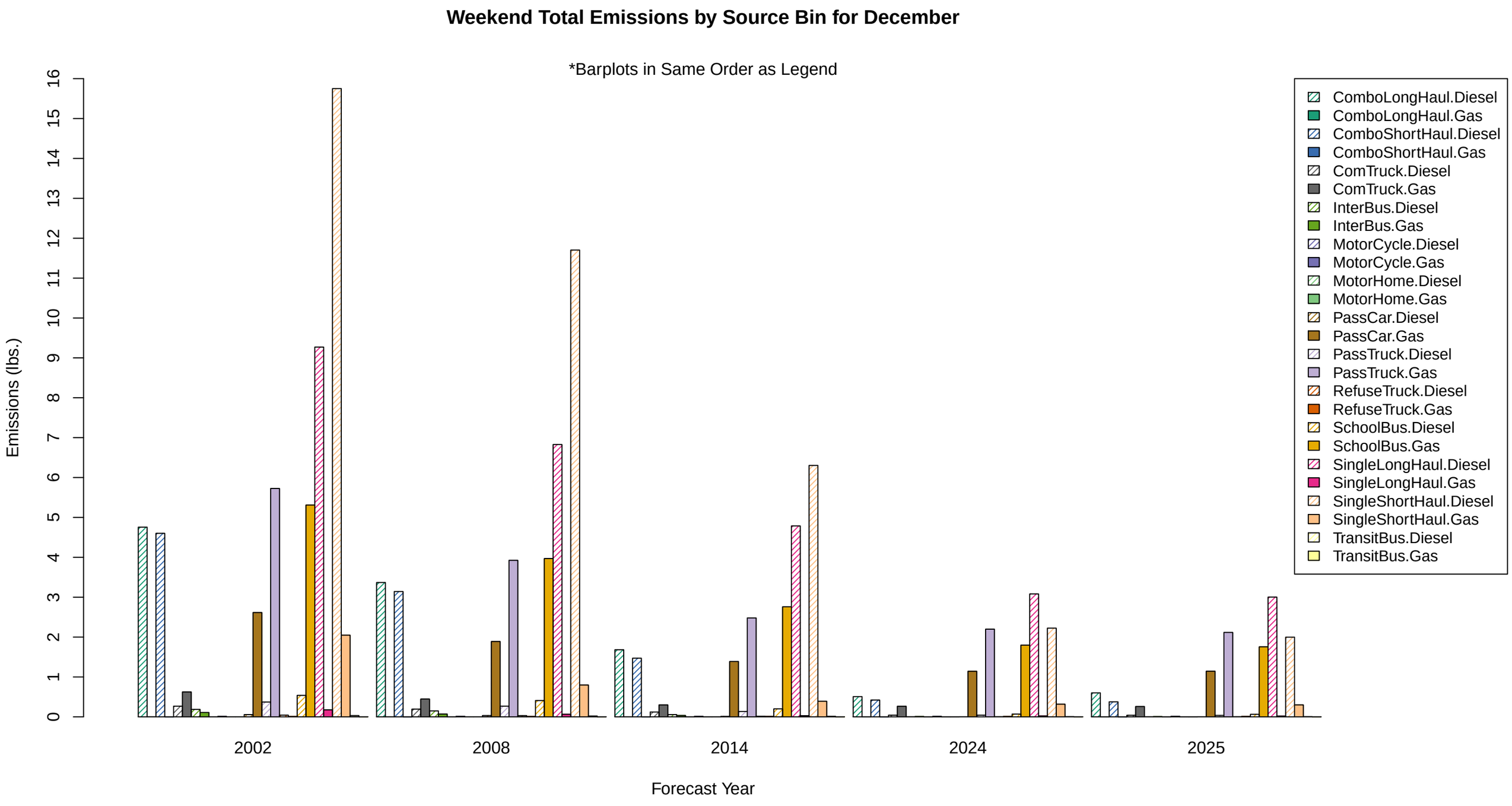
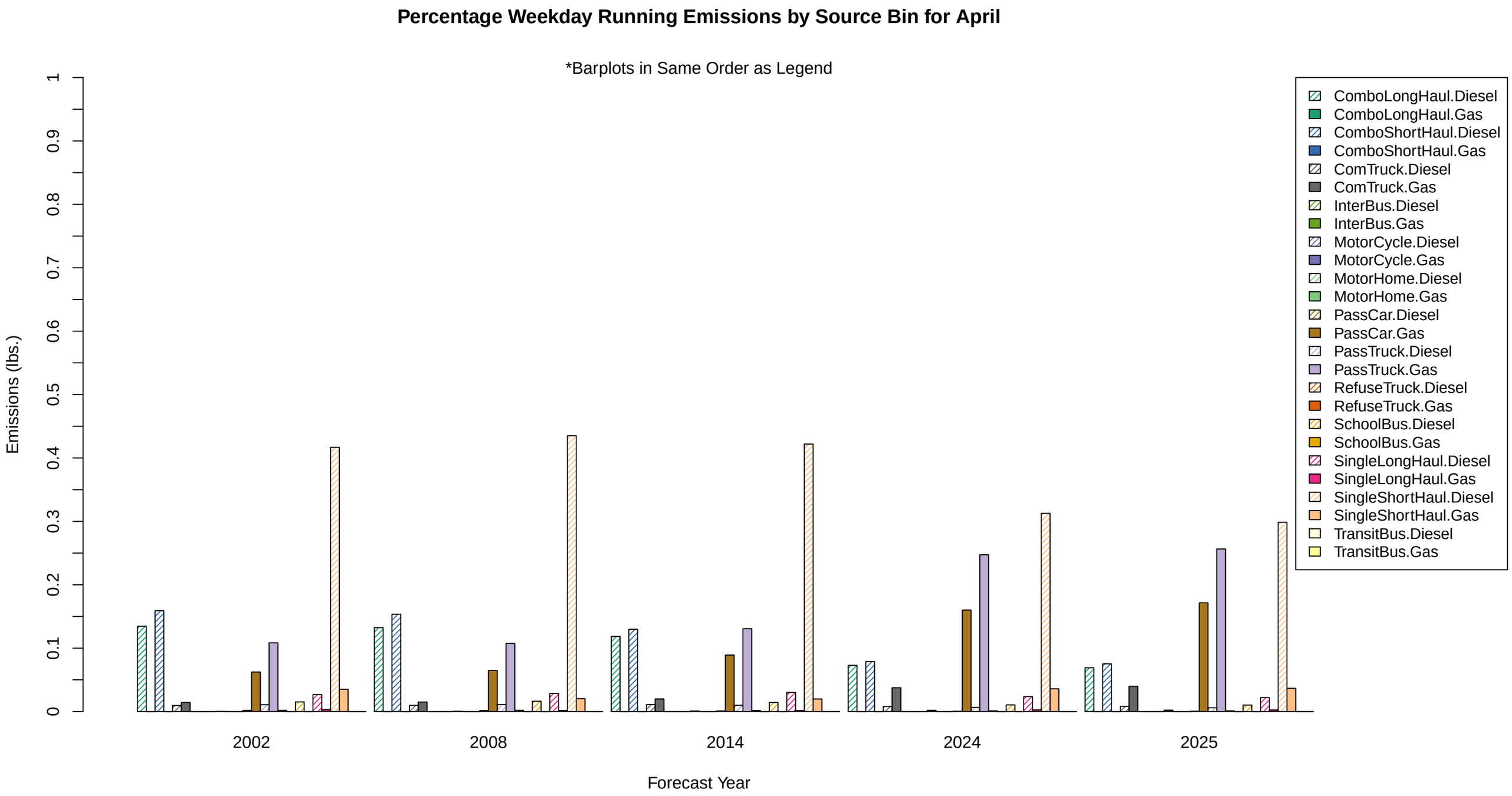
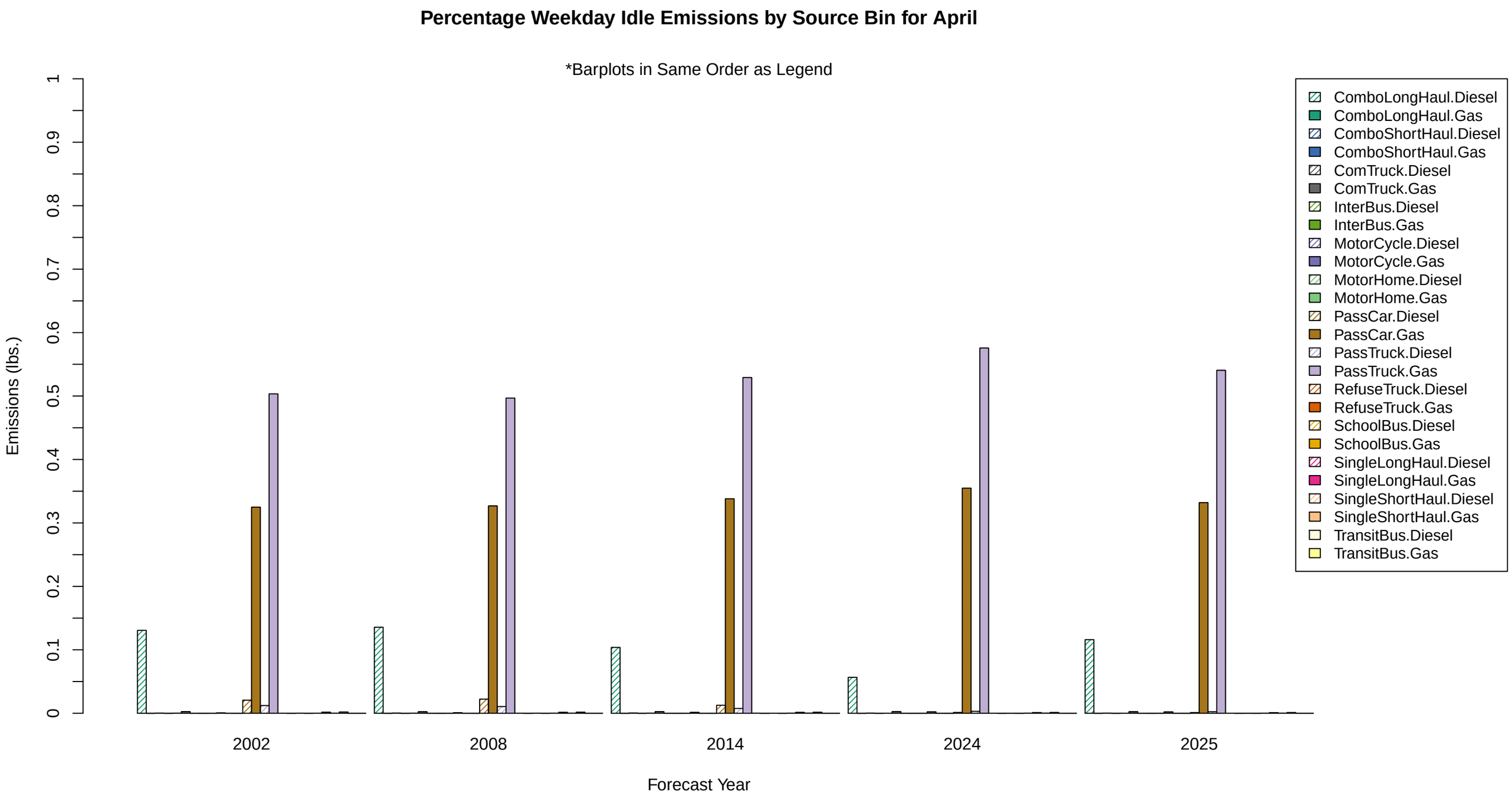
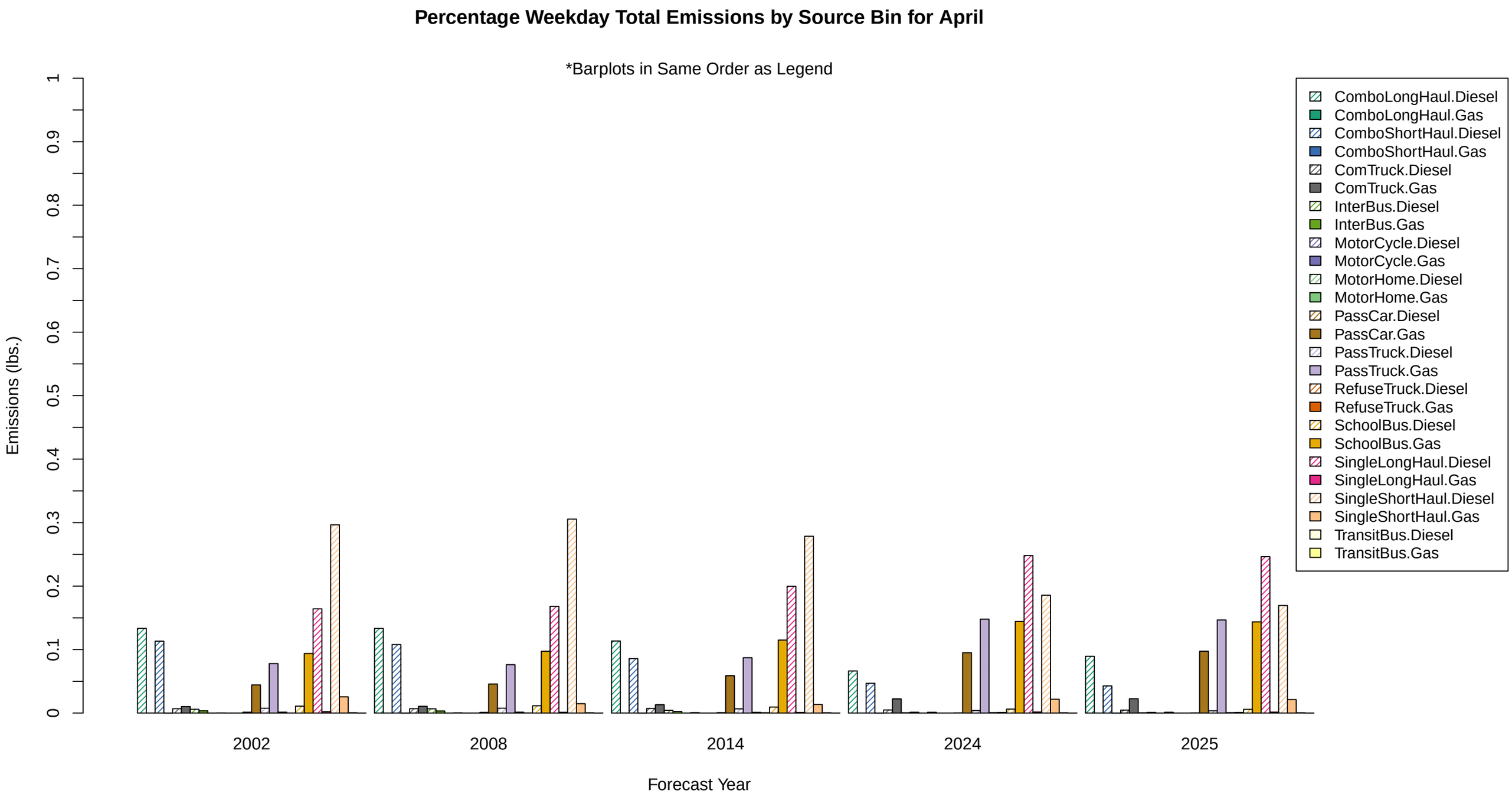
9
10
11
12
13
14
15
16
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

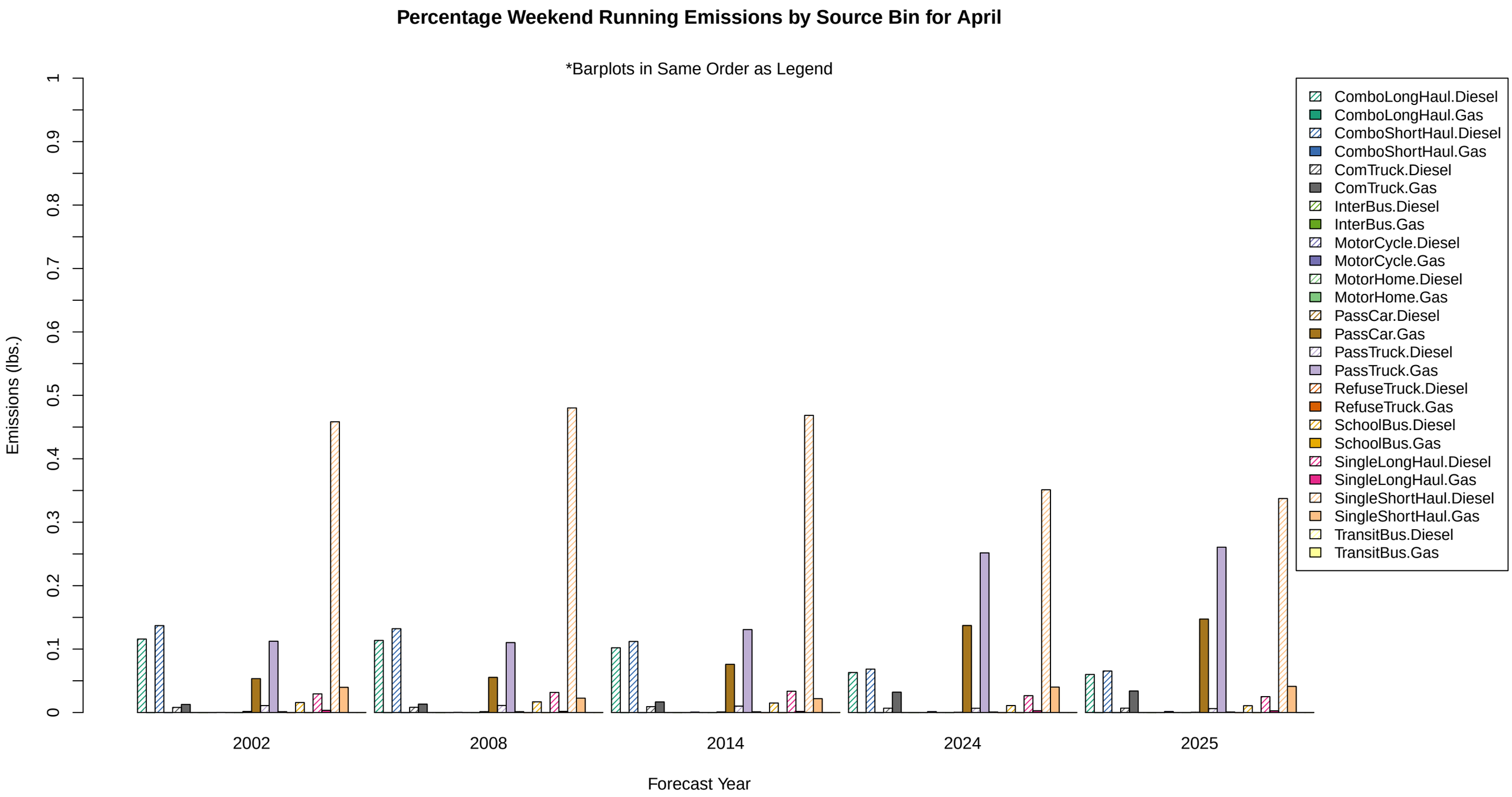

Weekend Idle Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
5
6
7
8
9
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

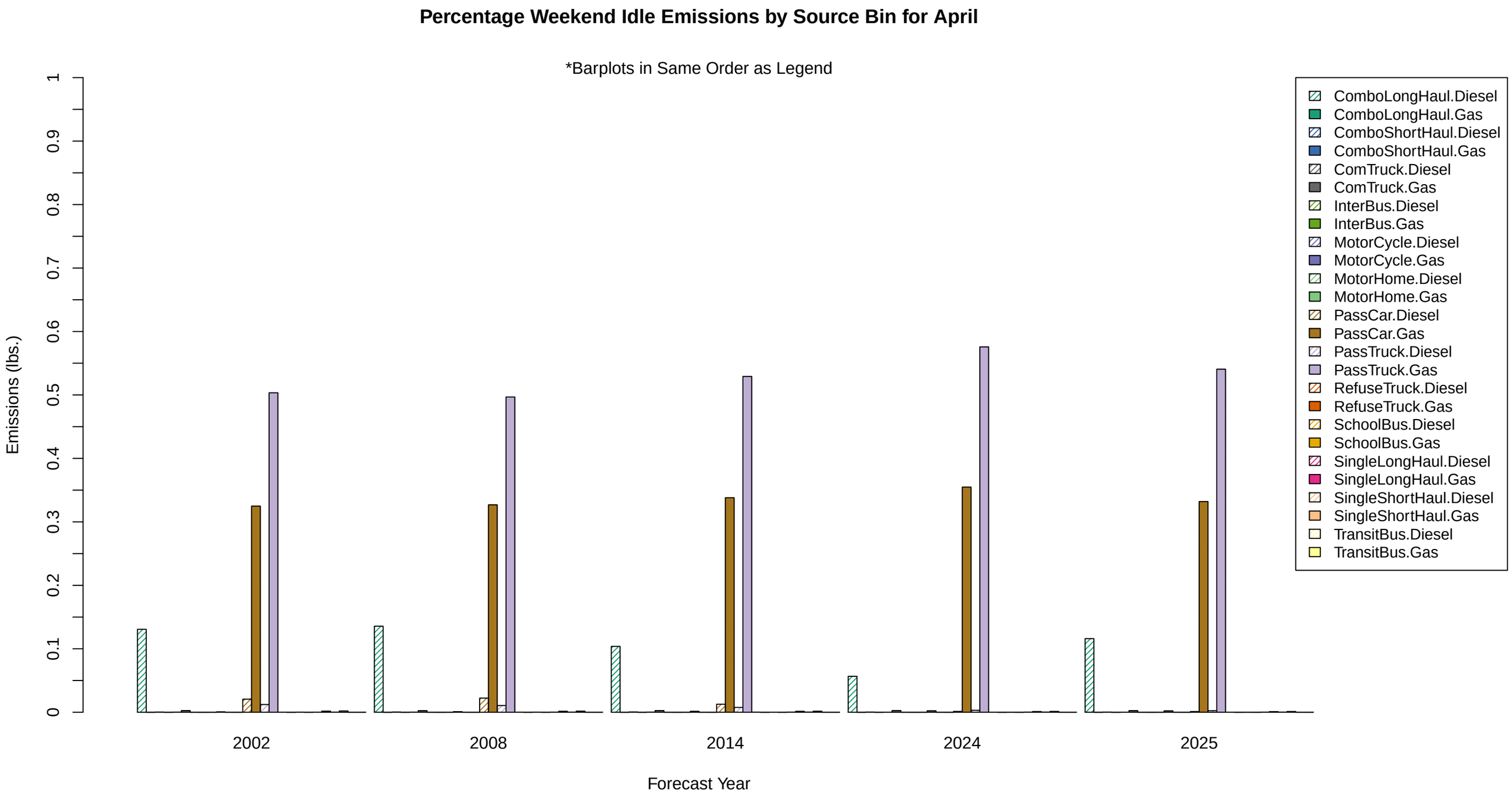

Weekend Total Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

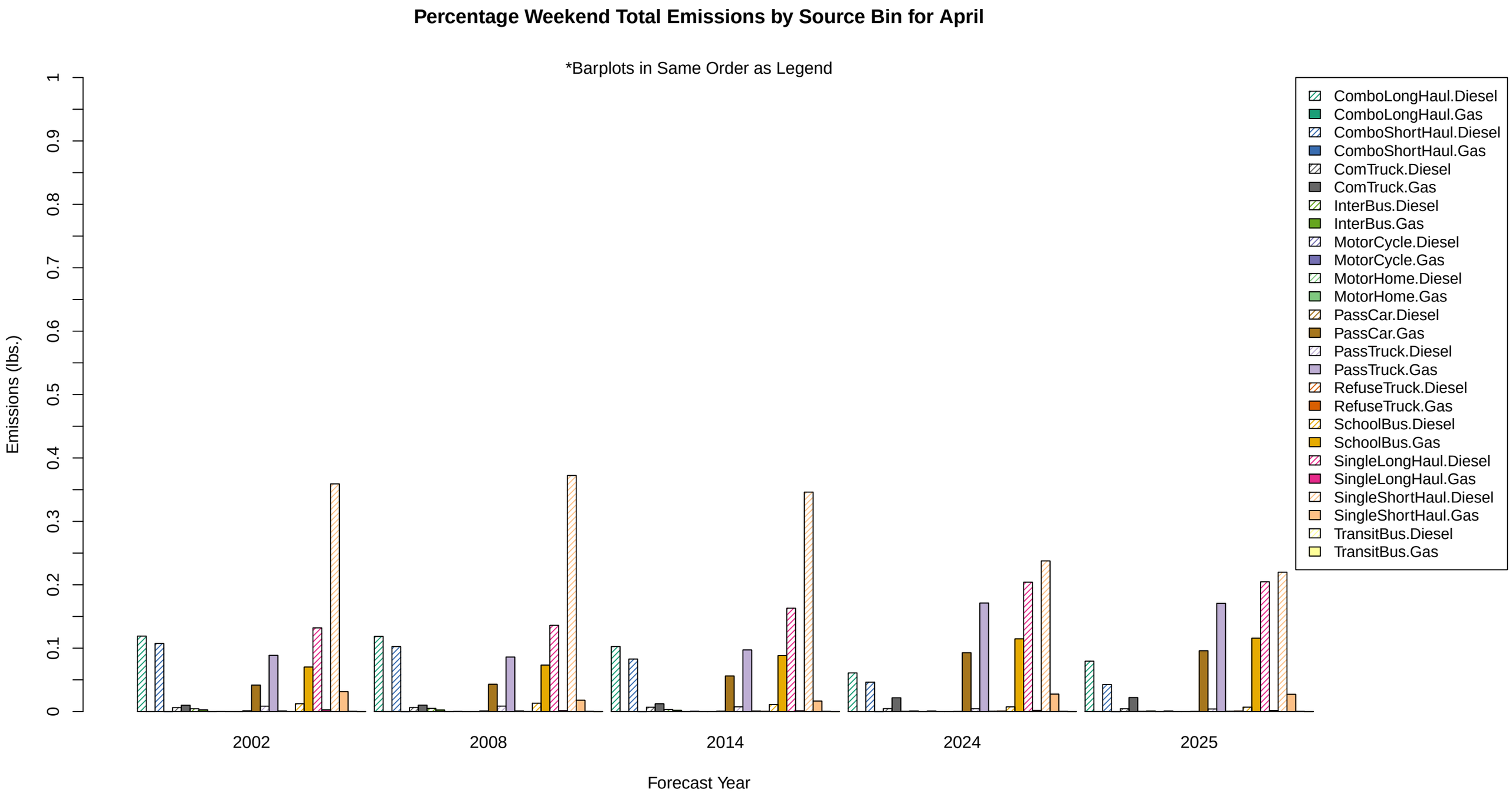

Percentage Weekday Running Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

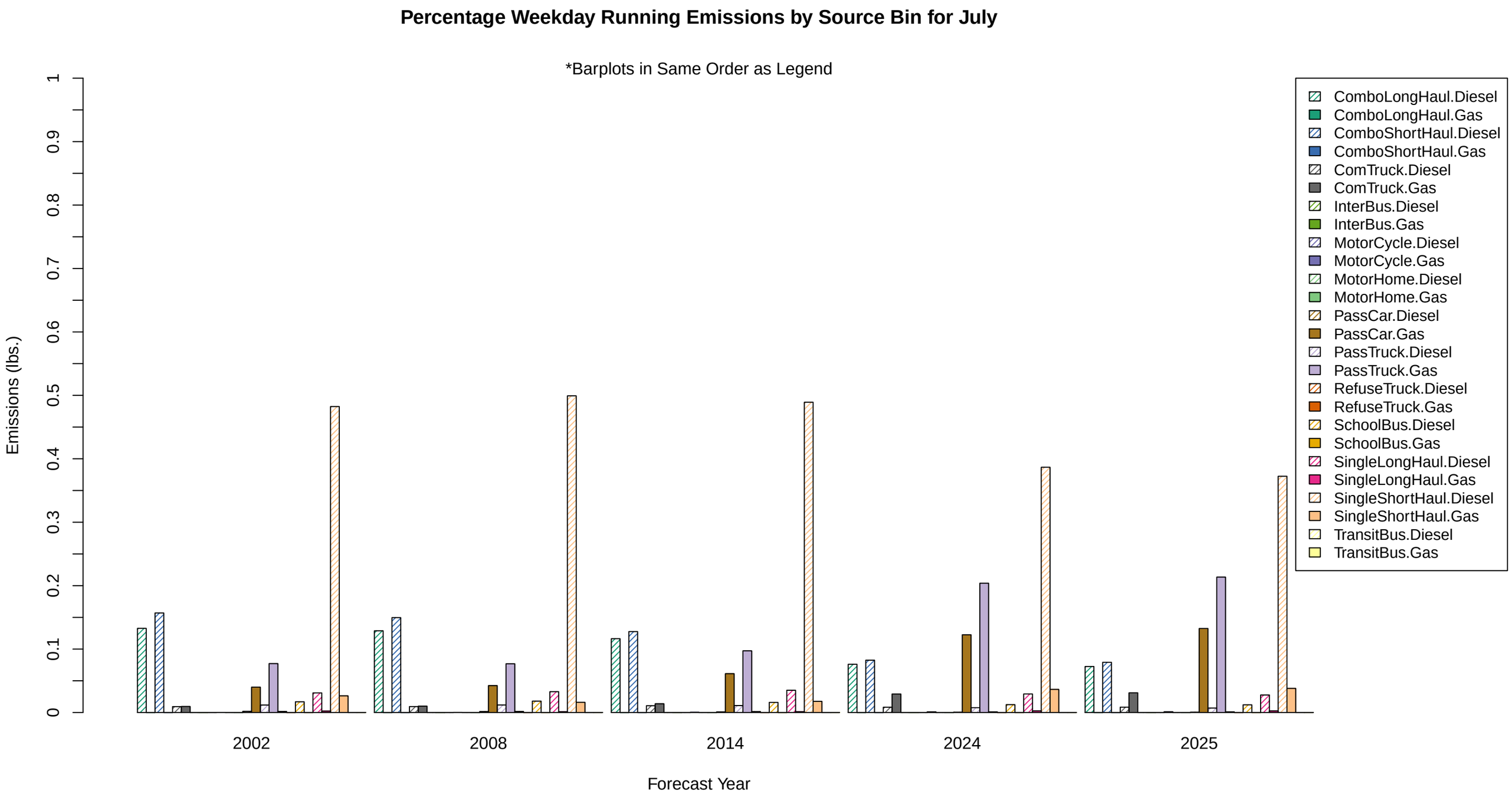

Percentage Weekday Idle Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

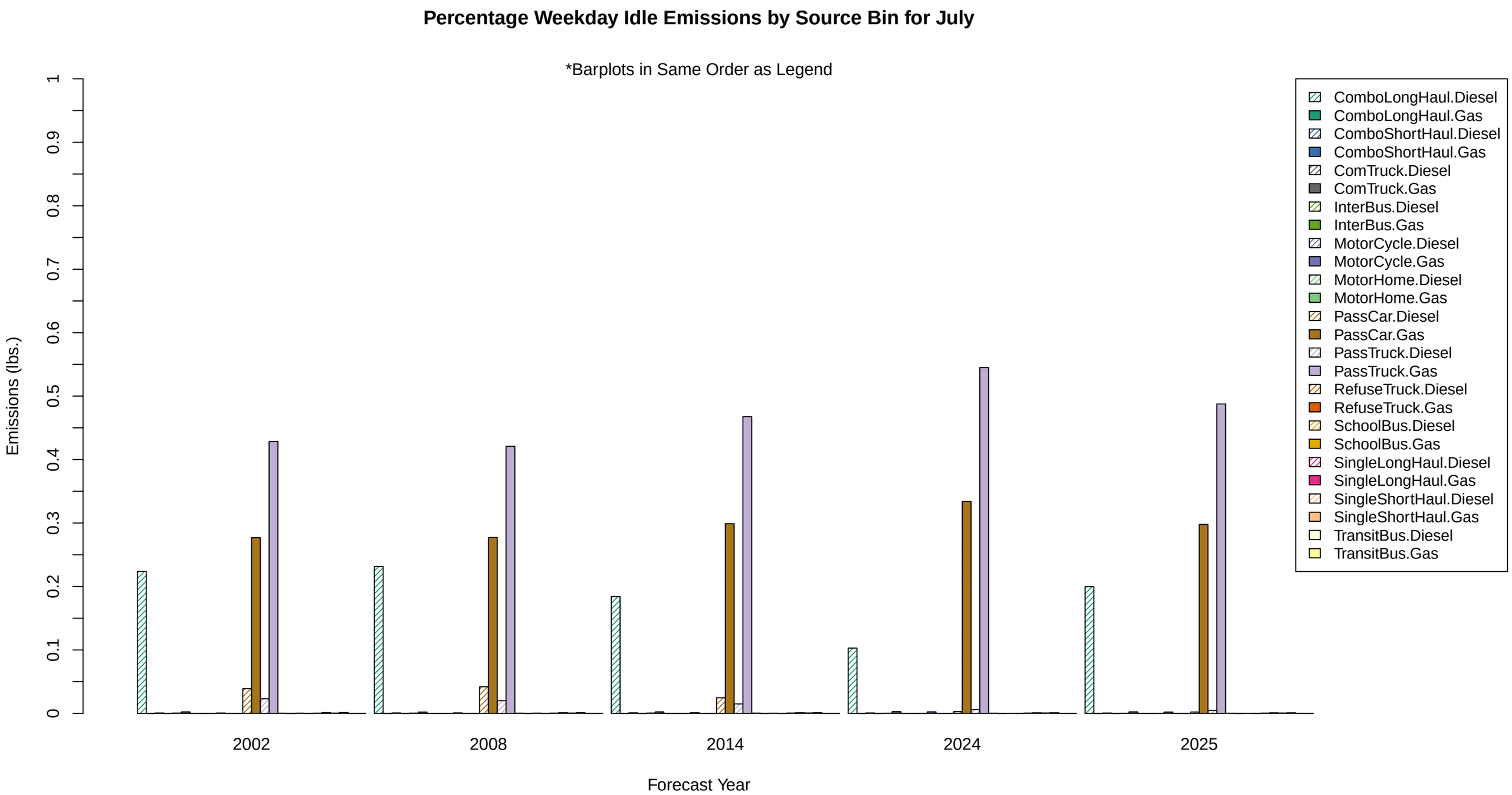

Percentage Weekday Total Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Running Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Idle Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Total Emissions by Source Bin for April
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Running Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Idle Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
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ComTruck.Gas
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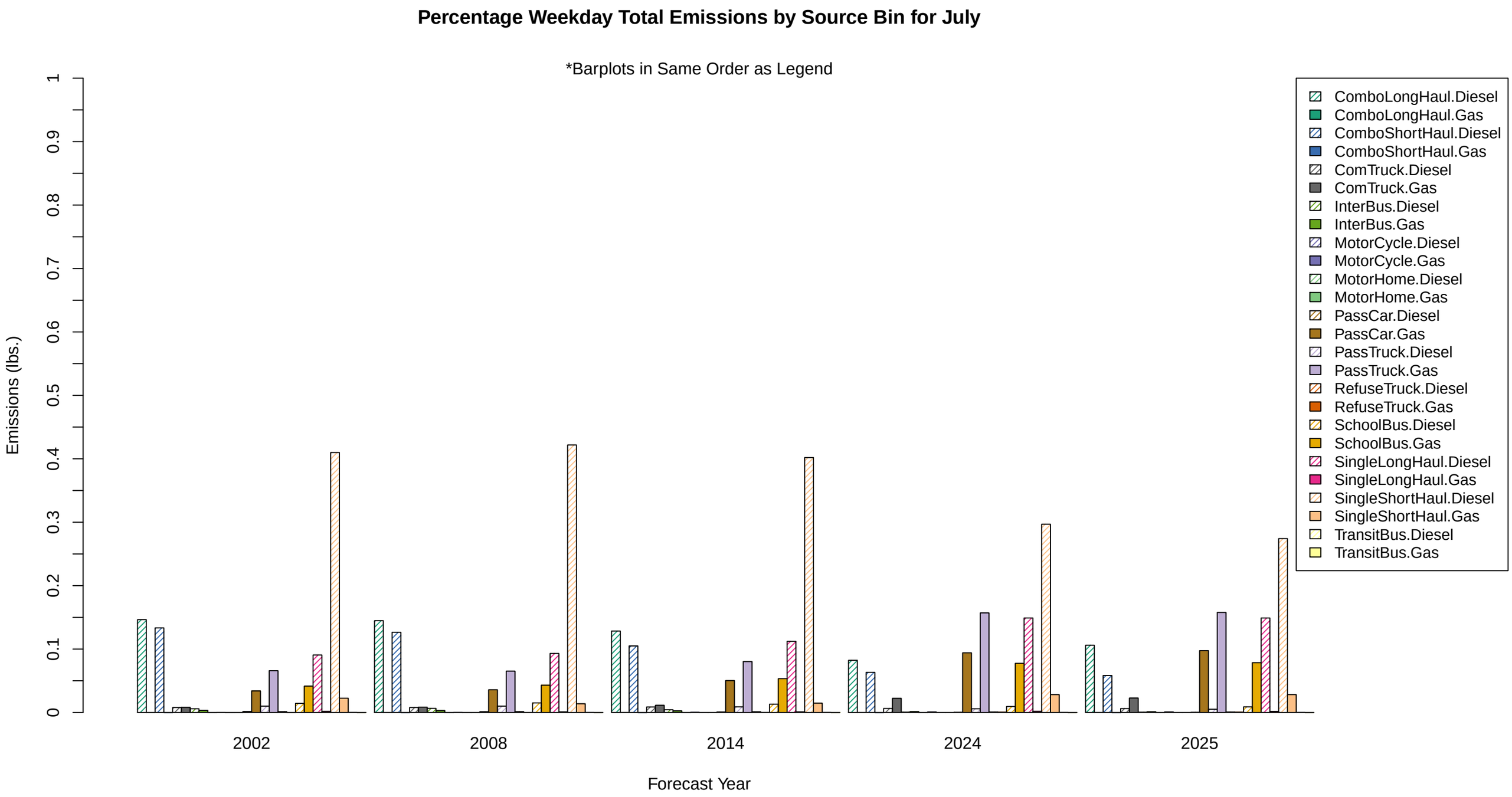
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Total Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
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MotorCycle.Gas
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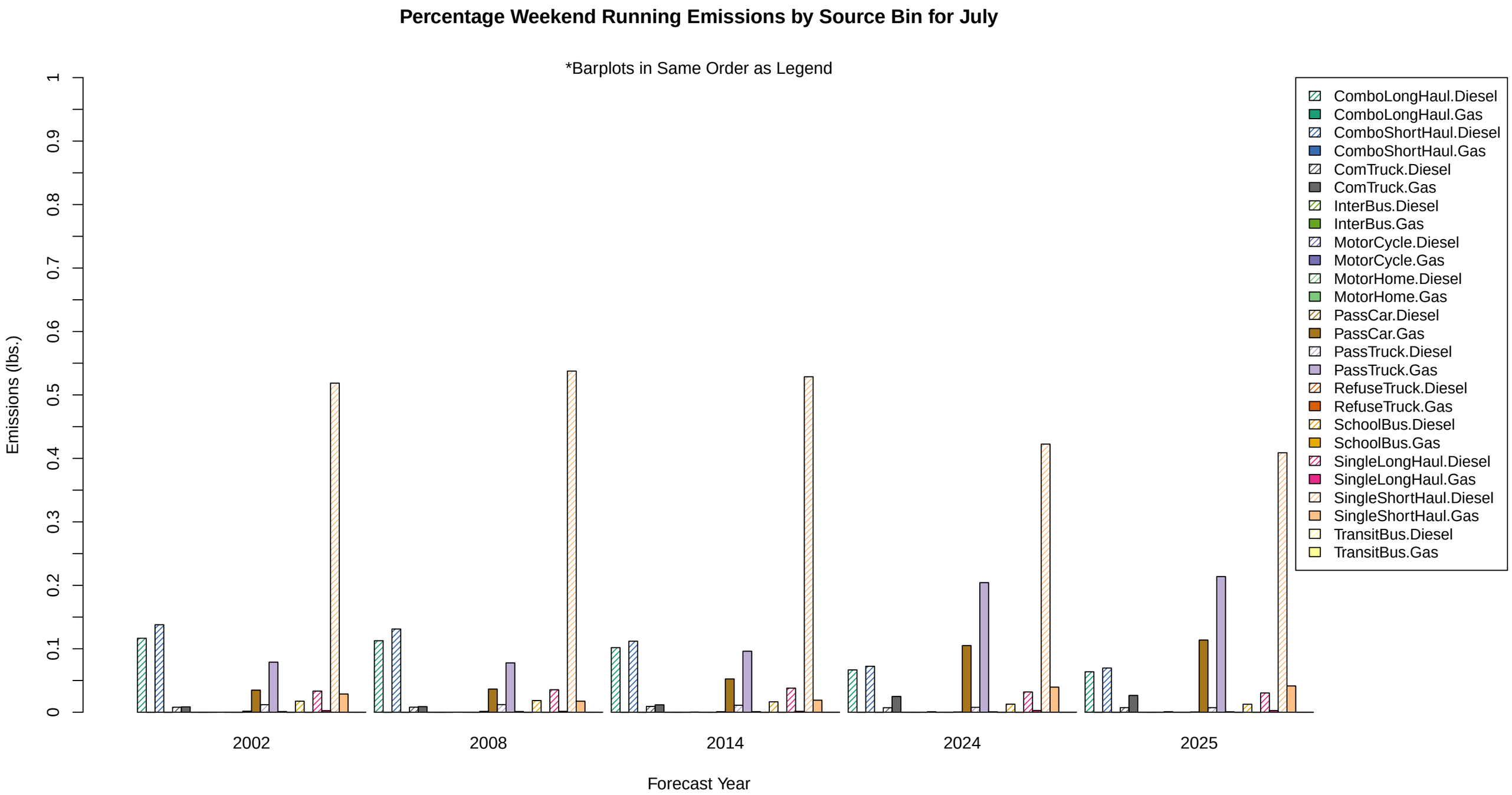
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Running Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
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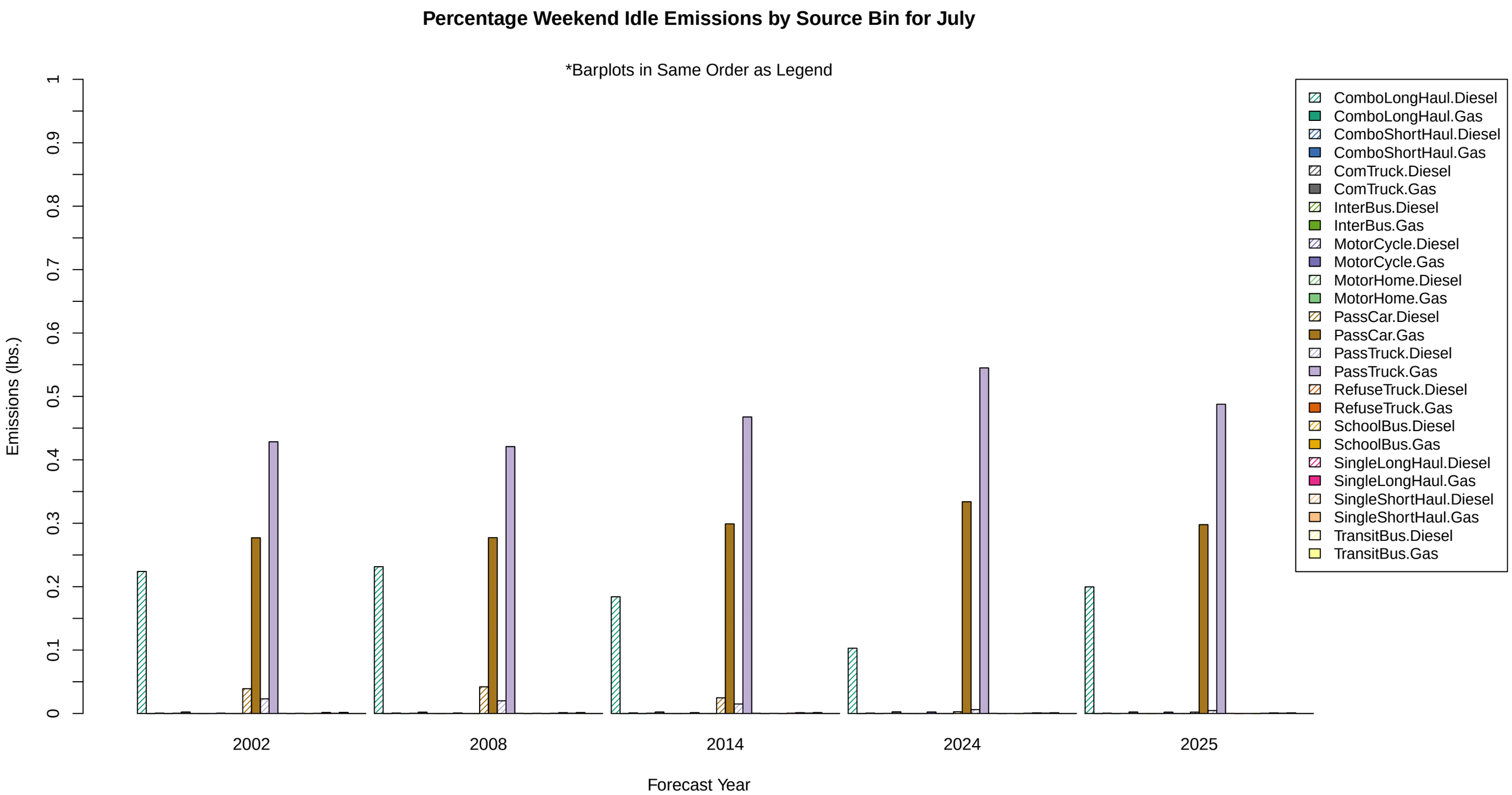
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Idle Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
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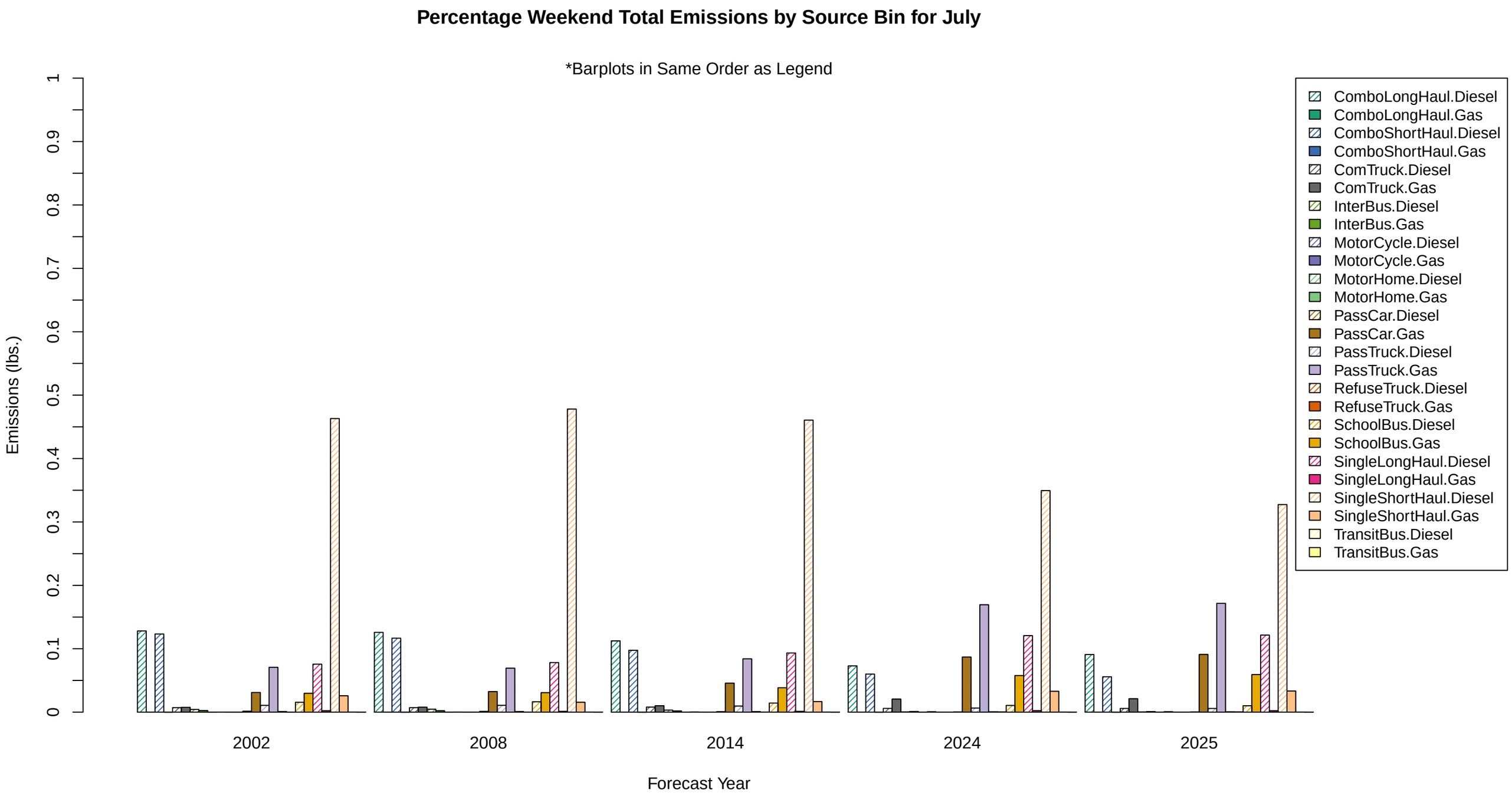
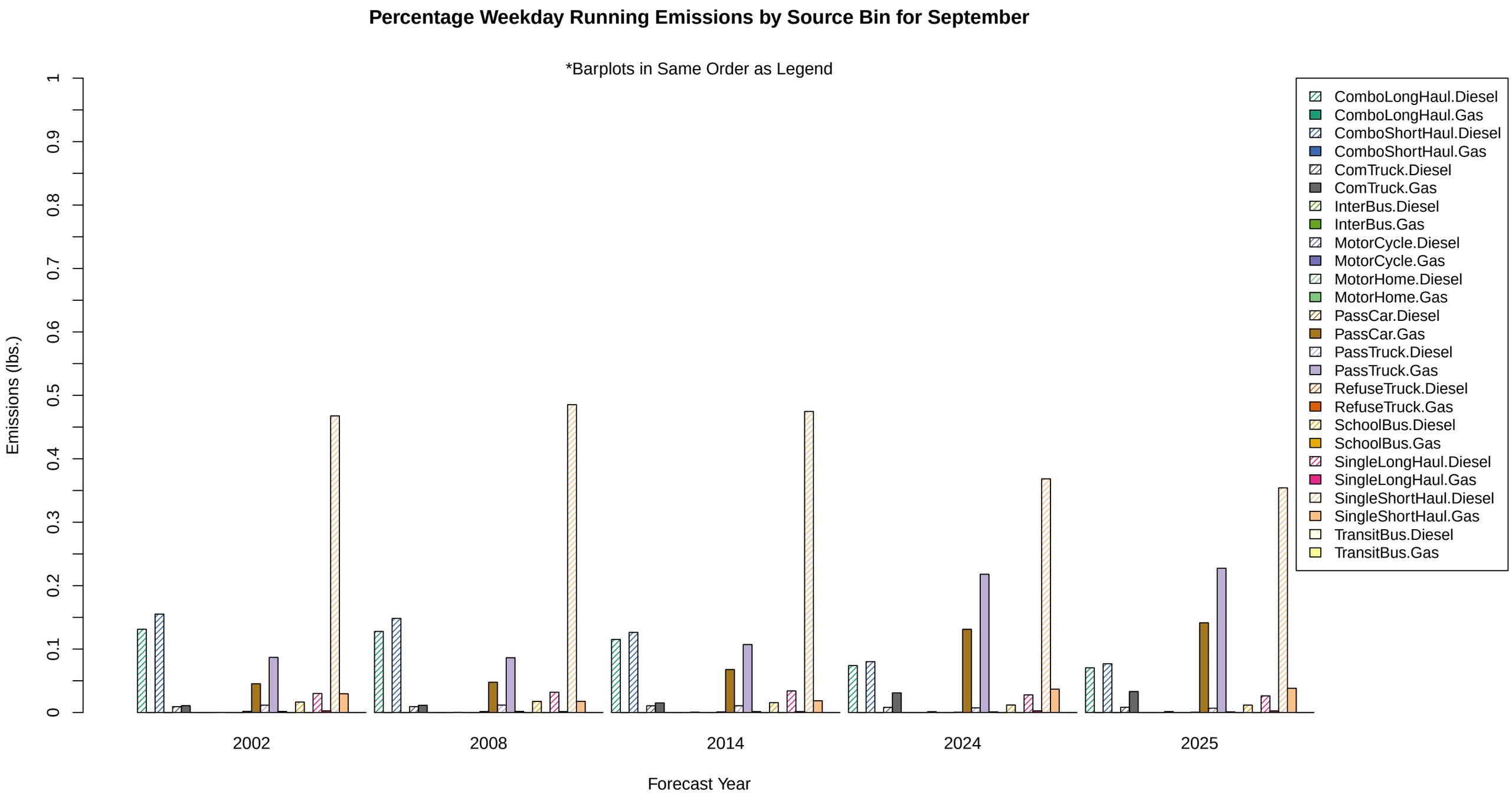
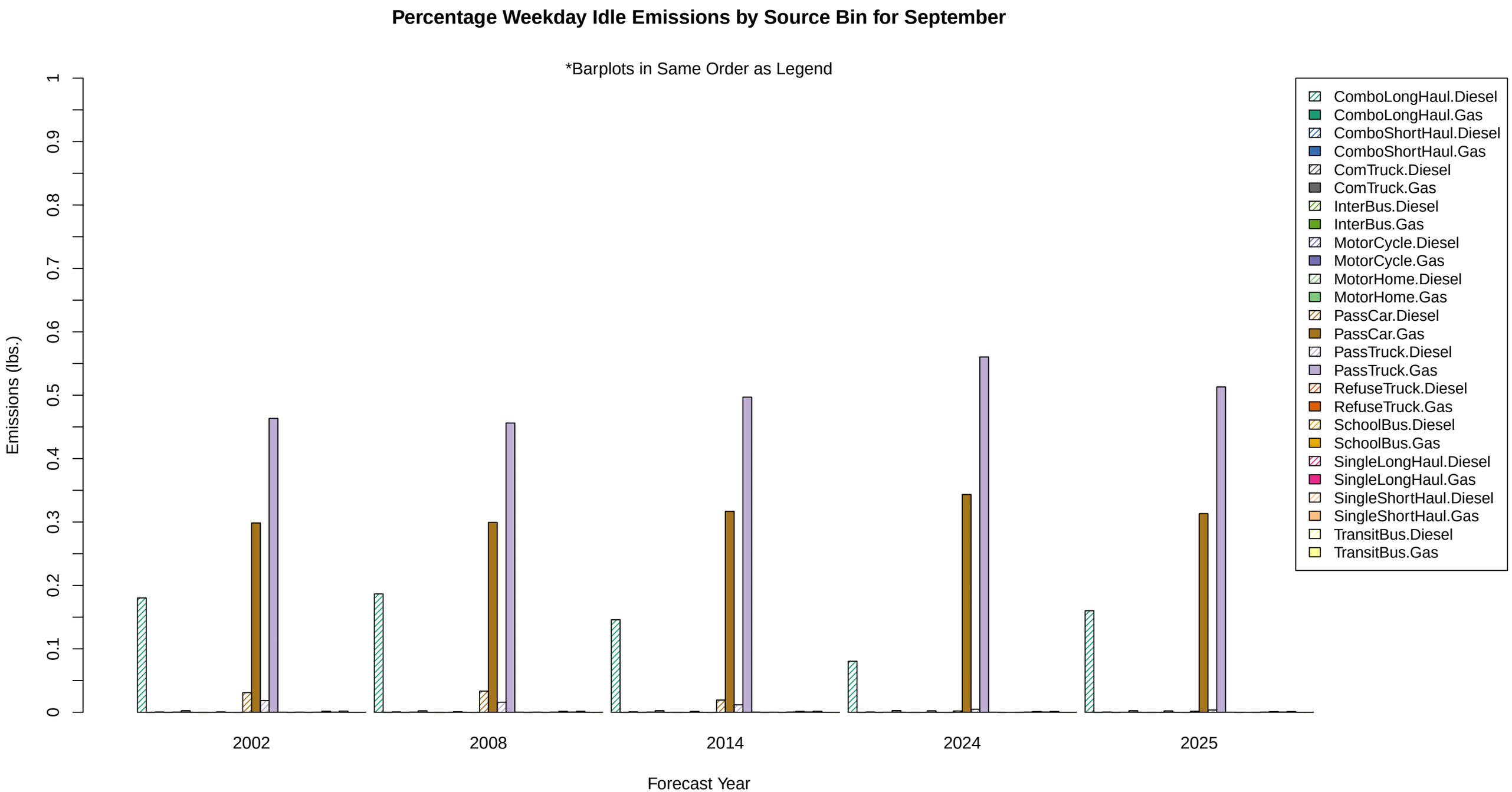
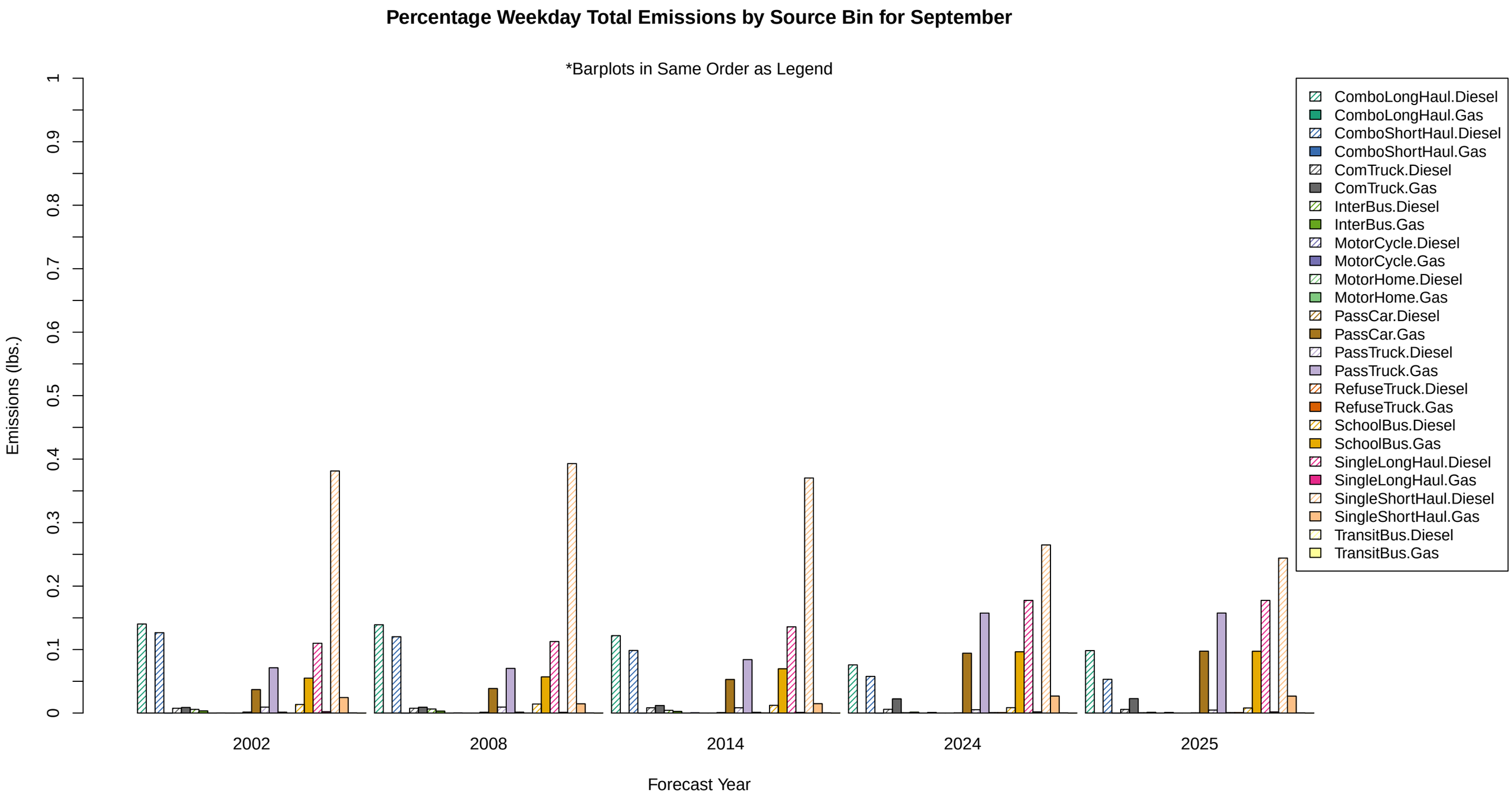
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Total Emissions by Source Bin for July
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Running Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Idle Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Total Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2002
2008
2014
2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
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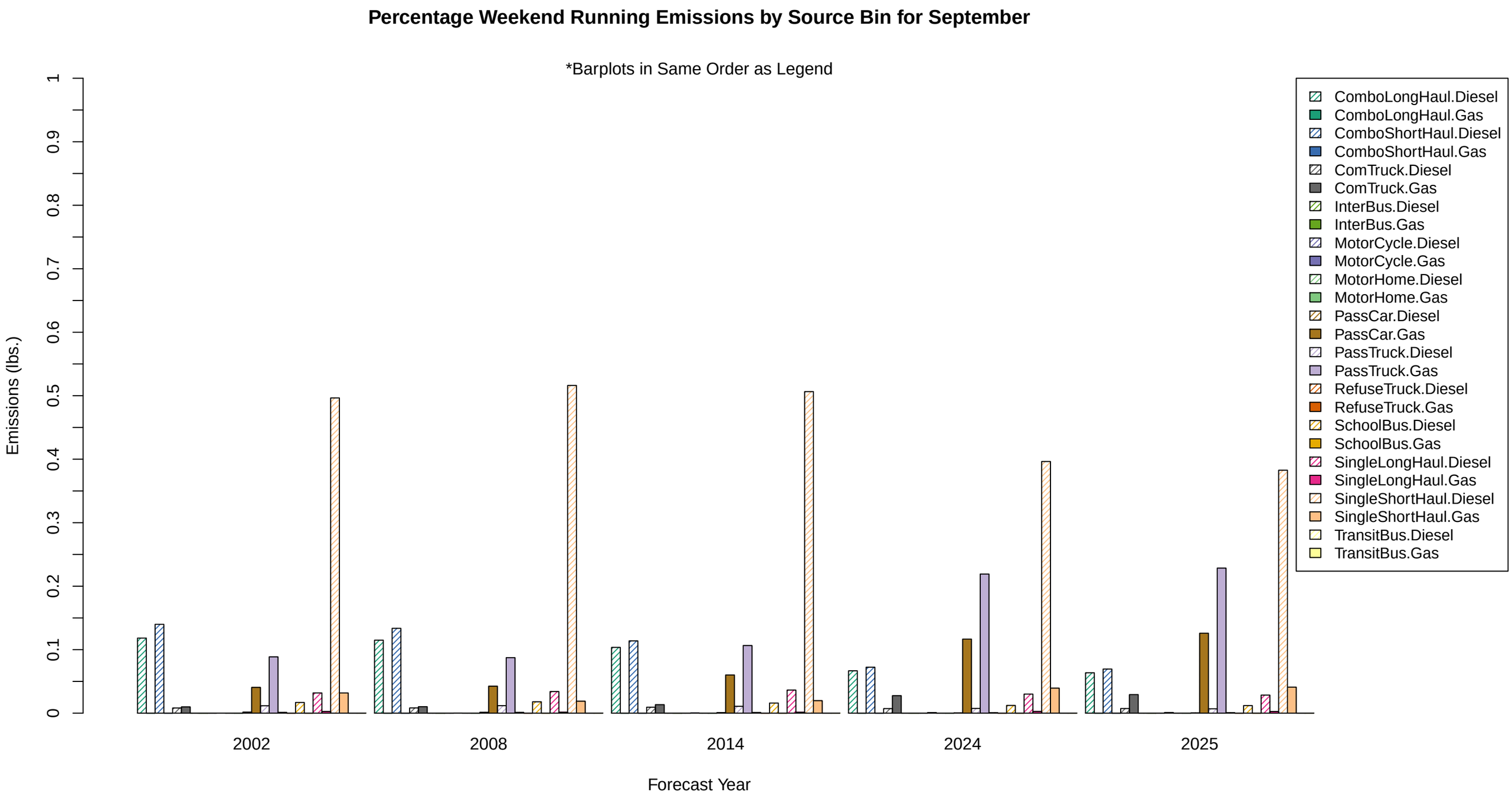
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Running Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
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0.7
0.8
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1
2002
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2014
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PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
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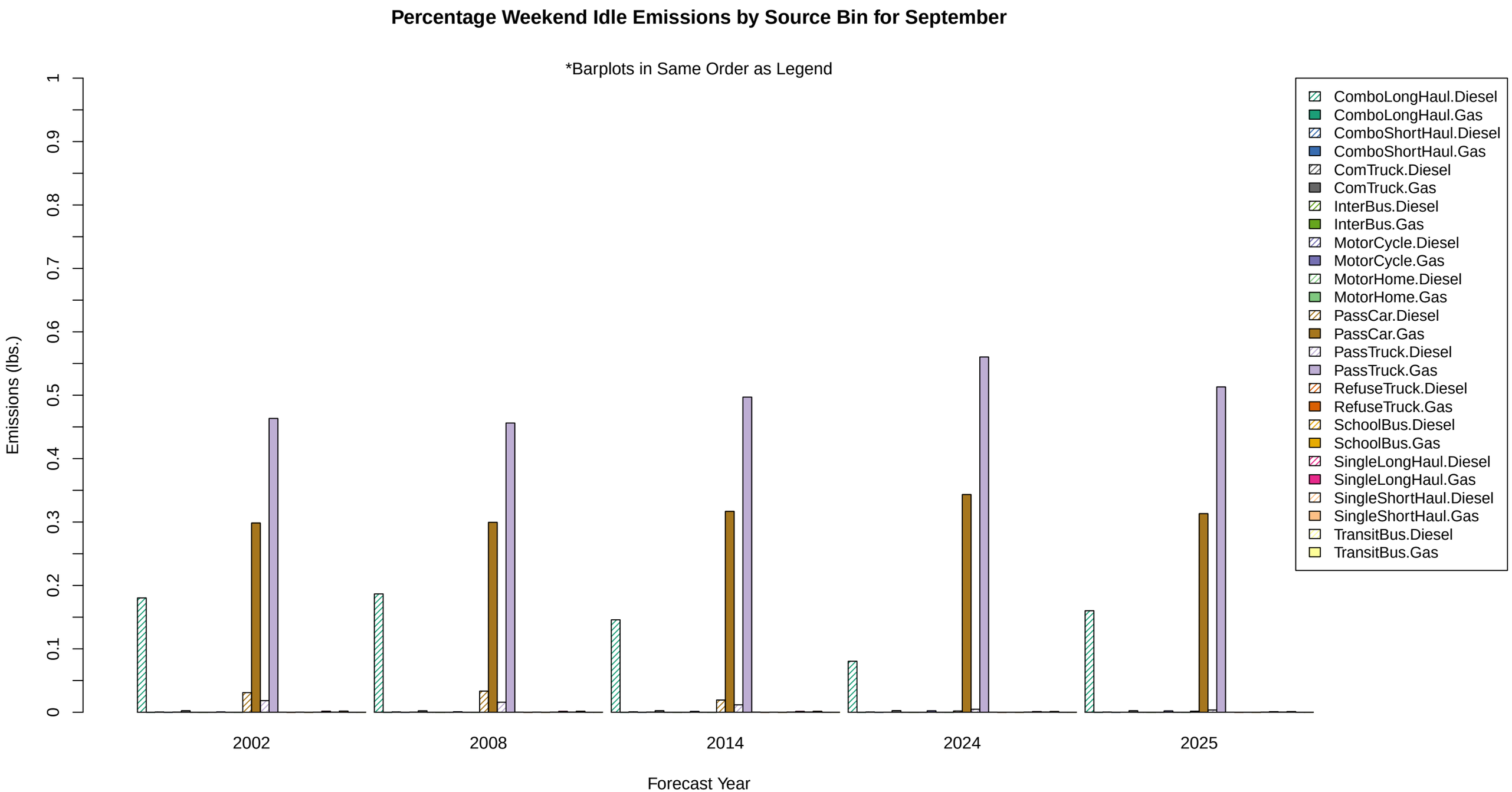
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Idle Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
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0.8
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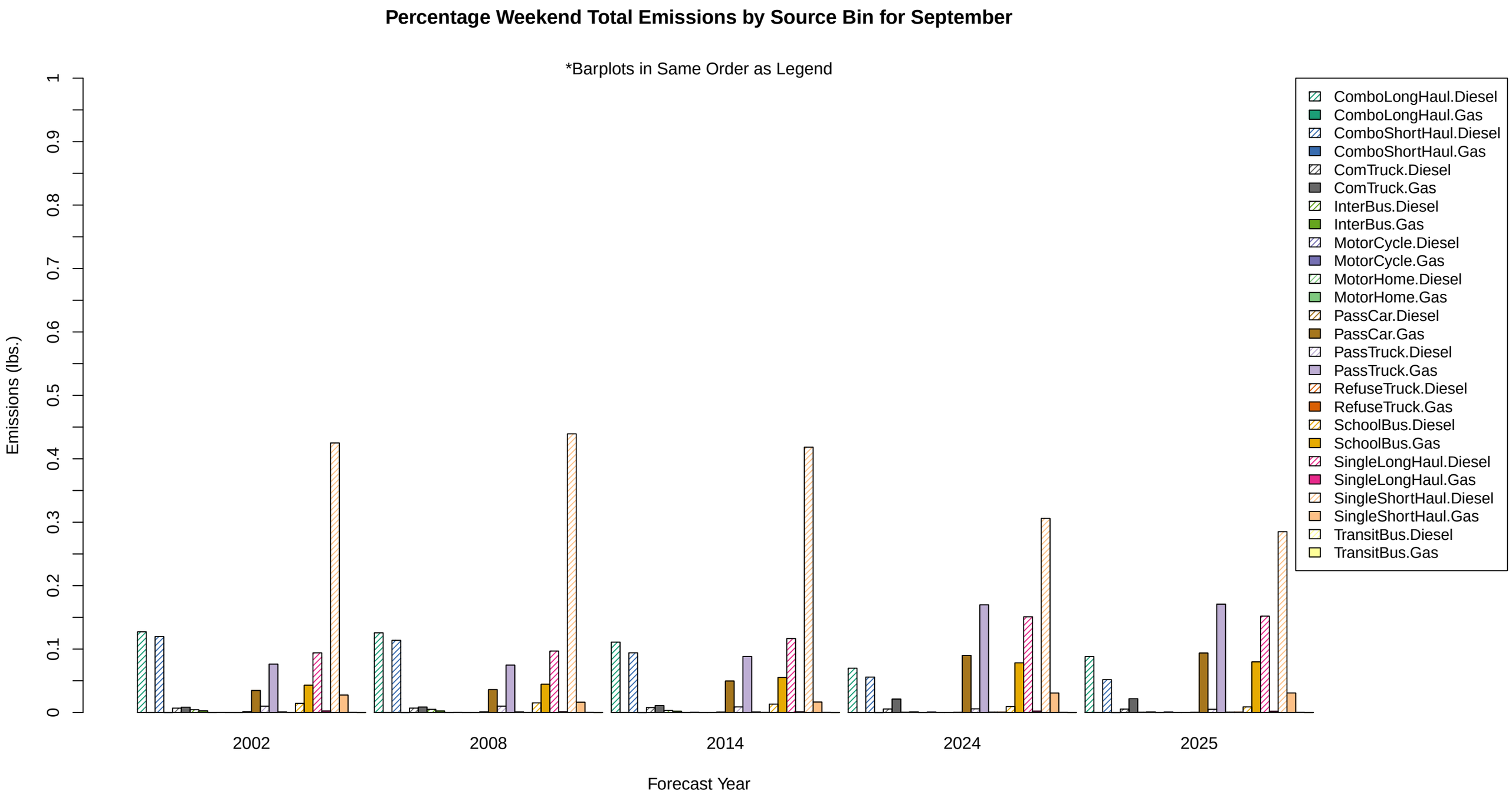
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
ComTruck.Diesel
ComTruck.Gas
InterBus.Diesel
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Total Emissions by Source Bin for September
*Barplots in Same Order as Legend
Emissions (lbs.)
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0.7
0.8
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1
2002
2008
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2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
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ComTruck.Gas
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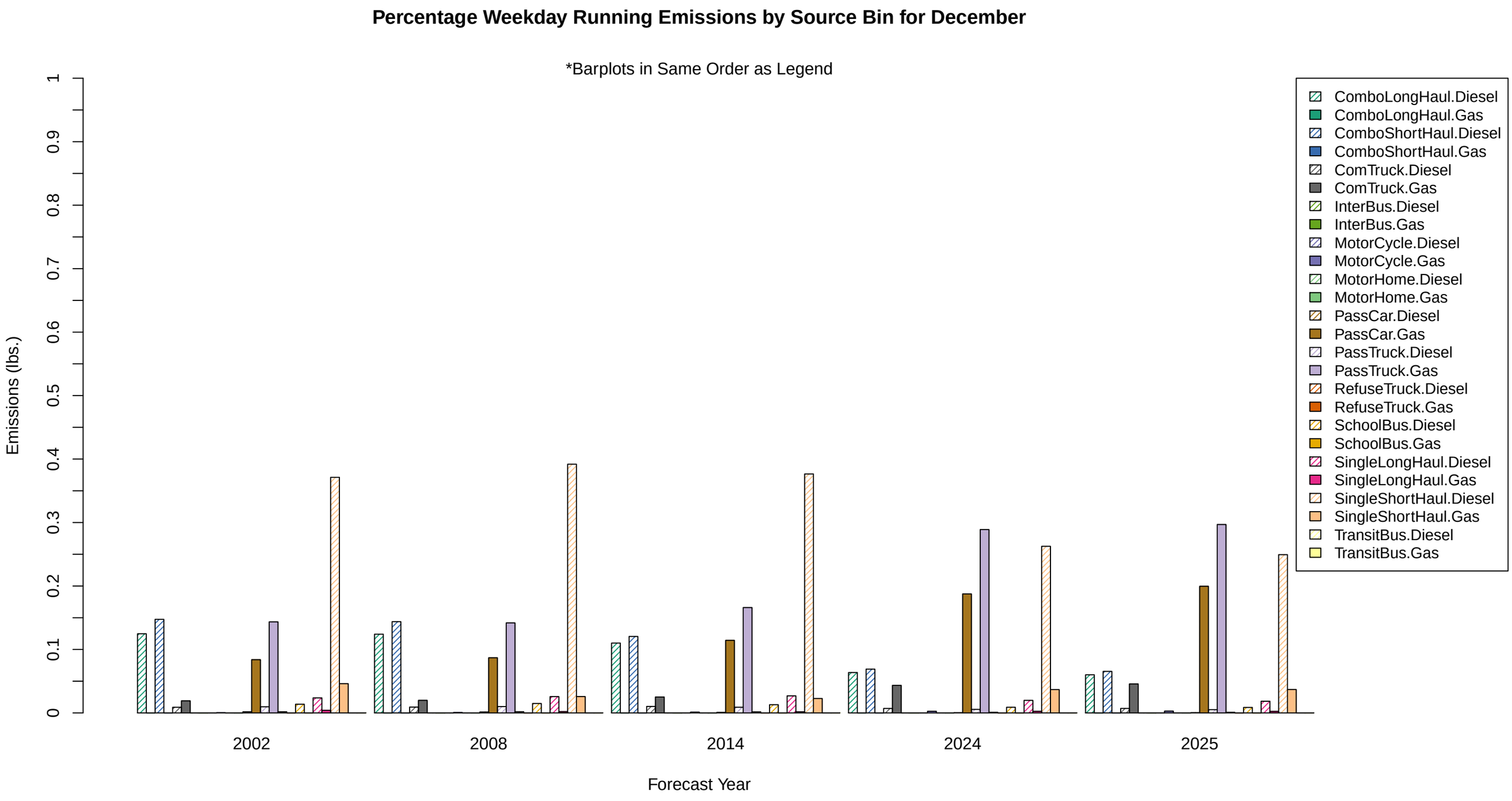
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Running Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
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Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
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InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
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PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
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SingleLongHaul.Gas
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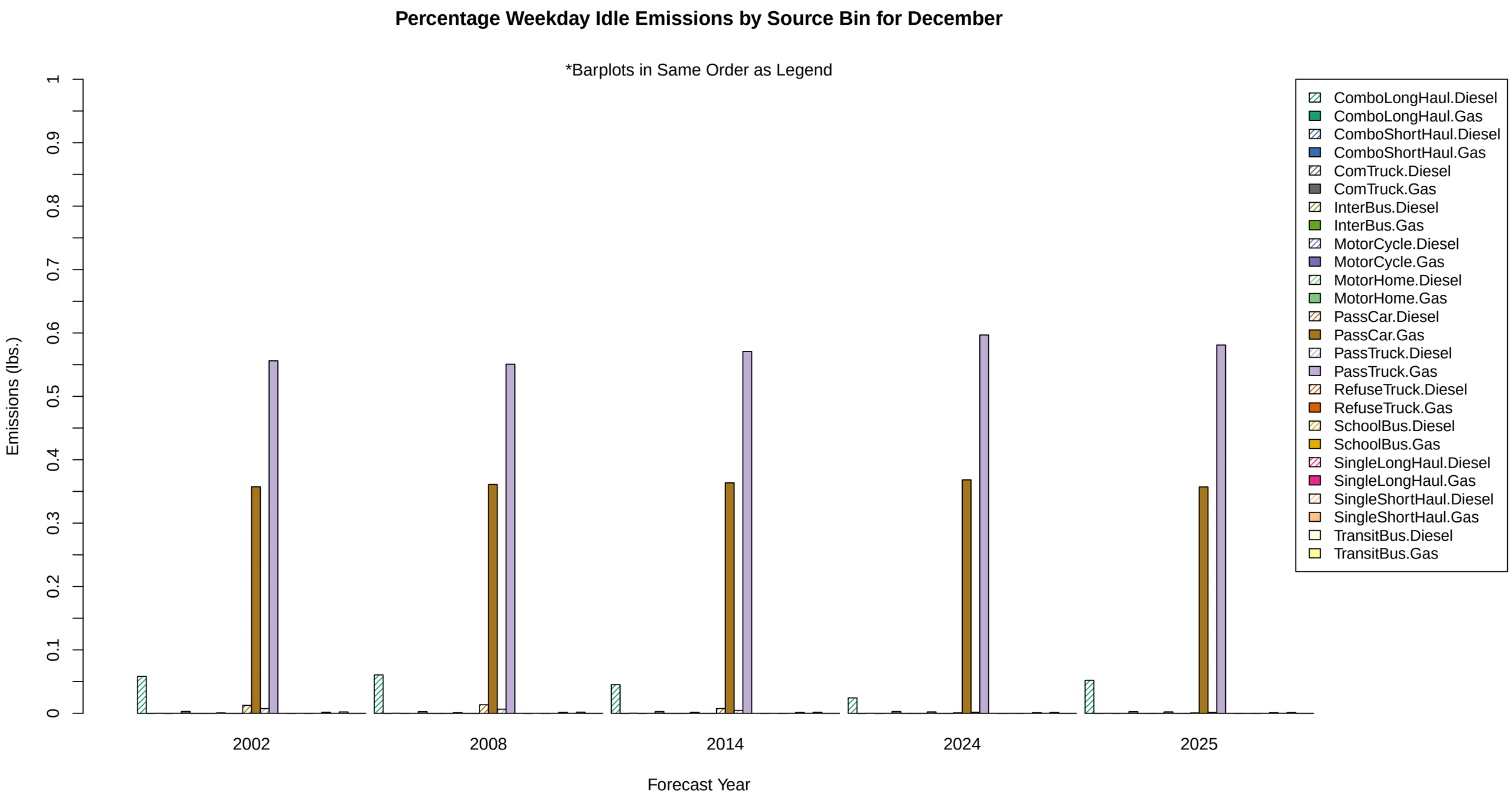
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Idle Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
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ComboLongHaul.Diesel
ComboLongHaul.Gas
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InterBus.Gas
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MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
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PassCar.Gas
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PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
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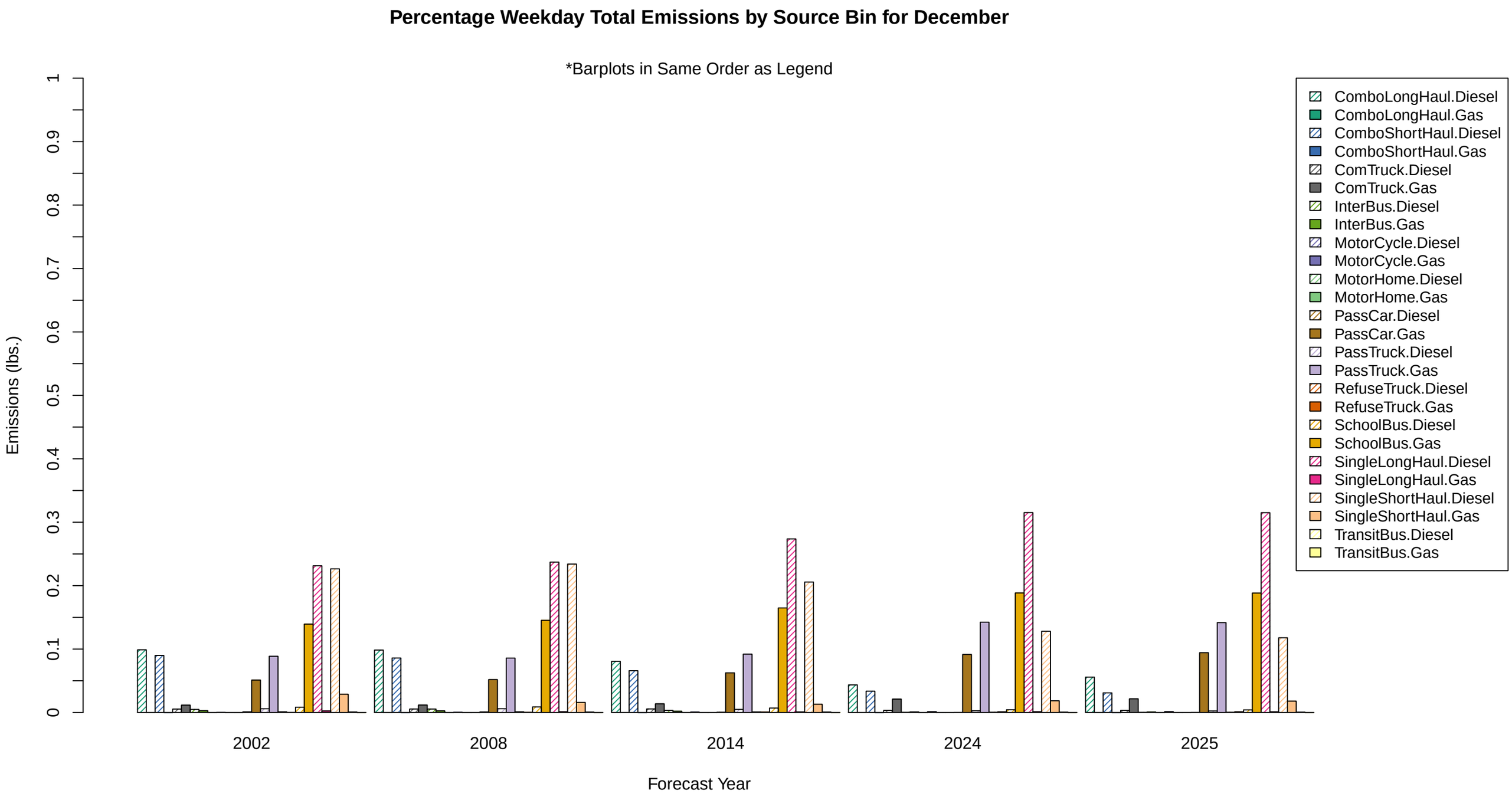
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekday Total Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
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ComboLongHaul.Gas
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PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
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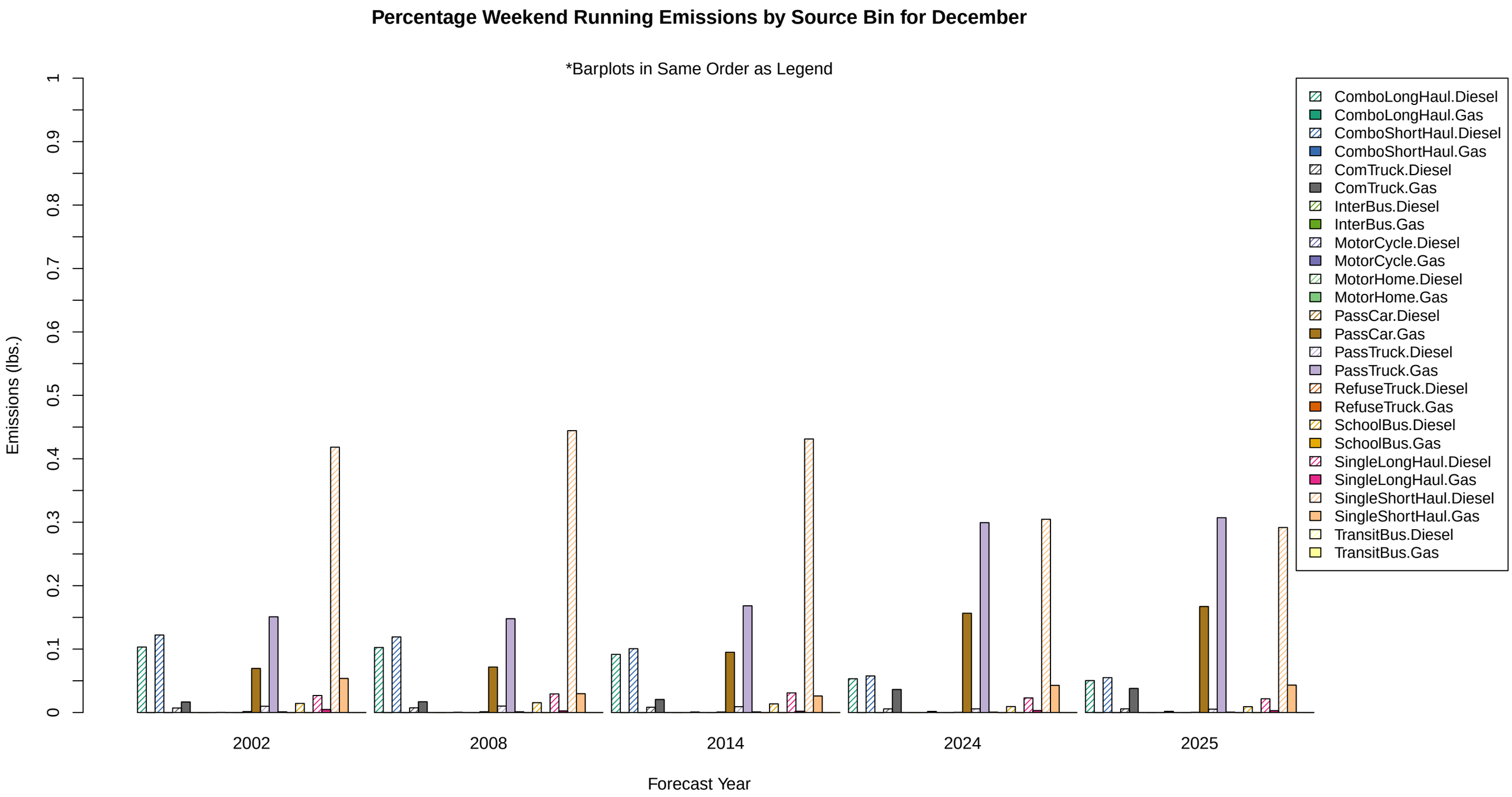
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Running Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
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0.4
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2002
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ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
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ComTruck.Gas
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InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
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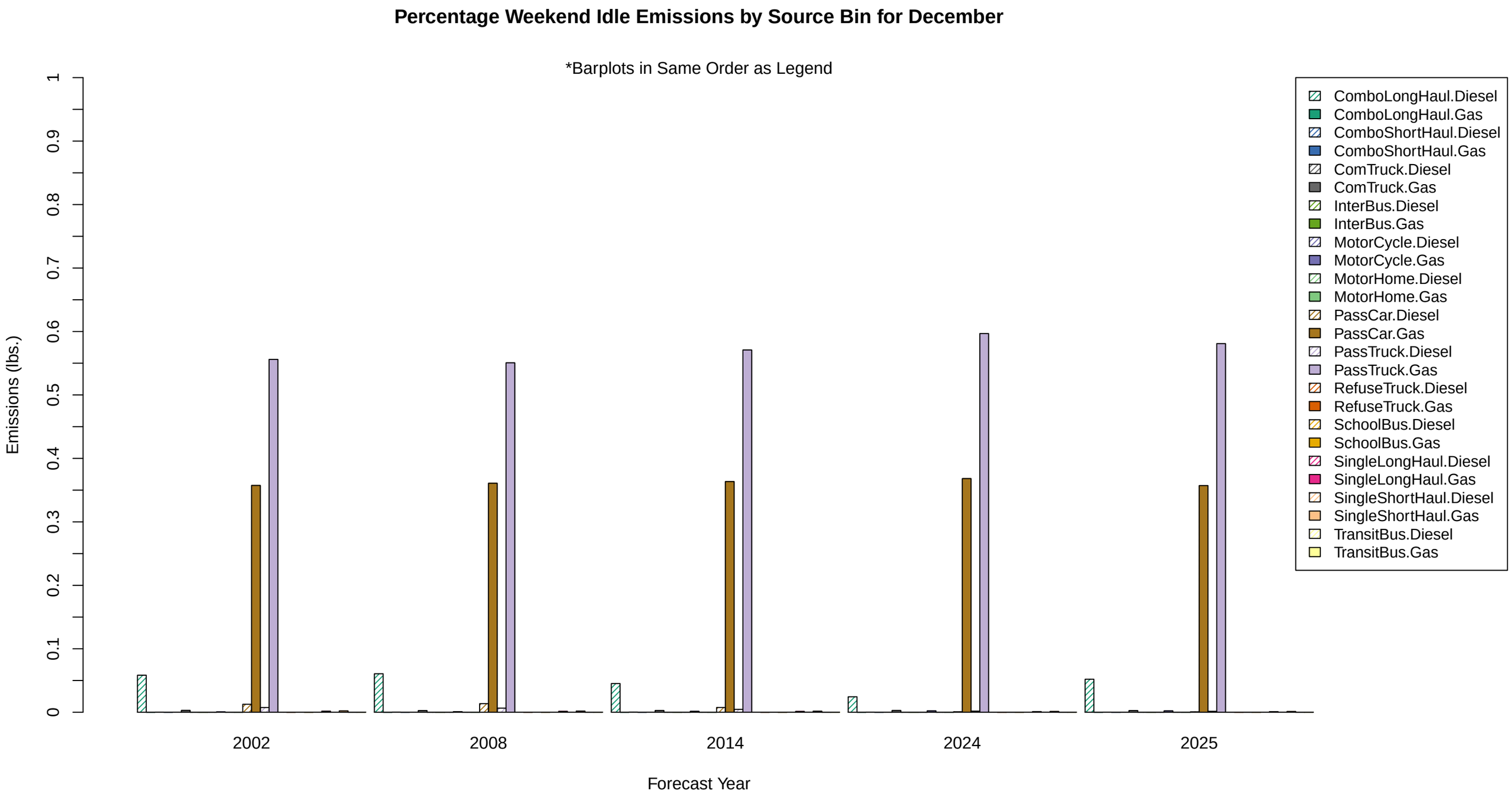
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Idle Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
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2002
2008
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2024
2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
ComboShortHaul.Diesel
ComboShortHaul.Gas
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ComTruck.Gas
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InterBus.Gas
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MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
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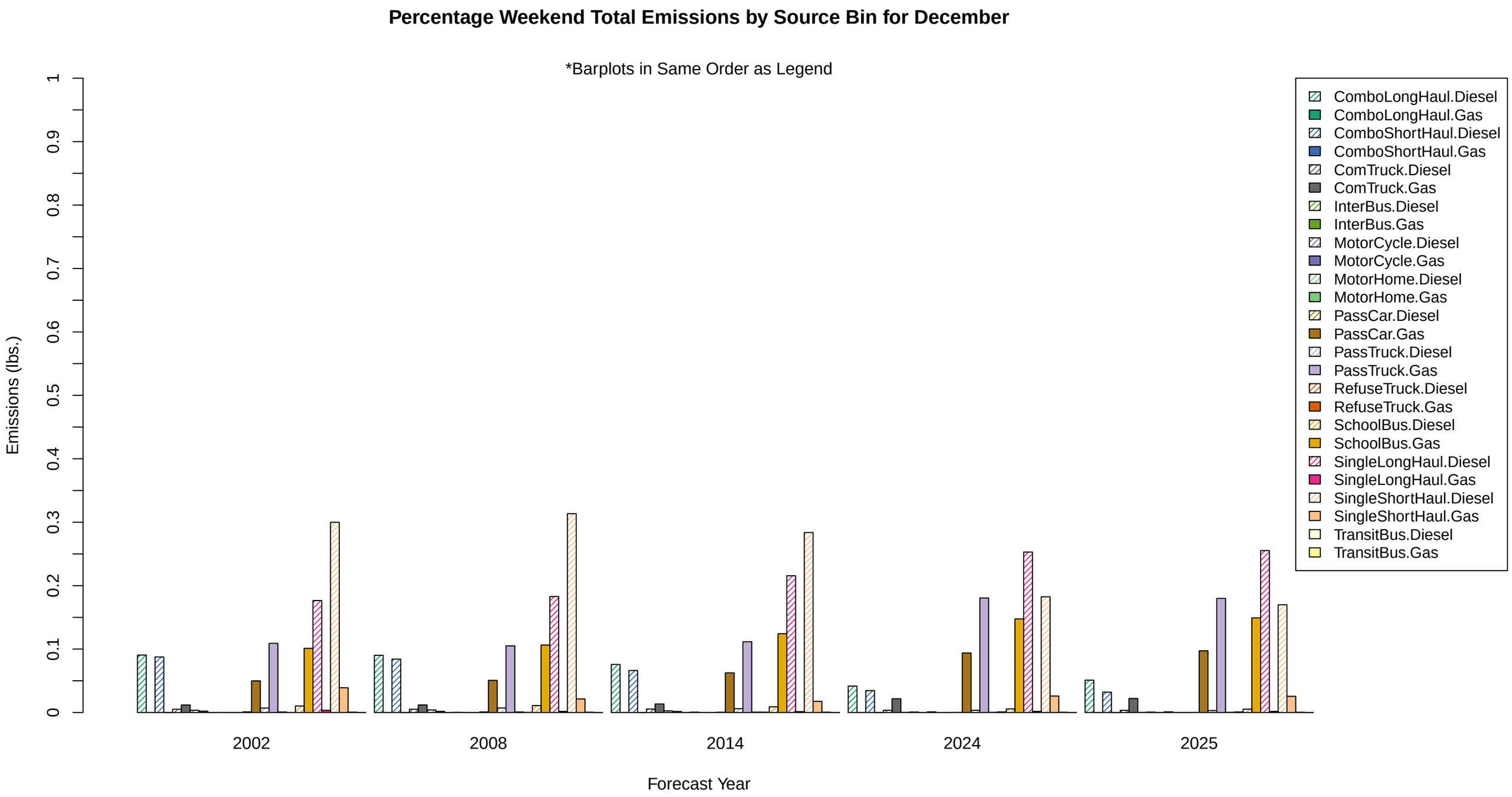
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas


Percentage Weekend Total Emissions by Source Bin for December
*Barplots in Same Order as Legend
Emissions (lbs.)
0
0.1
0.2
0.3
0.4
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0.6
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2002
2008
2014
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2025
Forecast Year
ComboLongHaul.Diesel
ComboLongHaul.Gas
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ComTruck.Gas
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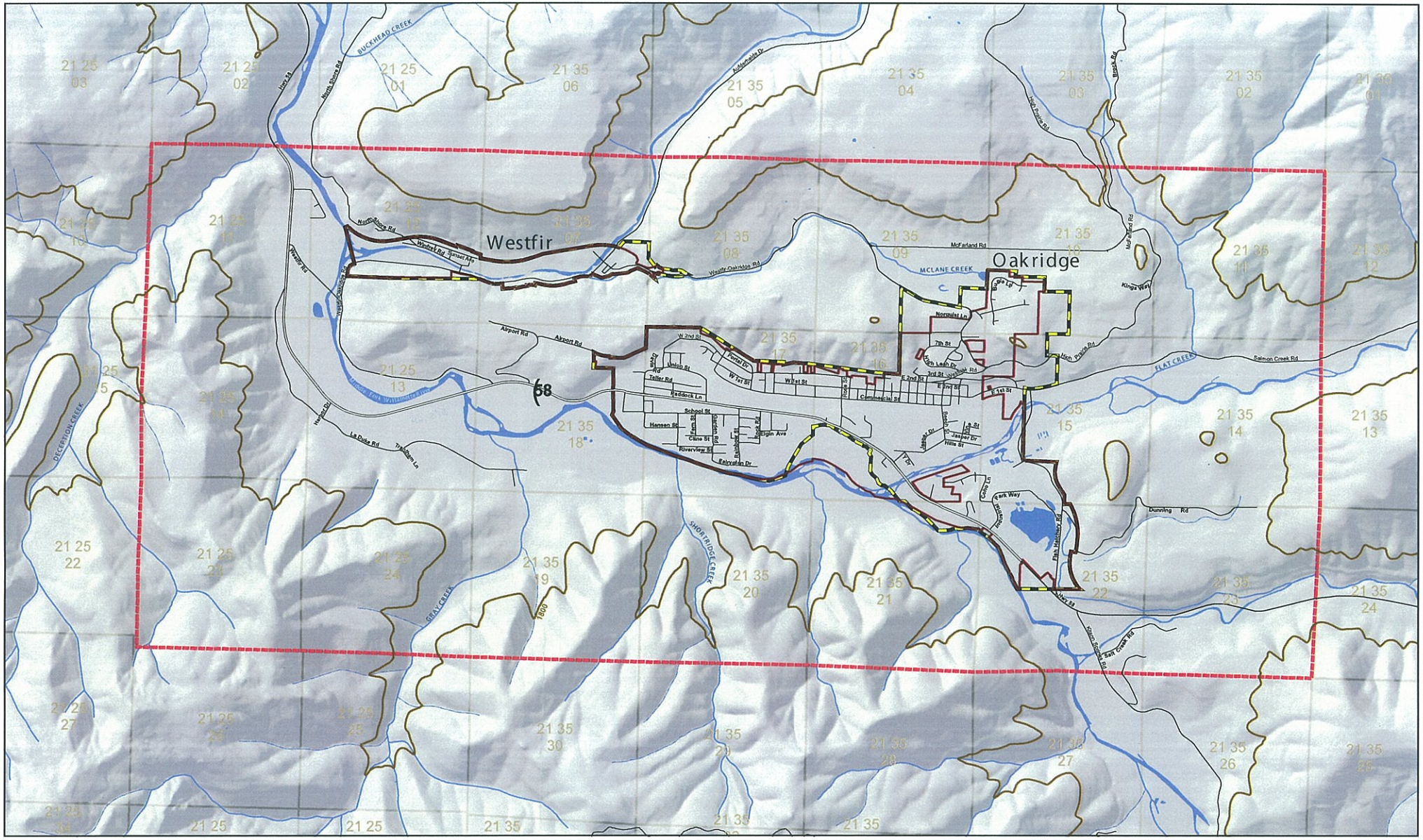
InterBus.Gas
MotorCycle.Diesel
MotorCycle.Gas
MotorHome.Diesel
MotorHome.Gas
PassCar.Diesel
PassCar.Gas
PassTruck.Diesel
PassTruck.Gas
RefuseTruck.Diesel
RefuseTruck.Gas
SchoolBus.Diesel
SchoolBus.Gas
SingleLongHaul.Diesel
SingleLongHaul.Gas
SingleShortHaul.Diesel
SingleShortHaul.Gas
TransitBus.Diesel
TransitBus.Gas

Appendix D-4
Railroad Emission Inventory

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477



EPA Non-Attainment Area
1800' Contour
City Limits
Urban Growth Boundary

Rivers and Streams
Intermittent
Perennial

Water Features
Water
Marsh

Oakridge / Westfir Oregon

0 1,000 2,000 3,000 Feet

Printing Date: March 30, 2011

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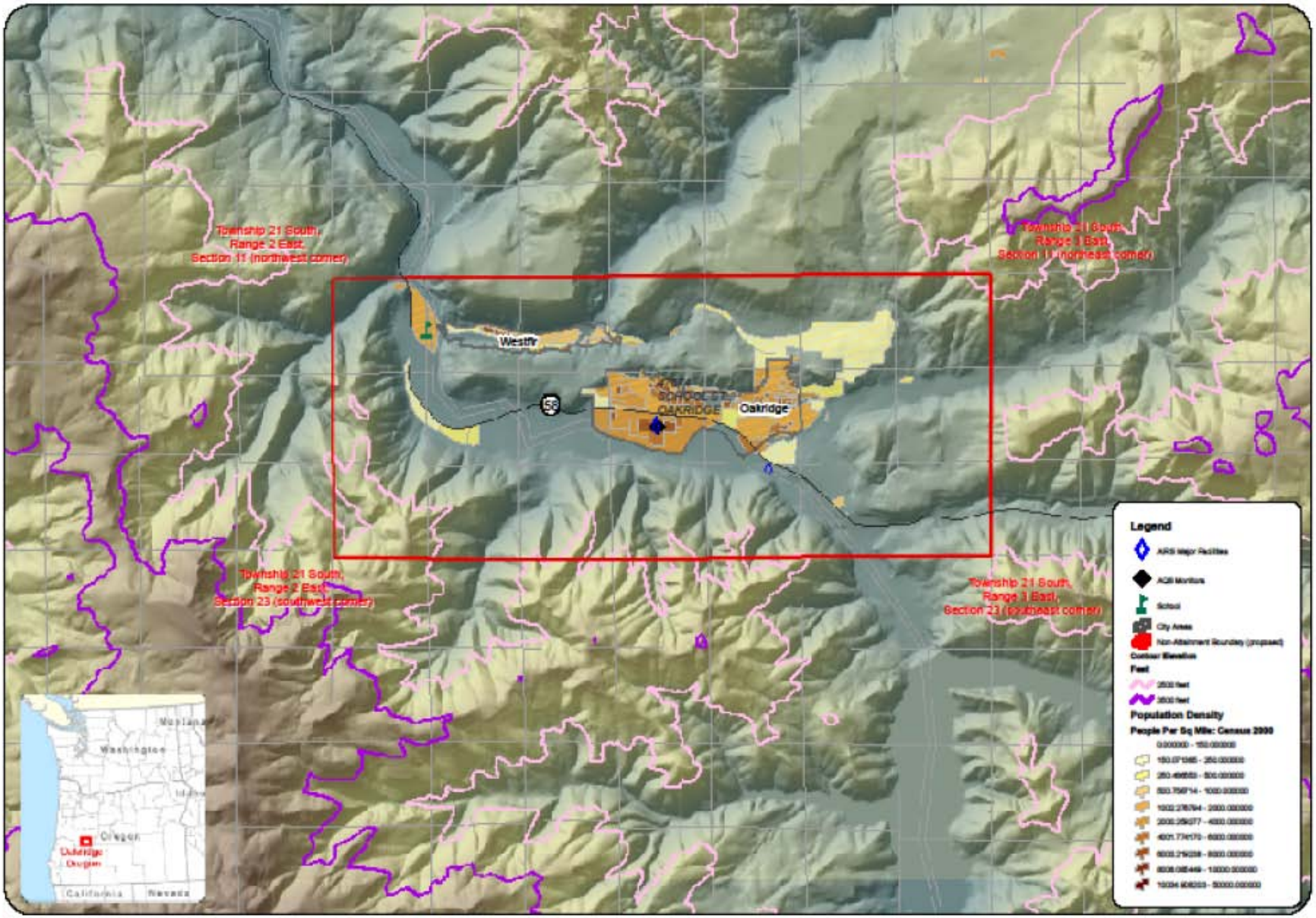
MAP PRODUCED BY:
LCOG
LANE COUNCIL OF GOVERNMENTS
859 WILLAMETTE STREET, SUITE 500
EUGENE, OREGON 97401-2910
www.lcog.org (541) 682-4283



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PM 2.5 Non-Attainment Area (proposed)
Oakridge Oregon Area
shown with Topography & Population Density

From http://www.epa.gov/pmdesignations/2006standards/final/TSD/tsd_4.0_4.10_4.10.3_r10_OR.pdf (Fig. 5.41, Page 27)

NetControl Track Network Map - Windows Internet Explorer provided by Union Pacific

https://home.www.uprr.com/tda2/secure/imap.jsp

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Favorites

Engineering - Facilities Infor... | NetControl Track Networ...

Page Safety Tools

Search or Identify on layer AEI Reader for

Street Satellite

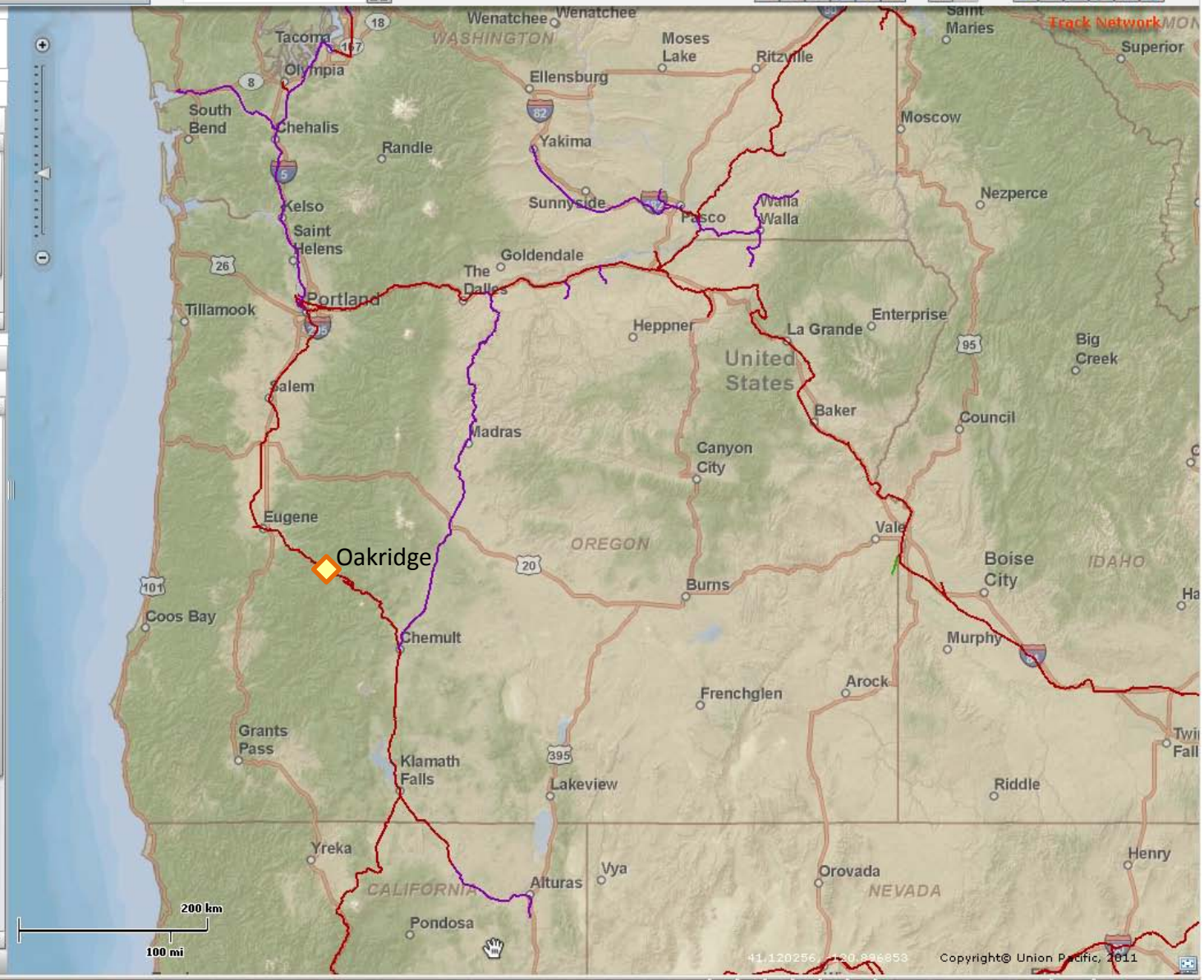
Data Tools Bookmarks

Overlay	Visibility
Track Network	ON
Slow Orders	
Heat / Cold Orders	
Dark Territories	
Bridges and Tunnels	
Telecom Facilities	
Supervisor Territories	
Network Velocity Impact	

Overlay Layers

Visible	Layer
	Point Locations
☑	Mile Post
☐	Mile Post Equation
☐	Rail Crossing
☐	Circ7 Station
☐	Road Crossing
☐	AEI Reader
☐	Control Point
☐	Switch
☐	Signal
☐	Detection Device
	Area - Spans
☐	Bridge
☐	Tunnel
☐	Dark Territory
☐	Subdivision
	Service Unit
☐	Southern
☐	Northern
☐	Western
☐	Region
☐	Dispatcher Key

Feedback



Done

Local intranet

105%

NetControl Track Network Map - Windows Internet Explorer provided by Union Pacific

https://home.www.uprr.com/tda2/secure/imap.jsp

File Edit View Favorites Tools Help

Favorites

Engineering - Facilities Infor... | NetControl Track Networ...

Page Safety Tools

Search or Identify on layer AEI Reader for

Street Satellite

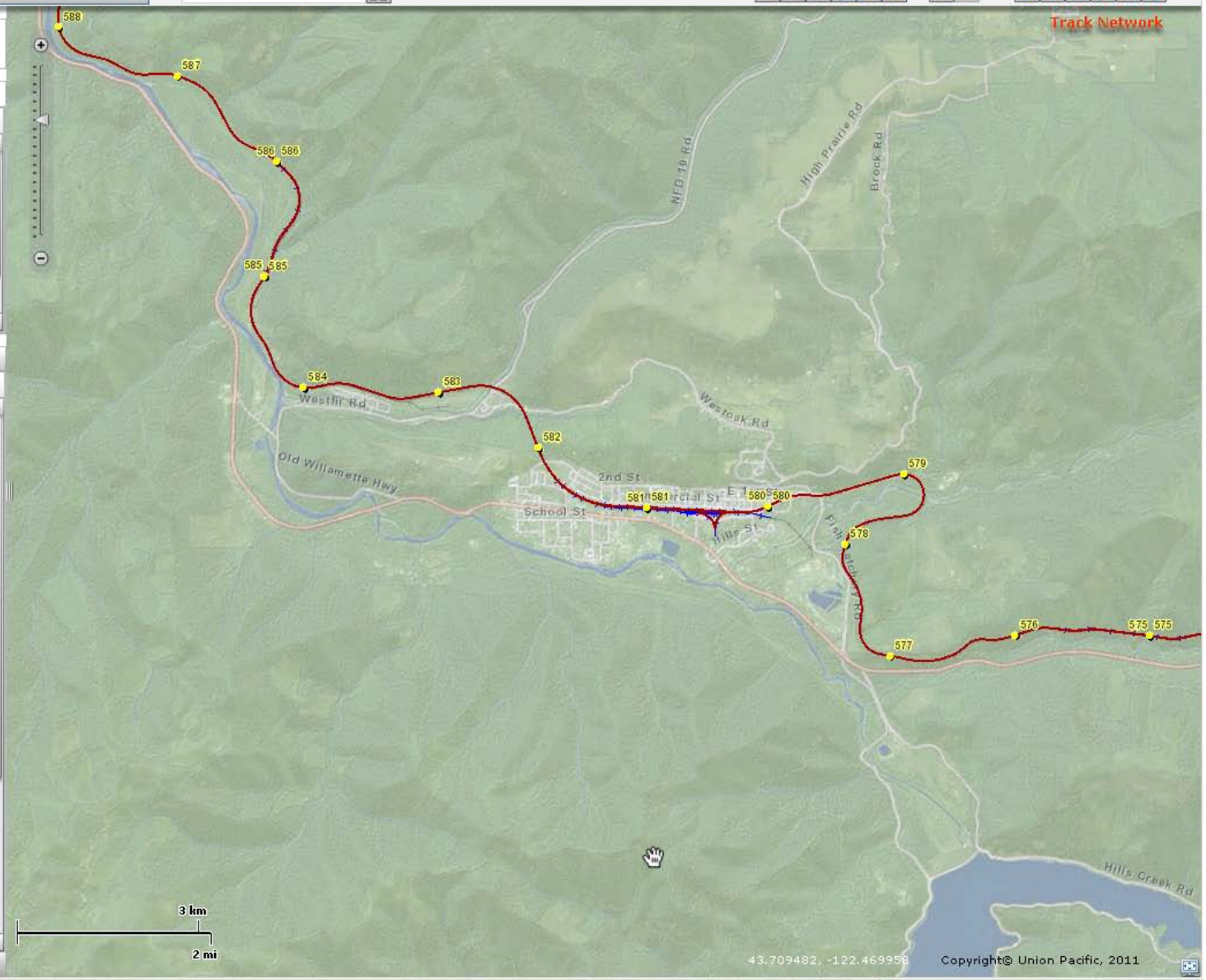
Data Tools Bookmarks

Overlay	Visibility
Track Network	ON
Slow Orders	
Heat / Cold Orders	
Dark Territories	
Bridges and Tunnels	
Telecom Facilities	
Supervisor Territories	
Network Velocity Impact	

Overlay Layers

Visible	Layer
	Point Locations
☑	Mile Post
☐	Mile Post Equation
☐	Rail Crossing
☐	Circ7 Station
☐	Road Crossing
☐	AEI Reader
☐	Control Point
☐	Switch
☐	Signal
☐	Detection Device
	Area - Spans
☐	Bridge
☐	Tunnel
☐	Dark Territory
☐	Subdivision
	Service Unit
☐	Southern
☐	Northern
☐	Western
☐	Region
☐	Dispatcher Key

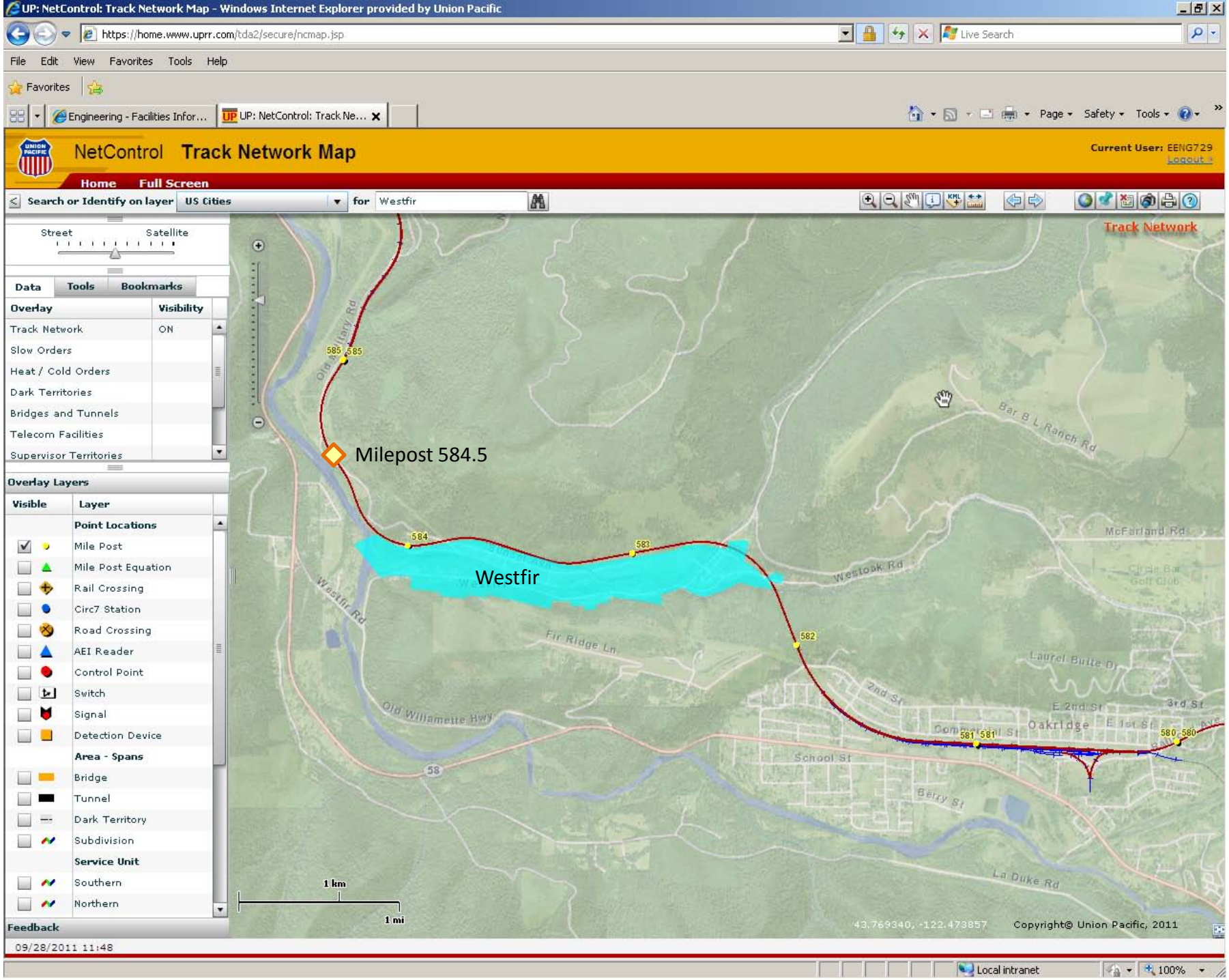
Feedback



Done

Local intranet

105%


UP: NetControl: Track Network Map - Windows Internet Explorer provided by Union Pacific
https://home.www.uprr.com/tda2/secure/ncmap.jsp
NetControl Track Network Map
Current User: EENG729
Logout
Home
Full Screen
Search or Identify on layer
US Cities
for
Westfir
Track Network
Street
Satellite
Data
Tools
Bookmarks
Overlay
Visibility
Track Network
ON
Slow Orders
Heat / Cold Orders
Dark Territories
Bridges and Tunnels
Telecom Facilities
Supervisor Territories
Overlay Layers
Visible
Layer
Point Locations
Mile Post
Mile Post Equation
Rail Crossing
Circ7 Station
Road Crossing
AEI Reader
Control Point
Switch
Signal
Detection Device
Area - Spans
Bridge
Tunnel
Dark Territory
Subdivision
Service Unit
Southern
Northern
Feedback
Milepost 584.5
Westfir
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584
583
582
581
580
Old Military Rd
Westfir Rd
Fir Ridge Ln
Old Willamette Hwy
Westoak Rd
Bar B L Ranch Rd
McFarland Rd
Laurel Butte Dr
Oakridge
School St
Berry St
La Duke Rd
58
1 km
1 mi
43.769340, -122.473857
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09/28/2011 11:48
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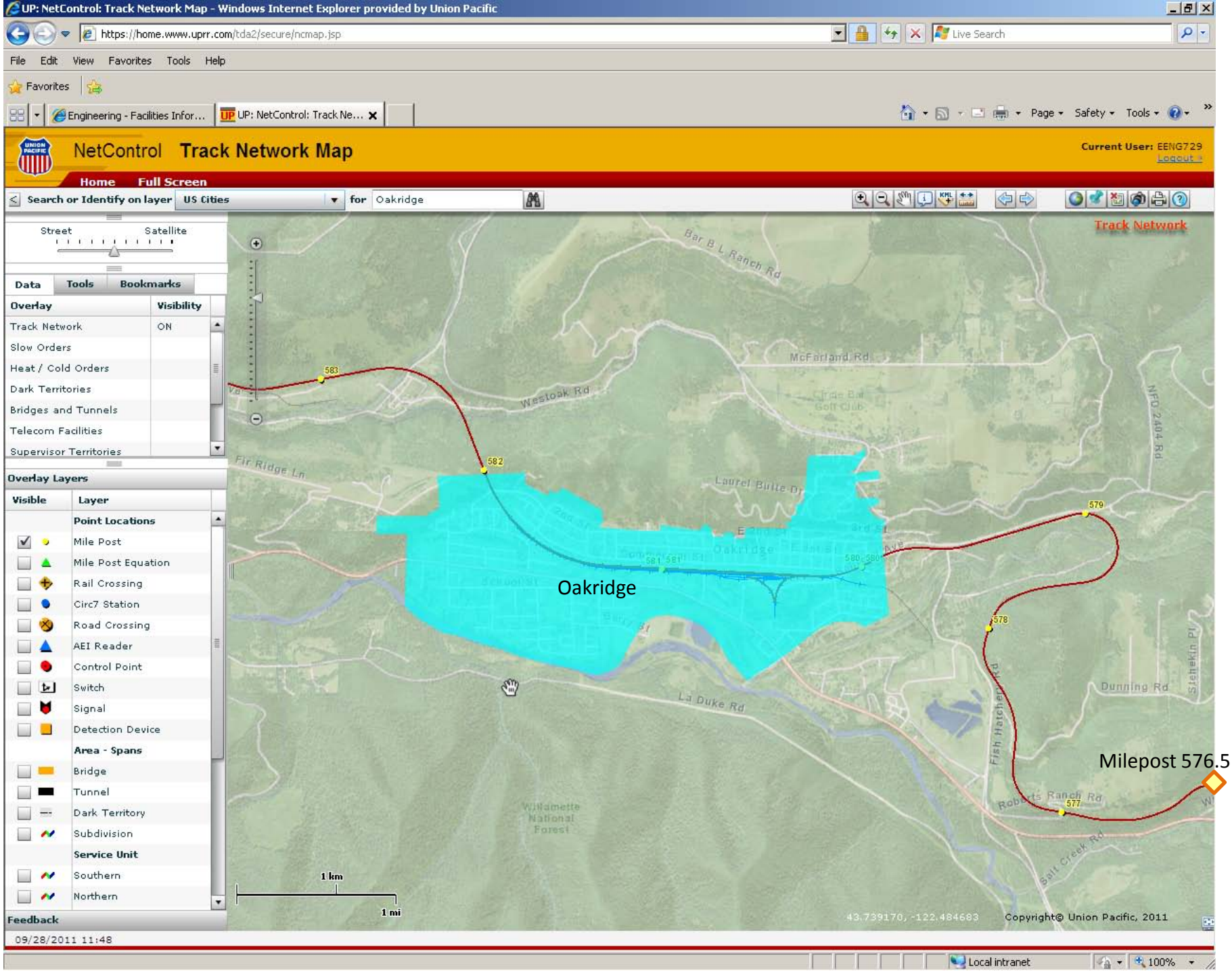
UP: NetControl: Track Network Map - Windows Internet Explorer provided by Union Pacific
https://home.www.uprr.com/tda2/secure/ncmap.jsp
NetControl Track Network Map
Current User: EENG729
Logout
Home
Full Screen
Search or Identify on layer
US Cities
for
Oakridge
Track Network
Street
Satellite
Data
Tools
Bookmarks
Overlay
Visibility
Track Network
ON
Slow Orders
Heat / Cold Orders
Dark Territories
Bridges and Tunnels
Telecom Facilities
Supervisor Territories
Overlay Layers
Visible
Layer
Point Locations
Mile Post
Mile Post Equation
Rail Crossing
Circ7 Station
Road Crossing
AEI Reader
Control Point
Switch
Signal
Detection Device
Area - Spans
Bridge
Tunnel
Dark Territory
Subdivision
Service Unit
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Oakridge
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583
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Bar B L Ranch Rd
McFarland Rd
Westlake Rd
Fir Ridge Ln
Laurel Butte Dr
La Duke Rd
Dunning Rd
Fish Hatchery Rd
Roberts Ranch Rd
Salt Creek Rd
Willamette National Forest
1 km
1 mi
43.739170, -122.484683
Copyright© Union Pacific, 2011
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Appendix D-5
Lane County 2008 Emission Inventory
from 2008 National Emission Inventory (NEI)
with Initial Screening EIs for PM2.5, NOx, SO2, VOC and NH3

Oakridge-Westfir $PM_{2.5}$ Nonattainment Area

Lane Regional Air Protection Agency
1010 Main Street
Springfield, Oregon 97477

Lane County 2008 Emission Inventory for PM2.5 from the 2008 National Emission Inventory (NEI).

EI_sector	pollutant_code	description	emissions	uom	Oakridge	Annual	Winter
Agriculture - Crops & Livestock Dust	PM25-PRI	PM2.5 Primary (Filt + Cond)	30.07	TON	No	0.00	Insignificant
Commercial Cooking	PM25-PRI	PM2.5 Primary (Filt + Cond)	88.82	TON	Yes	0.10	Insignificant
Dust - Construction Dust	PM25-PRI	PM2.5 Primary (Filt + Cond)	178.52	TON	Yes	0.21	Insignificant
Dust - Paved Road Dust	PM25-PRI	PM2.5 Primary (Filt + Cond)	325.88	TON	Yes	3.70	Significant
Dust - Unpaved Road Dust	PM25-PRI	PM2.5 Primary (Filt + Cond)	1181.65	TON	No	0.00	Insignificant
Fires - Agricultural Field Burning	PM25-PRI	PM2.5 Primary (Filt + Cond)	1.20	TON	No	0.00	Insignificant
Fires - Prescribed Fires	PM25-PRI	PM2.5 Primary (Filt + Cond)	2246.15	TON	No	0.00	Insignificant
Fires - Wildfires	PM25-PRI	PM2.5 Primary (Filt + Cond)	2126.43	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Biomass	PM25-PRI	PM2.5 Primary (Filt + Cond)	74.91	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	PM25-PRI	PM2.5 Primary (Filt + Cond)	4.71	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Oil	PM25-PRI	PM2.5 Primary (Filt + Cond)	11.16	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Other	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.64	TON	No	0.00	Insignificant
Fuel Comb - Residential - Natural Gas	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.36	TON	No	0.00	Insignificant
Fuel Comb - Residential - Oil	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.92	TON	Yes	0.01	Insignificant
Fuel Comb - Residential - Other	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.03	TON	Yes	0.00	Insignificant
Fuel Comb - Residential - Wood	PM25-PRI	PM2.5 Primary (Filt + Cond)	1453.18	TON	Yes	16.50	Significant
Industrial Processes - Chemical Manuf	PM25-PRI	PM2.5 Primary (Filt + Cond)	577.47	TON	No	0.00	Insignificant
Industrial Processes - Mining	PM25-PRI	PM2.5 Primary (Filt + Cond)	50.83	TON	No	0.00	Insignificant
Industrial Processes - NEC	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.89	TON	No	0.00	Insignificant
Industrial Processes - Pulp & Paper	PM25-PRI	PM2.5 Primary (Filt + Cond)	368.91	TON	No	0.00	Insignificant
Industrial Processes - Storage and Transfer	PM25-PRI	PM2.5 Primary (Filt + Cond)	42.83	TON	No	0.00	Insignificant
Miscellaneous Non-Industrial NEC	PM25-PRI	PM2.5 Primary (Filt + Cond)	0.07	TON	No	0.00	Insignificant
Mobile - Aircraft	PM25-PRI	PM2.5 Primary (Filt + Cond)	1.60	TON	Yes	0.02	Insignificant
Mobile - Locomotives	PM25-PRI	PM2.5 Primary (Filt + Cond)	40.09	TON	Yes	0.46	Significant
Mobile - Non-Road Equipment - Diesel	PM25-PRI	PM2.5 Primary (Filt + Cond)	88.25	TON	Yes	1.00	Insignificant
Mobile - Non-Road Equipment - Gasoline	PM25-PRI	PM2.5 Primary (Filt + Cond)	46.90	TON	Yes	0.53	Insignificant
Mobile - Non-Road Equipment - Other	PM25-PRI	PM2.5 Primary (Filt + Cond)	2.44	TON	Yes	0.03	Insignificant
Mobile - On-Road Diesel Heavy Duty Vehicles	PM25-PRI	PM2.5 Primary (Filt + Cond)	219.53	TON	Yes	4.12	Significant
Mobile - On-Road Diesel Light Duty Vehicles	PM25-PRI	PM2.5 Primary (Filt + Cond)	7.83	TON	Yes	0.15	Significant
Mobile - On-Road Gasoline Heavy Duty Vehicles	PM25-PRI	PM2.5 Primary (Filt + Cond)	6.25	TON	Yes	0.12	Significant
Mobile - On-Road Gasoline Light Duty Vehicles	PM25-PRI	PM2.5 Primary (Filt + Cond)	104.71	TON	Yes	1.97	Significant
Solvent - Industrial Surface Coating & Solvent Use	PM25-PRI	PM2.5 Primary (Filt + Cond)	12.60	TON	No	0.00	Insignificant
Waste Disposal	PM25-PRI	PM2.5 Primary (Filt + Cond)	31.82	TON	Yes	0.36	Significant
			9327.66			29.27	

Location	2000 Population	2000 Occupied HH
Lane County	322,959	130,453
Oakridge	3,148	1,345
Westfir	276	100
Other NAA	536	226
Oakridge-Westfir NAA Total	3,960	1,671

Location	2010 Population	2010 Occupied HH
Lane County	351,715	145,966
Oakridge	3,205	1,437
Westfir	253	114
Other NAA	536	226
Oakridge-Westfir NAA Total	3,994	1,777

Location	2000-2010 Difference	2000-2010 Difference
Lane County	28,756	15,513
Oakridge	57	92
Westfir	-23	14
Other NAA	0	0
Oakridge-Westfir NAA Total	34	106

Lane County emissions from: http://www.epa.gov/ttn/chief/net/2008inventory.html
Cities and county population and housing units from: http://www.pdx.edu/sites/www.pdx.edu.prc/files/2010_PL94_counties_updated.pdf

Vehicle Miles Traveled in 2008 Base Year	
Lane County	1,494,200,000
Oakridge-Westfir NAA	28,058,910

From Appendix C3, and Lane County VMT from: http://www.oregon.gov/ODOT/TD/TDATA/Pages/ata/tsm/vmtpage.aspx#Oregon_VMT_by_County

Lane County 2008 Emission Inventory for NOx from the 2008 National Emission Inventory (NEI).

EI_sector	pollutant_code	description	emissions	uom	Oakridge	Annual	Winter
Biogenics - Vegetation and soil	NOX	Nitrogen Oxides	288.20	TON	Yes	1.31	Insignificant
Commercial Cooking	NOX	Nitrogen Oxides	0.00	TON	Yes	0.00	Insignificant
Fires - Agricultural Field Burning	NOX	Nitrogen Oxides	0.40	TON	No	0.00	Insignificant
Fires - Prescribed Fires	NOX	Nitrogen Oxides	243.86	TON	No	0.00	Significant
Fires - Wildfires	NOX	Nitrogen Oxides	174.09	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Biomass	NOX	Nitrogen Oxides	102.33	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	NOX	Nitrogen Oxides	313.66	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Oil	NOX	Nitrogen Oxides	41.00	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Other	NOX	Nitrogen Oxides	0.70	TON	No	0.00	Insignificant
Fuel Comb - Residential - Natural Gas	NOX	Nitrogen Oxides	78.55	TON	No	0.00	Insignificant
Fuel Comb - Residential - Oil	NOX	Nitrogen Oxides	7.81	TON	Yes	0.09	Insignificant
Fuel Comb - Residential - Other	NOX	Nitrogen Oxides	8.59	TON	Yes	0.10	Insignificant
Fuel Comb - Residential - Wood	NOX	Nitrogen Oxides	189.93	TON	Yes	2.16	Significant
Industrial Processes - Chemical Manuf	NOX	Nitrogen Oxides	349.04	TON	No	0.00	Insignificant
Industrial Processes - Pulp & Paper	NOX	Nitrogen Oxides	784.24	TON	No	0.00	Insignificant
Miscellaneous Non-Industrial NEC	NOX	Nitrogen Oxides	1.05	TON	No	0.00	Significant
Mobile - Aircraft	NOX	Nitrogen Oxides	29.29	TON	Yes	0.33	Insignificant
Mobile - Locomotives	NOX	Nitrogen Oxides	1435.32	TON	Yes	16.30	Significant
Mobile - Non-Road Equipment - Diesel	NOX	Nitrogen Oxides	1118.08	TON	Yes	1.27	Insignificant
Mobile - Non-Road Equipment - Gasoline	NOX	Nitrogen Oxides	227.18	TON	Yes	0.26	Insignificant
Mobile - Non-Road Equipment - Other	NOX	Nitrogen Oxides	249.77	TON	Yes	0.28	Insignificant
Mobile - On-Road Diesel Heavy Duty Vehicles	NOX	Nitrogen Oxides	3282.93	TON	Yes	61.65	Significant
Mobile - On-Road Diesel Light Duty Vehicles	NOX	Nitrogen Oxides	83.36	TON	Yes	1.57	Significant
Mobile - On-Road Gasoline Heavy Duty Vehicles	NOX	Nitrogen Oxides	308.64	TON	Yes	5.80	Significant
Mobile - On-Road Gasoline Light Duty Vehicles	NOX	Nitrogen Oxides	4747.18	TON	Yes	89.15	Significant
Solvent - Industrial Surface Coating & Solvent Use	NOX	Nitrogen Oxides	4.71	TON	No	0.00	Insignificant
Waste Disposal	NOX	Nitrogen Oxides	0.00	TON	Yes	0.00	Insignificant
			14069.89			180.25	

Vehicle Miles Traveled in 2008 Base Year

Lane County	1,494,200,000
Oakridge-Westfir NAA	28,058,910

From Appendix C3, and Lane County VMT from: http://www.oregon.gov/ODOT/TD/TDATA/Pages/ata/tsm/vmtpage.aspx#Oregon_VMT_by_County

Location	2000 Population	2000 Occupied HH
Lane County	322,959	130,453
Oakridge	3,148	1,345
Westfir	276	100
Other NAA	536	226
Oakridge-Westfir NAA Total	3,960	1,671

Location	2010 Population	2010 Occupied HH
Lane County	351,715	145,966
Oakridge	3,205	1,437
Westfir	253	114
Other NAA	536	226
Oakridge-Westfir NAA Total	3,994	1,777

Location	2000-2010 Difference	2000-2010 Difference
Lane County	28,756	15,513
Oakridge	57	92
Westfir	-23	14
Other NAA	0	0
Oakridge-Westfir NAA Total	34	106

Lane County emissions from: http://www.epa.gov/ttn/chief/net/2008inventory.html
Cities and county population and housing units from: http://www.pdx.edu/sites/www.pdx.edu.prc/files/2010_PL94_counties_updated.pdf

Lane County 2008 Emission Inventory for SO2 from the 2008 National Emission Inventory (NEI).

EI_sector	pollutant_code	description	emissions	uom	Oakridge	Annual	Winter
Commercial Cooking	SO2	Sulfur Dioxide	0.000	TON	Yes	0.00	Insignificant
Fires - Agricultural Field Burning	SO2	Sulfur Dioxide	0.060	TON	No	0.00	Insignificant
Fires - Prescribed Fires	SO2	Sulfur Dioxide	165.379	TON	No	0.00	Significant
Fires - Wildfires	SO2	Sulfur Dioxide	141.096	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Biomass	SO2	Sulfur Dioxide	4.689	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	SO2	Sulfur Dioxide	1.090	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Oil	SO2	Sulfur Dioxide	233.900	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Other	SO2	Sulfur Dioxide	16.100	TON	No	0.00	Insignificant
Fuel Comb - Residential - Natural Gas	SO2	Sulfur Dioxide	0.501	TON	No	0.00	Insignificant
Fuel Comb - Residential - Oil	SO2	Sulfur Dioxide	18.474	TON	Yes	0.21	Insignificant
Fuel Comb - Residential - Other	SO2	Sulfur Dioxide	0.036	TON	Yes	0.00	Insignificant
Fuel Comb - Residential - Wood	SO2	Sulfur Dioxide	26.919	TON	Yes	0.31	Significant
Industrial Processes - Chemical Manuf	SO2	Sulfur Dioxide	38.780	TON	No	0.00	Insignificant
Industrial Processes - Pulp & Paper	SO2	Sulfur Dioxide	612.730	TON	No	0.00	Insignificant
Miscellaneous Non-Industrial NEC	SO2	Sulfur Dioxide	0.162	TON	Yes	0.00	Insignificant
Mobile - Aircraft	SO2	Sulfur Dioxide	4.703	TON	Yes	0.05	Insignificant
Mobile - Locomotives	SO2	Sulfur Dioxide	13.706	TON	Yes	0.16	Significant
Mobile - Non-Road Equipment - Diesel	SO2	Sulfur Dioxide	26.356	TON	Yes	0.03	Insignificant
Mobile - Non-Road Equipment - Gasoline	SO2	Sulfur Dioxide	1.373	TON	Yes	0.00	Insignificant
Mobile - Non-Road Equipment - Other	SO2	Sulfur Dioxide	0.674	TON	Yes	0.00	Insignificant
Mobile - On-Road Diesel Heavy Duty Vehicles	SO2	Sulfur Dioxide	75.267	TON	Yes	1.41	Significant
Mobile - On-Road Diesel Light Duty Vehicles	SO2	Sulfur Dioxide	2.656	TON	Yes	0.05	Significant
Mobile - On-Road Gasoline Heavy Duty Vehicles	SO2	Sulfur Dioxide	1.275	TON	Yes	0.02	Significant
Mobile - On-Road Gasoline Light Duty Vehicles	SO2	Sulfur Dioxide	24.174	TON	Yes	0.45	Significant
Solvent - Industrial Surface Coating & Solvent Use	SO2	Sulfur Dioxide	0.030	TON	No	0.00	Insignificant
Waste Disposal	SO2	Sulfur Dioxide	0.000	TON	Yes	0.00	Insignificant
			1410.13			2.70	

Vehicle Miles Traveled in 2008 Base Year

Lane County	1,494,200,000
Oakridge-Westfir NAA	28,058,910

From Appendix C3, and Lane County VMT from: http://www.oregon.gov/ODOT/TD/TDATA/Pages/ata/tsm/vmtpage.aspx#Oregon_VMT_by_County

Location	2000 Population	2000 Occupied HH
Lane County	322,959	130,453
Oakridge	3,148	1,345
Westfir	276	100
Other NAA	536	226
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Location	2010 Population	2010 Occupied HH
Lane County	351,715	145,966
Oakridge	3,205	1,437
Westfir	253	114
Other NAA	536	226
Oakridge-Westfir NAA Total	3,994	1,777

Location	2000-2010 Difference	2000-2010 Difference
Lane County	28,756	15,513
Oakridge	57	92
Westfir	-23	14
Other NAA	0	0
Oakridge-Westfir NAA Total	34	106

Lane County emissions from: http://www.epa.gov/ttn/chief/net/2008inventory.html
Cities and county population and housing units from: http://www.pdx.edu/sites/www.pdx.edu.prc/files/2010_PL94_counties_updated.pdf

Lane County 2008 Emission Inventory for VOC from the 2008 National Emission Inventory (NEI).

EI_sector	pollutant_code	description	emissions	uom	Oakridge	Annual	Winter
Biogenics - Vegetation and soil	VOC	Volatile Organic Compounds	47248.165	TON	Yes	214.76	Insignificant
Bulk Gasoline Terminals	VOC	Volatile Organic Compounds	83.410	TON	No	0.00	Insignificant
Commercial Cooking	VOC	Volatile Organic Compounds	12.531	TON	Yes	0.00	Insignificant
Fires - Agricultural Field Burning	VOC	Volatile Organic Compounds	0.900	TON	No	0.00	Significant
Fires - Prescribed Fires	VOC	Volatile Organic Compounds	6374.260	TON	No	0.00	Insignificant
Fires - Wildfires	VOC	Volatile Organic Compounds	6150.084	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Biomass	VOC	Volatile Organic Compounds	7.400	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Natural Gas	VOC	Volatile Organic Compounds	3.610	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Oil	VOC	Volatile Organic Compounds	0.700	TON	No	0.00	Insignificant
Fuel Comb - Industrial Boilers, ICEs - Other	VOC	Volatile Organic Compounds	0.010	TON	No	0.00	Insignificant
Fuel Comb - Residential - Natural Gas	VOC	Volatile Organic Compounds	4.596	TON	No	0.00	Insignificant
Fuel Comb - Residential - Oil	VOC	Volatile Organic Compounds	0.304	TON	Yes	0.00	Insignificant
Fuel Comb - Residential - Other	VOC	Volatile Organic Compounds	0.334	TON	Yes	0.00	Insignificant
Fuel Comb - Residential - Wood	VOC	Volatile Organic Compounds	1663.316	TON	Yes	18.89	Significant
Gas Stations	VOC	Volatile Organic Compounds	1091.605	TON	Yes	20.50	Significant
Industrial Processes - Chemical Manuf	VOC	Volatile Organic Compounds	54.140	TON	No	0.00	Insignificant
Industrial Processes - Pulp & Paper	VOC	Volatile Organic Compounds	1312.234	TON	No	0.00	Insignificant
Industrial Processes - Storage and Transfer	VOC	Volatile Organic Compounds	70.522	TON	No	0.00	Insignificant
Miscellaneous Non-Industrial NEC	VOC	Volatile Organic Compounds	208.496	TON	No	0.00	Insignificant
Mobile - Aircraft	VOC	Volatile Organic Compounds	16.897	TON	Yes	0.19	Insignificant
Mobile - Locomotives	VOC	Volatile Organic Compounds	78.192	TON	Yes	0.89	Significant
Mobile - Non-Road Equipment - Diesel	VOC	Volatile Organic Compounds	113.714	TON	Yes	0.13	Insignificant
Mobile - Non-Road Equipment - Gasoline	VOC	Volatile Organic Compounds	1795.524	TON	Yes	2.04	Insignificant
Mobile - Non-Road Equipment - Other	VOC	Volatile Organic Compounds	64.321	TON	Yes	0.07	Insignificant
Mobile - On-Road Diesel Heavy Duty Vehicles	VOC	Volatile Organic Compounds	224.548	TON	Yes	4.22	Significant
Mobile - On-Road Diesel Light Duty Vehicles	VOC	Volatile Organic Compounds	14.007	TON	Yes	0.26	Significant
Mobile - On-Road Gasoline Heavy Duty Vehicles	VOC	Volatile Organic Compounds	228.721	TON	Yes	4.30	Significant
Mobile - On-Road Gasoline Light Duty Vehicles	VOC	Volatile Organic Compounds	3754.542	TON	Yes	70.50	Significant
Solvent - Consumer & Commercial Solvent Use	VOC	Volatile Organic Compounds	1612.909	TON	No	0.00	Insignificant
Solvent - Dry Cleaning	VOC	Volatile Organic Compounds	83.360	TON	No	0.00	Insignificant
Solvent - Industrial Surface Coating & Solvent Use	VOC	Volatile Organic Compounds	339.689	TON	No	0.00	Insignificant
Solvent - Non-Industrial Surface Coating	VOC	Volatile Organic Compounds	523.305	TON	No	0.00	Insignificant
Waste Disposal	VOC	Volatile Organic Compounds	14.375	TON	Yes	0.16	Insignificant
			73150.72			336.92	

Vehicle Miles Traveled in 2008 Base Year

Lane County	1,494,200,000
Oakridge-Westfir NAA	28,058,910

From Appendix C3, and Lane County VMT from: http://www.oregon.gov/ODOT/TD/TDATA/Pages/ata/tsm/vmtpage.aspx#Oregon_VMT_by_County

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Location	2000-2010 Difference	2000-2010 Difference
Lane County	28,756	15,513
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Lane County emissions from: http://www.epa.gov/ttn/chief/net/2008inventory.html
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Lane County 2008 Emission Inventory for NH3 from the 2008 National Emission Inventory (NEI).

EI_sector	pollutant_code	description	emissions	uom	Oakridge	Annual	Winter
Agriculture - Fertilizer Application	NH3	Ammonia	918.90	TON	No	0.00	Insignificant
Agriculture - Livestock Waste	NH3	Ammonia	651.83	TON	No	0.00	Insignificant
Fires - Prescribed Fires	NH3	Ammonia	443.43	TON	No	0.00	Insignificant
Fires - Wildfires	NH3	Ammonia	427.83	TON	No	0.00	Insignificant
Fuel Comb - Residential - Natural Gas	NH3	Ammonia	16.71	TON	No	0.00	Insignificant
Fuel Comb - Residential - Oil	NH3	Ammonia	0.43	TON	Yes	0.00	Insignificant
Fuel Comb - Residential - Other	NH3	Ammonia	0.03	TON	Yes	0.00	Insignificant
Fuel Comb - Residential - Wood	NH3	Ammonia	83.70	TON	Yes	0.95	Significant
Mobile - Locomotives	NH3	Ammonia	0.47	TON	Yes	0.01	Significant
Mobile - Non-Road Equipment - Diesel	NH3	Ammonia	0.98	TON	Yes	0.00	Insignificant
Mobile - Non-Road Equipment - Gasoline	NH3	Ammonia	0.74	TON	Yes	0.00	Insignificant
Mobile - On-Road Diesel Heavy Duty Vehicles	NH3	Ammonia	5.77	TON	Yes	0.11	Significant
Mobile - On-Road Diesel Light Duty Vehicles	NH3	Ammonia	0.37	TON	Yes	0.01	Significant
Mobile - On-Road Gasoline Heavy Duty Vehicles	NH3	Ammonia	4.53	TON	Yes	0.09	Significant
Mobile - On-Road Gasoline Light Duty Vehicles	NH3	Ammonia	122.95	TON	Yes	2.31	Significant
Waste Disposal	NH3	Ammonia	1.31	TON	Yes	0.01	Insignificant
			2679.99			3.49	

Vehicle Miles Traveled in 2008 Base Year

Lane County	1,494,200,000
Oakridge-Westfir NAA	28,058,910

From Appendix C3, and Lane County VMT from: http://www.oregon.gov/ODOT/TD/TDATA/Pages/ata/tsm/vmtpage.aspx#Oregon_VMT_by_County

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Other NAA	0	0
Oakridge-Westfir NAA Total	34	106

Lane County emissions from: http://www.epa.gov/ttn/chief/net/2008inventory.html
Cities and county population and housing units from: http://www.pdx.edu/sites/www.pdx.edu.prc/files/2010_PL94_counties_updated.pdf

Appendix E1 – SANDWICH Analysis and Speciation

Speciation of the FRM measured PM2.5 data used the co-located STN speciation data following the SANDWICH approach (sulfate, adjusted nitrate, derived water, inferred carbonaceous material balance approach). The Willamette Activity Center STN data was compiled for 2009-2011, and sample data for total mass greater than 25 µg/m³ was used as the basis for the SANDWICH approach.

An examination of the STN speciated data showed that carbonaceous mass (OC and EC) was the predominant component and that SO4 and NO3 were relatively minor contributors to total mass. Because control strategies for emissions reductions would be focused on OC and EC, primarily from residential wood heating, and to simplify the roll back model, it was considered effective to conservatively estimate SO4 and NO3 and hold these components constant in the rollback.

The NO3 and SO4 concentrations of 0.14 and 0.35 µg/m³, respectively, are estimates based on the average STN monitor concentration for the first and fourth annual quarters (Q1 and Q4). These values for NO3 and SO4 were proposed to EPA to be used in the SANDWICH speciation, and in the rollback given a Relative Response Factor (RRF) of 1.0. The attainment demonstration will not take credit for the small emission reductions in nitrate, sulfate, ammonia, and water that are expected to occur during the period from 2008 to 2014. Pollution reductions strategies and the attainment demonstration are focused on the organic and elemental carbon components of PM2.5.

The Crustal (OPP) concentration 0.35 µg/m³ is an estimate based on the STN monitor average concentration of Q1 and Q4.

In preparation for SANDWICH, the speciated data was adjusted to estimate retained NO3 mass, NH4 associated with SO4 and NO3 mass, particle bound water, and other primary PM2.5 (OPP). Most of this preparation was done by EPA Region 10 in concert with LRAPA. The results of the SANDWICH process, in which organic carbon (OC) is calculated by mass balance as the remainder from total mass less all other components, are shown in the table below.

							SANDWICH										
	FRM	Blank	Non-blank	Sulfate	Nitrate	OC	EC	Water	NH3	OPP	Sulfate	Nitrate	OCM	EC	Water	NH3	OPP
	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	%	%	%	%	%	%	%
Q1	35.70	0.5	35.20	0.40	0.22	30.74	2.83	0.57	0.01	0.4331	1.1	0.6	87.3	8.0	1.6	0.0	1.2
Q2	8.05	0.5	7.55	0.82	0.16	4.10	0.51	0.78	0.06	1.1292	10.8	2.1	54.3	6.7	10.3	0.7	15.0
Q3	18.48	0.5	17.98	0.64	0.14	15.44	0.78	0.35	0.14	0.4903	3.6	0.8	85.9	4.3	2.0	0.8	2.7
Q4	27.53	0.5	27.03	0.30	0.05	24.16	1.92	0.32	0.01	0.2728	1.1	0.2	89.4	7.1	1.2	0.0	1.0
Mean Q1+Q4	**31.62**	0.50	31.12	0.35	0.14	27.45	2.37	0.44	0.01	0.35	**1.1**	**0.4**	**88.4**	**7.6**	**1.4**	**0.0**	**1.1**

Figure 1 : SANDWICH analysis of Oakridge $PM_{2.5}$ speciation data.

SOAs and minor $PM_{2.5}$ species

In addition to quantifying the species components to the DV mass, as shown in the SANDWICH table, attention was paid to the sources of precursors to $PM_{2.5}$, and in particular to chemical processes in the atmosphere that might affect the dynamics of $PM_{2.5}$ formation. The focus of this effort was the formation of biogenic and anthropogenic secondary organic aerosols (SOA). Oregon DEQ partnered with a research associate (Dr. Kelly Barsanti) at Portland State University (PSU) to examine the formation of these SOAs using chemical box models in which biogenic emissions as precursors to Biogenic SOA were estimated for the vegetative cover in the Klamath Falls Nonattainment area (NAA) and adjusted to reflect wintertime temperatures. In the same model, anthropogenic SOA formation was estimated from benzene, toluene, and xylene precursor emissions from On Road Mobile sources in the Klamath Falls NAA. The results of that work are included as an Appendix to the Klamath Falls, OR $PM_{2.5}$ attainment demonstration, and show that these contributions to total OC are relatively low, as shown below. In consultation with EPA Region 10 staff, LRAPA determined that use of these values from Klamath Falls for the Oakridge NAA was a conservative approach, overestimating the SOA components of $PM_{2.5}$ for the Oakridge NAA.

Finally, background EC and OC concentrations are derived from the average concentrations for Q1 and Q4 for the period 1/3/2007 to 3/30/2010, which represents all available data, from the IMPROVE sites at Crater Lake (CRLA), Kalmiopsis (KALM), and Lava Beds (LABE).

As shown in the list below, these species, and background, were treated as constants in the rollback model, and their concentrations will be assigned a Relative Reduction Factor (RRF) = 1.0:

Biogenic SOA = 0.4 $\mu g/m^3$ (1% of the $PM_{2.5}$ DV).
Anthropogenic SOA = 1.2 $\mu g/m^3$ (3% of the $PM_{2.5}$ DV)
SO4 = 0.4 $\mu g/m^3$
NO3 = 0.2 $\mu g/m^3$
Ammonia = 0.01 $\mu g/m^3$
Water = 0.5 $\mu g/m^3$
Crustal material = 0.4 $\mu g/m^3$
Background EC = 0.1 $\mu g/m^3$
Background OC = 0.6 $\mu g/m^3$

Report on PM2.5 receptor modeling for Oakridge, Oregon.

This receptor modeling analysis was conducted by Robert Kotchenruther, EPA Region 10 (206-553-6218, Kotchenruther.Robert@epa.gov). This draft modeling report is dated December 15, 2011. The goal of this receptor modeling analysis is to better understand sources of PM2.5 in Oakridge, Oregon and to provide modeling support to Lane Regional Air Protection Agency (LRAPA).

Summary of Analysis and Results

The Positive Matrix Factorization (PMF) model was used for this analysis. The available chemically speciated PM2.5 data from Oakridge OR spanned the time period of 7/6/2009 to 3/28/2011 and constituted 92 24-hour integrated aerosol samples with 23 chemical species. The PMF modeling resulted in a 7-factor solution and model factors were named Wood Smoke, OP (organic pyrolysis) Rich, Gasoline Vehicles, Fe (iron) Rich, SO4 (sulfate) Rich, Sea Salt, and Fugitive Dust. While source category (or otherwise descriptive) names have been assigned to each factor, there is overlap and factor names should not be taken too literally. For example, it is possible that mobile sources contribute at least partially to the factors: OP Rich, Gasoline Vehicles, Fe Rich, SO4 Rich and Fugitive Dust. It is also likely that wood smoke contributes to the OP Rich factor as well as the Wood Smoke factor.

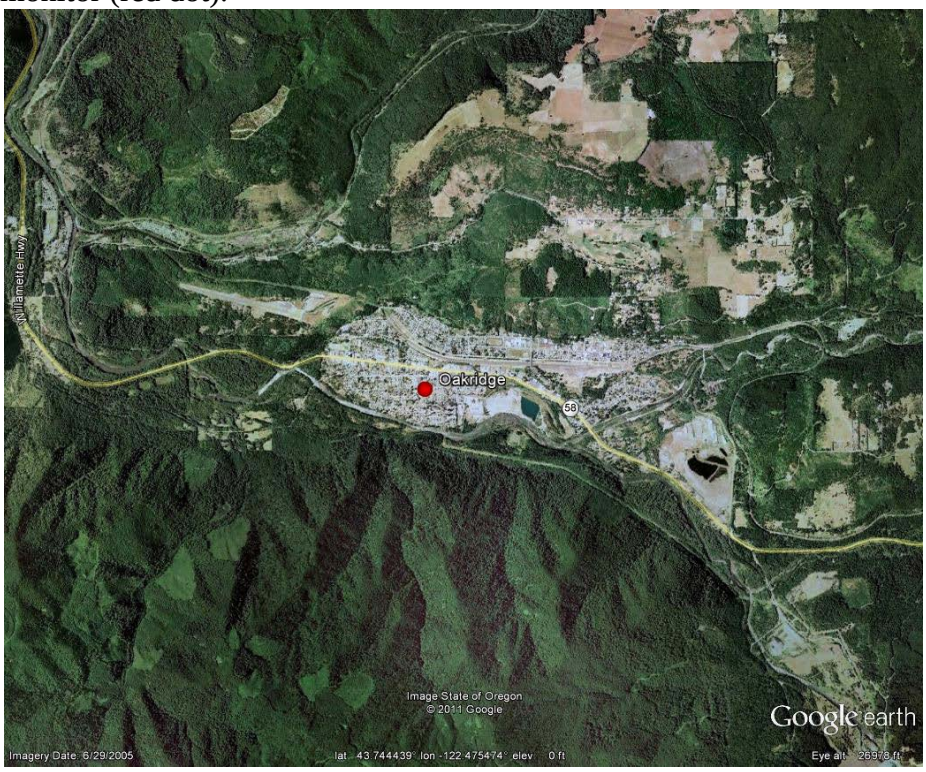
Model results were aggregated to winter days when total PM2.5 was above 15 ug/m3 (12 sample dates) and also for PM2.5 above 25 ug/m3 (5 sample dates). For this subset of the data, the Wood Smoke Factor was determined to be 70.7% and 75.8% of total PM2.5 mass for PM2.5 greater than 15 ug/m3 and 25 ug/m3, respectively. The OP Rich Factor was found to contribute 12.5% and 15.1% of PM2.5, respectively. The author believes the OP Rich factor represents aged or otherwise more highly oxidized sources of organic carbon, so it is likely wood smoke also contributes somewhat to this factor. The Gasoline Vehicles Factor was found to contribute 8.8% and 2.7% of PM2.5, respectively. All other factors were found to contribute individually less than 3% each to total PM2.5 mass for winter days over 15 ug/m3 and 25 ug/m3.

1. Monitoring Site and Data Information.

1.1. Map of the monitoring location used in this analysis:

Figure 1.1 shows a map of the Oakridge area and the location of the PM2.5 monitor. EPA's AQS site number for the monitor is 410392013, the site latitude is 43.744352 and longitude is -122.480518.

Figure 1.1. Map of the Oakridge area showing the location of the PM2.5 FRM and speciation monitor (red dot).



1.2. Metadata information:

- The data source was the EPA AQS database and data were downloaded on 12/9/2011. The data reports used were AMP350 raw data report and AMP503 sample blank report. No sample blanks were recorded in the AQS database for the Klamath Falls site, so the average sample blank data from 4 sites in California (AQS identifiers 060190008, 060670006, 060850005, 061112002) were used. These California sites were chosen because they were on the same schedule for carbon sampler replacement, and therefore had sample blank data coincident with the Oakridge dataset.
- The date range of data extracted was 7/6/2009 – 3/28/2011, which was all of the available speciation sampler data at the time of data extraction.
- The number of 24-hour integrated filter samples used in this analysis was 92.
- Chemical species used in this modeling analysis were Al, Ca, Cr, Cl, Fe, Mn, Ni, Ti, Si, Zn, K, NH4, Na, NO3, OC1, OC2, OC3, OC4, OP, EC1, EC2, EC3, and SO4. OP data is based on the optical reflectance method (TOR).

2. Data Preparation Methodology

Except as noted below the measured values, uncertainties, sample blank correction, and method detection limits for each chemical species were obtained and prepared as recommended in the EPA Region 10 guidance document "EPA Region 10 Guidance for the Use of Receptor Models to Support Policy and Regulatory Decisions", dated 12/17/2009 (Kotchenruther, 2009).

Chemical species data are typically quality controlled for receptor modeling purposes by excluding chemical species that do not meet certain guidelines. These guidelines are based on

some combination of (1) the amount of data reported below the method detection limit (MDL), (2) an evaluation of signal-to-noise (S/N) ratio in the data, and/or (3) the number of valid samples of a chemical species compared to the total number of samples. In analysis of Oakridge data, chemical species were removed from the modeling dataset if the S/N ratio was less than 0.27 or if the number of valid samples was less than 60%. The result was that 19 trace-level chemical species were not considered including P, Sb, Sn, Sr, Cd, Ba, Cs, In, Rb, Ce, Ag, Zr, Pb, V, Co, Se, Br, As, and Cu. The main reason for excluding these chemical species was because measured concentrations were very low, near the noise level for background concentrations, resulting in a very low S/N ratio.

Other data processing choices included:

- To avoid double counting of chemical species, the following species were also removed from the datasets: S (SO4 was retained, S and SO4 are very well correlated), K+ (K was retained), and OP via the TOT method (OP is reported by two measurement methods, TOT and TOR, here OP via TOR was retained). The chemical species that were retained were chosen based on either higher data completeness or higher S/N ratio.
- Data from July 4 and 5 were removed to mitigate the influence of fireworks on the modeling result.

3. Modeling

The model used in this receptor modeling analysis was the Positive Matrix Factorization (PMF) model. The PMF model version used was EPA PMF v4.0 beta. The current publically available version is 3.0 (http://www.epa.gov/heasd/products/pmf/pmf.html). However, for the purposes of this modeling analysis, v4.0 beta is identical to the publically available v3.0.

User setting for modeling scenarios in this work were as follows:

- PM2.5 mass data was set as the 'Total Variable', which allows the model to estimate each factor contribution to total mass. Setting total PM2.5 as the 'Total Variable' increases its uncertainty to down weight its influence in the model solution.
- For each scenario, 20 model runs were made to find the best least-squares minimum with the 'seed' variable set to 10 ('seed' determines where the model begins looking for a solution, setting a specific number rather than using the 'random' setting allows the user to reproduce the model results exactly).
- The optimum number of factors for each scenario was determined somewhat subjectively based on the interpretation of model results, but also from the quality of the least-squares fit (analysis of Q values) in the model output.

4. Modeling Results and Analysis

4.1. Resulting PMF Factors and Factor Classification

The PMF model uses a form of factor analysis where the underlying co-variability of many variables (e.g., sample to sample variation in particulate matter chemical species) is described by a smaller set of factors (e.g., particulate matter sources) to which the original variables are related.

The interpretation/classification of factors output by the PMF model is a subjective process. It can depend on the experience of the modeler, availability of current source profiles and literature references, availability of supplementary information about the airshed, and an understanding of the range of possible sources impacting the monitoring location. A PMF factor could represent the impact on the monitor of a single source (e.g. industrial facility), a source category (e.g. a bunch of sources that have very similar chemical fingerprints and emissions patterns such as cars, trucks, wood burning sources), or multiple sources or source categories grouped together (PMF may group together multiple sources because of insufficient variability in emissions, chemical fingerprint, and/or temporal/spatial resolution).

It should be also noted that the factors determined in a PMF analysis are not necessarily mutually exclusive. For example, a factor identified as predominantly sulfate aerosol is possibly from a combination of multiple sources including diesel engines and industrial facilities, even though these sources may also have separately identified PMF factors. Hence, caution should be used in interpreting factor classifications too literally or with exclusivity.

The optimal result for the date range modeled in this analysis was a 7-factor solution for Oakridge. Factors are given source category names for ease of reference. The 7 PMF factors found in Oakridge are named Wood Smoke, OP Rich, Gasoline Vehicles, Fe Rich, SO4 Rich, Sea Salt, and Fugitive Dust.

The factors found are consistent with the current conceptual understanding of the range of aerosol sources in this airshed and are similar to factors found in other airsheds in the Pacific Northwest. Further discussion of factor identification and classification can be found in Sections 4.3 and 5 of this report.

4.2. Factor Contributions on Winter (Quarters 1 and 4, October – March) Season Days with Elevated PM2.5

Figure 4.1 depicts the average percent contribution of each PMF factor during the winter season (October through March) when total PM2.5 was measured at greater than 15 ug/m3 and 25 ug/m3. Error bars in Figure 4.1 represent the standard deviation around the mean. Average percent contributions and standard deviations represent the aggregation of data from 12 dates and 5 dates for PM2.5 > 15 ug/m3 and PM2.5 > 25 ug/m3, respectively. Table 4.1 is the tabulated data corresponding to Figure 4.1, Table 4.2 shows the PM2.5 mass rather than percent contribution. 'Unattributed mass' in Figure 4.1 and Tables 4.1 and 4.2 is the average amount of mass either under or over-attributed by the model compared to the observed PM2.5. In both data aggregations (i.e., PM2.5 > 15 ug/m3 and PM2.5 > 25 ug/m3) the amount of mass either under or over-attributed by the model is not significantly different from zero.

Figure 4.1. Average percent contributions of PMF derived factors to PM2.5 on winter season days with PM2.5 > 15 ug/m3 and PM2.5 > 25 ug/m3 (contributions are the average of 12 dates and 5 dates for PM2.5 > 15 ug/m3 and PM2.5 > 25 ug/m3, respectively; 'error bars' represent the standard deviation from the dates averaged).

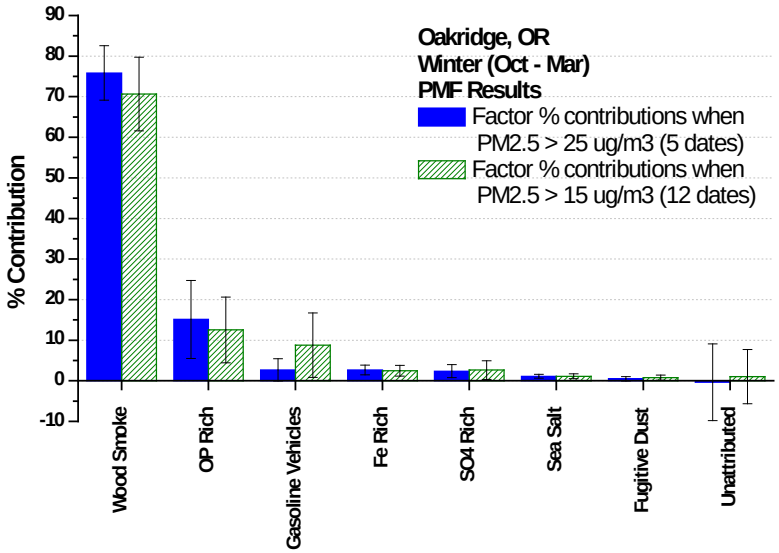


Table 4.1. Average percent contributions of PMF derived factors to PM2.5 on winter season days with PM2.5 > 15 ug/m3 and PM2.5 > 25 ug/m3 (12 and 5 dates were averaged for PM2.5 > 15 ug/m3 and PM2.5 > 25 ug/m3, respectively).

Model Factors	Average Contribution for PM2.5 > 15 ug/m3 (%)	Average Contribution for PM2.5 > 25 ug/m3 (%)
Wood Smoke	70.7	75.8
OP Rich	12.5	15.1
Gasoline Vehicles	8.8	2.7
Fe Rich	2.5	2.7
SO4 Rich	2.6	2.4
Sea Salt	1.1	1.1
Fugitive Dust	0.8	0.5
Unattributed(+) /Over-attributed(-)	1.0	-0.3

Table 4.2. Average mass contributions of PMF derived factors to PM2.5 on winter season days with PM2.5 > 15 ug/m3 and PM2.5 > 25 ug/m3 (12 and 5 dates were averaged for PM2.5 > 15 ug/m3 and PM2.5 > 25 ug/m3, respectively).

Model Factors/PM2.5	Average Contribution for PM2.5 > 15 ug/m3 (ug/m3)	Average Contribution for PM2.5 > 25 ug/m3 (ug/m3)
PM2.5	24.0	32.7
Wood Smoke	17.1	24.5
OP Rich	3.3	5.2
Gasoline Vehicles	1.7	0.8
Fe Rich	0.6	0.8
SO4 Rich	0.6	0.8
Sea Salt	0.3	0.4
Fugitive Dust	0.2	0.2
Unattributed(+) /Over-attributed(-)	0.2	-0.1

4.3. Discussion of PMF Factors found in Oakridge

Section 5 of this report discusses in more detail each PMF factor, how the source classification names were determined, the chemical profile for each factor, the time series of mass impacts for each factor, the monthly average impact of each factor, and examples of similar factor chemical profiles from PMF analyses conducted in other areas of the Pacific Northwest.

The reader will see in Section 5 bar plots that represent the chemical profile/composition for each factor. Because these bar plots can be difficult to interpret, the following describes how to read them. Along the x-axes are the chemical species input into the model. The vertical blue bars match to the left y-axes and represent the percent contribution of each chemical species to the factor's overall chemical composition. The left y scale is on a log basis to better represent trace element contributions. The red squares match to the right y-axes and can be interpreted as representing how important each chemical species was to the models' identification of that factor (e.g., for the Wood Smoke factors, red squares are elevated for OC, EC, and K).

The Wood Smoke Factor percent attribution was similar between the two data aggregations, where 70.7% and 75.8% of winter PM2.5 greater than 15 ug/m3 and 25 ug/m3 was attributed, respectively. The OP Rich Factor attribution was also similar between the two data aggregations, 12.5 ug/m3 and 15.1 ug/m3, respectively. OP (organic pyrolysis) is the portion of organic carbon that chars and converts to elemental carbon during the temperature ramped measurement of organic carbon fractions. A number of other urban/suburban PM2.5 nonattainment areas in the Pacific Northwest have also had a separate 'OP Rich' factor identified during PMF receptor modeling (Kotchenruther 2011a, Kotchenruther 2011b, Kotchenruther 2011c). These other areas include two monitoring sites in Tacoma Washington, three sites near Salt Lake City Utah, and Klamath Falls Oregon.

The current hypothesis by this author is that the OP Rich factor represents organic carbon sources that have been aged, or are otherwise more highly oxidized, relative to primary organic

carbon sources such as fresh wood smoke. The rational for this hypothesis is that as organic carbon ages in the atmosphere it generally becomes more oxidized from reactions with OH and O3, and more oxidized organics have lower volatility and have been found to be more likely to pyrolyze rather than volatilize when subjected to heating (Yu et al., 2002). This hypothesis is supported by the chemical profile of the OP Rich factors found in Oakridge and in other locations in the Pacific Northwest (see section 5.2). In each OP Rich chemical profile there is very little EC2 or EC3 attributed to the factors and in most cases EC1 is approximately equal to OP (note, EC1 measurements include OP even though OP is also reported separately, so we expect that EC1 should be at least equal to OP when OP is present). The relative lack of EC unassociated with OP within OP Rich factors suggests that secondary organic carbon may be a significant component, rather than fresh primary combustion emissions which are known to contain varying but significant EC. It should also be noted that the locations where OP Rich factors have been identified, the Wood Smoke factors also identified at those locations have had no OP component (see section 5.1).

Further support for this hypothesis comes from a separate PMF analysis of rural IMPROVE sites throughout the Pacific Northwest (24 sites; Kotchenruther, 2011d). In that analysis it was found that every IMPROVE site had a single PMF factor that was a combination of biomass combustion (probably mostly wildfire emissions) plus secondary organic carbon aerosol (SOA). All of the IMPROVE analysis biomass combustion+SOA factors contained a significant OP component and no separate OP Rich factors were identified. Since the expectation is that most aerosols impacting IMPROVE sites are well aged, the significant OP component of the IMPROVE biomass combustion+SOA factors jibes with the hypothesis that OP is an indication of organic aerosol aging.

It is interesting to look at time series plots of the Wood Smoke Factor and OP Rich Factor (sections 5.1 and 5.2). The Wood Smoke factor is close to zero ug/m3 in the non heating season whereas the OP Rich factor has non-zero mass allocation throughout the year, but with higher impacts in the winter. This is consistent with the hypothesis that the Wood Smoke Factor represents primary wood smoke emissions and that the OP Rich factor is a conglomeration of secondary organic carbon sources, likely including wood smoke, but also probably including other biogenic and anthropogenic SOA. It should be noted that the Wood Smoke Factor and OP Rich Factor are better correlated for winter data (r2=0.52) compared to the correlation of the two Factors for the dataset as a whole (r2=0.23).

Other factor contributions to winter high PM2.5 days were relatively small compared to Wood Smoke and OP Rich. The Gasoline Vehicles Factor contributed 8.8% to PM2.5 > 15 ug/m3, but the contribution fell to only 2.7% for PM2.5 > 25 ug/m3. The next largest contribution was from the Fe Rich factor, which was also at 2.7% for PM2.5 > 25 ug/m3. There is some indication that the Fe Rich factor represents diesel vehicles because of similar PMF factors found in other locations in the Pacific Northwest (see section 5.4). However, the absence of elemental carbon in the Oakridge Fe Rich Factor makes the attribution of this factor to diesel vehicles more uncertain.

The other factor found in Oakridge were SO4 Rich, Sea Salt, and Fugitive Dust, each contributing less than 3% to elevated winter PM2.5 concentrations. The SO4 Rich factor likely originates from a combination of secondary and primary sulfate sources. While a Sea Salt Factor seems improbable given the distance of Oakridge from the Pacific Coast, Sea Salt Factors with similar mass impacts have been found in PMF analysis of IMPROVE PM2.5 data from Mount

Rainier WA and the Columbia Gorge site (Kotchenruther, 2011d), which are at similar distances from the Pacific Coast as Oakridge. Having said that, winter road salting may also contribute to this factor.

5. PMF Factor Details

5.1. Wood Smoke Factor

Factor identification: This factor was identified (1) by the chemical composition, in particular the importance of OC, EC & K, (2) the seasonal pattern of mass impacts, and (3) similarities to Wood Smoke factor composition identified by Kim et al. 2004 and Maykut et al. 2003 (and others) and the authors experience with PMF profiles from other wood smoke impacted sites in the Western US (Kotchenruther 2011a, Kotchenruther 2011b, Kotchenruther 2011c).

Figure 5.1.1. Factor Chemical Composition

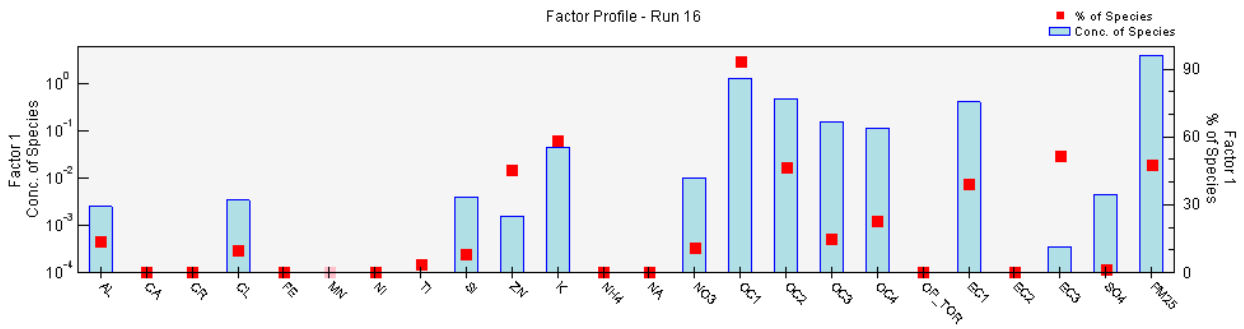


Figure 5.1.2. Time series of factor mass impacts

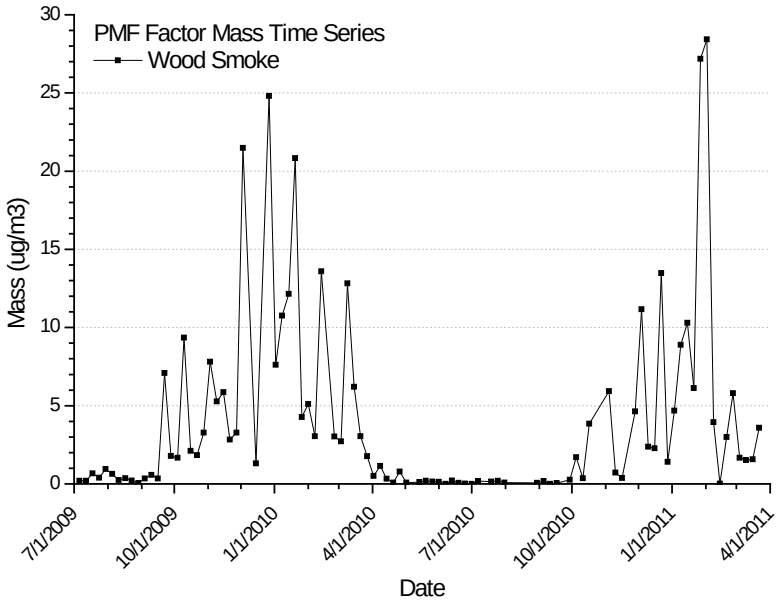


Figure 5.1.3. Monthly mean factor mass

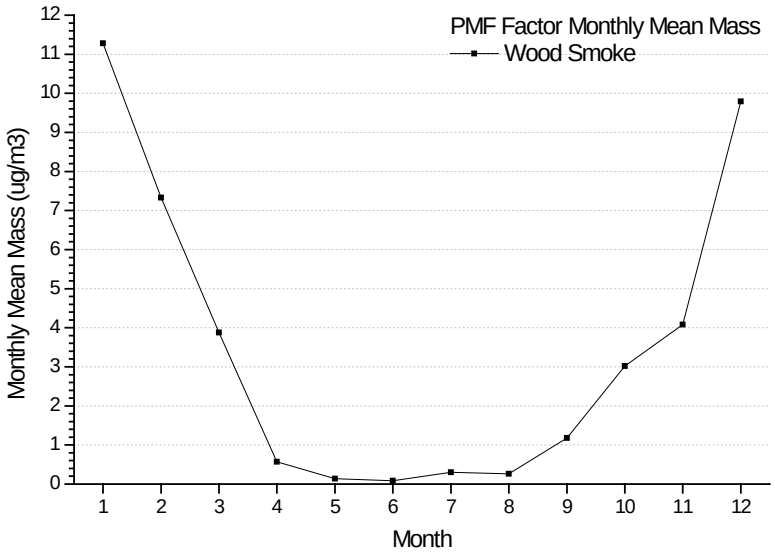
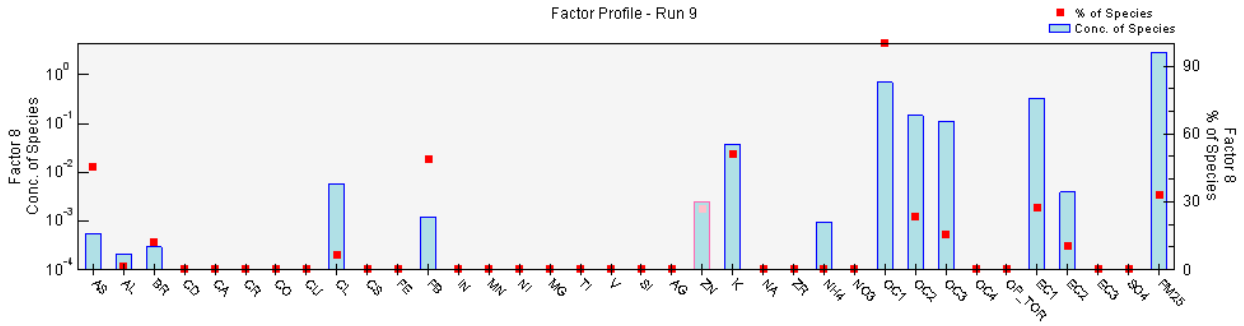
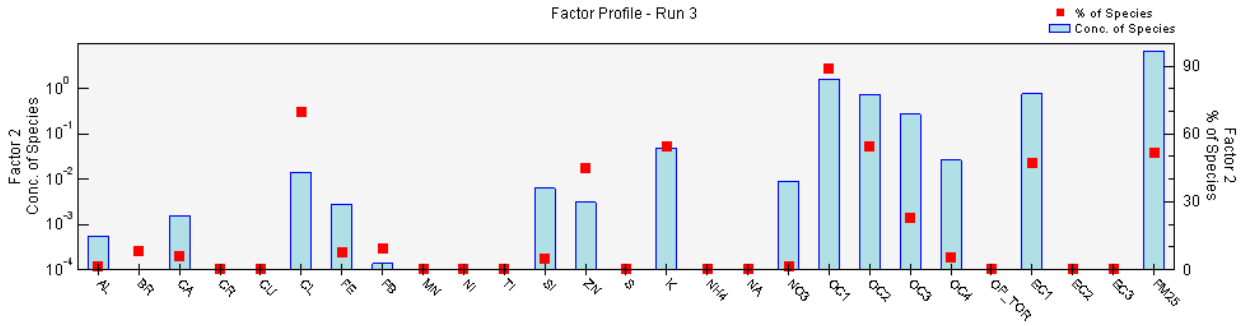


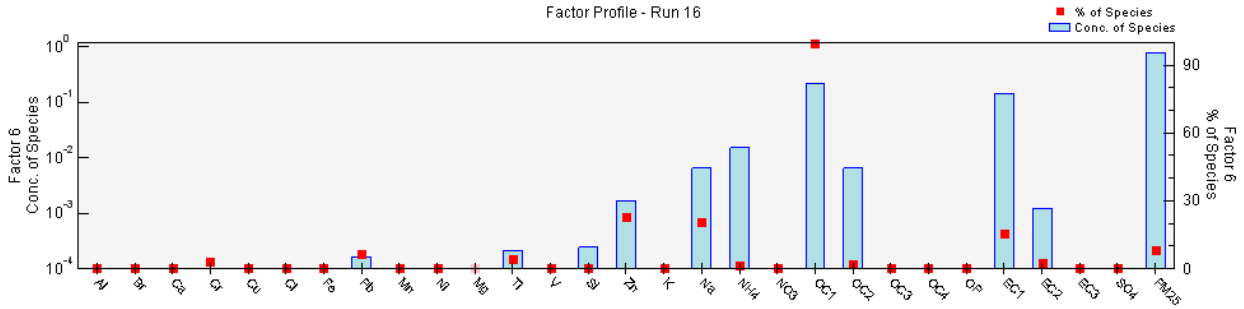
Figure 5.1.4. Comparative Wood Smoke factor profiles from other areas:
(a) Tacoma, WA South L Street



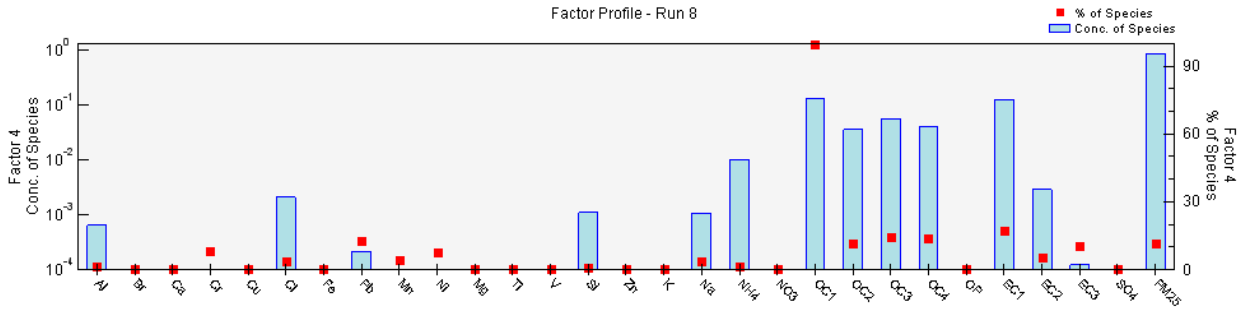
(b) Klamath Falls, OR



(c) Salt Lake City, UT



(d) Bountiful, UT



5.2. OP Rich Factor

Factor identification: This factor was identified by the importance of OP in the factor composition. Similar OP Rich factors were identified in unpublished reports by Kotchenruther (2011a, 2011b, 2011c) that describe the results of a PMF analysis of monitoring sites in Tacoma, WA, sites near Salt Lake City, UT, and Klamath Falls, OR. It is believed that this factor represents sources of organic aerosol that have been aged or are otherwise more oxidized. See section 4.3 of this report for further discussion.

Figure 5.2.1. Factor Chemical Composition

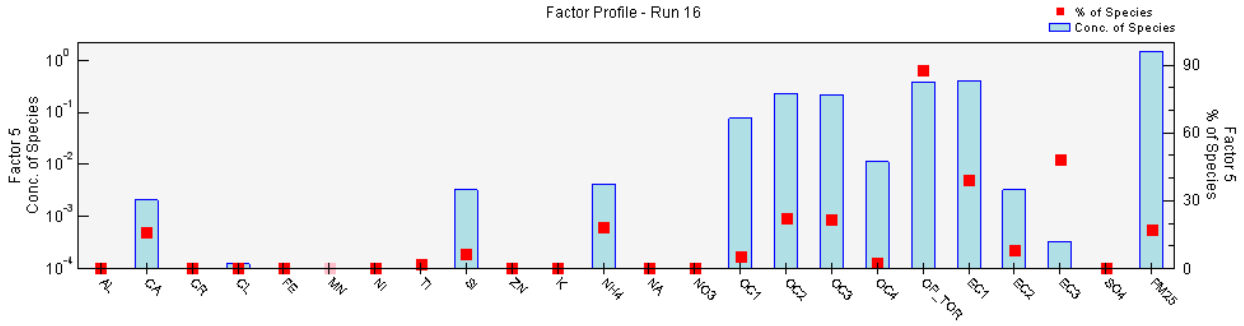


Figure 5.2.2. Time series of factor mass impacts

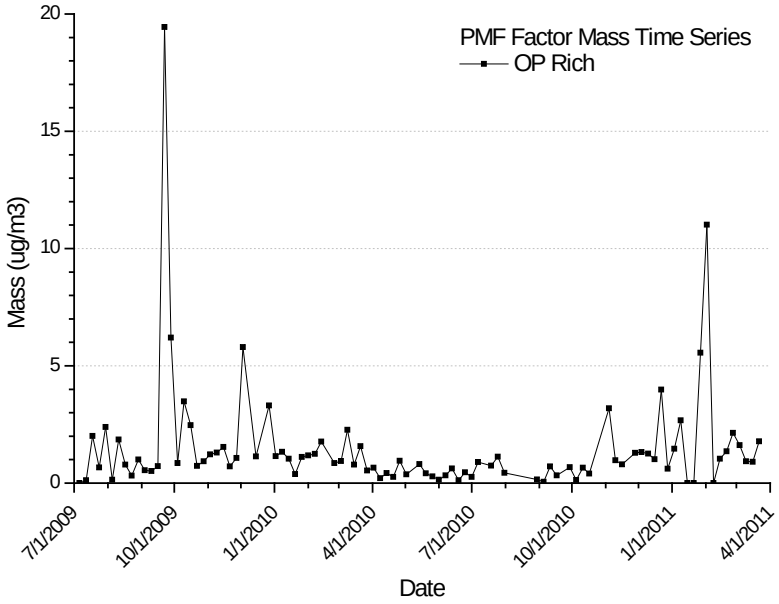


Figure 5.2.3. Monthly mean factor mass impacts

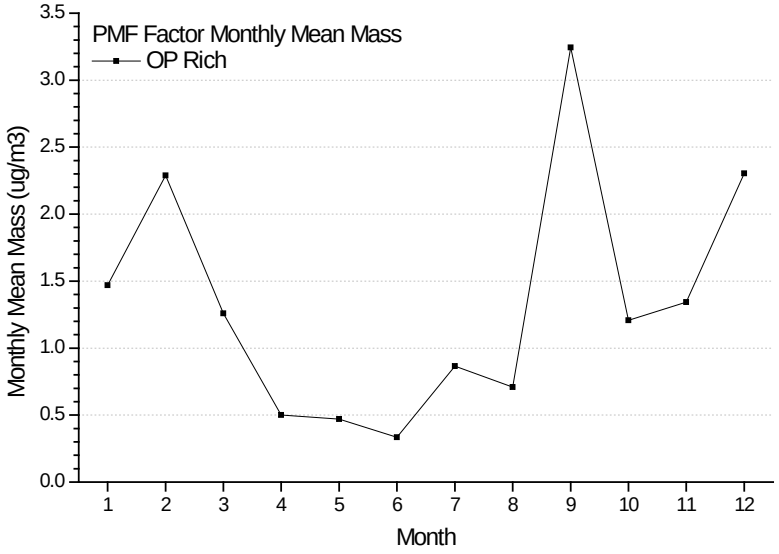
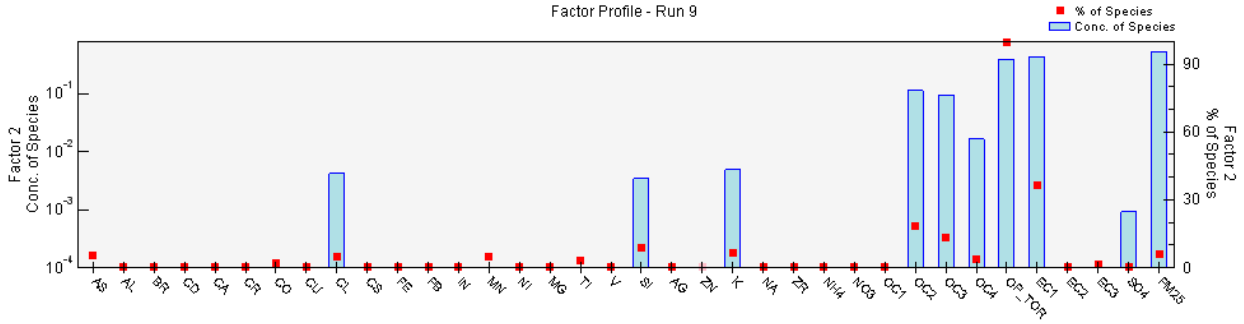
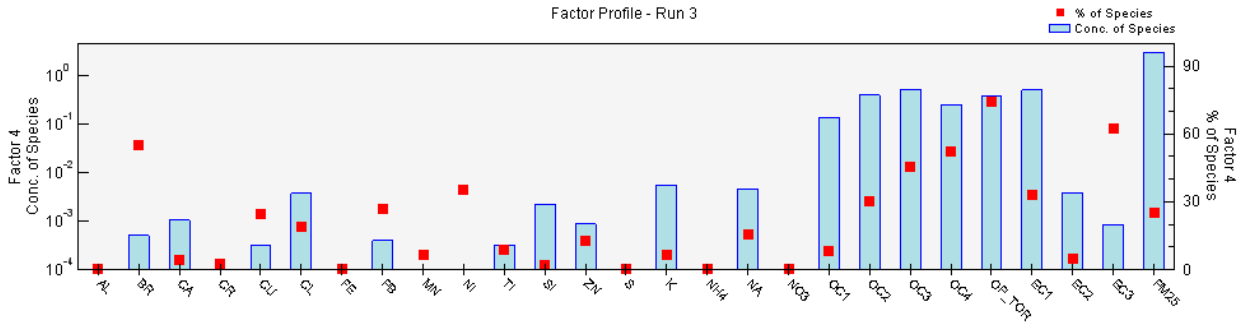


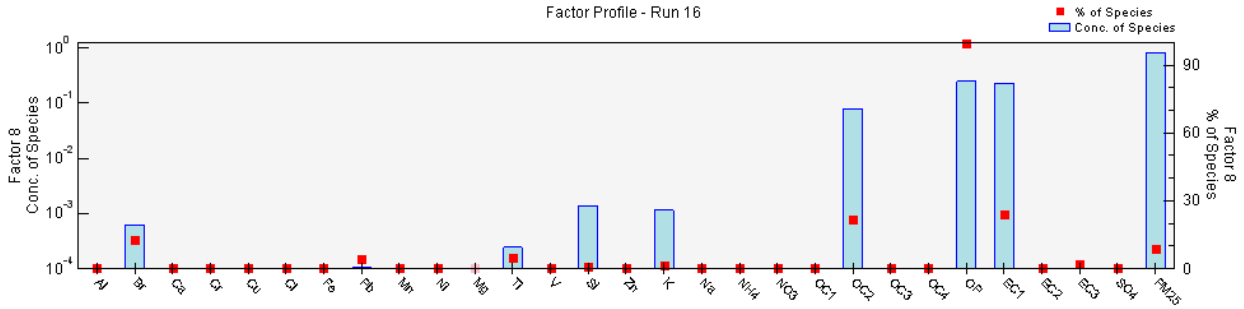
Figure 5.2.4. Comparative OP Rich factor profiles from other areas:
(a) Tacoma, WA South L Street



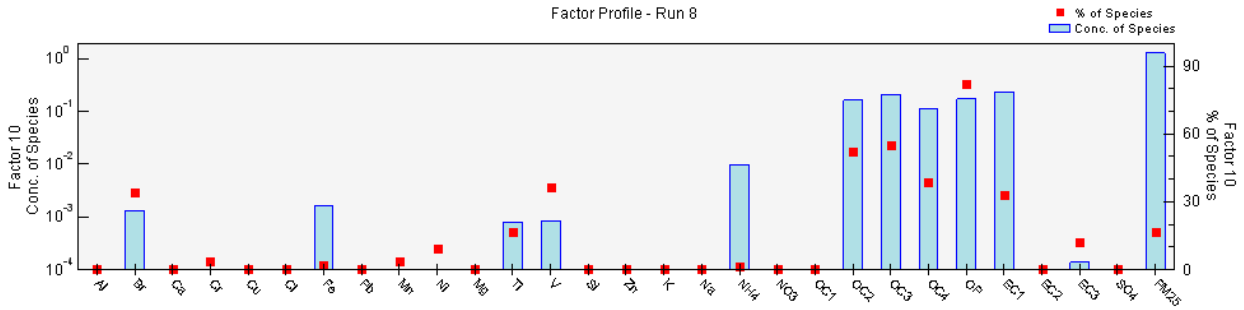
(b) Klamath Falls, OR



(c) Salt Lake City, UT



(d) Bountiful, UT



5.3. Gasoline Vehicles Factor

Factor identification: This factor was identified by the importance of OC and EC to overall mass as well at the pattern of OC and EC fractions. The pattern of OC & EC fractions in this work matches closely the patterns identified as Gasoline Vehicles in the work of Zhao and Hopke, 2004, Kim et al. 2004, Maykut et al. 2003, and others, and the authors experience with PMF profiles from other gasoline vehicle impacted sites in the Western US.

Figure 5.3.1. Factor Chemical Composition

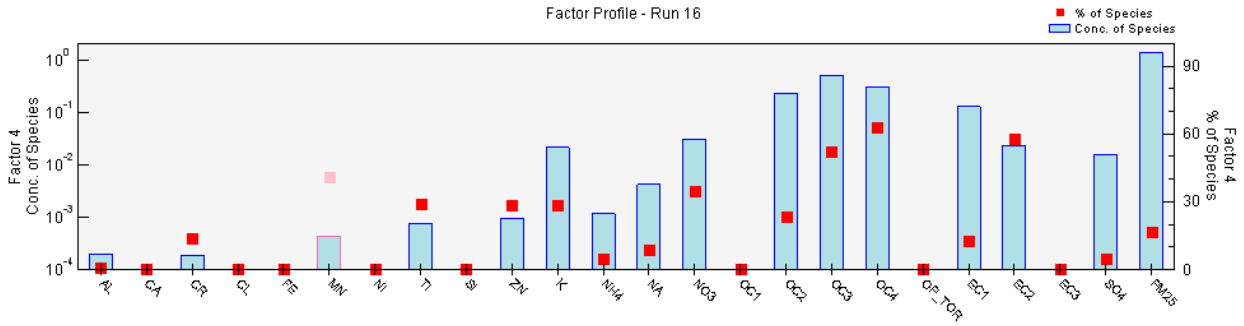


Figure 5.3.2. Time series of factor mass impacts

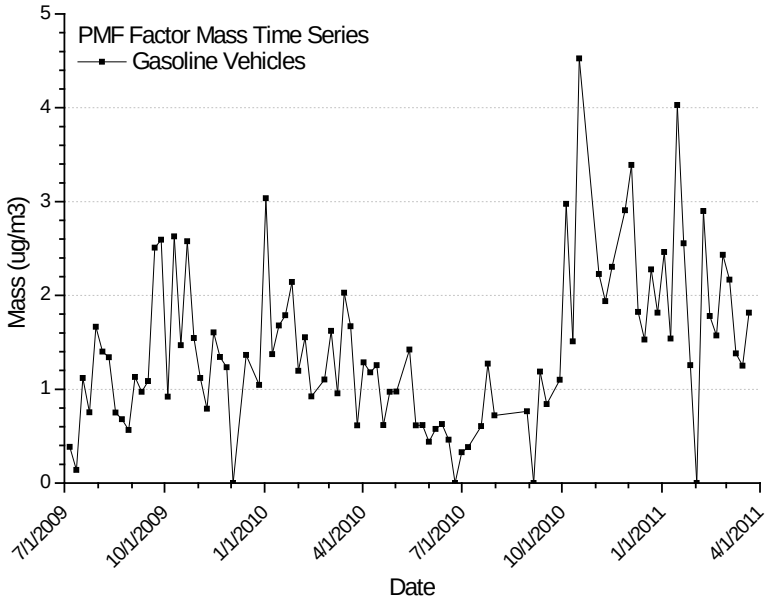


Figure 5.3.3. Monthly mean factor mass impacts

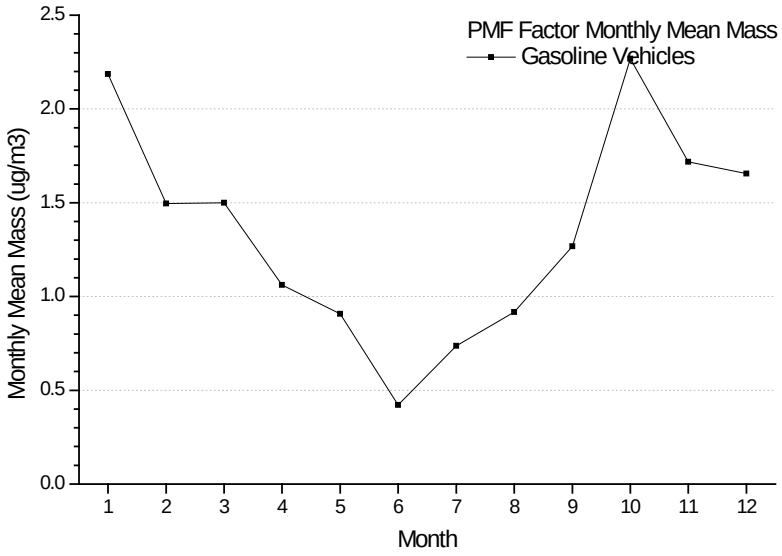
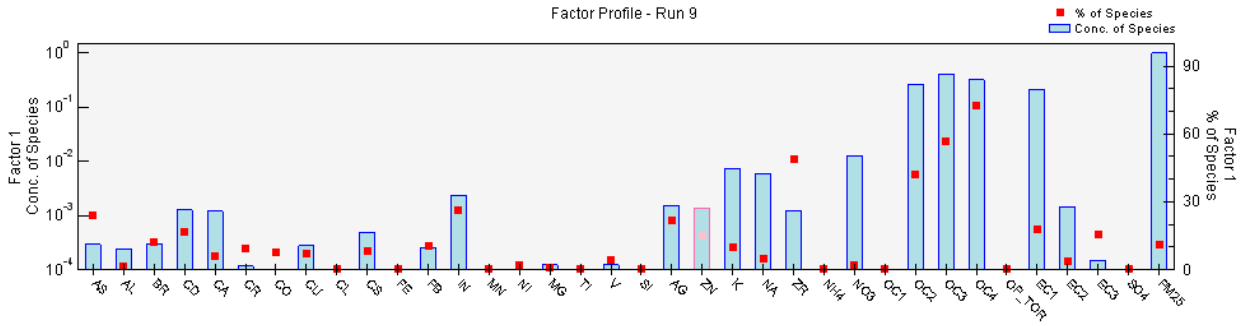
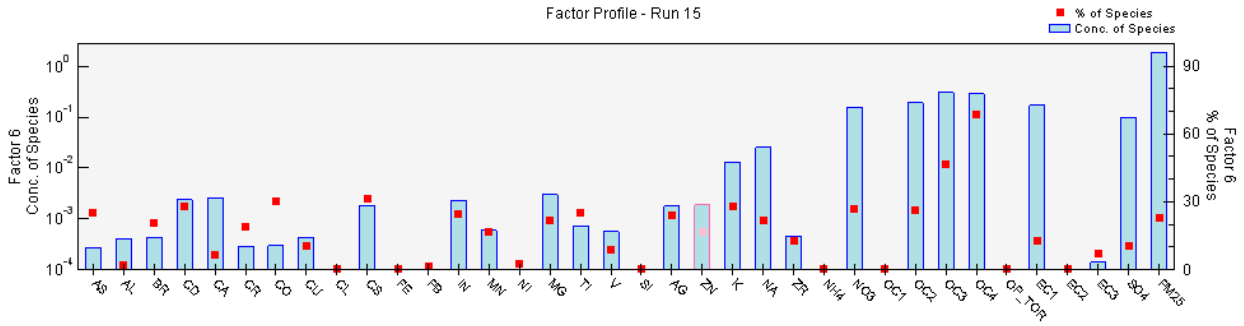


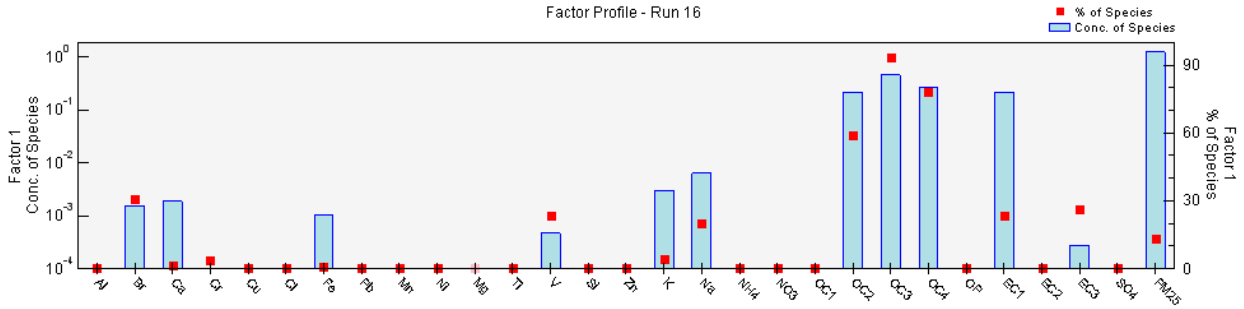
Figure 5.3.4. Comparative Gasoline Vehicle Factor profiles from other areas:
(a) Tacoma, WA South L Street



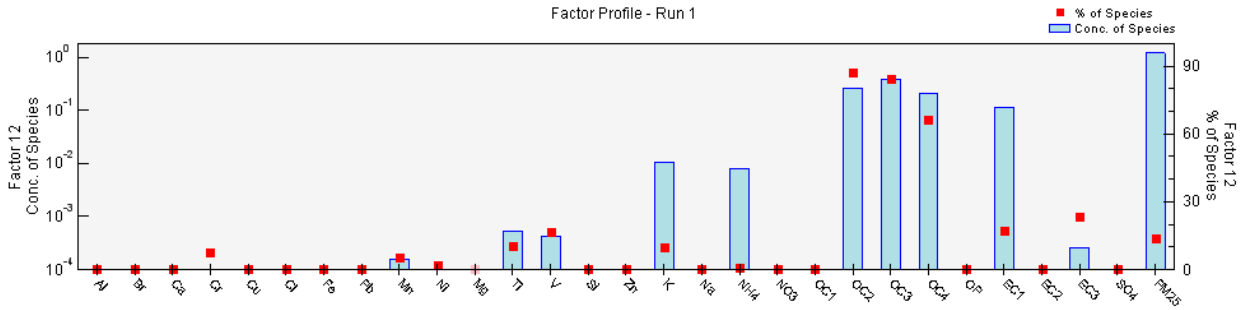
(b) Tacoma, WA Alexander Ave.



(c) Salt Lake City, UT



(d) Lindon, UT



5.4. Fe Rich Factor

Factor identification: This factor was identified by the importance of Fe in the factor composition. Further identification of this factor is somewhat unclear at the moment and is ongoing. A PMF analysis of PM2.5 for South L St. in Tacoma WA conducted by David Ogulei (2010) identified a Fe Rich factor that he labeled as Diesel. Kotchenruther (2011a, 2011b) also identified Fe Rich factors at two sites in Tacoma WA and three sites near Salt Lake City UT. However, Kotchenruther (2011a) also identified a separate and very different Diesel factor for PMF modeling at Alexander Ave. in Tacoma. It should be noted that the Oakridge Fe Rich Factor has very little EC component, and typically EC is a significant component of Diesel emissions. EC was a significant component of the Fe Rich factors identified by Ogulei (2010) and Kotchenruther (2011a, 2011b).

Figure 5.4.1. Factor Chemical Composition

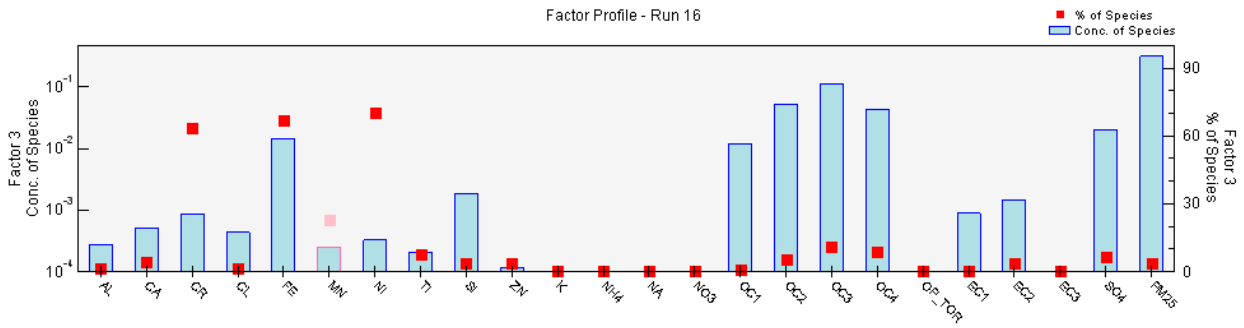


Figure 5.4.2. Time series of factor mass impacts

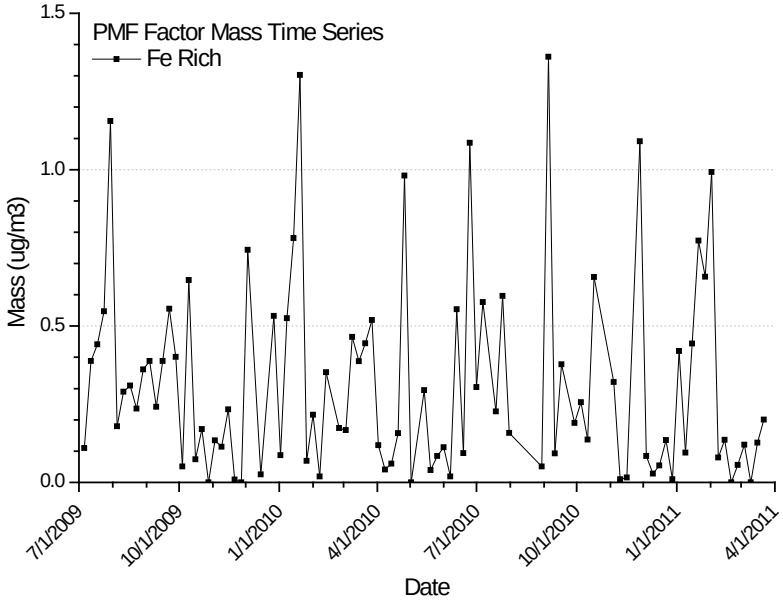


Figure 5.4.3. Monthly mean factor mass impacts

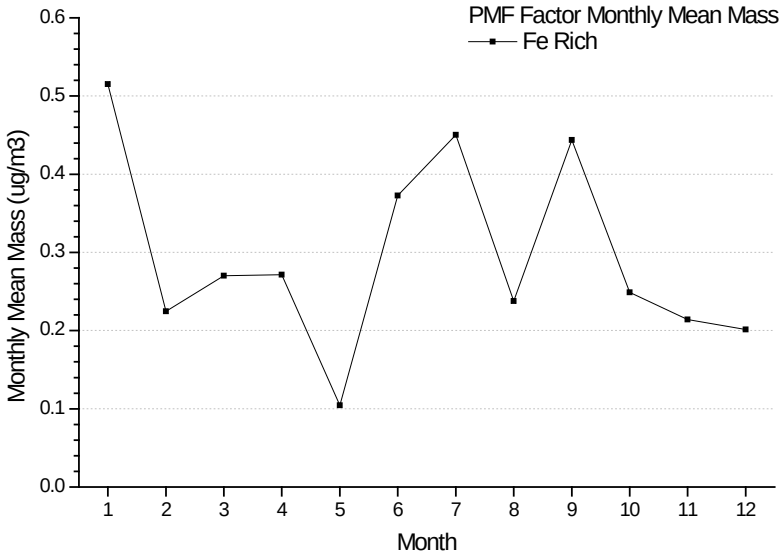
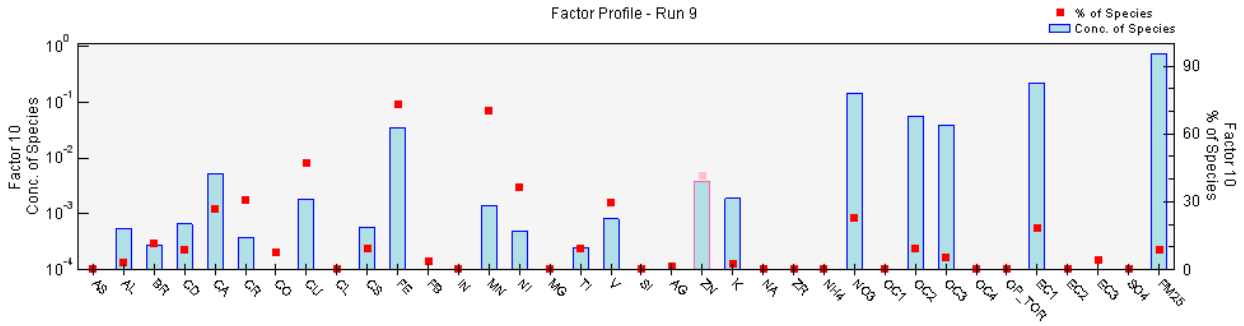
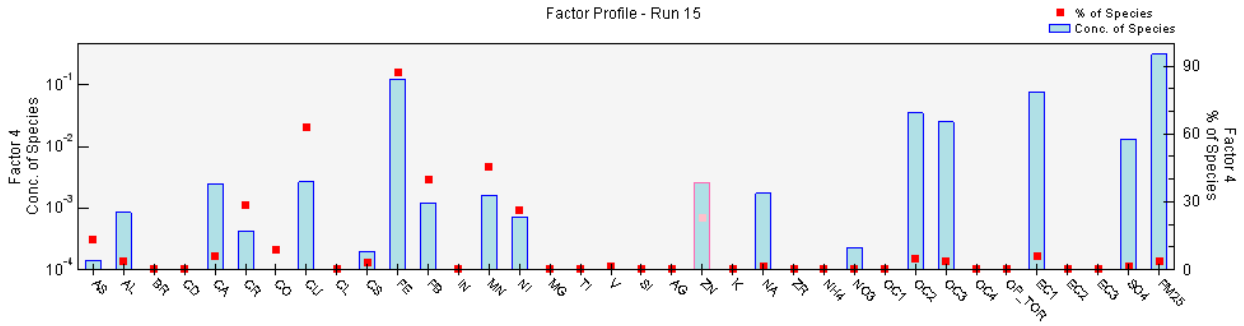


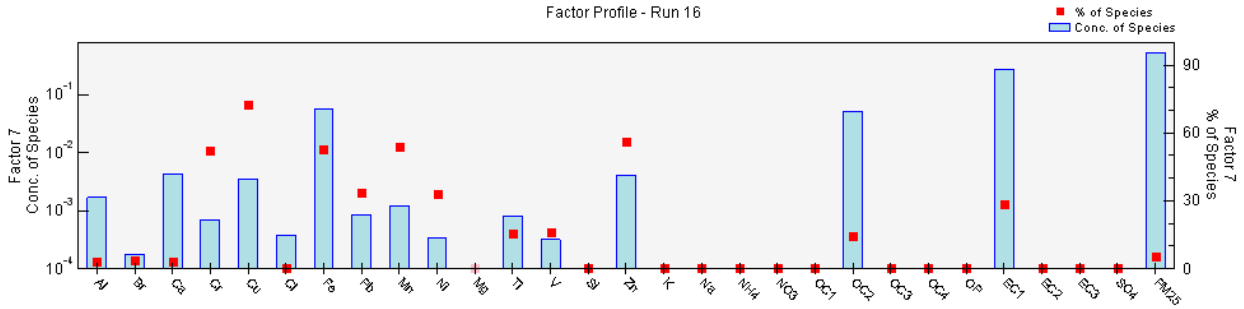
Figure 5.4.4. Comparative Fe Rich Factor profiles from other areas:
(a) Tacoma, WA South L Street



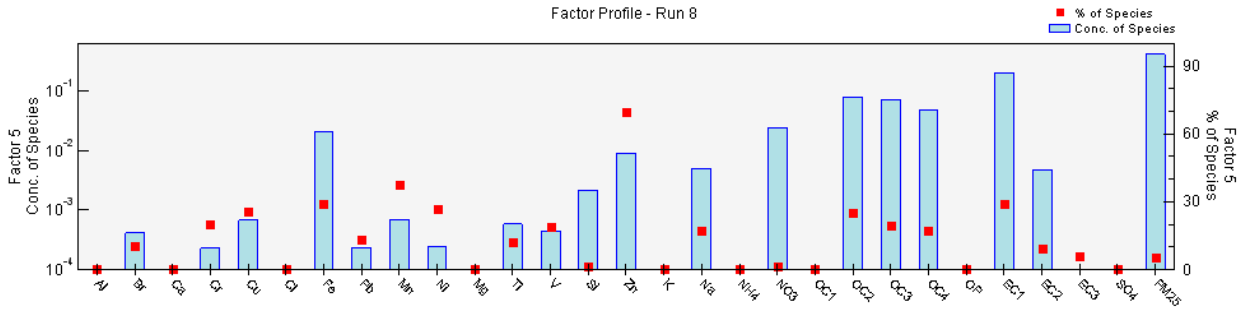
(b) Tacoma, WA Alexander Ave.



(c) Salt Lake City, UT



(d) Bountiful, UT



5.5. Sulfate Rich Factor

Factor identification: This factor was identified by the importance of SO4 in the factor composition.

Figure 5.5.1. Factor Chemical Composition

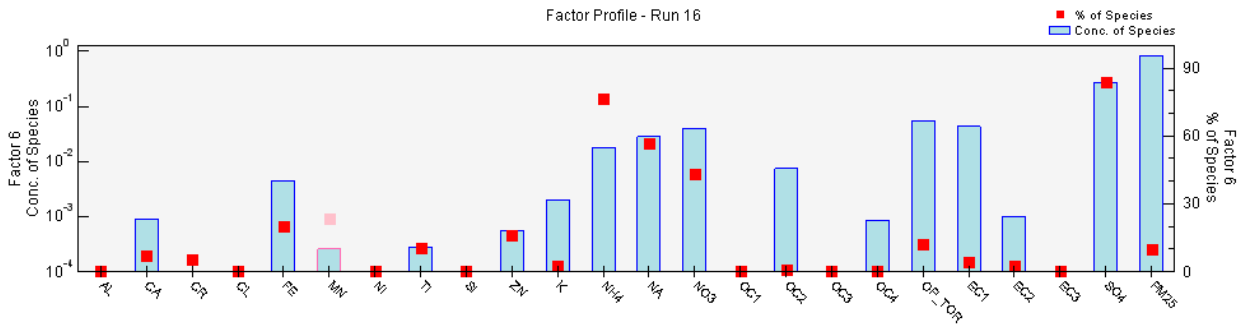


Figure 5.5.2. Time series of factor mass impacts

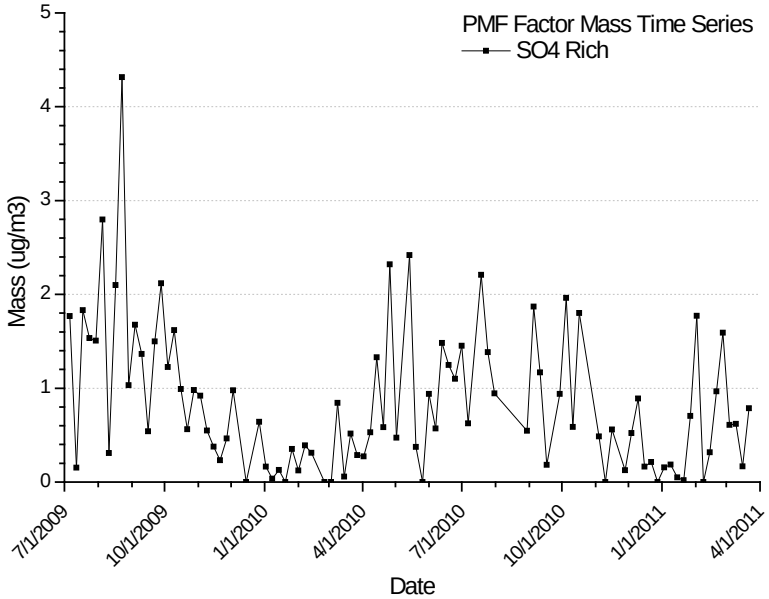


Figure 5.5.3. Monthly mean factor mass impacts

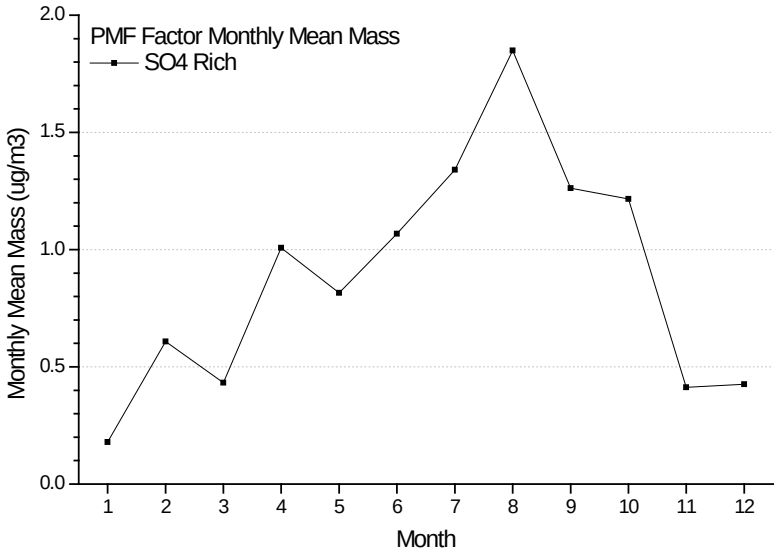
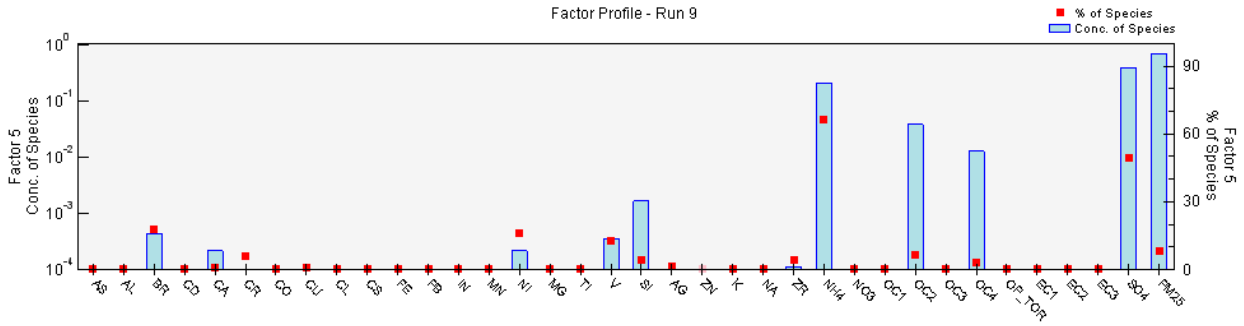
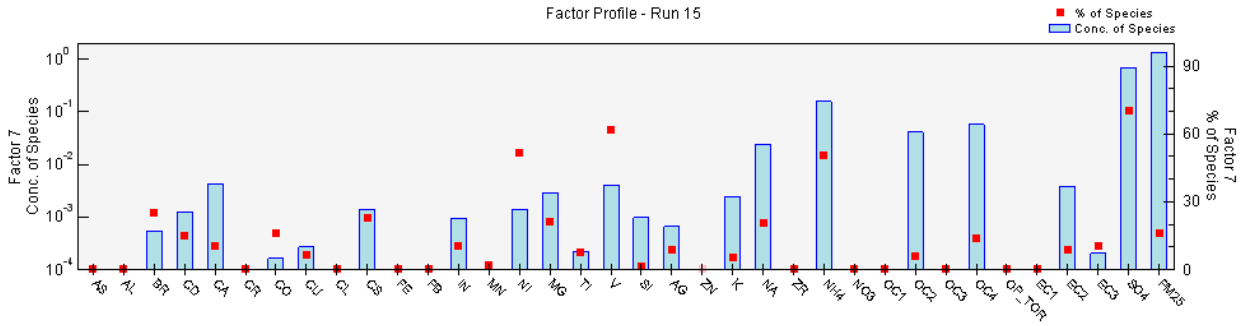


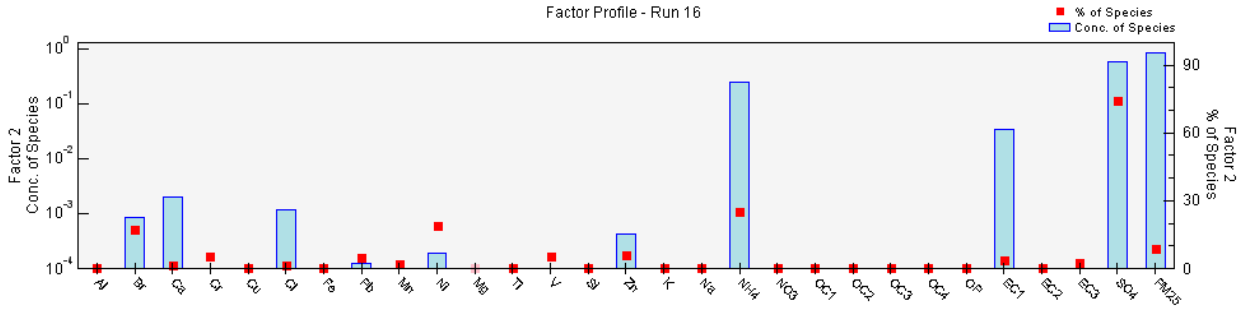
Figure 5.5.4. Comparative Sulfate Rich factor profiles from other areas:
(a) Tacoma, WA South L Street



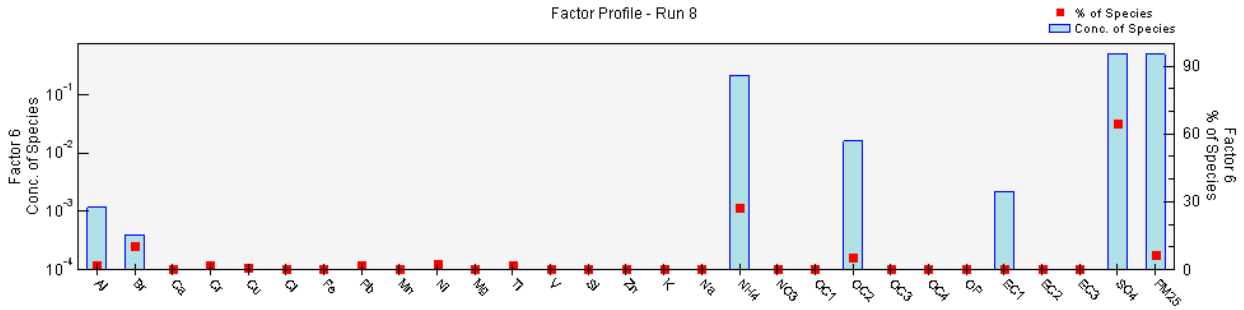
(b) Tacoma, WA Alexander Ave



(c) Salt Lake City, UT



(d) Bountiful, UT



5.6. Sea salt Factor

Factor identification: This factor was identified by the importance of Na and Cl in the factor composition.

Figure 5.6.1. Factor Chemical Composition

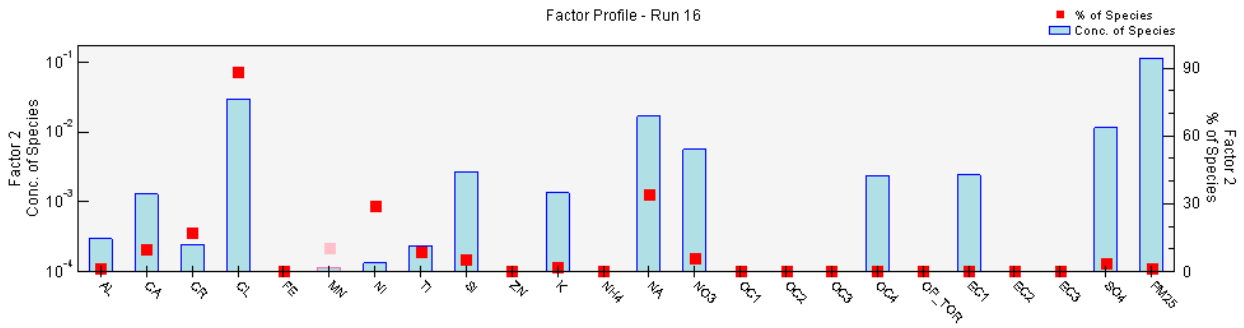


Figure 5.6.2. Time series of factor mass impacts

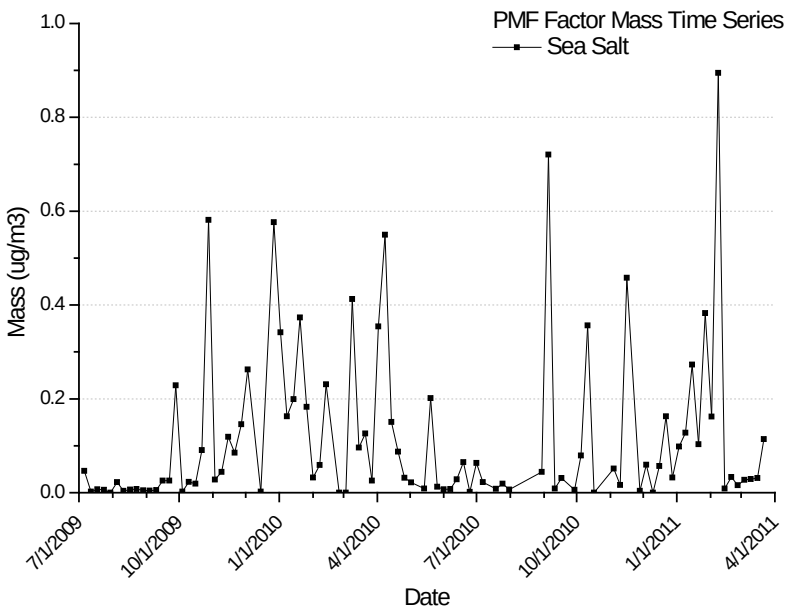


Figure 5.6.3. Monthly mean factor mass impacts

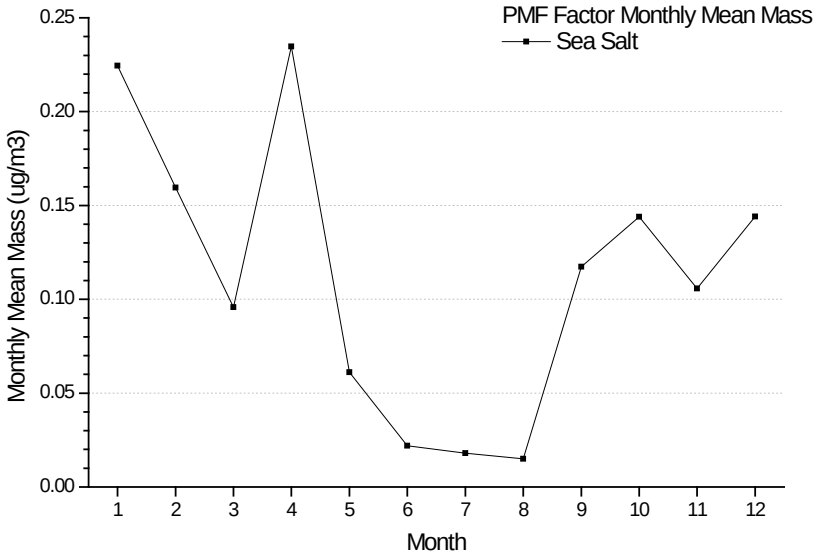
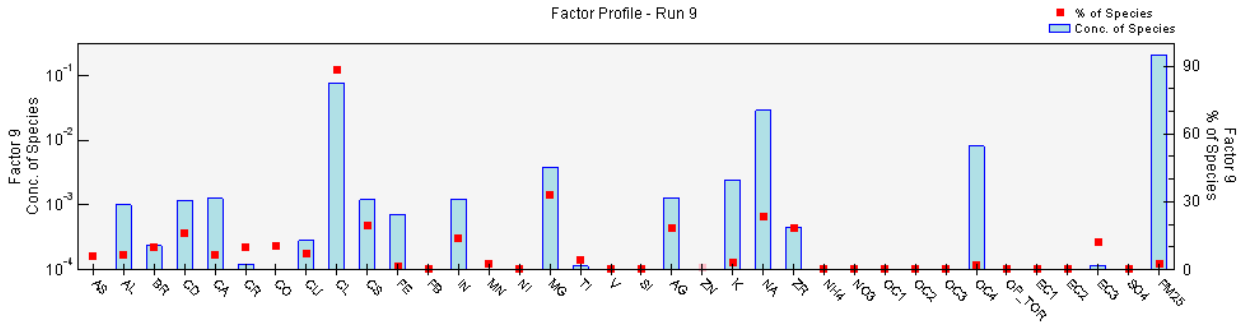
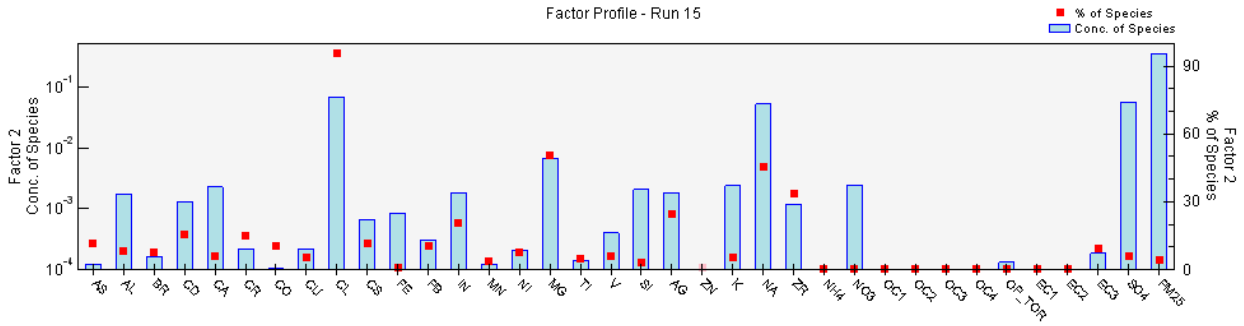


Figure 5.6.4. Comparative Sea Salt factor profiles from other areas:
(a) Tacoma, WA South L Street



(b) Tacoma, WA Alexander Ave



5.7. Fugitive Dust Factor

Factor identification: This factor was identified by the importance of Al, Ca, Fe, Ti, and Si in the factor composition.

Figure 5.7.1. Factor Chemical Composition

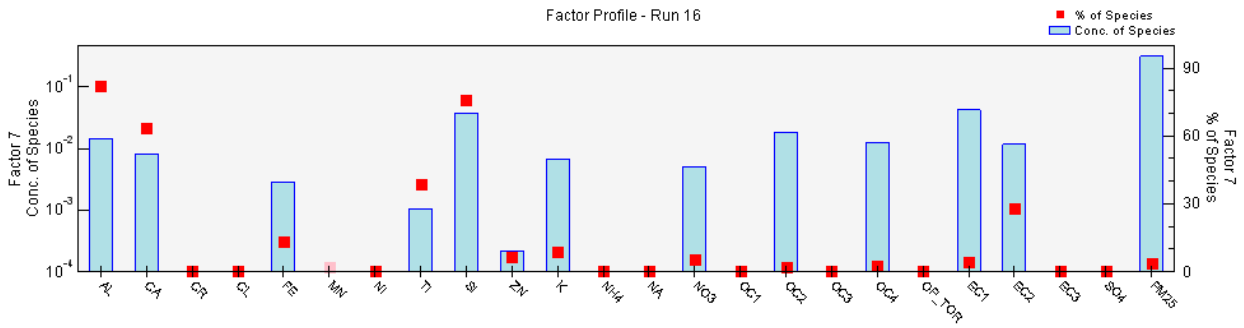


Figure 5.7.2. Time series of mass impacts

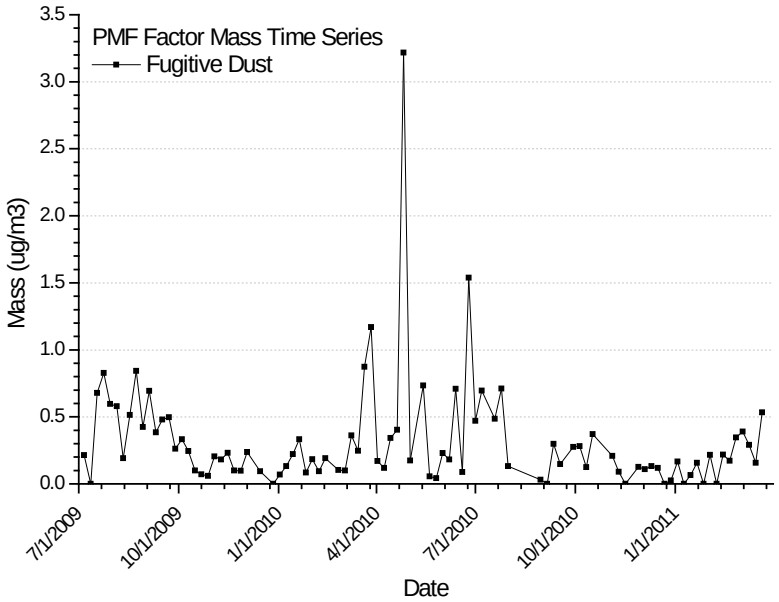


Figure 5.7.3. Monthly mean mass impacts

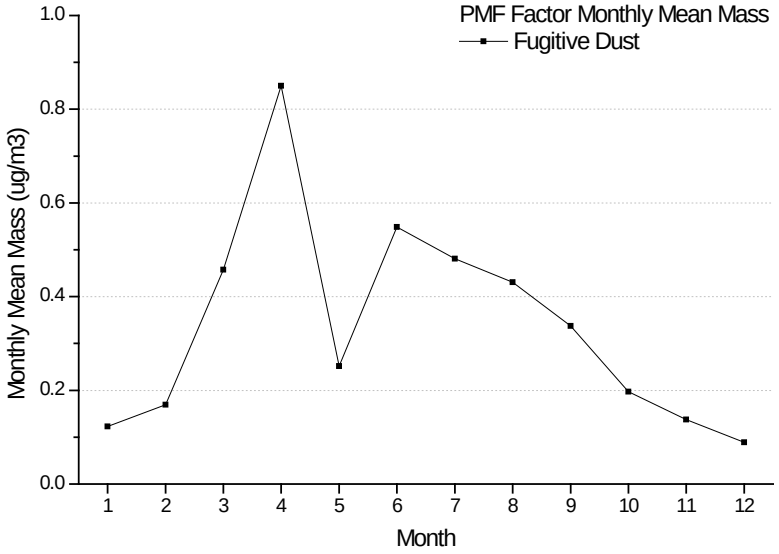
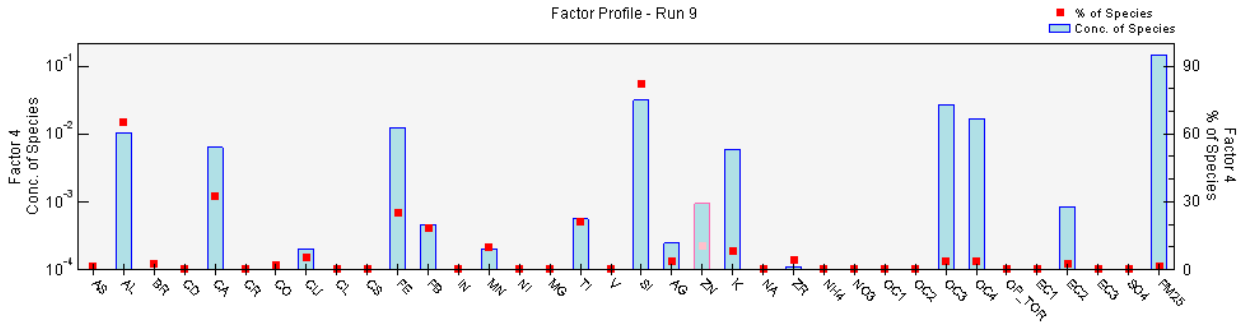
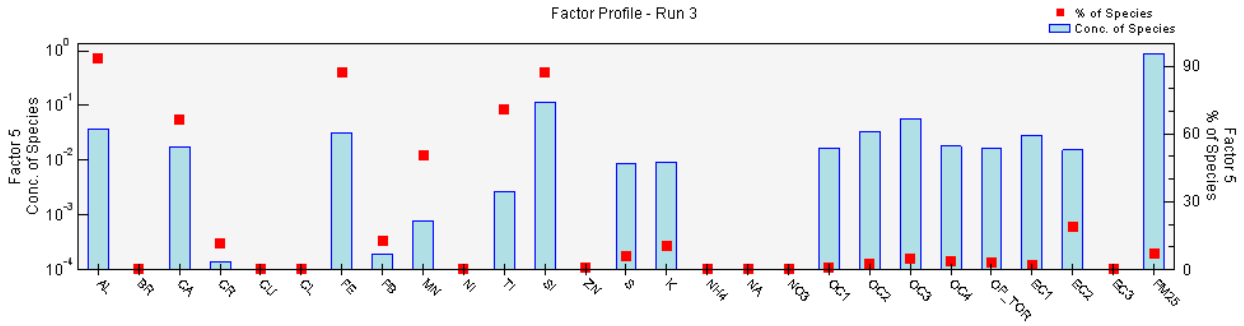


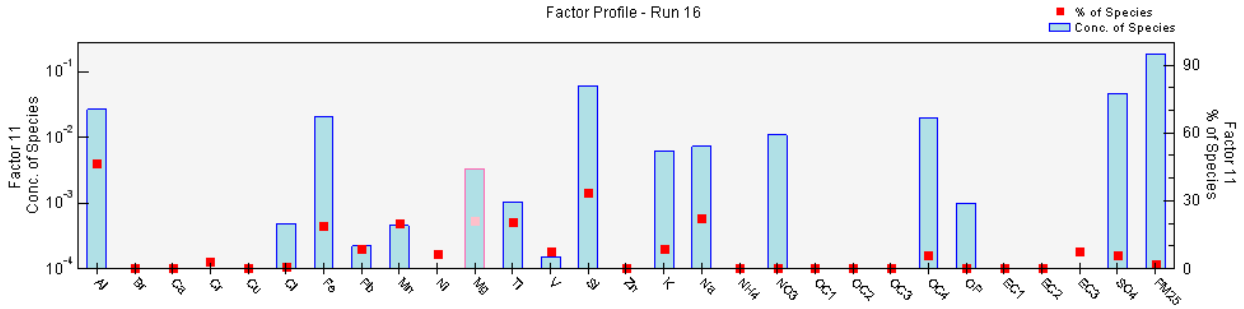
Figure 5.7.4. Comparative Fugitive Dust factor profiles from other areas:
(a) Tacoma, WA South L Street



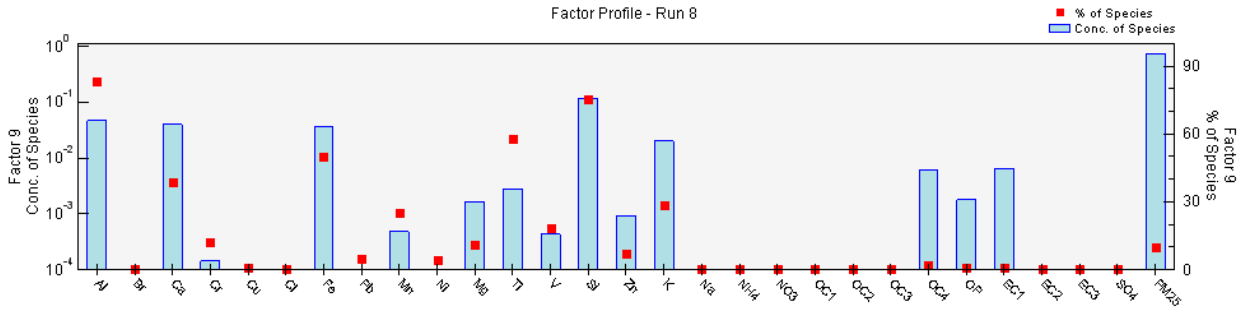
(b) Klamath Falls, OR



(c) Salt Lake City, UT



(d) Bountiful, UT



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Appendix H – Rollback Modeling

Introduction

The method chosen to demonstrate attainment for Oakridge is a rollback/rollforward proportional model that assumes a linear correlation between emissions and measured concentrations. A photochemical grid model, such as CMAQ or CAMx, was not used for the following reasons:

1) Photochemistry plays a minor role in $PM_{2.5}$ formation in Oakridge, which is dominated by organic carbon (OC) primarily the result of winter season residential wood smoke, with highest measure concentrations occurring in evening hours during periods of high burning activity, frequent temperature inversions, and stagnant air.
2) Secondary $PM_{2.5}$, including sulfate, nitrate, and secondary organic aerosols (SOAs), are minor constituents of total PM mass.
3) The NAA is small and bowl shaped – surrounded by elevated terrain. With low mixing heights and light winds during periods of high concentration, it is assumed pollutants are relatively well-mixed and concentration gradients low within the highly populated portion of the non-attainment area. A typical configuration for CMAQ or CAMx would not resolve the spatial patterns in PM2.5 within the nonattainment area any more than the rollback/forward box model.
4) The relative ease of use of the rollback/forward model facilitated troubleshooting, quality control, and sensitivity testing.

The EPA Guideline on Air Quality models (40 CFR Part 51, Appendix W) addresses the choice of models for analyzing $PM_{2.5}$ concentrations, and in 5.2.2.1 a states:

> *Treating secondary components of $PM_{2.5}$, such as sulfates and nitrates, can be a highly complex and resource-intensive exercise. Control agencies with jurisdiction <u>over areas with secondary $PM_{2.5}$ problems are encouraged to use models which integrate chemical and physical processes</u> important in the formation, decay and transport of these species (e.g., Models-3/CMAQ 38 or REMSAD 41). <u>Primary components can be simulated using less resource-intensive techniques</u>.* [emphasis added]

This language suggests that for NAAs without secondary $PM_{2.5}$ problems, the $PM_{2.5}$ attainment demonstration in which primary components are the major component can be made using simpler, less resource-intensive techniques. Though not stated explicitly in this section of the Guidelines, this simpler technique could include a proportional rollback/rollforward model.

Secondary $PM_{2.5}$, including sulfate, nitrate, and SOAs, will be included in the rollback model. Because levels of secondary $PM_{2.5}$, as well as their precursor emissions, are relatively low, they will be included in the rollback with a RRF of 1.0, that is, the level of secondary $PM_{2.5}$ species will be held constant from the baseline year to the future year. This is considered a

conservative approach as reductions in residential wood smoke with corresponding reductions in organic carbon (the target of control strategies to reach attainment) will also reduce emissions of secondary $PM_{2.5}$ precursors. In addition, reductions in motor vehicle emissions from existing rules will increasingly work their way through the vehicle fleet.

Rollback

The rollback model is based on the assumption that there is a direct correlation between emissions of a pollutant and measured concentrations of that pollutant in the same airshed, and that changes in emissions will result in corresponding changes in concentration. This correlation is then used to predict future concentrations based on future emissions. The change in concentrations from the change in emissions is represented by the Relative Reduction Factor (RRF). An RRF of less than 1.0 indicates a reduction in emissions-concentrations; an RRF greater than1.0 indicates an increase. This relationship is summarized in the following equation.

(DVF) = (RRF) (DVB)

Where,

(DVB) = the Design Value Baseline, developed from the monitored concentration (µg/m³)
(RRF) = relative response factor (ratio of the future concentration to the baseline concentration)
(DVF) = the Design Value Future predicted at the monitor (µg/m³)

The rollback model as used here has four main parts:

1) a table that calculates the PM mass available for increases and decreases in the model, by species, based on the SANDWICH speciated FRM mass
2) the 2008 Baseline table that calculates speciated mass for each source category in the model (and associated Source Category and Speciation Profile tables)
3) the 2014 Future Year table that calculates speciated mass for each source category based on emissions changes since the Baseline Year together with a calculated total RRF for changes between Baseline and Future Year
4) a table that applies the total RRF to each Design Day in the Base Year DV in order to predict the Future Year DV.

Species Mass Used for Rollback

The SANDWICH method speciates FRM $PM_{2.5}$ mass (regulatory concentration that determines attainment) based on the SASS and URG speciation monitor data from Willamette Activity Center. The Mass for Rollback table below shows what portion of that mass, by species, is available for increases or decreases in the rollback model, and what portion is held constant from the Baseline to the Future Year, that is, assigned an RRF of 1.0.

Row 1	Mass for Rollback			*DV = 39.5 - 0.5 =*	**39**				
					SANDWICH Fraction				
Row 3		**7.6%**	**88.4%**	**1.1%**	**1.1%**	**0.4%**	**1.4%**	**0.0%**	**100.0%**
		EC	OC	Crust	SO4	NO3	H20	NH3	Total
	Source Category	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Row 6	*Background*	*0.10*	*0.60*						*0.70*
Row 7	*Anthropogenic SOA*		*1.17*						*1.17*
Row 8	*Biogenic SOA*		*0.39*						*0.39*
Row 9	*Inorganics*				*0.43*	*0.16*			*0.60*
Row 10	*Water*						*0.54*		*0.54*
Row 11	*Ammonia*							*0.01*	*0.01*
Row 12	*Total Bkg+SA+Other*	***0.10***	***2.16***	***0.00***	***0.43***	***0.16***	***0.54***	***0.01***	***3.41***
Row 13	*Calculated DV Mass*	***2.95***	*34.46*	*0.44*					
Row 14	*Net Mass for Rolling*	***2.85***	***32.30***	***0.44***					***35.59***
	Total Roll + Non-roll								***39.00***

Figure 1: Mass for rollback table for Oakridge.

A row by row description of the table is as follows:

Row 1: The 39.5 µg/m³ DV includes an assumed contamination of 0.5 µg/m³, leaving a net 39.0 µg/m³ actual mass for the rollback
Row 3: Speciation fractions of FRM PM mass using SANDWICH method
Row 6: Estimated background EC and OC from IMPROVE sites
Row 7: Estimated Anthropogenic SOA from PSU study
Row 8: Estimated Biogenic SOA from PSU from study
Row 9: Secondary Inogranic Aerosols estimated from LRAPA speciation data
Row 10: Water fraction from SANDWICH
Row 11: Ammonia from SANDWICH
Row 12: Total mass by species that will be constant from Baseline to Future Year
Row 13: Calculated mass for EC, OC, and PM Other (crustal) as SANDWICH fraction of DV
Row 14: Net speciated mass that is used in the rollback.

EC, OC, and Other PM (crustal, etc.) are the $PM_{2.5}$ species that will used in the rollback model.

Baseline 2008 Rollback Table

The 2008 portion of the rollback lists the major source categories from the emissions inventory, their emission rates, and source profiles that speciate the $PM_{2.5}$ in the inventory into the active species used in the rollback (EC, OC, and Other PM).

Source Categories

Multiple source categories were used in the rollback reflecting those source types considered to be significant in the analysis. Because residential wood heating is the largest $PM_{2.5}$ emissions source, based on its percentage of emissions from all sources, and because proposed controls of that source type could be selectively applied by device type, residential wood heating

emissions are defined at the level of device type. Source categories used in the rollback are shown in the table below.

1	Cement Production
2	Sand and gravel mining
3	Fireplace
4	Woodstove Insert Non-Cert
5	Woodstove Insert Cert (Non-Cat)
6	Pellet / Woodstove Cert
7	Ag and open burn
8	Rail
9	Passenger Vehicles - light diesel
10	Trucks - Heavy diesel
11	Passenger Vehicles - gas
12	Vehicle Road Dust

Figure 2 : Oakridge rollback source categories

Details of source type, device type, and the methodologies for estimating their emissions are described in the Emissions Inventory section of this report.

Speciation Profiles

The rollback is based on a speciated emissions inventory. Emissions from source categories in the inventory were initially estimated as total PM2.5, and source profiles were used to allocate emissions to individual PM2.5 species. Since SO4 and NO3 are held constant in the rollback, the components of concern in the speciation are OC, EC, and Other PM. Speciation profiles were taken from EPA SPECIATE 4.2 and 4.3.

LRAPA		SPECIATE Profiles			
ID	Categories used in Rollback	4.2		4.3	
1	Cement Production	92127		91127	
2	Sand and gravel mining	92048		91112	
3	Fireplace	92069		91032	
4	Woodstove Insert Non-Cert	92069		91032	
5	Woodstove Insert Cert (Non-Cat)	92069		91032	
6	Pellet / Woodstove Cert	92069		91032	
7	Ag and open burn	92000		91103	
8	Rail	92035		91106	
9	Passenger Vehicles - light diesel	92042		91162	
10	Trucks - Heavy diesel	92035		91106	
11	Passenger Vehicles - gas	92050		91122	
12	Vehicle Road Dust	92053		91108	

Figure 3: Oakridge rollback source category speciation profiles

Baseline half of the Rollback

The Baseline half (2008) of the Rollback incorporates information and data described in previous tables, including, 1) speciated $PM_{2.5}$ mass for rollback, 2) source categories, and 3) speciation profiles. The Future Year half (2014) follows and is described in the next section.

The upper portion of the Baseline Table repeats the speciated $PM_{2.5}$ mass data, and shows in the first row (Background + Secondary Aerosols + Other) concentrations that are either in the background or are not overall important contributors to total mass. The relative increases and decreases in these concentrations are considered to be minor, and these concentrations are considered constant from 2008 to 2014, and will be added back to total mass in 2014.

Concentrations that will be explicitly modeled are shown in the row Net Mass for Rolling, and in this example are EC (2.85 $\mu g.m^3$), OC (32.30 $\mu g.m^3$), and Crust - PM Other (0.44 $\mu g.m^3$).

The lower portion of the table shows the source categories, their associated emissions (either actual or calculated), and the speciation profile fractions based on profiles unique to each source category. The next group of columns shows the speciation of emissions based on the source profile fractions, and the relative percentage that each source category contributes to each of three species (EC, OC, and Other).

Based on their percentage contribution for each species, the last group of columns calculates the concentrations for each source category for each species. This calculation uses the total EC, OC, and Other concentrations that are available for roll, as shown in the upper portion of the table, as described above.

As a check, the totals match. From the speciated $PM_{2.5}$ mass data at the top of the table, total mass is 39.00 $\mu g/m^3$ (of which 35.59 $\mu g/m^3$ was available for rolling), and at the bottom of the table, the total speciated mass by category is 35.59 $\mu g/m^3$ plus 3.41 $\mu g/m^3$, giving an overall total of the same 39.00 $\mu g/m^3$.

The last group of columns with species-specific concentrations for each source category provides the basis for ratio Future emissions to Baseline emissions in order to estimated Future concentrations.

Rollback Baseline Year: 2008

Emission Category	EC µg/m³	OC µg/m³	Crust µg/m³	SO4 µg/m³	NO3 µg/m³	H20 µg/m³	NH3 µg/m³	Total µg/m³
	Mass for Rollback							
Total Bkg+SA+Other	***0.10***	***2.16***	***0.00***	***0.43***	***0.16***	***0.54***	***0.01***	***3.41***
Calculated DV Mass	***2.95***	*34.46*	*0.44*					
Net Mass for Rolling	***2.85***	***32.30***	***0.44***					***35.59***
Total Roll + Non-roll								***39.00***

LRAPA ID	Source Category	PM2.5 Emissions lbs/day	Emissions as %	Speciation Profile EC fraction	OCM fraction	PMOther fraction	Speciated Emissions EC lbs/day	OCM lbs/day	PMOther lbs/day	EC %	OCM %	PMOther %	Effective Source Concentrations EC ug/m3	OCM ug/m3	PMOther ug/m3	SO4 ug/m3	NO3 ug/m3	H20 ug/m3	NH3 ug/m3	Total ug/m3
1	Cement Production	0.1	0.0%	0.029	0.177	0.498	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.00	0.00	0.00					
2	Sand and gravel mining	0.8	0.1%	0.000	0.000	0.996	0.0	0.0	0.8	0.0%	0.0%	0.4%	0.00	0.00	0.00					
3	Fireplace	42.3	7.7%	**0.056**	**0.528**	**0.409**	2.4	22.3	17.3	4.7%	8.1%	7.7%	0.13	2.63	0.03					
4	Woodstove Insert Non-Cert	174.8	31.7%	**0.056**	**0.528**	**0.409**	9.8	92.3	71.4	19.4%	33.6%	32.0%	0.55	10.87	0.14					
5	Woodstove Insert Cert (Non-Cat)	250.8	45.4%	**0.056**	**0.528**	**0.409**	14.0	132.5	102.5	27.9%	48.3%	45.9%	0.79	15.59	0.20					
6	Pellet / Woodstove Cert	7.4	1.3%	**0.056**	**0.528**	**0.409**	0.4	3.9	3.0	0.8%	1.4%	1.4%	0.02	0.46	0.01					
7	Ag and open burn	4.7	0.9%	0.109	0.660	0.193	0.5	3.1	0.9	1.0%	1.1%	0.4%	0.03	0.37	0.00					
8	Rail	6.0	1.1%	0.771	0.219	0.005	4.6	1.3	0.0	9.2%	0.5%	0.0%	0.26	0.16	0.00					
9	Passenger Vehicles - light diesel	13.8	2.5%	0.052	0.687	0.251	0.7	9.5	3.5	1.4%	3.5%	1.6%	0.04	1.12	0.01					
10	Trucks - Heavy diesel	22.5	4.1%	0.771	0.219	0.005	17.4	4.9	0.1	34.6%	1.8%	0.1%	0.99	0.58	0.00					
11	Passenger Vehicles - gas	1.0	0.2%	0.190	0.687	0.097	0.2	0.7	0.1	0.4%	0.3%	0.0%	0.01	0.08	0.00					
12	Vehicle Road Dust	27.8	5.0%	0.010	0.136	0.844	0.3	3.8	23.5	0.6%	1.4%	10.5%	0.02	0.45	0.05					
	Total	**552**	**100%**				**50**	**274**	**223**				**2.85**	**32.30**	**0.44**					35.59
	Total Bkg+SA+Other												**0.10**	**2.16**	**0.00**	**0.43**	**0.16**	**0.54**	**0.01**	3.41
	Total with Bkg+SA+Other												**2.95**	**34.46**	**0.44**	**0.43**	**0.16**	**0.54**	**0.01**	**39.00**

Figure 4: Oakridge rollback baseline table

Future Year half of the rollback

The Future Year rollback table follows the structure of 2008. The upper portion shows the speciated $PM_{2.5}$ mass data, and in particular the species concentrations that were held constant from 2008 to 2014, that is those concentrations from background and secondary aerosols that were not explicitly modeled in the rollback.

The left set of columns shows the 2008 total $PM_{2.5}$ emissions and their respective speciated concentrations for each source category. Only concentrations for EC, OC, and Other are shown. The right set of columns shows the 2014 data, including total predicted $PM_{2.5}$ emissions by source category, and the ratio of these emissions to their 2008 counterpart. Thus, for example, the ratio of 2014 to 2008 emissions for Fireplace Insert (Non-Catalyst) is 0.78, or a reduction of 22% emissions for this source category.

The 2014/2008 emissions ratios for each source category are applied to their speciated concentrations to estimate speciated concentrations for 2014. The concentrations are summed for each species to which are then added the concentrations that were held constant from 2008. Thus, for example, total OC from all source categories for 2014 is 21.64 $\mu g/m^3$, which is added to the 2.16 $\mu g/m^3$ from the concentration of OC held constant.

The Relative Reduction Factor (RRF) is calculated for each species by ratioing the total for 2014 concentrations to total 2008. For example, the RRF for OC of 0.691 = 23.80 / 34.46. In order to apply the RRFs to the Design Day concentrations for calculating the Future Year DV, the species-specific RRFs are multiplied by the species percentage of their contribution to total DV $PM_{2.5}$ mass from the SANDWICH method. Thus, for OC based on its contribution of 88.4% to total $PM_{2.5}$, its weighted RRF is 0.610. After all species-specific RRFs have been weighted a total RRF is calculated. In this example, the total RRF is 0.700, which will be used to factor the 2008 Design Days in order to calculate a 2014 DV.

Rollback Future Year : 2014 with concentrations and total RRF

SANDWICH Fraction	7.6%	88.4%	1.1%	1.1%	0.4%	1.4%	0.0%	100.0%
	EC	OC	Crust	SO4	NO3	H20	NH3	Total
Emission Category	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Total Bkg+SA+Other	***0.10***	***2.16***	***0.00***	***0.43***	***0.16***	***0.54***	***0.01***	***3.41***
Calculated DV Mass	***2.95***	*34.46*	*0.44*					
Net Mass for Rolling	***2.85***	***32.30***	***0.44***					***35.59***
Total Roll + Non-roll								***39.00***

	Base Year : 2008					**Future Year : 2014**									
		2008	Effective Emissions			2014	2008/2014	Concentations After Reductions							
LRAPA		Emissions	EC	OCM	PMOther	Emissions	emissions	EC	OCM	PMOther	SO4	NO3	H20	NH3	Total
ID	Source Category (3)	lbs/day	lbs/day	lbs/day	lbs/day	lbs/day	ratio	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	
1	Cement Production	0.1	0.00	0.00	0.00	14.0	140.00	0.023	0.3	0.0					
2	Sand and gravel mining	0.8	0.00	0.00	0.00	4.0	5.00	0.000	0.0	0.0					
3	Fireplace	42.3	0.13	2.63	0.03	***29.6***	0.70	0.094	1.8	0.0					
4	Woodstove Insert Non-Cert	174.8	0.55	10.87	0.14	***81.7***	0.47	0.259	5.1	0.1					
5	Woodstove Insert Cert (Non-Cat)	250.8	0.79	15.59	0.20	***194.4***	0.78	0.616	12.1	0.2					
6	Pellet / Woodstove Cert	7.4	0.02	0.46	0.01	***8.0***	1.08	0.025	0.5	0.0					
7	Ag and open burn	4.7	0.03	0.37	0.00	4.7	1.00	0.029	0.4	0.0					
8	Rail	6.0	0.26	0.16	0.00	6.0	1.00	0.263	0.2	0.0					
9	Passenger Vehicles - light diesel	13.8	0.04	1.12	0.01	8.2	0.59	0.024	0.7	0.0					
10	Trucks - Heavy diesel	22.5	0.99	0.58	0.00	13.3	0.59	0.582	0.3	0.0					
11	Passenger Vehicles - gas	1.0	0.01	0.08	0.00	0.7	0.70	0.008	0.1	0.0					
12	Vehicle Road Dust	27.8	0.02	0.45	0.05	16.3	0.59	0.010	0.3	0.0					
	Total		**3**	**32**	**0**	380.9		**1.93**	**21.64**	**0.31**					
	Total Bkg+SA+Other		0.10	2.16	0.00			**0.10**	**2.16**	**0.00**	**0.43**	**0.16**	**0.54**	**0.01**	
	Total with Bkg+SA+Other		2.95	34.46	0.44			**2.03**	**23.80**	**0.31**	**0.43**	**0.16**	**0.54**	**0.01**	**27.29**
	Species-specific RRF							0.689	0.691	0.699	1	1	1	1	
	RRF multiplied by Sandwich %							0.052	0.610	0.008	0.011	0.004	0.014	0.000	**0.700**

Figure 5 : Oakridge rollback future table

Future Year Design Value (DV)

The following table lists the design days in descending order for each year of the period 2006-2010. For each year, columns show concentrations for Base and Future years.

For each day, Baseline values are factored by the RRFs from the rollback table in order to predict Future Year concentrations. For example, the highest day in 2007 (02/02), has a concentration of 52.5 µg/m³. When multiplied by the total RRF of 0.700, and with the addition of the default 0.5 µg/m³ blank mass, the Future Year value is predicted to be 37.2 µg/m³. The 98th percentile value (usually the third highest) for each year is then entered into the DV table, described later, to calculate the Baseline and Future Year DVs.

The design days are listed in descending order with the highest of these days usually falling in the two quarters of the $PM_{2.5}$ "season" (1st and 4th quarters). The single relevant exception is 9/22/2009. This value is a documented wildfire impact. Since this value did not affect the year's design value, or Oakridge's $PM_{2.5}$ attainment status, an Exceptional Event exclusion was not sought by LRAPA. Because the residential wood combustion reduction strategies in this plan cannot apply to wildfire impact, this value is not eligible for application of the total RRF of 0.70 and is instead held constant at an RRF of 1.0.

The concentrations in the Design Day table that are used in the Design Value Table are color coded to match their locations. Note that since the value for 9/22/2009 is held constant to the future year, that value becomes the 2009 future year's highest value, making the third highest future value 29.6 µg/m³ (the future value for 2/21/2009).

2006			2007			2008			2009			2010		
Date	Base	Future	Date	Base	Future	Date	Base	Future	Date	Base	Future	Date	Base	Future
20061207	47	33.4	20070202	52.5	37.2	20080122	43.5	30.9	20091212	44.1	31.4	20100222	43.1	30.7
20060210	40.8	29.1	20070130	51.0	36.2	20080218	42.6	30.3	20090221	41.6	29.6	20100105	37.7	26.9
20060222	38.6	27.5	20070124	42.7	30.4	20080125	42.2	30.0	20090116	41.3	29.4	20100219	33	23.6
20060219	35.5	25.3	20070127	40.5	28.8	20081206	38.7	27.6	20090119	41	29.2	20100120	28.5	20.4
20060225	31.9	22.8	20071027	39.6	28.2	20081205	36.7	26.2	20090128	36.5	26.0	20100204	26.7	19.2
20060207	29.3	21.0	20070112	38.3	27.3	20081223	36.3	25.9	20090922	36.5	36.5	20100111	25.3	18.2
20060216	28.7	20.6	20071108	36.3	25.9	20080101	36.2	25.8	20091206	36.2	25.8	20101207	22.5	16.2
20061101	28.5	20.4	20071123	33.9	24.2	20081211	35	25.0	20091227	33.2	23.7	20101222	21.5	15.5
20061204	24.8	17.9	20070205	28.9	20.7	20081117	34.6	24.7	20090203	32	22.9	20100129	21.2	15.3
20061228	22.6	16.3	20070118	28.0	20.1	20080203	34.4	24.6	20090131	31.5	22.5	20101225	20.8	15.1
20061023	22.2	16.0	20070115	25.0	18.0	20081216	33.3	23.8	20090122	31.3	22.4	20101020	20.6	14.9
20060309	21.5	15.5	20071226	24.7	17.8	20081228	32.1	23.0	20091203	27.9	20.0	20100228	19.9	14.4
20061231	21.4	15.5	20071214	22.1	16.0	20081221	31.5	22.5	20090206	25.5	18.3	20101204	19.3	14.0
20061219	20.9	15.1	20071105	17.7	12.9	20080128	29.4	21.1	20090925	20.8	15.1	20101125	17	12.4
20060123	20.2	14.6	20071111	17.3	12.6	20080215	23.1	16.7	20091010	20.2	14.6	20101104	14.5	10.6
20061216	19.4	14.1	20071102	16.5	12.0	20080227	23	16.6	20090928	16.7	12.2	20101017	14.4	10.6
20060423	13.7	10.1	20070403	13.7	10.1	20080702	17	12.4	20091124	15.9	11.6	20100806	14.3	10.5
20060905	13.1	9.7	20070430	12.0	8.9	20080629	16.4	12.0	20091007	15.1	11.1	20100417	9.7	7.3
20060505	11.5	8.5	20070515	9.4	7.1	20080927	15.3	11.2	20090407	13.8	10.2	20100426	9	6.8
20060722	11.4	8.5	20070711	9.1	6.9	20080930	14.6	10.7	20090730	12.8	9.5	20100728	8.7	6.6
20060902	11.1	8.3	20070705	8.9	6.7	20080915	12.4	9.2	20090802	12.8	9.5	20100405	8.4	6.4
20060426	10.8	8.1	20070927	8.3	6.3	20080807	12.3	9.1	20091230	12.2	9.0	20100423	8.1	6.2
20060929	10.4	7.8	20070924	8.2	6.2	20080816	11.3	8.4	20090404	11.5	8.5	20100704	7.9	6.0
20060502	10	7.5	20070530	7.9	6.0	20080412	9.1	6.9	20090808	11.1	8.3	20100514	7.1	5.5
20060827	10	7.5	20070726	7.6	5.8	20080918	8.9	6.7	20090401	10.5	7.8	20100725	7	5.4
20060818	9.8	7.4	20070427	7.5	5.7	20080509	8.6	6.5	20090425	10.5	7.8	20100716	6.8	5.3
20060625	9.6	7.2	20070602	7.5	5.7	20080924	8	6.1	20090703	9.6	7.2	20100803	6.8	5.3
20060517	9.5	7.1	20070406	7.4	5.7	20080503	7.5	5.7	20090510	9.2	6.9	20100411	6.6	5.1
20060806	9.3	7.0	20070506	7.4	5.7	20080617	7	5.4	20090718	7.9	6.0	20100722	6.3	4.9
20060514	8.6	6.5	20070801	7.0	5.4	20080506	6.9	5.3	20090525	7.2	5.5	20100710	6	4.7
20060704	8.3	6.3	20070912	7.0	5.4	20080518	6.6	5.1	20090528	7	5.4	20100508	5.2	4.1
20060511	8	6.1	20070921	6.9	5.3	20080427	6.5	5.0	20090516	6.9	5.3	20100408	5	4.0

Figure 6: Oakridge rollback design day table

The Design Value Table pulls together the Design Day concentrations for each year, and calculates the Design Value based on the averaging algorithm from the EPA $PM_{2.5}$ attainment modeling guidance. The colors in the table sections below match the locations in the Design Day table from which the concentrations come.

Year	All data	Year	All data
2006	38.6	2006	27.5
2007	42.7	2007	30.4
2008	38.7	2008	27.6
2009	41.3	2009	29.6
2010	33.0	2010	23.6
Baseline DV	**39.5**	Future DV	**28.2**

Figure 7: Oakridge rollback design value table

As shown in the table, the 2014 Future Year Design Value is 28 µg/m³, which shows predicted attainment at the Willamette Activity Center monitor.

Rollback Modeling and Emission Reduction Measures

The control strategies included in the attainment plan have associated reductions in emissions and ambient concentration. The table below summarizes those values. For each control measure in the table, values are displayed for future year emissions and modeled DV with and without that measure. The change in emissions and future DV are listed as well. Changes in future DV values were calculated in the rollback model by varying the input emissions as is shown here. A discussion of the expected efficiency of these measures is found in the emissions inventory appendix to this document.

Oakridge Rollback Scenarios	Future Year Without Scenario		Future Year With Scenario		Scenario Driven Change	
Scenario	$PM_{2.5}$ Emissions lbs/day	Future DV µg/m³	$PM_{2.5}$ Emissions lbs/day	Future DV µg/m³	$PM_{2.5}$ Emissions lbs/day	Future DV µg/m³
Control Strategies						
2009-2011 Woodstove change-out program*	543	39.0	512	36.9	-31	-2.1
Strengthened mandatory HWH curtailment program	512	36.9	381	28.2	-131	-8.7

* The 2009-2011 change-out program was completed after the base year, prior to this demonstration. For this reason, these strategies are used here in a cumulative manner.

Figure 8 Oakridge rollback scenarios table

Two control measures are to be employed to bring Oakridge into attainment for $PM_{2.5}$. The emissions inventory and modeled concentrations use the control strategies in a cumulative manner. The first measure is a grant funded woodstove change-out program implemented over the period 2009-2011. The table above indicates that this measure reduces emissions by 31 lbs/day, which in turn reduces the future year DV by 2.1 µg/m³. These change-outs, and so emission reductions, were completed after the base year, but prior to the attainment demonstration period of 2012-2014. Therefore, these reductions are assumed when considering to the second control measure, a strengthening of the existing home wood heating

(HWH) curtailment program. Reduction in modeled concentrations for this measure are subtracted from the future DV calculated by assuming the reductions from the woodstove change-out control measure. The strengthened HWH control measure then reduces emissions by 131 lbs/day and the future DV by 8.7 $\mu g/m^3$.