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### PM25\_USA\_EPA\_NEI ###

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# Question 5 : How have emissions from motor vehicle sources  
# changed from 1999–2008 in Baltimore City?

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### Resources ###

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# EPA Government references

# Reference 1. 2011 National Emissions Inventory, version 1 Technical Support Document November 2013 - DRAFT

# [http://www.epa.gov/ttn/chief/net/2008neiv3/2008\\_neiv3\\_tsd\\_draft.pdf](http://www.epa.gov/ttn/chief/net/2008neiv3/2008_neiv3_tsd_draft.pdf)

# Reference 2. 2008 National Emissions Inventory, version 3 Technical Support Document September 2013 - DRAFT

# [http://www.epa.gov/ttn/chief/net/2011nei/2011\\_neiv1\\_tsd\\_draft.pdf](http://www.epa.gov/ttn/chief/net/2011nei/2011_neiv1_tsd_draft.pdf)

# STATE Government references

# Reference 3. Methodologies for U.S. Greenhouse Gas Emissions Projections: Non-CO2 and Non-Energy CO2 Sources DECEMBER, 2013

# <http://www.state.gov/documents/organization/219472.pdf>

# MOVES Government references

# Reference 4. MOVES (Motor Vehicle Emission Simulator) Website

# <http://www.epa.gov/otaq/models/moves/index.htm>

# Reference 5. MOVES FAQ - <http://www.epa.gov/otaq/models/moves/420f09073.pdf>

# Definition of a Motor Vehicle from MOVES:

# MOVES2010 is the state-of-the-art upgrade to EPA's modeling tools

# for estimating emissions from highway vehicles,

# based on analysis of millions of emission test results

# and considerable advances in the Agency's understanding of vehicle emissions.

# MOVES2010 replaces the previous model for estimating

# on-road mobile source emissions, MOBILE6.2.

# reshape2

# 1. CRAN - <http://cran.r-project.org/web/packages/reshape2/index.html>

# 2. Sean C. Anderson Blog - An Introduction to reshape2 - <http://seananderson.ca/2013/10/19/reshape.html>

# ggplot2

# 1. GGPLOT2 - <http://docs.ggplot2.org>

# 2. GGPLOT2 - [http://www.cookbook-r.com/Graphs/Axes\\_\(ggplot2\)/](http://www.cookbook-r.com/Graphs/Axes_(ggplot2)/)

# 3. GGPLOT2 - <http://acaird.github.io/computers/r/2013/11/27/slopegraphs-ggplot/>

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# Data sets inspection #

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# Inspect the SCC file for the requested data

# > str(SCC)

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# levels(SCC$Data.Category)
# [1] "Biogenic" "Event" "Nonpoint" "Nonroad" "Onroad" "Point"
# interesting result: "Onroad" Data Category

# > levels(SCC$El.Sector)
# interesting results: 4 Source Category Sectors are corresponding to the question
# [49] "Mobile - On-Road Diesel Heavy Duty Vehicles"
# [50] "Mobile - On-Road Diesel Light Duty Vehicles"
# [51] "Mobile - On-Road Gasoline Heavy Duty Vehicles"
# [52] "Mobile - On-Road Gasoline Light Duty Vehicles"

# > levels(SCC$SCC.Level.Two)
# interesting results: 2 Source Category Levels 2 are corresponding to the question
# [48] "Highway Vehicles - Diesel"
# [49] "Highway Vehicles - Gasoline"

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### plot5 R code ###

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# Create a function called
plot5_MOVES_TotalEmissionsPM2.5_BALTIMORE_Source_MotorVehicule_1999_to_2008() to do
the requested plot

plot5_MOVES_TotalEmissionsPM2.5_BALTIMORE_Source_MotorVehicule_1999_to_2008 =
function()
{
  library(reshape2) # use reshape2 to clean and prepare the data
  library(ggplot2) # use ggplot2 to plot
  library(scales) # use scale functions to modify aesthetics to legend's plot

  # Set the working directory on my local machine
  setwd("~/Desktop/Data Science Specialization/Exploratory Data Analysis/Course project 2")

  # Read the PM2.5 Emissions Data in summarySCC_PM25.rds file with readRDS() function
  NEI <- readRDS("summarySCC_PM25.rds")

  # Read the Source Classification Code Table in Source_Classification_Code.rds file with readRDS()
function
  SCC <- readRDS("Source_Classification_Code.rds")

  # Define the Baltimore dataset
  # Subset of PM2.5 Emissions Data with NEI$fips == "24510"
  NEI_Baltimore <- subset(NEI, fips == "24510")

  # Find the Baltimore Motor Vehicle sources
  # Inspect Source Classification Code Table (SCC) file: column SCC.Level.Three
  # Use of regular expressions and grep() function
  Baltimore_Motor_Vehicule_Related_Source <- grep("Highway Vehicles(*)", SCC$SCC.Level.Two,
ignore.case = TRUE)

  # Subset Motor Vehicule sources for Baltimore
  SCC_Baltimore_Motor_Vehicule <- SCC[Baltimore_Motor_Vehicule_Related_Source, "SCC"]

  # Subset PM2.5 Emissions with Motor Vehicule sources for Baltimore
  NEI_Baltimore_Motor_Vehicule_Combustion_Related_Source <- subset(NEI_Baltimore, SCC %in%
SCC_Baltimore_Motor_Vehicule)

```

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# Split the PM2.5 emissions for Motor Vehicle sources
# into two column frame year and type, with melt() function
NEI_Baltimore_Motor_Vehicule_Combustion_Related_Source_Year_Type <-
melt( NEI_Baltimore_Motor_Vehicule_Combustion_Related_Source, id.vars = c("year","type"),
measure.vars="Emissions")

# Sum the PM2.5 emmissions in Baltimore resulting dataset by year variable with dcast() function
NEI_Baltimore_Motor_Vehicule_Combustion_Related_Source_Year_Type_Sum <-
dcast(NEI_Baltimore_Motor_Vehicule_Combustion_Related_Source_Year_Type, year ~ variable,
fun.aggregate = sum, na.rm = TRUE)

# Create a barplot with a colour per year : modify year variable from integer to factor
# Modify the NEI_Baltimore_Motor_Vehicule_Combustion_Related_Source_Year_Type_Sum
dataset
NEI_Baltimore_Motor_Vehicule_Combustion_Related_Source_Year_Type_Sum$year <-
factor(NEI_Baltimore_Motor_Vehicule_Combustion_Related_Source_Year_Type_Sum$year,
levels=c('1999', '2002', '2005', '2008'))
# Begin the plot with ggplot() funtion
g <- ggplot(data = NEI_Baltimore_Motor_Vehicule_Combustion_Related_Source_Year_Type_Sum,
aes(x = year, y = Emissions))
# Use bar for the plot with scaling color for variable year
g <- g + geom_bar(aes(fill = year), stat = "identity")
# Add a title to the plot
g <- g + ggtitle("PM2.5 Emissions for Motor Vehicle Sources type in Baltimore (USA)")
# Add text values in bars for results
g <- g + geom_text(aes(label = round(Emissions,0)), size = 6, hjust = 0.5, vjust = 2, colour =
"darkblue")
# Add a legend on x with "Year"
g <- g + xlab("Year")
# Add a legend on y with "PM2.5 Emissions (Tons)"
g <- g + ylab("PM2.5 Emissions (Tons)")
# Modify themes of the plot
g <- g + theme_bw(base_family = "Times", base_size = 12)

# print the plot()
print(g)

# Save png file in working directory
dev.copy(png, filename = "plot5.png", height = 600, width = 800, unit = "px", bg = "transparent")

# Release screen
dev.off()
}

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plot5_MOVES_TotalEmissionsPM2.5_BALTIMORE_Source_MotorVehicule_1999_to_2008()

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# Answer 5:

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# 1. PM2.5 Emissions from Motor Vehicle sources in Baltimore have decreased

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# from 1999 to 2009

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# 2. Note that the decrease is quite important between 1999 and 2002, and less important

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# between 2002 and 2008

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