Utility Software Applications - Course Assignment

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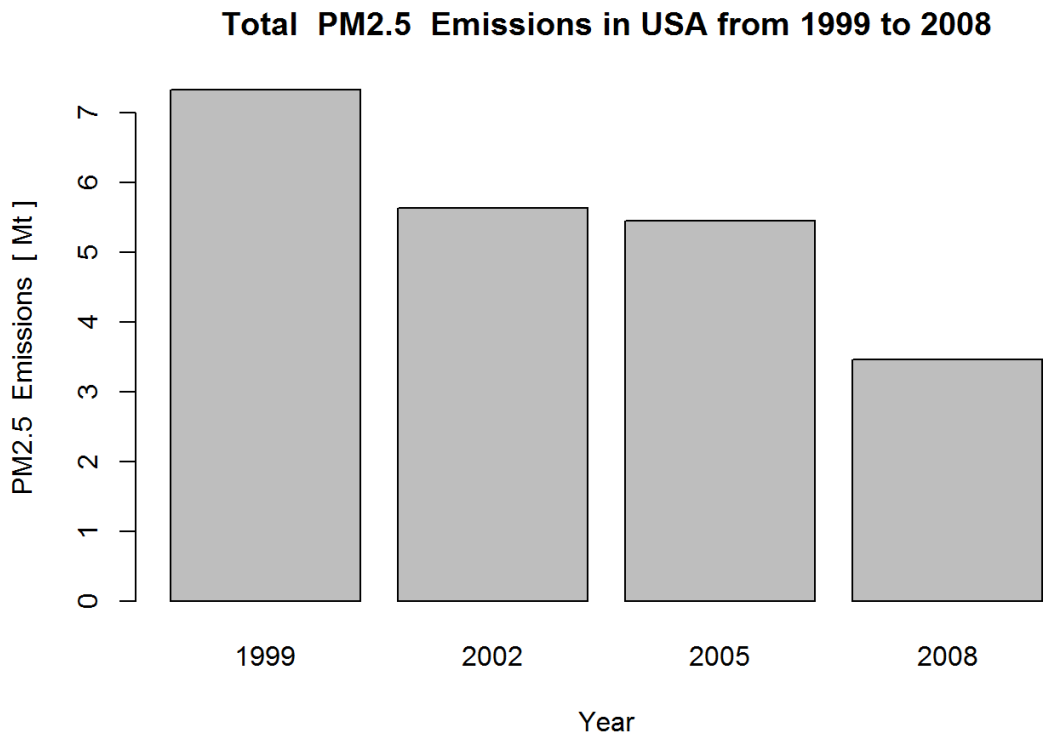
We will explore National Emissions Inventory database and answer 6 questions about pollution in the United States over the 10-year period (1999–2008).

loading data:

```
NEI <- readRDS("summarySCC_PM25.rds")
SCC <- readRDS("Source_Classification_Code.rds")
```

Question 1: Have total emissions from PM2.5 decreased in the United States from 1999 to 2008?

```
totalEmissions <- aggregate(Emissions ~ year,NEI, sum)
barplot(
   (totalEmissions$Emissions) / 1e6,
   names.arg=totalEmissions$year,
   xlab = "Year",
   ylab = "PM2.5  Emissions  [ Mt ]",
   main = "Total  PM2.5  Emissions in USA from 1999 to 2008"
)
```

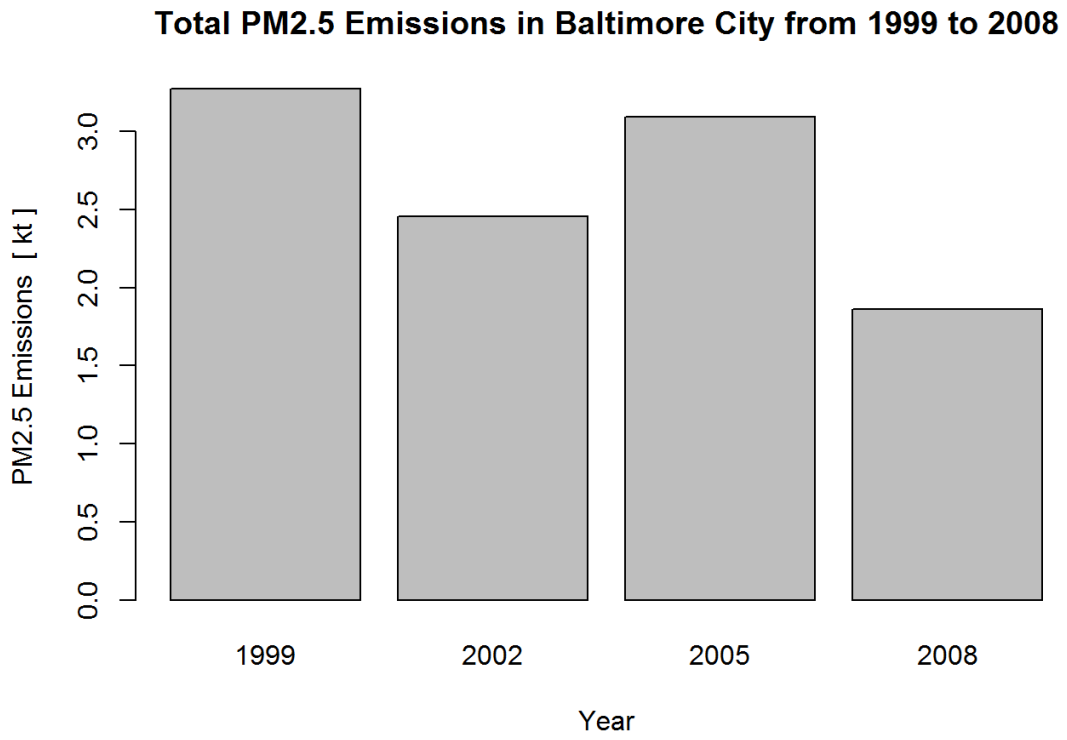


Answer: *Total emissions from PM2.5 indeed decreased in the USA from 1999 to 2008.*

Question 2: Have total emissions from PM2.5 decreased in the Baltimore City, Maryland (fips == “24510”) from 1999 to 2008?

```
NEIBaltimore <- NEI[NEI$fips == "24510",]
totalBaltimore <- aggregate(Emissions ~ year, NEIBaltimore, sum)

barplot(
  (totalBaltimore$Emissions) / 1e3,
  names.arg = totalBaltimore$year,
  xlab = "Year",
  ylab = "PM2.5 Emissions  [ kt ]",
  main = "Total PM2.5 Emissions in Baltimore City from 1999 to 2008"
)
```

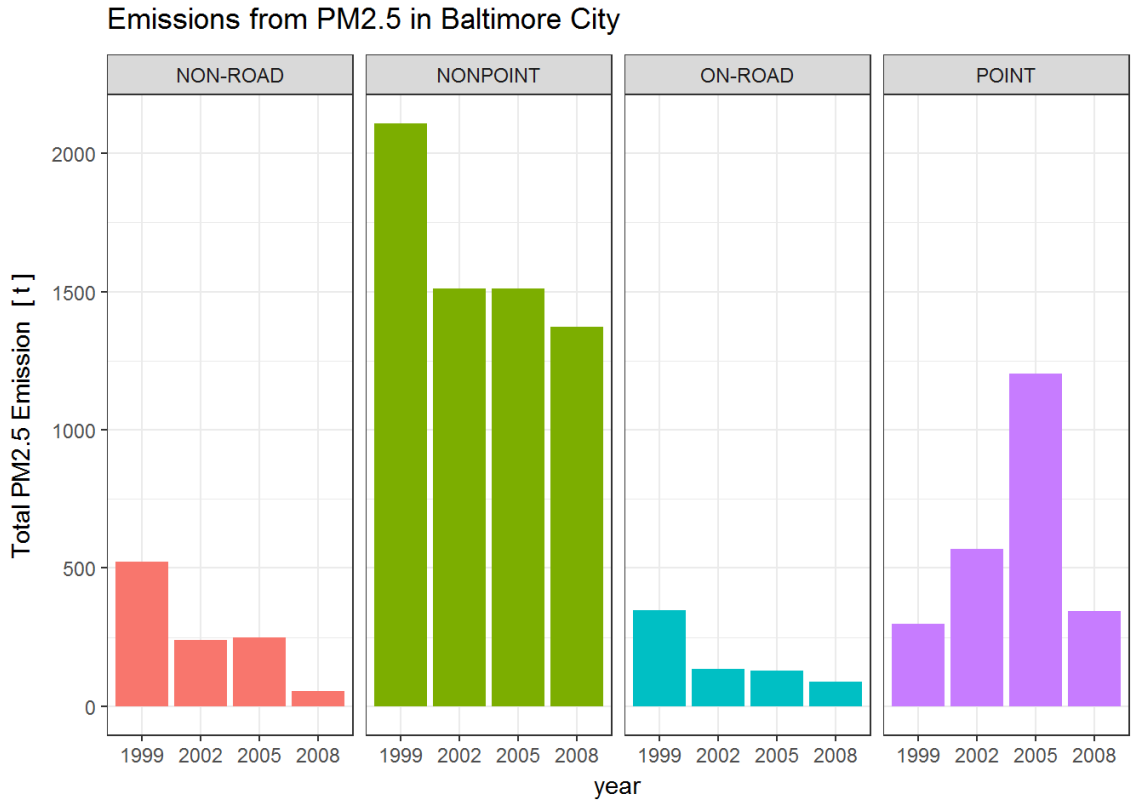


Answer: *Total emissions from PM2.5 in Baltimore City have decreased from 1999 to 2008.*

Question 3: Of the four types of sources indicated by the type (point, nonpoint, onroad, nonroad) variable, which of these four sources have seen decreases in emissions from 1999–2008 for Baltimore City?

```
library(ggplot2)

ggplot(NEIBaltimore, aes(factor(year), Emissions, fill = type)) +
  geom_bar(stat = "identity") +
  theme_bw() + guides(fill=FALSE) +
  facet_grid(.~type,scales = "free", space="free") +
  labs(x = "year", y = expression("Total PM2.5 Emission  [ t ]")) +
  labs(title = expression("Emissions from PM2.5 in Baltimore City"))
```



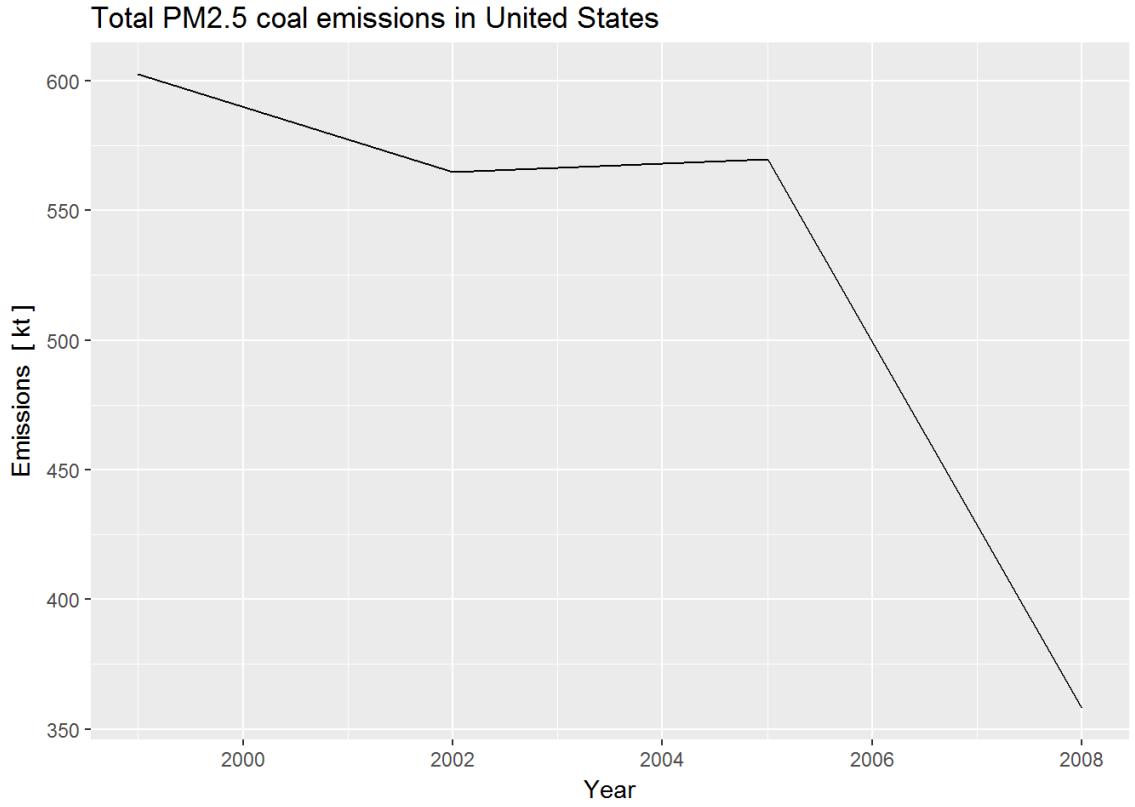

```
#print(plot3)
```

Answer: *The non-road, nonpoint and on-road source types.*

Question 4: Across the United States, how have emissions from coal combustion-related sources changed from 1999–2008?

```
NEIcoal <- NEI[which(NEI$SCC %in% SCC[grep("coal", SCC$Short.Name, ignore.case = TRUE), "SCC"]),]

  ggplot(NEIcoal, aes(year, Emissions / 1e3)) +
  geom_line(stat = "summary", fun.y = "sum") +
  labs(x = "Year",
       y = "Emissions  [ kt ]",
       title = "Total PM2.5 coal emissions in United States")
```

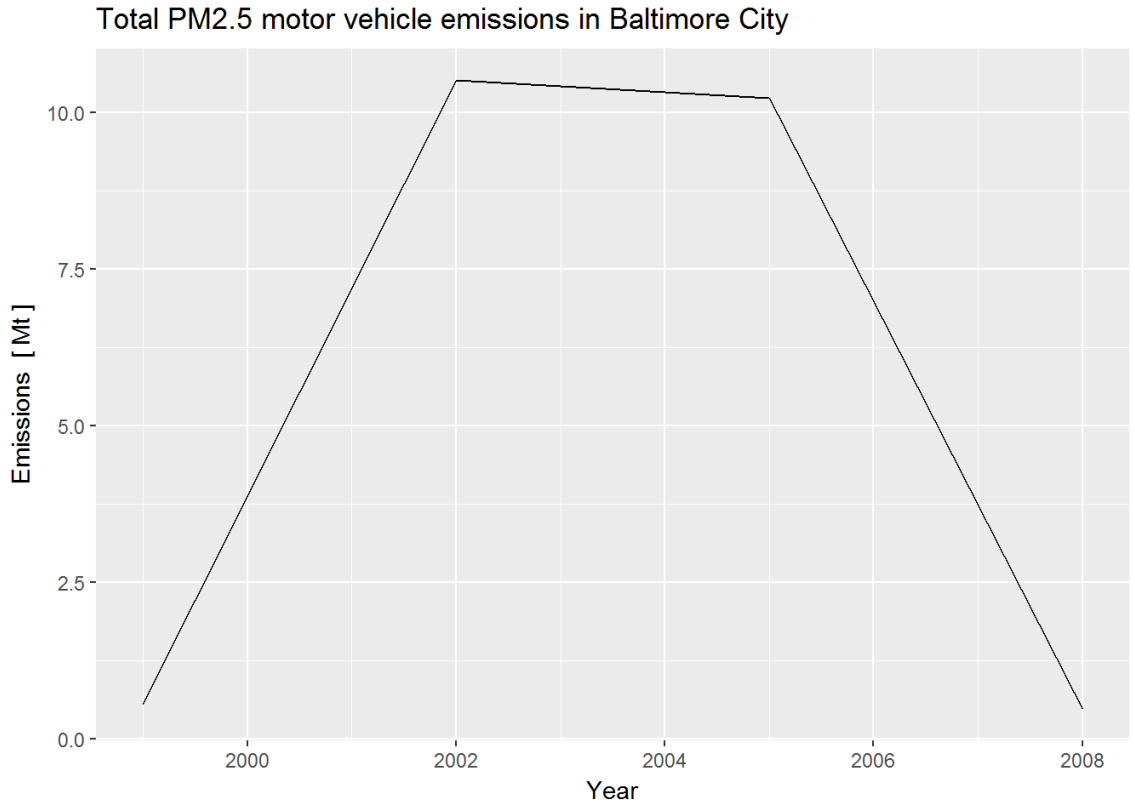


Answer: *Emissions from coal combustion related sources have decreased.*

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

```
NEImotorvehicle <- NEI[which(NEI$SCC %in% SCC[grep("motor",SCC$SCC.Level.Three,ignore.case = TRUE),"SCC"] & NE
I$fips=="24510"),]

ggplot(NEImotorvehicle, aes(year, Emissions)) +
  geom_line(stat = "summary", fun.y = "sum") +
  labs(x = "Year",
       y = "Emissions  [ Mt ]",
       title = "Total PM2.5 motor vehicle emissions in Baltimore City")
```



Answer: *Emissions from motor vehicle sources in Baltimore City changed for the worse in between those years, but overall in 2008 they returned to the same size as in the 1999.*

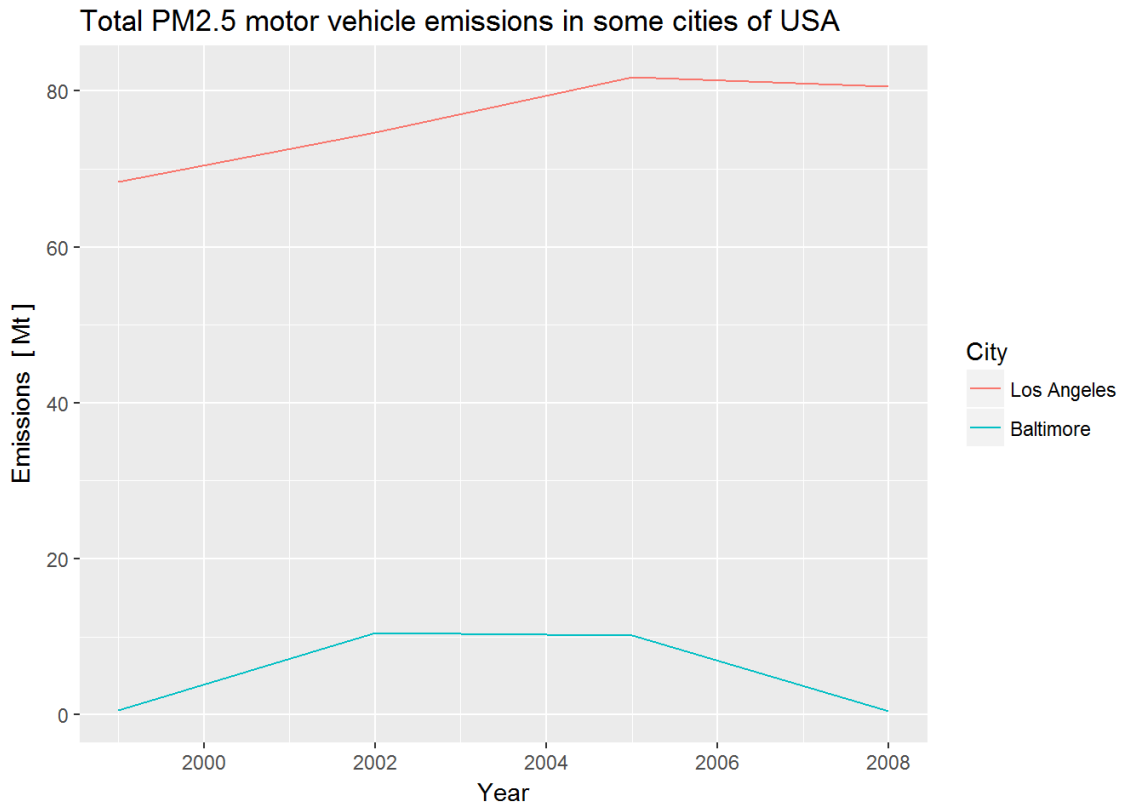
Question 6: Which city has seen greater changes over time in motor vehicle emissions?

Assumption: comparing Baltimore City (fips == “24510”) and Los Angeles County, California (fips == “06037”)

```
NEImotorvehicle <- NEI[which(NEI$SCC %in% SCC[grep("motor",SCC$SCC.Level.Three,ignore.case = TRUE),"SCC"]),]

cityFips <- c("24510", "06037")
cityNames <- c("Los Angeles", "Baltimore")
NEImotorvehicle_some <- subset(NEImotorvehicle, fips %in% cityFips)

ggplot(NEImotorvehicle_some, aes(year, Emissions, color = fips)) +
  geom_line(stat = "summary", fun.y = "sum") +
  labs(x = "Year",
       y = "Emissions  [ Mt ]",
       title = "Total PM2.5 motor vehicle emissions in some cities of USA") +
  scale_colour_discrete(name = "City", label = cityNames)
```



Now we will compare year 1999 with 2008 in both cities:

```
aggregateEmissions <- aggregate(Emissions ~ fips + year, data = NEImotorvehicle_some, sum)
aggregate(Emissions ~ fips, data = aggregateEmissions, range)
```

```
##    fips Emissions.1 Emissions.2
## 1 06037  68.4060000  81.7957985
## 2 24510   0.4772056  10.5183944
```

Answer: *Los Angeles County has seen greater changes over time in motor vehicle emissions in comparison to Baltimore City.*