Electric vehicles in Europe

Julia Eriksson

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Introduction

Driving an electric vehicle is an increasing trend in Europe. In 2018, Europe reached a milestone in the sales of electric vehicles as the total sold vehicles exceeded 1 million, according to The Electric Vehicle World Sales Database [8]. Until the third quarter of 2018, 290 500 electric vehicles were sold in Europe, which is an incerase by 35 % compared with the same period in 2017. This makes Europe the second largest continent of sold electric vehicles in the world where China is in the lead with 373 000 sold vehicles the first half of 2018, which is an increae of 114 % compared to the same period in 2017, and the US just after Europe. In the US, 232 500 electric vehicles were sold until the third quarter of 2018 which is an increase of 63 % compared to 2017.

The trend of driving electric vehicles has increase the last few years and in this project we are going to study the trend of electric vehicles in Europe by looking at the number of vehicles sold form 2013 to 2018 for each European country. Then we are going to compare this data with the total number of vehicles sold for each country to find the proportion of electric vehicles sold. The advantage of driving on electricity instead of petrol is that the emission of greenhouse gases that contributes to air pollution is lower [1]. We are going to use data on greenhouse emission from transport and study if there is a connection between the proportion of electric vehicles sold and the emission from transport. The last thing that we are going to study is the number of vehicles sold per inhabitant for each European country.

Electric vehicles in Europe

The number of electric vehicles sold has increased in Europe over the last few years and we are now going to study how much the increase has been. The data that we are going to use is from ACEA's website. ACEA is the European automobile manufactures association who, among other things, collect statisitics of sold petrol, diesel and APV (alternatively-powered vehicles) passenger vehicles in Europe. Every quarter they present a press release of statistics of fuel types of new passenger vehicles sold. From the press releases we can download these statistics as an excel file. The website have data from years 2013 to 2018 for each quarter and in the last press release of the year there are data from the whole year which we choose to use [2][3][4]. The exception is for the years 2017 and 2018, where the data has been released only for the first to the third quarters (the statistics for the fourth quarter will be released on February 7th 2019) .

The first step is to download the statistics and we read it to R using `read_excel` from the `readxl` package. Each ecxel file contains data from two following years, so we download three data sets. The files contains numerous sheets with statistics of sold vehicles for different fuel types and types of electric charges. We choose to study the statistics of the total electric chargeable vehicles, which is the sheet called `Total ECV`. This sheet includes data on plug-in hybrid electric vehicles, battery electric vehicles, fuel cell electric vehicle and extended-range electric vehicles which is a battery driven vehicle that contains an electric generator that charges the battery [11].

We make some small changes to the data sets as changing the names of the columns to more easy-to-understand names. For the data set with data from 2013 and 2014 we have to recode some of the rows so that they are consistent with the two other data sets. We do this so that these countries are included when we are going to join the data sets later.

```
library(readxl)
library(tidyverse)
library(utils)
library(Hmisc)

# Read data on vehicle registrations from 2017-2018
Vehicle_registrations_17_18 <- read_excel("20181108_PRPC_fuel_Q3_2018_FINAL.xlsx",
                                          sheet = "Total ECV",  range = "C17:I46",
                                          col_types = c("text", "skip", "skip", "skip", "numeric",  "nu
                                                        "numeric")) %>%
  rename("18/17" = "Change", "Country" = "...1") %>%
  mutate_all(tolower) %>% # So that we easier can join the data with other data sets.
  mutate(Country = capitalize(Country)) %>%
  mutate(`18/17` = as.numeric(`18/17`))

# Read data on vehicle registrations from 2015-2016
Vehicle_registrations_15_16 <- read_excel("20170201_AFV_Q4_2016_FINAL.xlsx",
                                          sheet = "Total ECV", range = "C18:I46",
                                          col_types = c("text", "skip", "skip", "skip", "numeric",  "nu
                                                        "numeric")) %>%
  rename("16/15" = "Change", "Country" = "...1") %>%
  mutate_all(tolower) %>%
  mutate(Country = capitalize(Country))

# Read data on vehicle registrations from 2013-2014
Vehicle_registrations_13_14 <- read_excel("ACEA_Electric_Vehicle_registrations_Q4_14-13.xlsx",
                                          sheet = "Total Electrically Charged", range = "C19:I46",
                                          col_types = c("text", "skip", "skip", "skip", "numeric",  "nu
                                                        "numeric")) %>%
  rename("2014" = "'14", "2013" = "'13","Country" = "...1")  %>%
  mutate(Country = recode(Country, "DENMARK2" = "DENMARK",
                          "IRELAND2" = "IRELAND", "ROMANIA2" = "ROMANIA")) %>% # So the rownames corres
  mutate(`14/13` = 100 * `14/13`) %>% # The change is in percent
  mutate_all(tolower) %>%
  mutate(Country = capitalize(Country))
```

Now that we have loaded the data sets containing information about the number of electric vehicles sold from the years 2013-2018 we will plot these numbers for each country respectively.

We have to join the three data sets in order to make this plot. We start with the data set for 2017-2018 and filter to include only the countries and not the numbers for the total EU. Then we join the other two data sets using a left join. We want the data set to be on long format with the years in one column. We use the command `gather` on the year columns to gather the columns into one that we call `Year` that will have the value of the number of vehicles sold that year for each country. To get a view of how the data set now looks like, we use `glimpse`.

```
# Join vehicle registrations for all years
Vehicles_all_years <- Vehicle_registrations_17_18 %>%
  filter(!Country == "Eu15" & !Country == "Eu (new members)" &
           !Country == "European union") %>%
  left_join(Vehicle_registrations_15_16, by = "Country") %>%
  left_join(Vehicle_registrations_13_14, by = "Country") %>%
  gather(c("2013","2014", "2015", "2016", "2017", "2018"), key = "Year", value = "Number")  %>%
  mutate(Number = as.numeric(Number), Number = replace_na(Number, 0))
```

```r
glimpse(Vehicles_all_years)
```

```
## Observations: 156
## Variables: 6
## $ Country <chr> "Austria", "Belgium", "Bulgaria", "Czech republic", "D...
## $ `18/17` <dbl> 15.784499, -1.858597, 280.000000, 137.755102, 481.0064...
## $ `16/15` <chr> "81.8442770003588", "133.463643471462", "-38.095238095...
## $ `14/13` <chr> "12.8292531763248", "148.107448107448", "100", "22.736...
## $ Year    <chr> "2013", "2013", "2013", "2013", "2013", "2013", "2013"...
## $ Number  <dbl> 3227, 819, 1, 475, 650, 150, 218, 9622, 7706, 4, 16, 5...
```

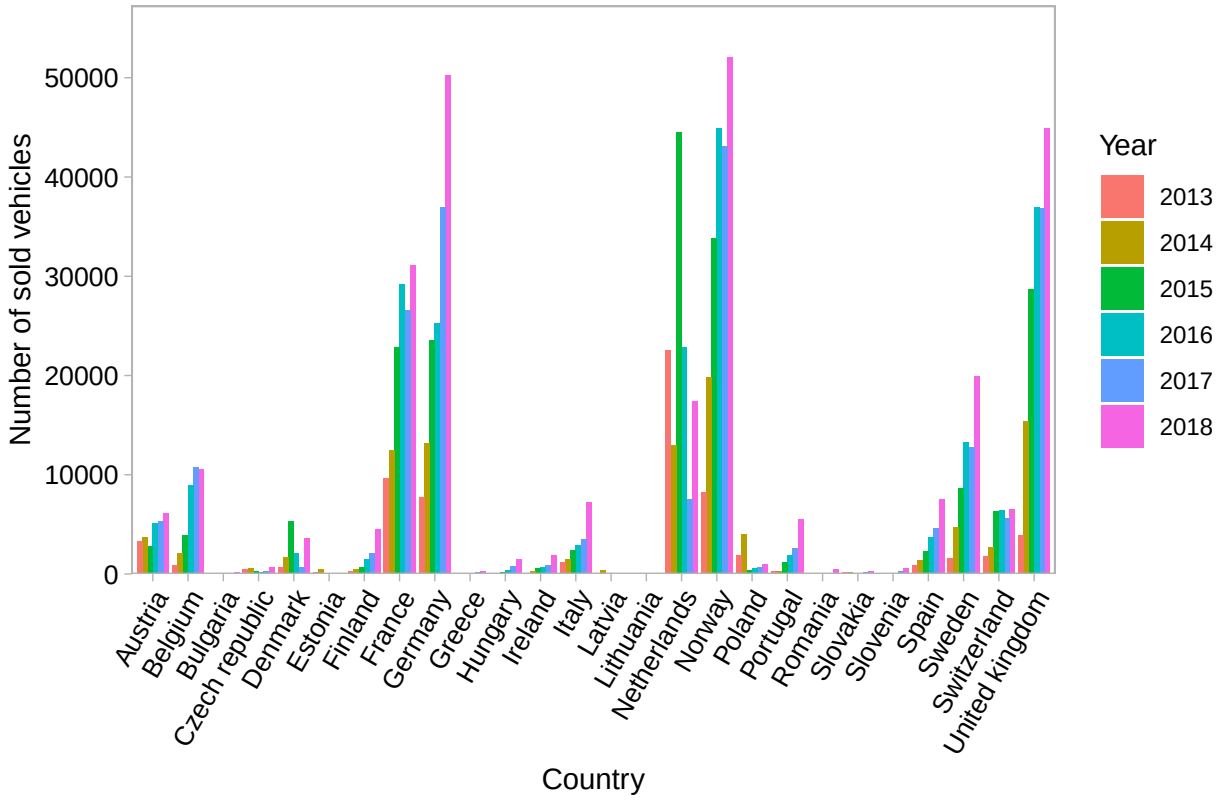
Before we make the plot we define a function that we name `new_theme_plot` that sets the theme and the size of the text. We make this a function so that we can use the same theme for all plots in this project.

Now we are ready to plot the number of sold vehicles for the countries in Europe for the years 2013-2018 using ggplot. The plot will look a bit messy since there are so many countires and years but the plot will give a rough view of which countries that have the most sold electric vehicles and we will also be able to study the increase of sold vehicles from each year to the other.

```r
# A theme we will use for the plots in the project.
new_theme_plot <- function(){
  theme_light() +
    theme(plot.title = element_text(size = 12, color = "black"),
          panel.grid = element_blank(),
          axis.text.y = element_text(size = 10, color = "black"),
          axis.text.x = element_text(size = 10, color = "black"))
}

# Plot all vehicle registrations for all countries and all years
ggplot(Vehicles_all_years, aes(x = Country, y = Number, fill = Year)) +
  geom_col(position = "dodge") +
  new_theme_plot() +
  theme(axis.text.x = element_text(angle = 60, hjust = 1)) +
  scale_y_continuous(expand = c(0, 0), limits = c(0, max(Vehicles_all_years$Number) * 1.1)) +
  ylab("Number of sold vehicles") +
  ggtitle("Fig. 1: Number of electric vehicles sold per year and country in Europe")
```

Fig. 1: Number of electric vehicles sold per year and country in Europe

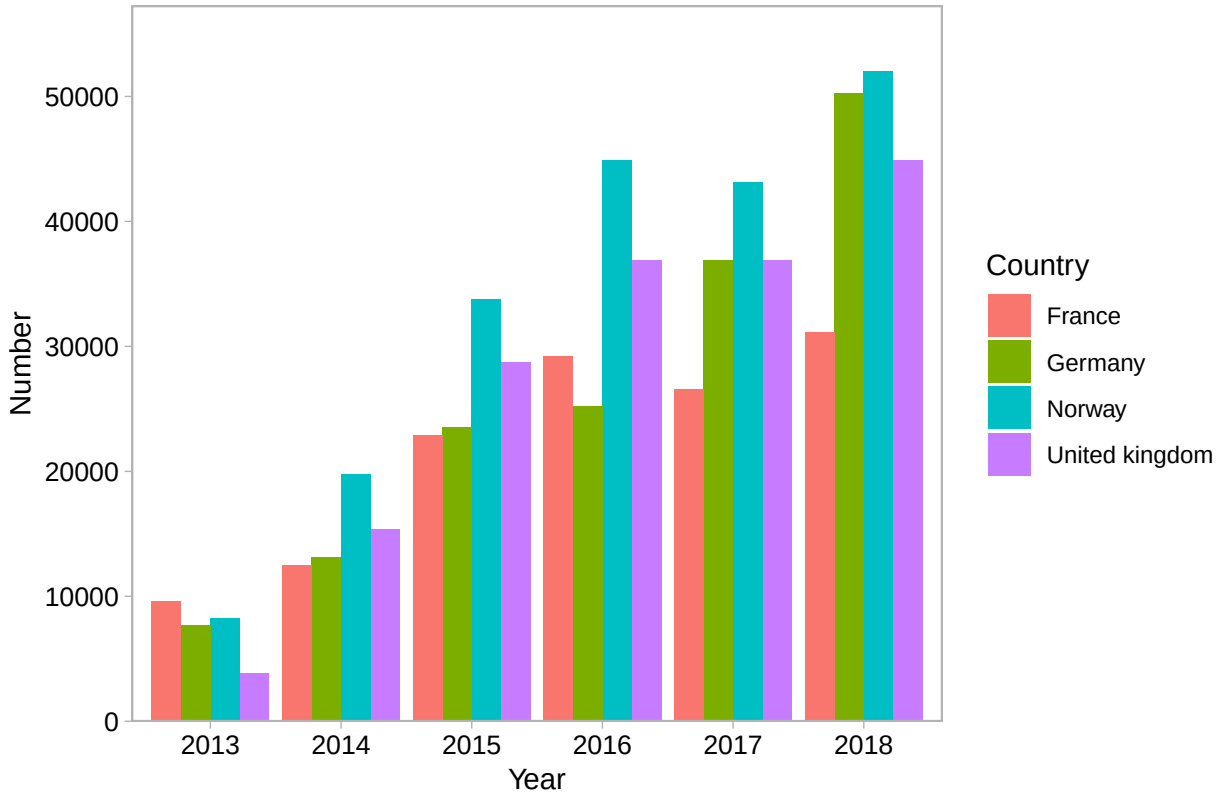


As we anticipated, Figure 1 looks a bit messy, but from it we can observe that Norway is the country with the must number of sold electric vehicles followed by Germany and the UK. We can also observe that the Netherlands had a high number of sold vehicles in 2015, but then the number decreased in 2016 and 2017 to increase again in 2018. We also observe that 2018 is for almost all countires the year with the most sold vehicles even though we only have data until the third quarter of 2018.

In the plot below we choose to plot the development of electric vehicles for the top four countires with the most sold vehicles from year 2013 to 2018. We will then obtain a zoomed in view of these countries to study the increase of sold cars.

```
# Plot of the top four electric vehicle countries
Vehicles_all_years %>%
filter(Country == "Norway"|Country == "Germany"|Country == "United kingdom"|Country == "France") %>%
  ggplot(aes(x = Year, y = Number, fill = Country)) +
  geom_bar(stat = "identity", position = "dodge") +
  ggtitle("Fig. 2: Top countries of number of sold electric vehicles") +
  new_theme_plot() +
  scale_y_continuous(expand = c(0, 0), limits = c(0, max(Vehicles_all_years$Number) * 1.1))
```

Fig. 2: Top countries of number of sold electric vehicles

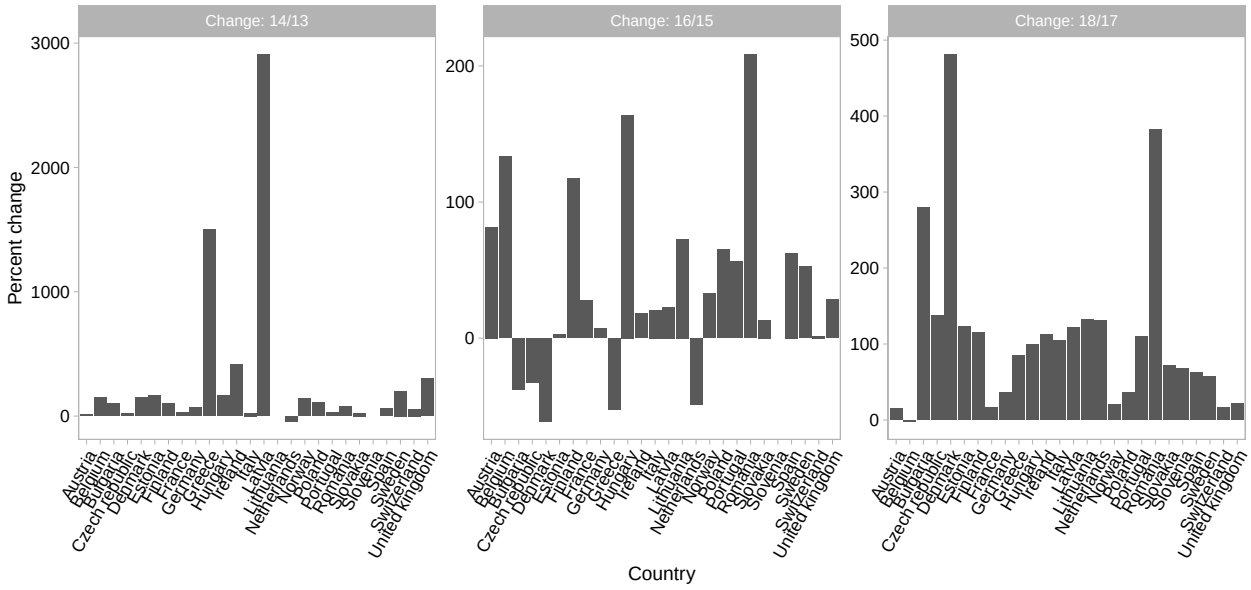


In Figure 2 we can observe that there has been an increase in the number of sold vehicles for Germany and the UK while in Norway there was an increase from 2013 to 2016, followed by a decrease in 2017 to then increase again in 2018. In France we can observe the same pattern as for Norway with a decrease from 2016 to 2017.

The change in the number of sold vehicles vary between the years and we are now goint to study the percent change between two following years. To plot this we use our data set called `Vehicles_all_years` and we plot the countries on the x-axis and the percent change on the y-axis. Then we use the command `facet_wrap` for the column `Change` so that we will obtain three different plots for each percent change.

```
# Plot the change of vehicle registrations from one year to the other
Vehicles_all_years %>%
  gather(c("18/17","16/15", "14/13"), key = "Change", value = "Percent_change" ) %>%
  mutate(Percent_change = as.numeric(Percent_change),
         Number = replace_na(Number, 0)) %>%
  ggplot(aes(x = Country, y = Percent_change)) +
  geom_col(position = "dodge") +
  facet_wrap(~Change, scales = "free_y", labeller = "label_both") +
  ylab("Percent change") +
  ggtitle("Figure 3: Percent change of electric vehicles sold per country in Europe") +
  new_theme_plot() +
  theme(axis.text.x = element_text(angle = 60, hjust = 1))
```

Figure 3: Percent change of electric vehicles sold per country in Europe



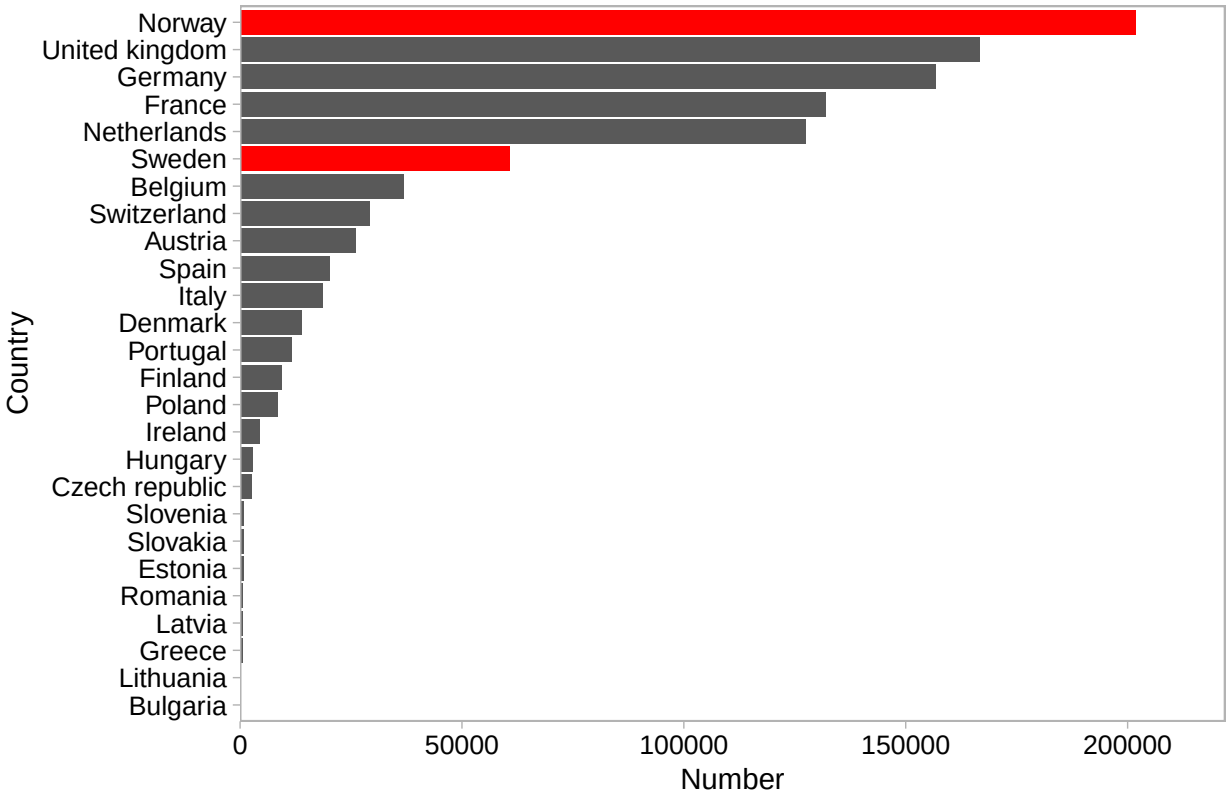
From Figure 3 we can observe that the first plot has a large increse in sold vehicles for the two countries Greece and Latvia. Germany had an increase of 1500 % and if we look at our data set `Vehicle_registrations_13_14` we find that in 2013 Greece sold 4 vehicles and in 2014, 64 were sold. In Latvia there was an increase of almost 3000 % and in 2013, 13 electric vehicles were sold and in 2014, 391 were sold. We can also observe that the only country with a negative decrease is the Netherlands, which we aslo observed before. If we move on to study the second plot we can observe that there is not any extreme increases like the plot before, but there are more negative changes. Again we observe an devcrease in the Netherlands and also in Greece who had a large increase the years before. Romania has the largest increase of sold electric vehicles between 2015 and 2016. Finally in the last grapgh we observe the changes between the first until the thirs quarters of 2017 and 2018. Here we find the highest increase of close to 500 % in Denmark and only Belgium has a decrease of only about 2%.

To find the total number of electric vehicles sold for each country we use the data set `Vehicles_all_year`, group by the column `Country` and then find the sum of vehicles sold for each country and save the result in a column that we call `Number`. Then we save this as `Total_vehicles_all_years`. We want the countries to be plot in order of the number of vehciles so we use the command `reorder` when we plot the x-axis. To obtain a better view of the plot we flip the axis using `coord_flip`.

```
# Find the total number of sold cars for each country from 2013-2015
Total_vehicles_all_years <- Vehicles_all_years %>%
  group_by(Country) %>%
  summarise(Total = sum(Number)) %>%
  arrange(desc(Total)) %>%
  mutate(highlight_bar = ifelse(Total == max(.$Total) | Total == 60773 , Total, 0)) # To highlight Norw

# Plot of the total number of sold cars for each country from 2013-2015
ggplot(Total_vehicles_all_years, aes(x = reorder(Country, Total), y = Total)) +
  geom_bar(stat = "identity") +
  geom_bar(stat = "identity", mapping = aes(y = highlight_bar), fill = "red") +
  coord_flip()  +
  xlab("Country") +
  ylab("Number") +
  ggtitle("Figure 4: Total electric vehicles sold from 2013-2018 in Europe") +
  scale_y_continuous(expand = c(0, 0), limits = c(0, max(Total_vehicles_all_years$Total) * 1.1)) +
  new_theme_plot()
```

Figure 4: Total electric vehicles sold from 2013−2018 in Europe



From Figure 4 we can see that Norway is in the lead of total sold vehicles followed by the Uk and Germany with Sweden on the 6th place. There is a big difference between the top half of the plot and the bottom half, to find out how many vehicles they sold we make a table from the `knitr` library with the total number of vehicles sold in descending order.

```
# Make a table of the total sold vehicles
Total_vehicles_all_years %>%
  select(-highlight_bar) %>%
  knitr::kable(format = "html",
               caption = "Table 1:Total sold electric vehicles for years 2013-2018")
```

Table 1:Total sold electric vehicles for years 2013-2018

Country

Total

Norway

201789

United kingdom

166572

Germany

156763

France

131860

Netherlands

127541

Sweden

60773

Belgium

36861

Switzerland

29174

Austria

26138

Spain

20231

Italy

18541

Denmark

13818

Portugal

11601

Finland

9327

Poland

8419

Ireland

4314

Hungary

2720

Czech republic

2549

Slovenia

805

Slovakia

767

Estonia

750

Romania

674

Latvia

585

Greece

523

Lithuania

224

Bulgaria

205

From Table 1 we can read that the bottom 8 countries have sold about 4500 vehicles together while in Norway only, over 200 000 vehicles were sold.

All but three coutnries that we have studied in Europe have a tax incentive to buy an electric vehicle [5]. In Germany you get an environmental bonus of € 4000 if you buy a pure electric vehiclue and you do not have to pay the annual circulation tax for the next ten years. In the UK electric vehicle owners pay a reduced company car tax rate and for cars that emits less than 50 g/km of CO2 will get a 100 % writing down allowances for one year. Sweden has a Climate bonus that you can use if you buy a vehicle that emits less than 60 g/km of CO2 and the bonus is on 60 000 kr. In Sweden you do not have to pay annual circulation tax for five years and you also have to pay a 40 % reduced price on the car taxation. In France electric vehicle that omits less than 60 g/km of CO2 does not need to pay tax on company cars and vehicles that emit lessn than 20 g/km of CO2 recieves a premium of € 6000. If you exchange a diesel vehicle that is at least 11 years old to an electric you recieve an extra bonus of € 4000. The three countries that do not have an incentive are Croatia, Estonia and Lithuania. From our data we can see that Lithuania and Estonia are among the bottom countries of total sold cars. We do not have data on Croatia but we can guess that the number of electric vehicles are low there as well.

The Norweigan government is investing heavily on electric vehicles and their goal is that by 2025 all new sold cars should be electric. To fulfill this goal the government has introduced a number of incentives to buy an electic car [9]. The list is long but some of them are: no taxes on purchases or annual road tax, free parking, allowed to drive in bus lanes and many more. Norway is the country in Europe with the most incentives to buy an electric vehicle can be a contribution factor as to why the number of sold vehicles in Norway is so much higher than the rest of Europe.

Proportion of sold electric vehicles

Up until now we have studied the statistics of sold electric vehicles and now we are going to compare these numbers with the total number of sold vehicles for each country. We will then obtain a clearer picture of how many that chose to buy an electric vehicle compared to the ones who chose to buy a petrol or hybrid.

Data on the total number of passenger cars registrations for each european country can be found on ACEA's webpage and we are going to look at the year 2018. Since ACEA has only released data on electric vehicles up until the third quarter, we must use the data on total vehicles registred up until August 2018 [6].

To import the excel file we follow the same procedure as we have done previously. After the import and small changes to the data we join with the data set `Vehicles_registration_17_18`. We group by country and calculate the percent of registred electric vehicles of the total registred vehicles by dividing the number of electric vehicles with the total and multiply by 100. We do this for 2017 as well because we will use that later on. The result for both years are presented in Table 2 below.

```
# Load and clean data of the total sold vehicles
Total_registrations_17_18 <- read_excel("20180919_PRPC_1808_FINAL.xlsx",
                                        sheet = "By Market", range = "C12:I48",
```

```
                                        col_types = c("text", "blank", "blank", "blank", "numeric", "nu
  rename("Country" = "...1", "2018" = "'18", "2017" = "'17", "Percent 18/17" = "18/17") %>%
  mutate_all(tolower) %>%
  mutate(Country = capitalize(Country))

# Join the total data with the electric vehicle data
Proportion_17_18 <- Total_registrations_17_18 %>%
  left_join(Vehicle_registrations_17_18, by = "Country") %>%
  rename("Electric_2018" = "2018.y","Electric_2017" = "2017.y", "Total_2018" = "2018.x", "Total_2017" =
  mutate(Electric_2018 = as.numeric(Electric_2018),
         Total_2018 = as.numeric(Total_2018),
         Electric_2017 = as.numeric(Electric_2017),
         Total_2017 = as.numeric(Total_2017)) %>%
  group_by(Country) %>%
  summarise(Proportion_2018 = (Electric_2018 / Total_2018) * 100,
            Proportion_2017 = (Electric_2017 / Total_2017) * 100) %>%
  mutate(Proportion_2018 = round(Proportion_2018, 2),
         Proportion_2017 = round(Proportion_2017, 2)) %>%
  arrange(desc(Proportion_2018))

# Make a table of the proportions
Proportion_17_18 %>%
  mutate(Proportion_2018 = sprintf("%0.1f%%", Proportion_2018),
         Proportion_2017 = sprintf("%0.1f%%", Proportion_2017)) %>%
  head(n = 10) %>%
  knitr::kable(format = "html",
               caption = "Table 2: Proportion of registred electric vehicles in 2018 and 2017",
               col.names = c("Country", "2018", "2017"))
```

Table 2: Proportion of registred electric vehicles in 2018 and 2017

Country

2018

2017

Norway

51.6%

41.9%

Sweden

7.6%

5.1%

Netherlands

5.2%

2.6%

Finland

4.9%

2.5%

Portugal

3.2%

1.7%

Switzerland

3.2%

2.7%

United kingdom

2.9%

2.2%

Belgium

2.5%

2.7%

Austria

2.4%

2.2%

Denmark

2.3%

0.4%

In Table 2 we see the ten countries with the highest percentage of registred electric vehicles in 2018 and the corresponding numbers for 2017. Norway is by far the country with the highest percentage of 51.6 % of sold electric vehicles with Sweden on second place with 7.6%. Then we have the Netherlands with 5.2% followed by Finland with 4.9%. The rest of the countries have percentages of 2 and lower.

We can illustrate the percentages in 2018 with a map of Europe using the library `rworldmap`. We join the data set `Proportion_17_18` with the map and then we plot the percentages. From the map we can also see that Norway is in a clear lead in the percentage of electric vehicles in 2018.

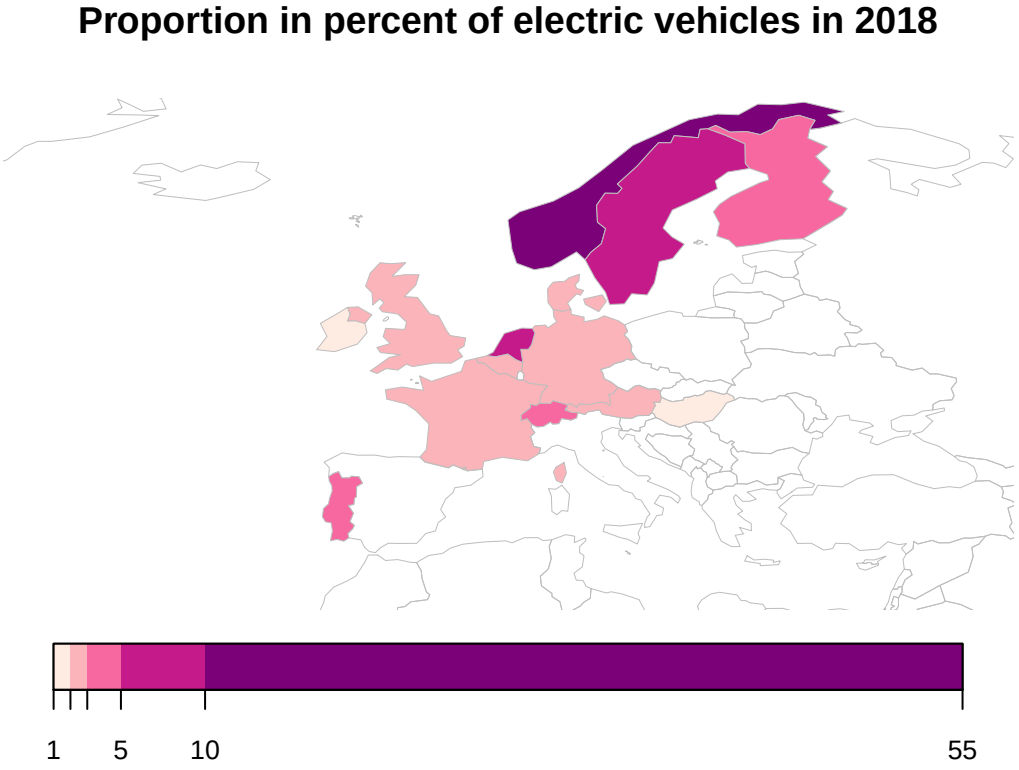
```
library(rworldmap)
library(RColorBrewer)

# Plot the proportion of electric vehicle for each country as a Europe map
Join_map <- joinCountryData2Map(Proportion_17_18, joinCode="NAME", nameJoinColumn="Country")
```

```
## 30 codes from your data successfully matched countries in the map
## 6 codes from your data failed to match with a country code in the map
## 213 codes from the map weren't represented in your data
```

```
Proportion_map <- mapCountryData(Join_map, nameColumnToPlot="Proportion_2018",
                                 colourPalette = brewer.pal(5, "RdPu"),
                                 mapTitle="Proportion in percent of electric vehicles in 2018",
                                 xlim=c(-10, 20), ylim=c(33, 70),
                                 catMethod= c(1, 2, 3, 5, 10, 55),
                                 addLegend = F)

do.call(addMapLegend, c(Proportion_map, legendLabels = "all", labelFontSize = 0.8))
```



Greenhouse gas emissions in Europe

When driving a car driven by petrol and diesel one contributes to greenhouse gas emissions into the atmosphere. According to the website Carbon footprint [1], the carbon emission of driving 10 000 miles (16093,44 km) with an average electric vehicle is 0.96t CO2e, driving with an average petrol car is 2.99t CO2e and the number for an average diesel car is 2.88t CO2e. From Eurostat's database we find data on the average CO2 emissions per km from new passenger cars from year 2017 [7], unfortunately there is no data from Norway. We load the data using `read_excel`

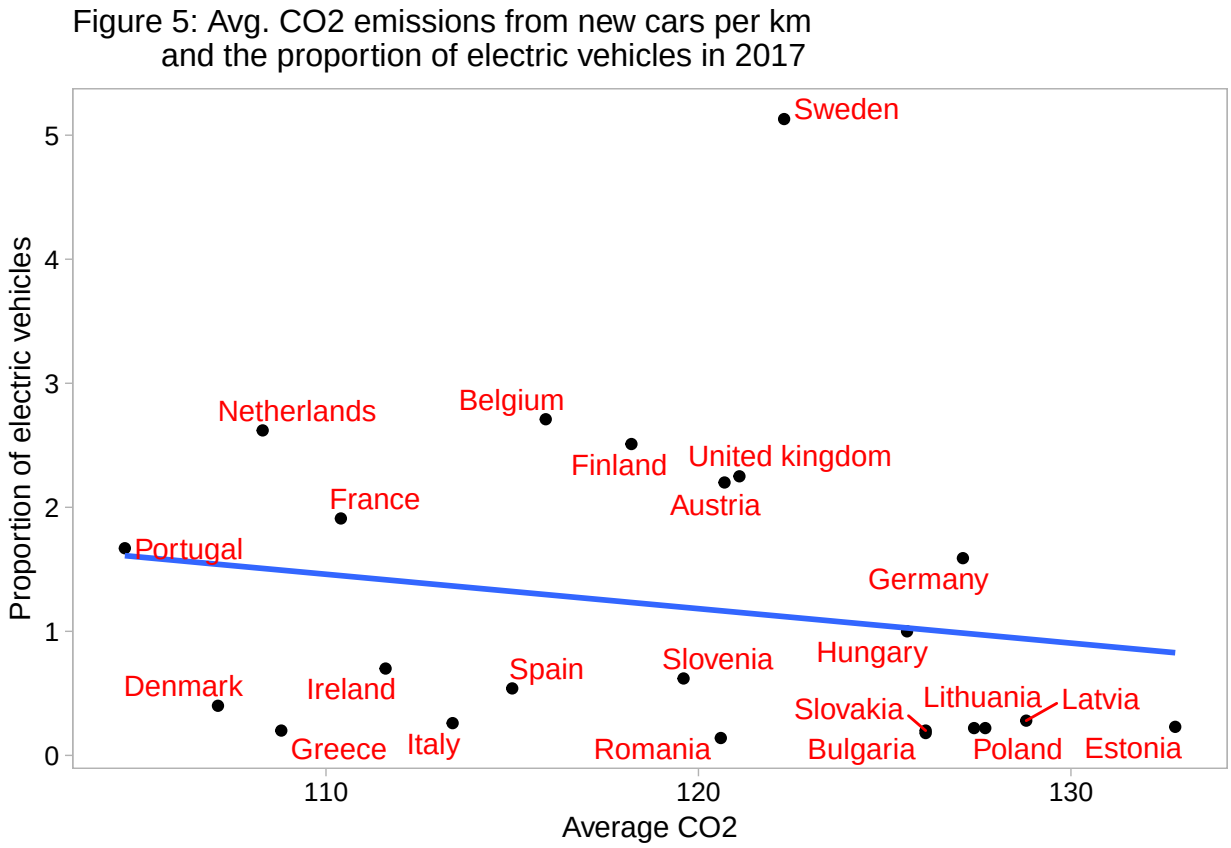
```
library(ggrepel)

#Load and clean data for CO2
Europe_CO2 <- read_excel("Eurostat_Table_sdg_12_30NoFlagNoDesc_ed1ff8ec-29db-4391-b737-c6858386d997.xls
           range = "A3:S36") %>%
  rename("Country" = "geo\\time" ) %>%
  mutate_all(tolower) %>%
  mutate(Country = capitalize(Country)) %>%
  select(Country,`2017`) %>%
  mutate(`2017` = as.numeric(`2017`))
```

Now we want to study if there is a relationship between the average CO2 emissions per km and the proportion of sold electric vehicles for each country.

```
# Join the CO2 data with the proportion data
Europe_CO2 %>%
  left_join(Proportion_17_18, by = "Country") %>%
  na.omit() %>%
  ggplot(aes(x = `2017`, y = Proportion_2017)) +
  geom_point() +
```

```
  geom_smooth(method = "lm", se = FALSE) +
  geom_text_repel(aes(label = Country), color = "red") +
  ggtitle("Figure 5: Avg. CO2 emissions from new cars per km
          and the proportion of electric vehicles in 2017") +
  ylab("Proportion of electric vehicles") +
  xlab("Average CO2") +
  new_theme_plot()
```



From Figure 5 we can observe a small negative relationship between the proportion of vehicles and the average CO2 emission from vehicles. Most of the countries with a close to 0 proportion of electric vehicles have a high average of CO2 emission from vehicles and the countries with a higher proportion of electric vehicles have a lower average of CO2 emission from vehicles. The outlier in this figure is Sweden who has the highest proportion of electric cars and also a quite high average of CO2 emission from vehicles as well.

Electric vehicles and the total population

The last topic in this project is to study the ratio of electric cars and the total population for each country. The webpage Statistics Times provides a table of the population for each European country in 2018 [10]. To obtain this table we must use webscraping using the library `rvest`. First we save the url file as `Pop_url` and read the url using`read_html`. To obtain the table on the webpage we set the argument "table" to the command `html_nodes`. Now we have obtained the table and we then convert the columns to numerics and select the columns of interest.

```
library(rvest)
# Scrape a table of the population for each country in Europe
Pop_url <- "http://statisticstimes.com/demographics/european-countries-by-population.php"
```

```
Population_countries <-  read_html(Pop_url) %>%
  html_nodes("table") %>%
  html_table(fill = TRUE) %>%
  as.data.frame() %>%
  rename("Country" = "Country.Region") %>%
    mutate_all(tolower) %>%
  mutate(Country = capitalize(Country)) %>%
  mutate(Population_2017 =  as.numeric(gsub(",","",Population)), Population_2018 =
         as.numeric(gsub(",","",Population.1))) %>%
  select(Country, Population_2017, Population_2018) %>%
  slice(-1)
```

Now that we have a data on the population for each country we want to join this with the data set `Vehicle_registrations_17_18`. To obtain the ratio of number of electric vehicles per inhabitant we divide the number of electric cars with the population and grop by each country. To show the result we use the `rworldmap` and plot this ratio. From the figure we can see that Norway has the highest ratio on about 0.009 followed by Sweden and the Netherlands with ratios between 0.001 and 0.005.

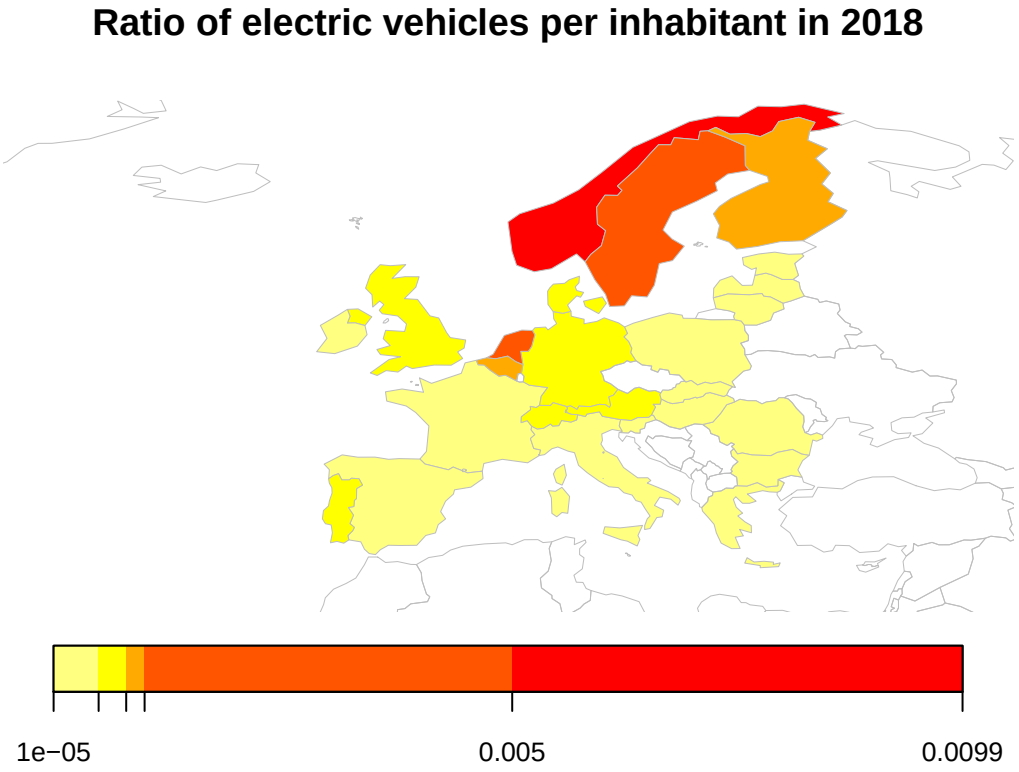
```
# Join the population data set with the number of vehicle registrations for each country
# and find the ratio of electric vehicles per inhabitant
Ratio_pop_vehicle <- Vehicle_registrations_17_18 %>%
  left_join(Population_countries, by = "Country") %>%
  mutate(`2018` = as.numeric(`2018`), Population_2018 = as.numeric(Population_2018)) %>%
  group_by(Country) %>%
  summarise(Ratio_pop = (`2018` / Population_2018)) %>%
  arrange(desc(Ratio_pop))

# Plot the ratio of electric vehicles per inhabitant as a Europe map
Join_map2 <- joinCountryData2Map(Ratio_pop_vehicle, joinCode="NAME", nameJoinColumn="Country")
```

```
## 26 codes from your data successfully matched countries in the map
## 3 codes from your data failed to match with a country code in the map
## 217 codes from the map weren't represented in your data
```

```
Ratio_map <- mapCountryData(Join_map2, nameColumnToPlot="Ratio_pop",
                                mapTitle="Ratio of electric vehicles per inhabitant in 2018",
                                xlim=c(-10, 20), ylim=c(33, 70),
                                catMethod= c(1e-05, 5e-04, 8e-04, 1e-03, 5e-03, 9.9e-03 ),
                                addLegend = F)

do.call(addMapLegend, c(Ratio_map, legendLabels = "all", labelFontSize = 0.8))
```



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