One small change in transportation, one giant leap for the environment[1]

The (Green)Power Rangers

Ruei-Hung Chen
Andrew Chew
Zhenyu Xuan
Elif Yurek

[1] Words inspired by Neil Armstrong. “One small step for man one giant leap for mankind”.

Climate Change & CO^2 101

What is climate change?

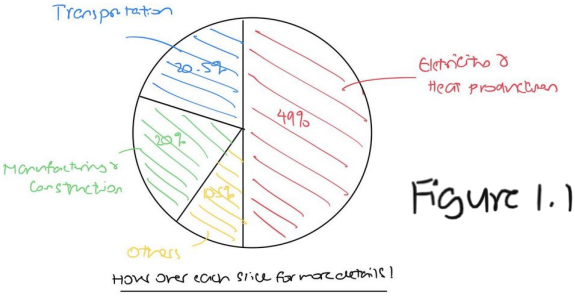
Climate change is long-term shifts in global or regional climate patterns. It often refers to specifically to the rise in global temperatures.

CO2 emissions and other pollutants and other greenhouse gases collect in the atmosphere and absorb sunlight and solar radiation. This radiation is trapped in the atmosphere from years to centuries, cause the planet to get hotter. (Also known as greenhouse effect).

We produce CO2 emissions when we use energy for electricity, cooking, transportation, heat, manufacturing and other sectors.

20.5% of CO2 emissions is from transportation.

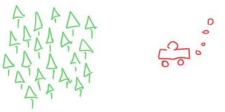
CO^2 emissions from transportation make up >20% of total CO^2 emissions.



How over each slice for more details!

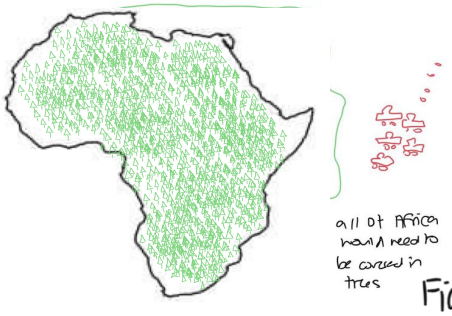
Figure 1.1

1 tree absorbs about 30kg of CO^2 per year on average. It would take 22 trees to offset the emissions of 1 car each year*.



* Assuming 20 km commute / day

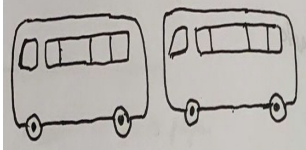
It would take X trees to offset the CO^2 emissions from the transportation sector in 2020



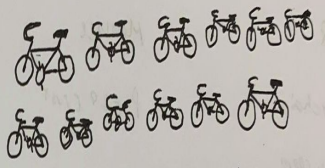
all of Africa would need to be covered in trees

Figure 1.2

1 medium (petrol) car produces 192 g of greenhouse gases per km



Roughly 2 buses with 30 passengers on average produce that much of CO2

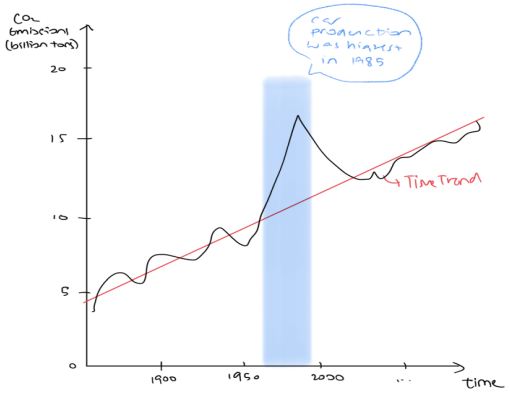


Roughly 12 bikes produce that much CO2 emissions because of rider's average meat intake.

Figure 1.3

Unsustainable CO^2 Emissions

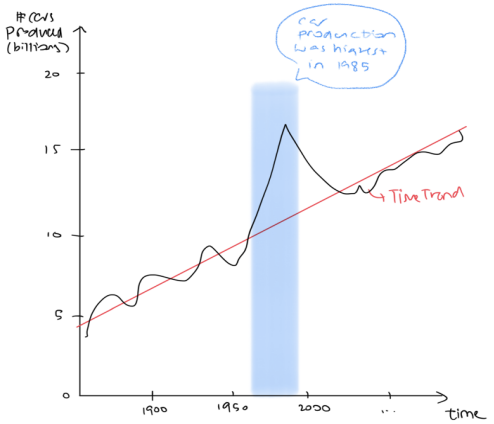
Total CO_2 Emissions 1900-2020



View : Total emissions | Total Emissions from Transportation | Total Emissions from Cars

Time Period : ALL | Past Decade | Past Year

Car production 1900-2020



Time Period : ALL | Past Decade | Past Year

CO^2 emissions is projected to increase by 2 billion tons every year

Figure 2

What's your "contribution"?

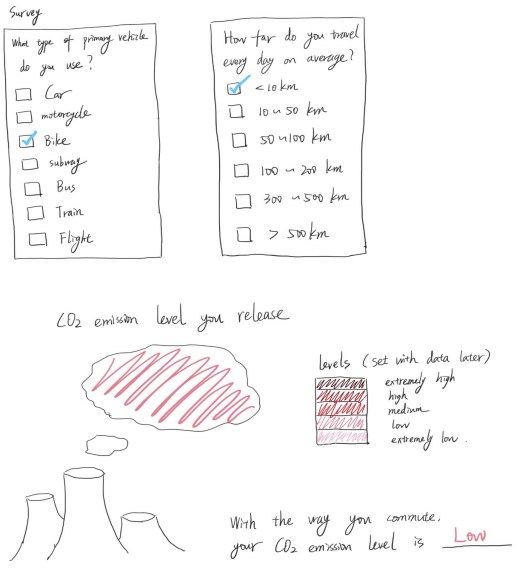


Figure 3.1

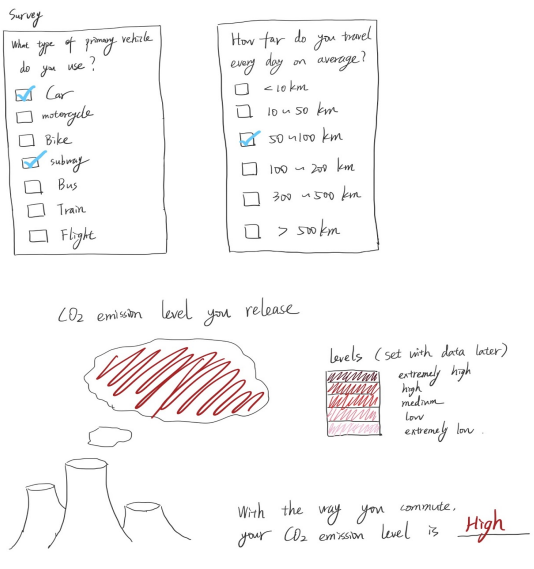


Figure 3.2

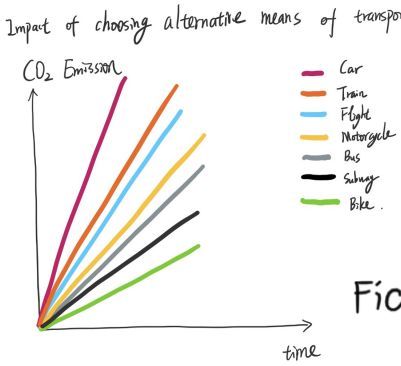


Figure 3.3

How can you help?

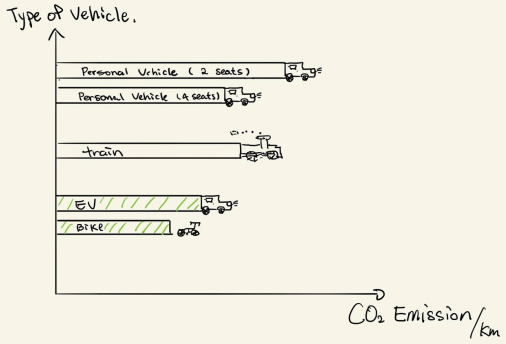


Figure 4.1

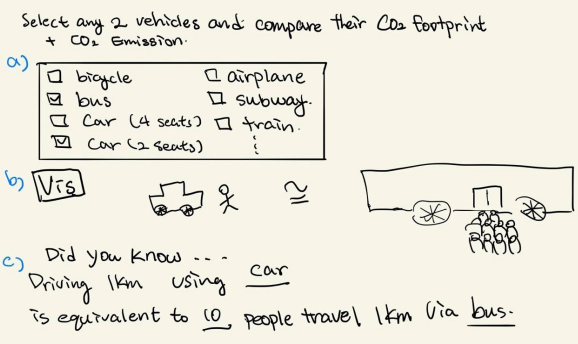


Figure 4.2

Flatten the Curve!

CO_2 emission levels are unsustainable for the planet.
(Talk about bad effects) ...
The average price of a car is $$$ NOT included operational cost. By comparison, a bike costs $.
(Talk about benefits of bikes e.g. healthy)...
Further, if X # of people switch from cars to greener alternatives we can flatten the curve ...
(Talk about how this would affect climate change)

Save the planet
Ride "Green" today!

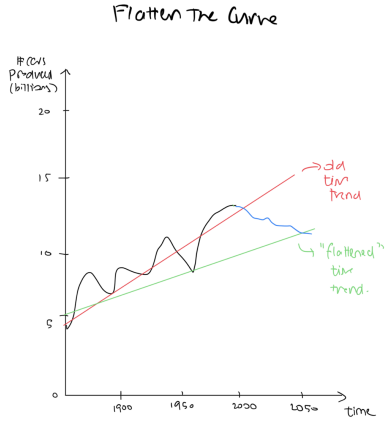


Figure 5

In “Climate Change & CO2 101”, we define climate change to ensure that all viewers understand the topic. Since we chose the general public as our target audience, there could be some people that do not fully know what climate change is. Later, we show the sources of CO2 emissions, how much transportation contributes to total CO2 emissions and how different types of transportation affects CO2 emissions. On the right side, with figure 1.1, we demonstrate the sources of CO2 emissions. Because this is a simple statistic, we choose to use a pie chart. This figure is an interactive visualization, in which when the viewer moves the mouse to a slice, a pop text box demonstrates the percentage of the slice and also the quantity of CO2 emissions it represents. Different colors are used for each slice to help viewers differentiate. We aim to overcome the limitation of using area as a channel by making the graph interactive. In figure 1.2, we display how many trees would need to be planted to absorb the average CO2 emissions produced from using a car for transportation for one year. We use small images to show this ratio to make vis more appealing. We also show many trees we would need to plant to absorb the total CO2 emissions produced in 2020. Because perceiving very large quantities is difficult, we use the continent of Africa to help them visualize the quantity. However, one limitation is that this figure might be misleading, as we are not comparing this to any other visual, we are depending on the viewers’ knowledge on continents. Lastly, In figure 1.3, we demonstrate how much different vehicles produce CO2 emissions per km. With use of drawings of vehicles, we emphasize the comparison of different CO2 emissions from three different vehicles and make the vis more appealing. However, this can also be misleading, because it does not represent the number of passengers for each vehicle.

In “Unsustainable CO2 Emissions”, the goal is to highlight two important points namely, that CO2 emissions are following an increasing trend and that there appears to be a correlation between CO2 emissions and car production. We felt that this section is crucial because it shows the user that the situation is not improving which we hope would help with persuading them to consider greener alternatives as a means of travel in the following sections. The line plots shown in figure 2 are interactive, with buttons allowing the user to select different views (for the left plot) over different time periods (for both plots). The default selection being total emissions from transportation over all years where data was collected. The line plot on the left shows the CO2 emission for a chosen view on the y-axis, against a chosen time period on the x-axis. The line plot on the right shows the total number of cars produced on the y-axis against a chosen time period on the x-axis. A linear regression will be performed on the data to produce the line of best fit, shown in red, for each plot. This is to highlight the time-trend for the user. Further, in the default view, a blue highlight would be present for the time period where car production was at its highest to hopefully show a relationship between CO2 emissions and car production. Finally, there would be a small text section highlighting how much CO2 emissions is expected to increase each year based on the model. The position on common scale magnitude channels with line marks are chosen for the plots as they are highly effective at representing the data. Depending on the data provided, a point mark might be used instead (e.g. data points are annual instead of daily). Another design considered was a bar chart, however we felt that it would be less effective at communicating our main points and potentially cause the visualization to be too cluttered. One limitation with this design is that it is highly dependent on the data. That is, we are assuming that there is reliable data that is publicly available for each plot and that there would be a clear correlation between CO2 emission data and car production data.

In “What’s your ‘contribution’?”, we want to conduct a survey on what type of vehicle people use in their daily life and how far they will commute every day on average. We set several choices for each question. These two questions can be multiple choices or single choice. Since in some situations, someone may commute by more than one means of transport. Based on the choices, we can know the means of transport and the distance they travel every day on average. Then we can calculate the CO2 emission level they release by multiplying the CO2 emission of various vehicles per kilometer by the distance people have chosen. This will be an interactive visualization. If you change the choices, the result will be changed by calculations. These changes will reflect on the visualizations. There are two examples of the survey part – Figure 3.1 and Figure 3.2:

From the example visualizations, we can see several chimneys at the bottom of the survey. There is smoke with different color hues. We chose red from the darkest to the lightest to stand for different levels of the CO2 emission levels from the highest to the lowest. (The actual level will be set by data later.) If one person commutes less than 10km with a bike in daily life on average. Then, the CO2 emission level for him or her is Low level, which is in relatively light red. For multiple choices one person selected, the total CO2 emission will be much higher. In Figure 3.1, we can see the color is dark red, which stands for High level CO2 emissions. There is one limitation that it’s not easy for people to determine how far they actually travel in their daily time, which will completely change the result of the calculation and the visualizations. Then, we display a

visualization to show that the impact of choosing alternative means of transport. Then, they can compare all types of vehicles through Figure 3.3.

From this visualization Figure 3.3, we use different color hues to represent categorical attributes – types of primary vehicles. The graph will be interactive based on the primary vehicles and kilometers people chose in the survey part. The slope will be the total amount of the CO2 emission people release. Then from the visualization, we can obviously see the difference among various types of vehicles. For example, if you choose to commute by bike for 10 kilometers instead of commuting by car, you will see a clear difference between car and bike from this graph. This can reflect the impacts on choosing alternative means of transport.

In "How Can You Help?", we aim to create visualizations that illustrate each type of vehicle's impact on the carbon emission. Figure 4.1 is a stationary bar graph with the different types of vehicles on the y-axis and the amount of CO2 emission each vehicle creates per km on the x- axis. Viewers can easily compare different types of vehicles and their effect on CO2 emission in this bar graph. Furthermore, we can also highlight the low carbon emission vehicles with colour hue- green, to highlight the most eco-friendly vehicles for viewers. In our opinion, this may be a little repetitive to figure 3.3, so in our actual project, we may incorporate the two together as one interactive chart.

In Figure 4.2, we design an interactive visualization that allows viewers to compare 2 vehicles by their carbon emission level. In step 1 (part a), we allow the viewers to choose two types of transportations that they want to compare. Step 2 (part b), viewers will see the corresponding two vehicles present side by side in a graph. According to the amount of CO2 emission of each chosen vehicle, we compare the difference in CO2 emission and visualize them by lining up the number of people it takes to emit the equivalent level of CO2 using each transportation type. Finally step 3, (part c), we summarise the result with a simple sentence of text.

An example of this visualization would be, a person driving a regular 4 seats sedan that emits 200 g of CO2 after traveling 1km on the left side. On the right hand side, we compare it with a bus traveling for 1km and each person contributes 20g of CO2 on average. Then, we show 1 person traveling 1km by 4 seats sedan is equivalent to 10 people traveling 1km by bus.

The magnitude channel we chose to present the difference is by the number of people standing in front of the vehicle (2D area). The vehicle with fewer people standing in front is the vehicle that contributes more CO2 emission to our environment per person. Different from standard bar charts, this visualization not only clearly shows the difference in carbon emission, it also shows which means of transportation are considered more harmful to the environment. On top of that, viewers may feel emotionally driven to use the "less selfish" transportation to travel after reading this article. One limitation to this visualization is that it constrains the viewers to only compare 2 vehicles, if they wish to compare another set of vehicles, they would have to manually change the choices.

The "Flatten the Curve" section would consist of a short text portion that restates our main point and the goal we hope people would strive for. It would also include some key facts about what would happen if the more people chose greener transportation alternatives. Figure 5 revisits the CO2 emissions plot described in "Unsustainable CO2 emission" with the addition of data points that were calculated assuming more and more users adopt greener alternatives of travel. The main goal is to highlight how user action can potentially "flatten the curve" of CO2 emissions to more acceptable levels in the future.

We plan to deploy a shiny app online using the R programming language to code for interaction charts. For static drawings such as the factory and trees we will use powerpoint to draw them. Our project has 4 clearly defined main sections as indicated by each section's title. Each group member would be in charge of data exploration/ analysis of one section as well as exploring how to implement the shiny app. We plan to use data from a variety of reliable sources including (but not limited to) the CO_2 and GHG Emissions Dataset from OurWorldInData.org. By Good Friday (April 2), the group will meet to discuss how to integrate each corresponding section into the shiny app. The final week will be dedicated to implementing the shiny app, completing the "Flatten the Curve" section with our conclusions, and writing the report. We share a Github repository to keep track of our work and plan to meet regularly through Zoom calls and use Facebook Messenger as a communication tool to monitor any possible problems in the upcoming work.