Mr. Eco-carbon app paper

Corrado Falco

Sabrina Mazouz

Julia Metlicka

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Introduction

Climate change is becoming a bigger part of our daily lives, and many people want to understand how their actions affect the environment. To help with this, our team created Mr. Eco – an app that makes it easy for users to calculate their carbon emissions.

To do so, we thought of using a narrative frame device based on the character of Mr. Eco, an investigator that will help our users to "investigate" their carbon footprint. This way we want to make our app an experience narrated in an engaging and captivating way that will make the user more interested, in order to make everyone feel like an investigator on a mission. Through this "investigation" we want to make the app simple and accessible to everybody, making it easy and entertaining to use.

The main source we rely on for developing our calculator Travelandclimate.org ,whose website explains in a detailed but yet simply the data, and includes various fuel types and vehicles, outlining the calculation method behind every reported figure.

Due to scarcity of data on motorcycles's carbon emission, we used the 2022 Methodology Paper for Conversion Factors Draft Report of the UK Government, a different source with the same level of accuracy.

Beyond these core features, the uniqueness of Mr. Eco stands in our "For you" page, a space dedicated to an estimate of how much it actually costs to travel in Norway.
This mix of sustainability and budget information makes Mr. Eco more useful in everyday life, giving an idea to our users of what they can actually do to move and travel in a greener way.

The documents our research is rooted in are the Norway Toll Roads Complete Guide: AutoPASS, Bompengar & Payment 2025 for the toll fees, oslobilutleie.no for giving an idea to our users of parking costs using Oslo as our sample, Norway Taxi Fare Calculator (2025 Rates) | GoByTaxi Norway to inform our users of taxi's fees, and finally the table "Energipris per 100km" from the Norwegian Public Road Administration web site (Statens Vegvesen) which gives us informations on cars with different fuels.

With this page we want to connect on a deeper level with our clients, and by giving these informations we want to create a relationship based on trust and transparency, because our aim is to have an app that is truly client-centered.

Mr. Eco is not just a calculator, it's our way of empowering our users to live their greenest future and bring it to life.

Methodology

To calculate carbon emissions in Mr. Eco, we based our formulas on data from Klimatsmart Semester(klimatsmartsemester.se). This website provides clear emission factors for different types of transportation, such as cars, buses, flights, and trains. Their calculator explains how the numbers are measured and how much CO_2 each type of travel produces.

By using the information from Klimatsmart Semester, we were able to create simple formulas that give users realistic and easy-to-understand results. We used their emission factors to estimate CO_2 output per kilometer, which allows users to track their emissions based on the distance they travel.

All calculations in Mr. Eco come directly from this source, helping us keep the results consistent and reliable for our users.

Calculations:

For Mr. Eco, we created a simple formula to calculate the carbon emissions from different types of vehicles. The main part of the formula is the emission factor, which tells us how much CO_2 a vehicle produces per kilometer. This factor is different for each type of transport.
We also included calculations for electric vehicles. Since they do not burn fossil fuel, we added a separate factor based on electricity use instead of fuel use. This allows us to give users realistic results whether they drive a petrol, diesel, or electric vehicle

In all our formulas, we also consider the number of passengers. Vehicles like buses, trains, ferries, and airplanes carry many people, so the total emissions are shared between all passengers. To calculate this fairly, we use p = 1 to show the emissions for one single passenger. This gives users a clearer picture of their own individual impact, even when they travel in shared transportation.

$$CO_2 = d \times \frac{fe}{p}$$

Where:

fe= Emission factor in CO2/ km

d = distance

p =amount of passengers

Car:

The reason why we chose Travelandclimate.org as our main source is also because it based its cars emissions calculations on the Swedish Energy Agency's annual report "Drivmedel 2022" (Energimyndigheten, 2023), which includes emission from the extraction, production and distribution of the fuels, in order to give a more complete analysis of their impact to our users.

The emission calculations differ between small, medium-sized, and large cars. Small cars are almost always petrol cars. These are assumed to use an average of 24% less energy than medium-sized petrol cars. Campers/caravans are assumed to use 96% more fuel than a medium-sized car (Hammarström, 1999). (Travelandclimate.org)

This calculation also assumes that if the number of people exceeds the number of seats in the vehicle, it will add another vehicle to the calculation, meaning that in cases where the number of people exceeds five, it is assumed that the group will travel in more than one car.

Gram CO_2e/person-kilometer

		Small Car	Medium Car	Large Car	Camper/Caravan
car	Diesel	58	76	101	149
	Gasoline	50	66	87	129
	Electricity Nordic	15	20	26	36
	Fossil gas	51	68	89	132
	Vehicle gas	6.8	9.0	12	18
	Biogas	6.6	8.6	11	17
	Ethanol	23	31	40	60

Ferry:

For this kind of vehicle the calculation is based on the principle of financial allocation, according to which the emissions are divided between passengers and freight based on their share of the ferry company's income from passengers and freight.

The logic behind this is that it is the revenue of the ferry companies that drives their ongoing operations and that it is therefore reasonable that the proportions from their revenue are used to distribute the emissions. (Travelandclimate.org)

It is relevant to underline that the distribution of calculated emissions between passengers and personal cars is also based on economic allocation, and it shows that the additional cost of taking a car corresponds on average to the price for two passengers without a car.

Gram CO_2e/person-kilometer

Ferry	Standard fuel	186	377

Train:

Electric trains in Norway usually have an emission factor of 7 grams CO2 equivalents per passenger km, while diesel trains have an emission factor of 91 g CO2e/pkm (Knörr & Hüttermann, 2016). By having this information, it is possible to know your own carbon footprint when you travel with both diesel and electricity run trains. A third category related to this vehicle are trains using 100% biodiesel (HVO), whose emission is calculated based on the Swedish Energy Agency (where HVO100 has 89% lower

emissions than standard diesel with a greenhouse gas reduction mandate of 6%) (Energimyndigheten, 2023).

Gram CO_2e/person-kilometer

Train	Electricity Nordic	7
	Diesel	91
	Biofuel HVO100	10

Bus:

The emissions calculation assumes that the average number of bus passengers is 28, and with an average fuel consumption of 26 litres per 100 km (Sveriges Bussföretag, 2022). This translates into diesel emissions of 30 gCO2e/pkm, HVO100 emissions of 3,5 gCO2/pkm and FAME100 emissions of 11 gCO2/pkm. (travelandclimate.org)

Gram CO_2e/person-kilometer

Bus	Diesel	30
	Biofuel HVO100	3,5
	Biofuel FAME100	11

Airplane:

When looking up the carbon emissions of the airplane, Travel and Climate uses a new formula which is more accurate and gives the user a realistic idea of their carbon footprint. Traditional calculators often used a single average emission factor for all flights, but in reality, flight emissions vary greatly depending on distance, aircraft type, seat class, fuel mix, and even how many people are on board. Because of this, a more detailed method is necessary.

The different components of the formula are the distance of the trip, multiplied for the emission factor and the seat class multiplier, to which we add the ground transfer emissions. Let's explain each element.

The distance of the trip derives from the Google Maps API, which calculates the great-circle distance.

For this project we made the first distinction between scheduled flights and charter flights.The first type has a carbon emission of 127 gCO2e/pkm which includes the

combustion of aviation fuel, high altitude effects (equivalent to 47 grams) and emissions from the extraction and refining of aviation fuel (16 grams). The second type has an average of 115 gCO2/pkm, since charter companies have higher occupancy rates resulting in lower emissions.

A second distinction is made based on the type of fuel, between standard fuel and 100% biofuel. For this last option the emissions are assumed to be 51 grams of CO2-eq per person-km (which mainly consists of the high-altitude effect).

Moreover, it is important to specify that emissions per p km are significantly affected by the seat class chosen by the passenger. Since premium economy and business class seats take up more physical space in an aircraft, fewer passengers can be carried on each flight. Therefore, premium economy and business class passengers should account for a larger share of emissions per passenger, which for premium economy and business class precisely results in 1.2 ans 2.2 times the emissions of an economy passenger.

Finally, we add the ground transfer emissions from traveling to and from the airport (44 g CO_2/km standard value) .

Therefore, the formula is:

$$E = (d \times EF \times \text{seat class multiplier}) +$$

(Distance to departure airport + Distance from arrival airport) × 44 gCO2e/pkm

Where:

- E = total emissions for the trip (e.g., in g CO_2e)
- d = distance of the trip (in km), calculated by Google Maps or great-circle distance
- EF = emission factor (e.g., g CO_2e per person-kilometre), which already contains the fuel combustion, high-altitude effects and fuel extraction/refining

Gram CO_2e/person-kilometer

			Economy	Economy Premium	Business Class
Flight	Standard fuel	Scheduled	127	155	284
	Standard fuel	Charter	112	137	-

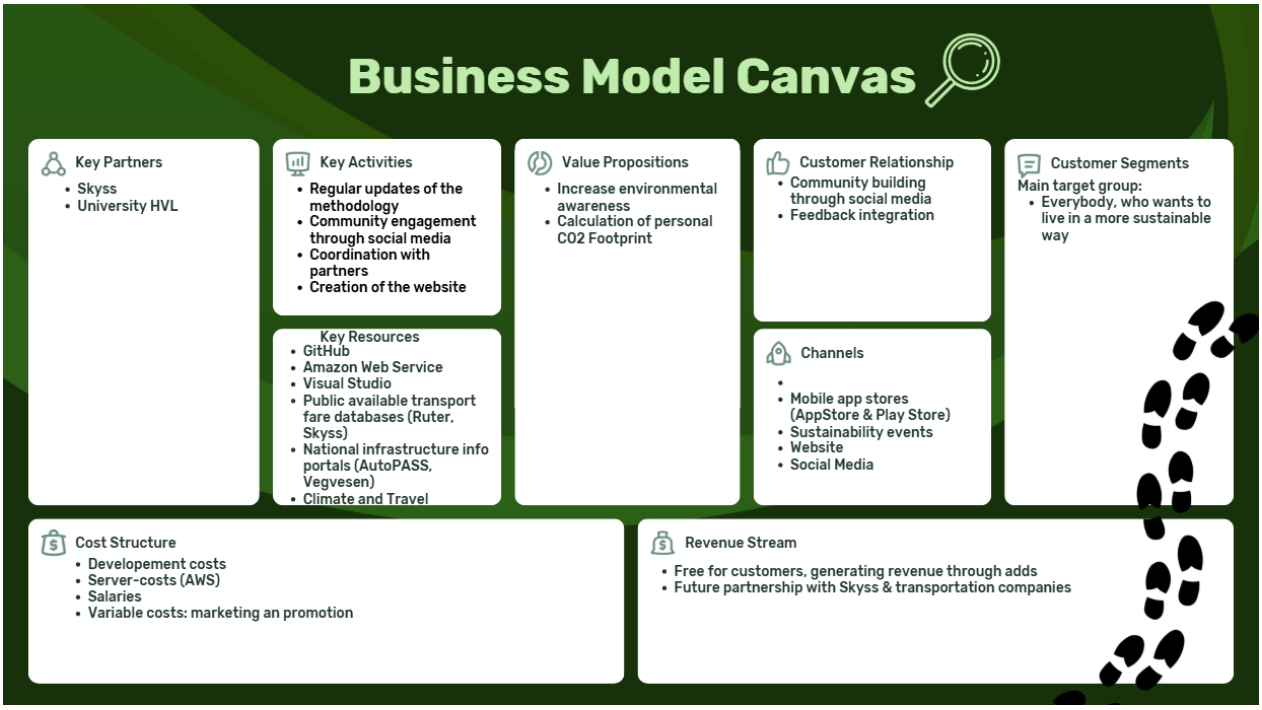
	100%Biofuel	Scheduled	51	63	115
	100% Biofuel	Charter	45	56	-

Motorcycles:

For these vehicles we used another source to base our research on, the 2022 Methodology Paper for Conversion factors Draft Report of the UK Government, where a distinction between small motorbikes (mopeds/scooters up to 125cc), medium motorbikes (125-500cc) and large motorbikes (over 500cc) was made. The conversion factors are calculated based on a large dataset provided by (Clear, 2008)22, based on a mix of magazine road test reports and user reported data.

CC Range	Model Count	Number	Av. gCO2/km	Av. MPG*
< 125 cc	24	58	85.0	77.3
126-500 cc	36	129	103.2	63.7
> 500 cc	243	992	137.2	47.9

Business Model Canva:



Customer Segment:

Our main customer group includes people who want to live in a more environmentally friendly way, and everyone who wants to learn about sustainability. To test our app we will launch it firstly in Norway which will be the testing market for our app. If the testing period in Norway turns out to be successful, we will expand it to other countries' markets.

Value Proposition:

Mr. Eco helps users understand how their daily travel impacts the environment. The app calculates personal CO_2 emissions in a simple and accurate way. This gives users a clear overview of their carbon footprint and helps them make more sustainable choices.

Besides providing data, our app encourages environmental awareness by showing users how small changes can lower their emissions over time.

And to prove how much we value the relationship with our users, we decided to add a new page to Mr. Eco, the "For you page", built for the them so that they will be able to find relevant information on the matter, to empower themselves and increase their knowledge. There we will put Norway's policies regarding carbon emissions, the cost of traveling in the country with public transportation and (environmental transportation tips for the biggest cities).

Channels:

We promote our app through different channels. These include app stores like the App Store and Google Play, whereusers can download the app easily.

We also reach people at sustainability events, on university campuses, and through our website. Social media platforms such as Instagram, TikTok, and Facebook help us connect with a wider audience and share updates or tips related to sustainability.

Customer Relationships:

We want to build a strong and open relationship with our users. Through social media, we create a small community where people can share their experience and follow our updates.

Revenue Streams:

Our app is free to use, and we generate income through advertisements. This allows everyone to access the app without paying.

In the future, we want to create partnerships with companies like Skyss and other transportation providers. These partnerships can help us improve the app further and offer more accurate data.

Key Resources:

Our main resources are our development tools and the skills of our team. We use GitHub for version control, Amazon Web Services for hosting, Visual Studio for coding and testing, and Travel and Climate. We have also referred to some publicly available transport fare databases (Ruter, Skyss, Kolumbus, AtB, Snelandia) and national infrastructure info portals (AutoPASS, Vegvesen).

Working together and coordinating tasks is essential, because each part of the app depends on accurate data and a reliable interface.

Key Activities:

Our key activities include updating our methodology, improving the app design, and collecting good data.

We also coordinate with partners like universities and transport companies, and we use social media to engage with users.

Our team works on developing the website and keeping the app running smoothly with tools like Visual Studio, Python, and AWS.

Key Partners:

Our most important partners are Skyss and the University of HVL. These partners help us access relevant information,reach students, and test our app in real situations.

We also rely on external data from websites that provide emission calculations for cars, planes, trains, and ferries. These sources help us make sure our app gives accurate results.

Cost Structure:

Our main costs include app development, server costs through AWS, and salaries for team members.

We also have variable costs such as marketing, social media promotion, and updates to the platform.

Keeping the app free for users means we focus on efficient cost management while still offering high quality and reliable design.

Organization of the Team:

Our team at HVL consists of three international students, each responsible for different parts of the project. Even though our group is small, we divided our work clearly to make sure everything was completed efficiently. Our main areas of responsibility include writing the paper, developing the methodology, and building the Mr Eco app.

In the paper section, we split tasks such as research, writing, and organizing the layout. This helps us present information from the methodology and app development teams in a clear and structured way. On the development side, responsibilities include researching technical solutions, creating the design, and testing the app to ensure the results are accurate and easy for users to understand. Within the methodology part, we focused on finding reliable data, creating simple formulas, and deciding how the calculations should be shown in the app. The goal of this group was to provide the development team with correct formulas for estimating carbon emissions from different types of transportation.

To stay organized and updated, we hold regular meetings throughout the week. We usually meet before or after lectures to discuss our progress, share ideas, and set new tasks for the next days. These meetings help us stay aligned and make sure every member knows what they need to work on. When we cannot meet in person, we communicate through Messenger, which makes coordination easier, especially since we all have different schedules as international students.

Summary:

Mr. Eco is designed not only to calculate emissions but also to make learning about sustainability simple and engaging. Many carbon-footprint apps are technical or difficult to use, while Mr. Eco uses the playful character of “Mr. Eco” an investigator who helps users discover the impact of their daily choices. This makes the experience more interactive and enjoyable, especially for users who are curious and want to understand the world around them. By combining accurate data with a friendly and accessible design, Mr. Eco helps people learn about carbon emissions, air pollution, and current environmental issues in a way that feels both informative and motivating. This approach makes our app stand out from others and encourages users to return, explore, and build more sustainable habits over time.

References

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