Høgskulen på Vestlandet

Essay on carbon emissions

"GreenMile"

Green Digitalization and App Development

Course code: SDG335 - H25

Supervisor: Mario Blazquez de Paz

Submission date: 24.11.2025

Candidates:

Nora Hjelle Aambø, B.Sc. Business Administration at HVL Bergen

Kajsa Austbø, B.Sc. Business Administration at HVL Bergen

Murielle Mareena Blok, B.Sc. Naval Engineering at NHL Stenden Leeuwarden

Emma Dahl Sørbo, B.Sc. Business Administration at HVL Bergen

Henrikke Håland Hopland, B.Sc. Business Administration at HVL Bergen

Maria Pernille Olsen, B.Sc. Business Administration at HVL Bergen

Thea Louise Veivåg, B.Sc. Business Administration at HVL Bergen

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1.0 Introduction

Climate change, largely driven by human emissions, is a defining challenge of our time. Achieving the outlined climate goals of the Paris agreement requires immediate reductions, especially in transport (Statistisk sentralbyrå, 2023). The transport section is responsible for nearly one fifth of all carbon emissions (Freudenreich, 2024). According to *regjeringen.no*, Norway must reduce its carbon emissions by 55% by 2030 (Regjeringen, 2023). In 2024, the total emissions were 44.6 million tons (SSB, 2025), meaning they must fall to about 20 million tons to meet this target. With a population of 5,606,944, each person needs to have a maximum emission of 3.6 tons by 2030. Spread over five years, this means a maximum of 720 kg per year. Furthermore, this means around 14kg for each week.

We are GreenMile - From awareness to action, measure today, change tomorrow. For our project we want to raise awareness about how much individuals contribute to total emissions through their transport choices. Our app focuses on students in Bergen, who move around the city daily and therefore have a direct and meaningful opportunity to influence these reductions. This app functions as a CO_2 calculator that helps compare transport modes in terms of emissions, cost and time. A key feature is the “what-if planning” function, which helps users explore which transport choices lead to the lowest emissions. By making personal climate impact visible and actionable, the app helps users make sustainable choices toward a shared goal. With transparent data and user friendly design, it helps students track and reduce their carbon footprint.

This paper covers our project in clear steps, beginning with the methodology behind the app. Here we detail the data sources and the different types of transportation included in the calculations. After that, we outline the business model that supports user engagement and sustainability goals. Finally, the paper concludes with a summary of our findings and discusses the anticipated environmental benefits resulting from the app’s use along with the organization of our team.

2.0 Methodology

In this part, we explain the methodology behind our carbon app by showing how data is collected and applied in our calculations. The subchapter on data sources details the origins of the data and how they are used to estimate emissions.

2.1 Data sources

To support our carbon calculations and develop the app, we have collected data from several reliable sources, including Framtiden i våre hender (2025), Vy (*Annual and Sustainability Report* 2023), Bybanen (*Annual report*, 2022), Statistisk Sentralbyrå (SSB), Ung i trafikken (2025), and Voi (Spencer, 2021).

Framtiden i våre hender provides CO_2 emission estimates per passenger-kilometer for various transport modes, while Vy and Bybanen offer data on public transport emissions and energy use in Norway. SSB contributes statistics on car ownership, travel habits and electrification trends relevant to students in Bergen. Additionally, Ung i trafikken and Voi offer insights into emerging transport modes and the growing share of electric and hybrid vehicles. Combining these sources provides users with a clear overview of the environmental impact of different transport options.

2.2 Calculations

This section provides an overview of the formulas and methods used in our app to calculate carbon emissions for both fossil-fuel and electric vehicles, per passenger and total, reflecting Norway's shift toward electrified transport and highlighting the benefits of shared travel.

This is the general formula for fossil-fuel vehicles that we will use in our carbon app:

The general formula:

$$\mathrm{CO}_2 = d \cdot ef$$

Where the different factors mean:

- **CO_2** = carbon emissions in grams of CO_2 for the distance traveled
- **d** = the distance traveled in kilometers
- **ef** = the emission factor in grams of CO_2 per passenger per kilometer

The formula below calculates electric vehicle emissions:

The general formula:

$$Ef = x \times Ec$$

Where the different factors mean:

- **Ef** = carbon emissions in grams of CO_2 for the distance traveled
- **Ec** = the emission factor in grams of CO_2 per passenger per kilometer
- **x** = the distance traveled in kilometers

By applying these formulas, our app provides students with clear, individualized feedback on the environmental impact of their transportation choices. Users can easily compare different modes of transport, such as buses, ferries, airplanes, electric scooters, trains or cars and see how even small changes in travel behavior can reduce their carbon footprint. By focusing on the transportation options most commonly used by students in Bergen, the app ensures that the information is both relevant and practical, helping users make more informed and environmentally friendly commuting decisions.

2.2.1 Airplane

Air travel is by far the most carbon-intensive form of transportation. According to *Framtiden i våre hender,* airplanes account for some of the highest emissions per passenger-kilometer (Helle 2025). The variation depends on the travel class. Business class emits 284 g CO_2/pkm, premium economy 155 g CO_2/pkm, and economy 127 g CO_2/pkm (Helle, 2025). Higher-class seats take up more space, so fewer passengers increase per person emissions. For students, economy class is most relevant, but air travel remains significantly more carbon-intensive than other transport modes.

Airplane	**g CO_2/pkm**
Business	**284**
Economy Premium	**155**
Economy	**127**

Table 2.1: Airplane with different travel classes - g CO_2/pkm

2.2.2 Train

For students in Bergen, taking the train is a practical and environmentally friendly way to commute. VY runs most local trains, providing fast and convenient connections for students commuting from surrounding areas like Arna. All VY trains run on electricity, emitting about 10 g CO_2/pkm (VY, 2023), far lower than diesel trains (91 g CO_2/pkm). The European average is 26 g CO_2/pkm, while Nordic countries, where renewable energy dominates, emissions are as low as 7 g CO_2/pkm (Helle, 2025).

Train	**g CO_2/pkm**
Diesel	**91**
Electric - Nordic countries	**7**

Table 2.2: Trains: diesel and electric - g CO_2/pkm

2.2.3 Light rail (Bybanen)

In Bergen, students often rely on the light rail system, Bybanen, as their main form of daily transportation. According to its 2023 sustainability report, Bybanen AS's emissions totaled 1 210 tonnes CO_2, with only 212 tonnes from electricity and heating (Bybanen AS, 2023). On average, line 1 had about 70,000 boardings per day, while line 2 had around 20,000 (Skyss, 2024). Assuming an average trip length of 9 km, we can estimate total passenger kilometers per year and calculate the carbon footprint, which comes to about 4 g CO_2/pkm.

Light rail (Bybanen)	g CO_2/pkm
Electric	4

Table 2.3: Bybanen - g CO_2/pkm

2.2.4 Car

For the first time since the 1990s, a decline in the number of personal vehicle ownership has been observed in Norway. The decline amounted to 1% and may be attributable to weakened household finances among Norwegians. Nevertheless, a positive purchasing trend can still be observed for electric and hybrid vehicles, with an increase of 202.6% for electric cars and 62.9% for hybrid cars compared to 2020 (Sulavik, 2025).

For cars, we start from emission factors given in grams of CO_2 per passenger-kilometre. To make these comparable with other vehicle-based values, we also calculate a total emission factor per kilometre for the whole vehicle by assuming a standard passenger occupancy of five passengers.

In our app, the user can then choose the actual number of passengers (1–5), and we calculate:

$$\text{Total } CO_2 = d \cdot ef_{total}$$

$$CO_2^{pp} = \frac{d \cdot ef_{total}}{p}$$

This way, the table shows both the per-passenger factor and the corresponding total vehicle emissions per kilometre, while the app allows the user to see how sharing a car reduces the per-passenger impact.

Car - Size	g CO_2/pkm	passenger	Total g CO_2/pkm
Diesel - Campervan	149	5	745
Diesel - Big	101	5	505
Diesel - Medium	76	5	380
Gasoline - Small	50	5	250

EL NC - Big	**26**	**5**	**130**
EL NC - Medium	**20**	**5**	**100**
EL NC - Small	**15**	**5**	**75**

Table 2.4: Car size: Diesel, gasoline and electric - g CO_2/pkm

2.2.5 Electric scooter

The electric scooter is among the most frequently used modes of transport for students in Bergen. To ensure that our carbon app remains relevant to its target audience, we therefore integrated the electric scooter as an additional feature. While electric scooters produce no local emissions, their life-cycle emissions amount to 29 g CO_2 per passenger-kilometer (Spencer, 2021). They can therefore serve as a greener alternative for short car trips: however, their short lifespan, emissions from production and the transportation of the scooters using fossil-fuelled vehicles may render them less environmentally sustainable than commonly assumed (Ung i trafikken, 2025).

Electric Scooter	**g CO_2/pkm**
Electric	**0**

Table 2.5: Electric Scooter - g CO_2/pkm

2.2.6 Ferries

Ferries are an important part of Norway's transport system, particularly for students traveling between coastal towns and university cities. Ferries account for a significant portion of CO_2 emissions, although new public contracts now require zero-emission vessels from 2025 (Regjeringen.no, 2024). Conventional heavy-fuel ferries emit around 186 g CO_2-equivalents per passenger-kilometer**,** while electric ferries represent a much lower-emission alternative (Helle, 2025). It should also be noted that the figures for large ferries only account for passengers; bringing a car on board adds on average 377 g CO_2 per kilometer in emissions (Helle, 2025).

Ferry	**g CO_2/pkm**
Big ferries on average	**186**

Table 2.6: Big ferry - g CO_2/pkm

2.2.7 Bus

Buses are a mode of transport for students in both urban and regional areas, making it essential to examine their carbon emissions. Framtiden i våre hender reports that conventional diesel buses emit around 30g CO_2 per passenger-kilometer (Helle, 2025). For comparison, Vy, Norway's largest bus operator, reports that buses running on biodiesel and electricity emit roughly 14g and 13g CO_2 per passenger-km (Vy, 2023).

Bus	**g CO_2/pkm**

Diesel (2025)	**30**
Biodiesel (2023)	**14**
Electric (2023)	**13**

Table 2.7: Bus: Diesel, biodiesel and electric - g CO_2/pkm

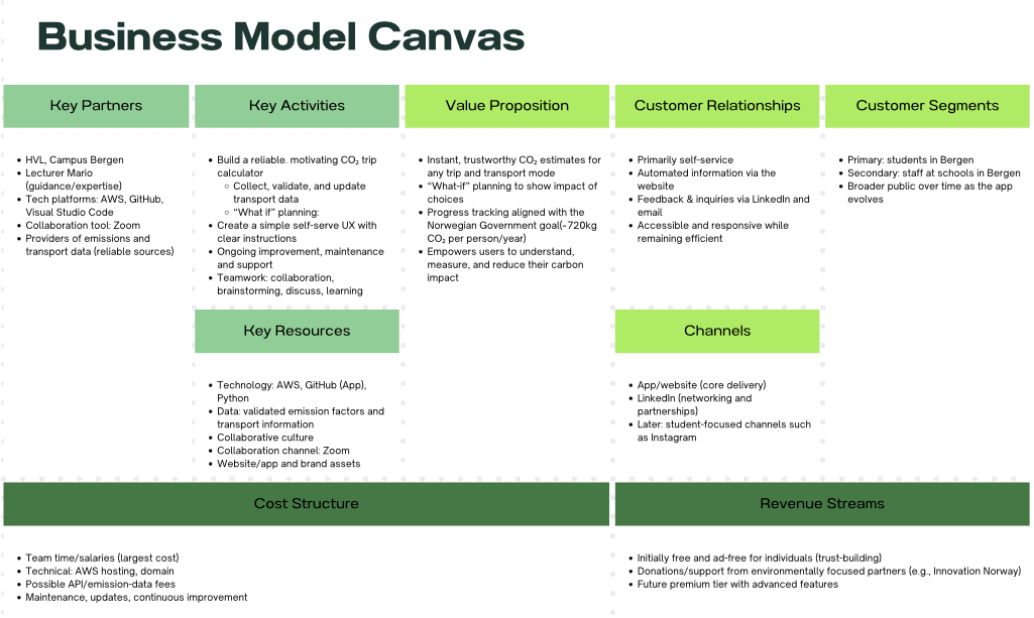
2.3. Summary

Our methodology enables the calculation of both total and per-passenger emissions, offering users a detailed understanding of their carbon footprint across different transport modes. The results show a clear contrast: private car travel generates the highest emissions, while shared and electrified options, such as buses and e-scooters, can cut emissions per traveler by up to two-thirds. These findings highlight that even a small shift in commuting behaviour can make a significant impact. By providing this information through the app, through "what-if" planning, students in Bergen can compare transport options, recognize the benefits of low-emission travel and make daily commuting choices that support sustainable transportation. These emission estimates form the basis of the business model outlined in the next section, showing how data-driven insights translate into user value.

3.0 Business Model Canvas

The Business Model Canvas (BMC)[1] helps us provide strategic clarity, accelerate decision-making and identify our key business elements (Innovasjon Norge, 2018). This will help us contribute to the Norwegian government's goal of reducing CO_2 emissions. The model consists of nine blocks; key partners, key activities, key resources, value propositions, customer relationship, channel, customer segments, cost structure and revenue streams.

[1] Business Model Canvas (BMC): A one-page template used to visualize and develop a company's business model by breaking it down into nine key building blocks.



3.1 Value Creation - *Key Partners, Key Activities and Key Resources*

3.1.1 Key Partners

Our School, Høgskulen på Vestlandet, Campus Bergen and Lecturer Mr. Blazquez de Paz are *key partners*[2], with the school facilitating this course and our professor providing guidance and expertise. Platforms such as AWS, Github and Visual Studio Code are essential technical partners, while Zoom enables smooth collaboration since one of our team members is located in a different geographical area.

3.1.2 Key Activities

Our *key activity*[3] is to develop a reliable and motivating CO_2 calculator for common transport modes. The calculator will enable users to compare alternatives for each trip and across a year, looking at emissions, time and cost. By doing so, people can not only measure but also track their own environmental footprint over time.

3.1.3 Key Resources

On the technical side, Amazon Web Services, GitHub App and Python are *key resources*[4] for development. Reliable emission data and transport information are also key resources, as accuracy is essential for trustworthiness. On the human side, teamwork stands out as one of our greatest resources, with brainstorming, cooperation and effective communication driving our

[2] Key partners: Describes the network of suppliers and partners that make the business model work.
[3] Key activity: The most important tasks a team must perform to operate successfully, deliver its value proposition to customers and make its business model work.
[4] Key resources: Essential assets a company needs to operate, create value and achieve its business model's goals.

progress. Zoom further supports collaboration and ensures seamless communication despite physical distance.

3.2 Value Delivery - *Value Propositions, Customer Relationships, Channels & Customer Segments*

3.2.1 Value Propositions

Our *value propositions*[5] center on turning awareness of carbon impact into meaningful everyday action. GreenMile is designed specifically for students in Bergen, reflecting their daily travel pattern, mobility options and cost considerations. This app provides instant CO_2 estimates for any trip and transport mode, supported by an interactive "what-if" function that allows users to test alternative choices and see how small adjustments can reduce their footprint. In this way, students can ensure that their emissions remain below 720kg, aligning with the Regjeringen´s (2023) goal of reducing emissions by 55%. Together, these features make our climate impact more visible and measurable, encouraging students to adopt more sustainable travel habits.

3.2.2 Customer Relationships

Customer relationships[6] will be primarily self-served, with clear instructions to ensure ease of use. Communication will partly be automated through our website, while feedback and questions will be handled via LinkedIn and email. This combination allows for accessibility and responsiveness while keeping the system efficient.

3.2.3 Channels

Our primary *channel*[7] is the app, which serves as the core platform for interaction. LinkedIn will function as an additional channel, particularly useful for networking and reaching potential partners. Over time, student-focused platforms such as Instagram could be considered to better reach our main customer group.

3.2.4 Customer Segments

Our *customer segments*[8] primarily consist of students in Bergen, while staff at different schools in Bergen represent a secondary group. Although the app is available to a broader audience, these two segments are our main focus at the start. In the long term, we are open to expanding to additional customer groups as the app develops further.

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[5] Value propositions: An innovation, service or feature intended to make a company or product attractive to customers.
[6] Customer relationship: The specific types of connections a company establishes and maintains with its different customer segments.
[7] Channels: The avenues through which a company communicates with its customer segments to deliver a value proposition.
[8] Customer segments: Distinct group of people or organizations a business aims to reach and serve.

3.3 Value Capture - *Cost Structure and Revenue Streams*

3.3.1 Cost Structure

The *cost structure*[9] of our project is primarily driven by salaries, as they form the main portion of expenses. Technical costs, such as hosting on AWS, domain fees, and potential expenses for APIs or emission data, also need to be accounted for. Additionally, ongoing maintenance and updates of the calculator will represent part of the cost base.

3.3.2 Revenue Streams

Our *revenue streams*[10] will evolve gradually as the app develops. The app will initially be free for individual users, and we will offer an ad-free experience at launch to build trust and credibility. Environmentally focused partners, such as Innovasjon Norge, represent a potential source of donations or support for the project. In the future, a premium version of the calculator with advanced features could be introduced as an additional revenue stream.

4.0 Summary

Our project, GreenMile, addresses the serious issue of transport-related carbon emissions by developing an interactive CO_2 calculator app specifically designed for students in Bergen. Using reliable data from credible Norwegian and international sources, the app allows users to compare different transport options, such as buses, trains, ferries and electric scooters to understand their climate impact and make more sustainable travel choices. Our findings clearly show that air travel and private car use are the most carbon-intensive, while shared and electrified options like trains and electric buses can reduce emissions per traveler by up to two-thirds. Through its “what-if” planning and progress-tracking features, the app transforms these findings into practical tools, helping students see how even small changes in their travel behavior, such as switching from car to bus, can make a significant difference.

Supported by a strong business model, a partnership with HVL Bergen and potential sustainability organizations, GreenMile makes climate impact both visible and actionable. Our expected impact is to promote sustainable commuting habits among students in Bergen, encouraging lasting environmental awareness and contributing meaningfully to Norway’s goal of cutting emissions by 55% by 2030 and the UN’s global vision of net-zero by 2050. Our team, consisting of six business students from HVL Bergen and one student on exchange in Haugesund, collaborated closely on the research, methodology and app development, meeting weekly to ensure shared progress and offcourse our unified vision: Empowering users to measure their impact today and change tomorrow.

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[9] Cost structure: Defines all expenses incurred to operate the business model.
[10] Revenue streams: The channels through which a company generates cash from each customer segment.

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6.0 Appendix

Table of Figures: