Eco Tracker

Measure – Reduce - Contribute

Presented by group 3 HVL.

Høgskulen
på Vestlandet

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1 Introduction

Transportation stands at the crossroad between necessity an environmental impact, serving as a lifeline for global connectivity while also contributing significantly to climate change. In response to this critical issue, our team has developed the Eco Tracker app – a tool created to empower individuals to understand and mitigate their carbon footprint. In this paper, we present the motivation behind our undertaking as well as the business model driving Eco Tracker's development, our target audience, and an overview of our methodology.

Our business model revolves around an essential commitment to sustainability and environmental awareness. Unlike traditional profit-driven businesses, Eco Tracker operates on a principle of accessibility, offering users a free platform supported by strategic partnerships and advertisement revenue. By utilizing the power of modern technology and data analytics, we deliver a user-friendly interface that enables individuals to effortlessly calculate their carbon emissions, intended to create a sense of environmental responsibility and informed decision making.

At the backbone of our mission lies our target demographic: environmentally conscious individuals aged 18 to 30, particularly students. By collaborating with academic institutions, we aim to reach this demographic effectively, integrating Eco Tracker into their daily routines and educational experiences. By providing personalized insights into carbon emissions, we aspire to create a community of eco-conscious individuals committed to reducing their environmental footprint.

Our methodological approach is grounded in thorough research and data analysis. Gaining information from reliable sources such as SSB and The Future in Our Hands, we have developed comprehensive formulas to calculate accurate carbon emissions across different modes of transportation, including road vehicles, ferries, trains, and airplanes. Eco Tracker use precise methodologies to provide users with accurate insight into their environmental impact.

As we navigate through this paper, we invite you to dive deeper into the complexities of Eco Tracker's development, its impact in environmental awareness, and the collective efforts of our diverse team compromising programmers, economists, and researchers. Together, we embark on a journey towards a greener, more sustainable future – one where every individual has the power to effect positive change.

2 Organization of the team

Our team at HVL consists of nine students, each assigned a specific role within distinct areas of responsibility. These areas primarily include the paper, methodology, and the development of the application itself.

Within **the paper segment**, tasks are further divided into research, layout, and integration, ensuring that all relevant information and data from other task groups are appropriately represented. In the **coding segment** the responsibilities mainly consist of research, development, and testing. This is to make sure that the app provides the user with accurate data within a user-friendly interface. Our **methodology segment** has three focus areas. These are layout, mathematics and formulas, and lastly research. Their main area of responsibility is to supply the app group with mathematical formulas for calculating carbon emissions from different forms of transportation.

To ensure alignment towards our common goal, we hold regular meetings. Typically, we convene on Tuesdays before lectures and on Wednesdays after lectures, providing updates on our progress and setting goals for the upcoming week. These meetings are particularly valuable for our research team, facilitating coordination and information sharing. Additionally, we utilize Messenger for communication which is especially beneficial when physical meetings are not feasible. This has been

important for us as one of our group members is stationed in the Norwegian Armed Forces in Northern Norway for extended periods of time.

3 Emissions in the transport sector

Transportation is crucial for both people's daily routines and the global economy. However, it also has a significant impact on climate change. In 2022, transportation alone accounted for approximately 14 percent of global greenhouse gas emissions, emitting roughly eight billion metric tons of carbon dioxide that year, making transportation the second largest emitter worldwide.

The outbreak of COVID-19 in 2020 brought a reduction in global transportation CO_2 emissions. However, according to data from the Statista Research Department, there has been a nearly five percent increase in emissions since then, indication a rebound from the pandemic. Over the past three decades, transportation emissions have jumped by over 70 percent, now making up for over 20 percent of global CO_2 emissions.

Emissions have risen at a faster pace in developing regions compared to North America and Europe, driven by rising incomes and greater car ownership. China's emissions from this sector have more than tripled since 2000. However, the United States remains the largest carbon polluter in this sector. The largest amount of transportation-related emissions stem from road vehicles, accounting for 12 percent of total global greenhouse gas emissions in 2021. This makes road transportation the second largest emitter globally, trailing coal-fired power. Among road vehicles, passenger cars, are the primary source of emissions. Their emissions have averaged a one percent annual increase since 2010, surpassing 3.5 gigatons of CO_2 emissions (Statista Research Department, 2024).
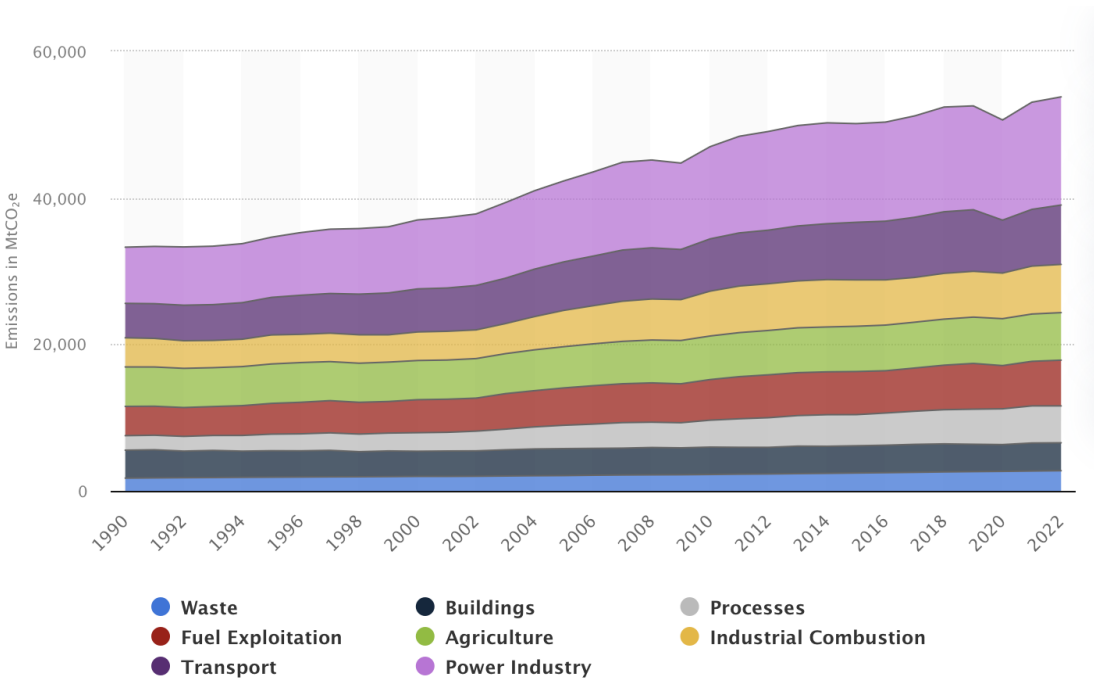

Figure 1: Annual greenhouse gas (GHG) emissions worldwide from 1990 to 2022, by sector (Statista research department, 2023).

4 Methodology

We need accurate data to incorporate into our carbon emissions formulas. To obtain precise figures for carbon emissions from different types of vehicles used globally, we have used two main sources, SSB and the future in our hands. We have additionally to these main sources of information compiled data from various sources to ensure accurate calculation of carbon emissions for our consumers. The two main sources SSB, Norway's primary authority for official statistics, and The Future in Our Hands, one of the country's largest environmental and solidarity organizations boasting over 45 000 members, provide valuable insights (SSB, ssb.no, n.d.) (Framtiden, framtiden.no, n.d.). These sources help us examine travel-related carbon emissions and present this information to our users, allowing them to track their emissions over time.

4.1 Calculations

We have developed a general formula to generate the exact carbon emissions of different vehicles. The formula is based on the emission factor which includes fossil fuel transportation. We also provide the consumers who use electric powered vehicles their carbon emissions. Therefore, we will include an extra factor to create a formula for electric vehicles. In both formulas, the number of passengers is included. Each passenger has their own emission factor that effects the general emissions for busses, trains, airplanes, and ferry's. People share these vehicles, which is an advantage for the carbon emissions. That's why we have included p=1 for the vehicles which is used for sharing purposes so we can calculate the carbon emissions for each passenger.

$$General: CO_2 = d * \frac{ef}{p}$$

- CO_2 = Carbon emissions
- d = Distance travelled
- ef = Emission factor gCO_2/km
- p = Passengers

$$Electric: CO_2 = d * 26 * \frac{ec}{p}$$

- CO_2 = Carbon emissions
- d = Distance travelled
- 26 = Carbon intensity gCO_2/kWh
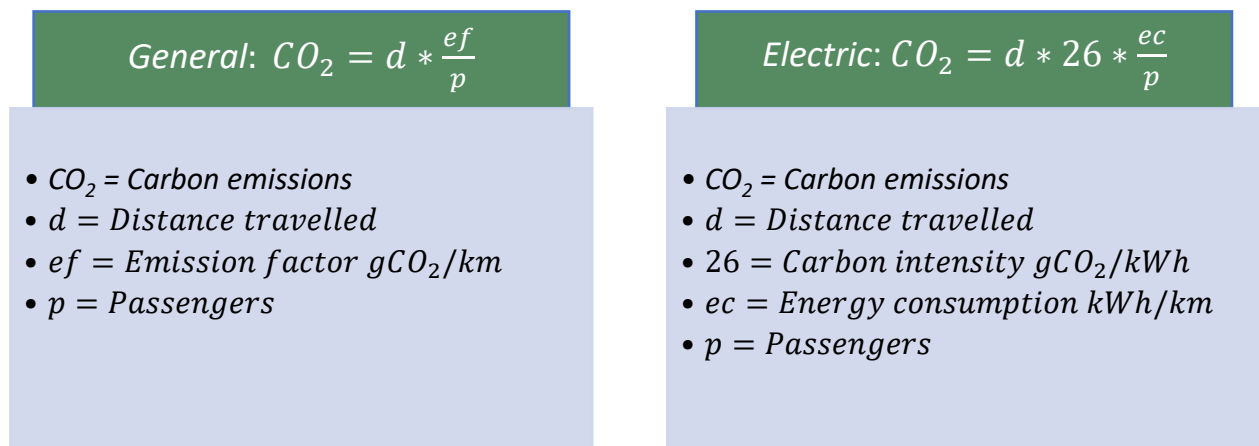- ec = Energy consumption kWh/km
- p = Passengers

Figure 2: General and electric formula to generate carbon emissions from different vehicles.

In the electric formula, we have used 26 as the carbon intensity in gCO_2/kWh. The carbon intensity can vary from place to place, even though it is constant for every transportation method. Our main area of focus are people between 18-30 based in one of Norway's biggest cities, Bergen. We have used the number 26 which is from the electricity map of Vestland county (electricitymaps, 2024). Carbon intensity measures how clean the electricity is over a certain area. It often refers to the grams of carbon dioxide which is released to produce electricity measured in kilowatt hour. The carbon intensity varies from place to place due to different ways of producing energy in different parts of the world (nationalgrid, 2022). Since it is easier to only include one formula, we can replace the emission factor that is mentioned over. That gives us a combined emission factor for electric powered vehicles.

4.1.1 Car

A car can pollute through various mechanisms depending on its propulsion method, whether it´s petrol, diesel, or electric power. As a result, there are numerous factors contributing to the emission profile of a vehicle. To accurately quantify these emissions, we have employed two distinct sources of data. For vehicles fueled by petrol and diesel, we have consulted the comprehensive data provided by the SSB (SSB, ssb.no, n.d.). To obtain information regarding electrically powered vehicles, we have utilized the Electric Vehicle Database, which has given us the necessary figures for precise calculations (EV-database, n.d.).

Petrol: $156{,}47 gCO_2/km$

Diesel: $130{,}09 gCO_2/km$

Electric vehicles:

Energy consumption: $0{,}188 kWh/km$

Emission factor: $26 gCO_2/kWh * 0{,}188 kWh/km = 4{,}89 gCO_2/km$

4.1.2 Ferry

In Norway, particularly in the vicinity of Bergen, numerous ferry routes traverse the fjords. Consequently, it's pertinent to examine the carbon footprint of these ferries. To assess emissions, we've relied on data provided by "The Future in our hands". This source conveniently incorporates passenger number into its calculations, ensuring consumers receive accurate information regarding their carbon emissions. Our calculations specifically focus on ferries powered by heavy fuel oil (Framtiden, framtiden.no, 2023).

Heavy fuel oil ferries: $226 gCO_2/km$

4.1.3 Train

Our primary demographic comprises individuals aged 18-30. A prevalent mode of transportation to and from Bergen is by train, which we have duly factored into our analysis. In Bergen, VY trains facilitate travel to some of Norway's most sought-after-destinations. According to their annual report, these trains operate using electric energy, thus we exclusively incorporate this option when quantifying carbon emissions attributable to train travel. Our formula computes emissions per person for each kilometer traveled (VY, 2023).

Train: $10 gCO_2/km$

4.1.4 Airplane

Airplanes represent one of the most common and time-efficient modes of transportation, even though they produce considerably higher pollution levels compared to other vehicles. The carbon emissions per person from air travel are a concern acknowledged by the global populace. In this regard, we also refer to "The Future in our hands" for insights into aircraft carbon emissions. Within our targeted demographic, economy class air travel holds the utmost relevance. According to data from "The Future in our hands", planes emit $133 gCO_2/km$ (Framtiden, framtiden.no, 2023).

4.1.5 Bus

Within our methodology for calculating carbon emissions from various transportation modes, buses stand out as an essential component of urban intercity transport. Our sources consider the average emission of $25 gCO_2/km$ per passenger per kilometer for diesel buses. Biodiesel buses emit significantly less, approximately $7 gCO_2/km$, highlighting the benefits of sustainable fuels (Framtiden, framtiden.no, 2023).

4.1.6 Motorcycle

Most motorcycles run on petrol, while there are other alternatives such as electrical bikes. Since the percentage of electrical bikes is only 0,871% of the total number of bikes in Norway, we only include fuel-based motorcycles in this methodology (Norsk Klimastiftelse, 2024). To calculate the carbon emissions coming from fuel-based motorcycles, we have used SSB for the information about the gCO_2/km (SSB, ssb.no, n.d.).

Fuel-based motorcycles: $85,2 gCO_2/km$

4.1.7 Walking and cycling

Virtually everyone engages in walking or cycles as part of their daily routine. These transportation modes do not generate any carbon emissions, and there's no need to calculate carbon emissions for these transportation methods. However, it remains important to take into account the distance traveled, which will be shown in our charts.

5 Business Model – BMC

In a world where climate change is becoming a pressing concern, it is important for businesses to act towards sustainability. Our business model is more than just a framework; it's a narrative of empowerment, community, and collective action towards sustainability. With an aim to increase environmental consciousness, we have formed a strong business model that not only outlines Eco Trackers functionalities, but also present an attractive narrative that speaks to our app's users desire for a better and greener future. Through this introduction, we invite you to dive into our Business Model Canvas, where the key elements of our vision truly come to life. Overall, our business model is well thought out with a clear focus on providing value to users, building strong partnerships, and optimizing costs while maintaining quality and innovation.

Business Model Canvas

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
Strong partnerships with academic institutions and transportation companies.	User-centric design and reliable data collection.	Unique value proposition focused on calculating personal CO2 emissions easily and accurately.	Trustpilot page for feedback and ratings.	Target audience primarily includes individuals aged between 18 and 30.
Leveraging expertise and data for app development.	Design with environmentally conscious elements.		Transparency and open communication values.	Specific focus on students due to collaboration with academic institutions.
Aspiring to collaborate with transportation companies for updated data.	Utilization of development tools and Amazon Web Services for deployment.	User-friendly interface for inputting data and receiving carbon footprint breakdown.	LinkedIn profiles for team member contact	Aim to attract individuals driven by a desire to reduce their carbon footprint.
	Key Resources		**Chanels**	
	Coordinated team efforts with assigned tasks.	Alignment with customers' environmental goals for differentiation.	Key partners include academic institutions for global promotion.	Goal to create a community of eco-conscious individuals committed to environmental sustainability.
	Coding software tools like Visual Studio and Python.		Utilization of traditional channels: stands and posters, and social media platforms for wider reach.	
	Collaborative approach for efficient app development.			

Cost Structure	Revenue Streams
Cost-based approach with focus on efficiency and accessibility.	Main income source from running advertisements.
Utilization of advertisements to provide the app for free.	Future partnerships with sustainable companies for monetization.
Balance between cost optimization and value creation without	Incentivizing student engagement through discounts for eco-friendly behavior.

Figure 3: Business Model Canvas BMC

Customer Segments

Our story begins with individuals driven by a desire to make a difference. Our target audience spans generations, united by a common goal: reducing their carbon footprint. These are first and foremost individuals aged between 18 and 30, with a particular focus on students due to our collaboration with academic institutions.

Our app offers a unique value proposition by providing users with personalized information about their CO_2 emissions. This empowers them to take informed decisions and actively participate in reducing their impact on the environment. By addressing to this demographic and offering solutions tailored to their needs, we aim to create a community of eco-conscious individuals committed to reducing their carbon footprint. This not only sets us apart, but also ensures that each component of our business model is distinct and engaging.

Value Propositions

At Eco Tracker, we don't just offer a service; we serve as a driver for change. Imagine the empowerment of knowing your personal carbon emissions, of seeing your actions translated into concrete environmental impact. With us, users gain not just data, but a sense of purpose – a roadmap towards a more sustainable lifestyle.

While customers normally exchange value by paying for problem-solving solutions, we aim to deliver a unique value that ensures their choice to use our app. We promise to provide customers with the ability to calculate their personal CO_2 emissions easily and accurately. By using Eco Tracker, users gain access to a user-friendly interface that allows them to input relevant data. The app then analyzes this information and provide them with breakdown of their carbon footprint. By offering this valuable functionality, we differentiate ourselves and align with the environmental goals of our customers.

Channels

Through strategic partnerships and a vibrant social presence, we seek to amplify our message far and wide. From university campuses decorated with posters, to the digital terrain of Instagram and TikTok. Together, we're creating a community where every share, like, and comment fuels the fire of environmental consciousness.

Leveraging the academic institutions, we plan to showcase our app through stands, posters, and sustainability events. In addition to these traditional avenues, we plan to utilize social media platforms such as Instagram, Facebook, and TikTok to further amplify our reach and engagement. Through a combination of academic partnerships and strategic social media presence, we are confident in effectively promoting our app to a diverse audience and maximizing its impact.

Customer Relationships

Trust is the cornerstone of our relationship with our users. With open communication channels and a commitment to transparency, we invite feedback and collaboration at every turn. To ensure that we constantly improve our app and meet the evolving needs of our users, we are establishing a Trustpilot page where users can rate our app and provide feedback, not just for us, but also for other users to see. Transparency and open communication are deeply ingrained in our values. Additionally, we have included LinkedIn profiles for each team member on the home page of our website, making it convenient for users to contact us, ask questions, and provide feedback. By creating a culture of trust and actively seeking user input, we are dedicated to delivering the best possible experience for our customers and continuously develop the value Eco Tracker provides.

Revenue Streams

The revenue streams section is a critical component of our business model, as it provides the necessary income to cover expenses and drive the future development of our app. While other apps

rely on methods such as a monthly subscription to generate revenue, we believe that sustainability should be accessible to all. Therefore, our main source of income will come from running advertisements. In the future, we plan to establish partnership with companies such as Skyss and other businesses committed to promoting sustainable services or products. These collaborations will give us an opportunity to monetize our app and guarantee its long-term sustainability.

The potential for generating income through running ads on our app increases as more users engage with our platform. Alongside our partnership with academic institutions, we aim to implement a system that motivates students to actively engage with our app and reduce their carbon emissions. Upon reaching specific targets, students will be eligible for discounts at the school cafeteria or the bookstore. This will not only encourage eco-friendly behavior but also directly benefit us, our users, and our key partners. It is important to note that while this functionality is not immediately available in our current app version, it underscores our commitment to delivering a unique value proposition and highlighting our vision for the future.

Key Resources

Our key resources lie around the coordination of our talented team, where each member is assigned specific tasks to integrate our methodology and develop our app effectively. Working together in a well-organized team is crucial for smoothly coordinating our efforts. In addition, our coding software serves as another essential resource, as we leverage tools such as Visual Studio and utilize Python as our primary programming language. With our collaborative approach and these resources, we can innovate and advance our app development efficiently, ensuring the successful realization of our vision.

Key Activities

The Key Activities of our business are centered around delivering a seamless and valuable experience to our customers. We prioritize two main aspects: user-centric design and reliable data collection.

In terms of design, we have created an app with excellent usability. With a focus on aesthetically pleasing design, we have employed darker colors and intuitive lines to ensure an engaging user experience. The background on the home page is deliberately chosen, this because the natural scenery serves as a gentle reminder of the impact that human activities have on the environment. The app´s design not only captures attention, but also guides users seamlessly through its features. To bring Eco Tracker to life, our dedicated team utilizes tools like VS Studio and Python coding. This enables us to develop a solid and functional application that effectively meets our user's needs. Furthermore, we leverage Amazon Web Services to deploy and host our app, ensuring widespread accessibility for our customers.

By strategically integrating user-centric design principles and employing cutting-edge development tools and technologies, our business model will consistently deliver an exceptional user experience while collecting reliable data. This approach not only position us for success but also underscores our commitment to driving positive environmental change through our innovative app.

Key Partners

Our business model relies on strong partnership with academic institutions like HVL and public transportation companies. We will collaborate with these partners to leverage their expertise and data in developing our app. Additionally, we study existing methodologies available on websites that focuses on transportations such as planes, cars, trains, and ferries to develop our app and ensure the accuracy of our calculations.

As our app becomes operational, we aspire to establish relationships with transportation companies that can provide us with more precise and updated data. Our commitment to collaboration and continues improvement sets us apart as a trusted resource for reducing carbon footprints.

Cost structures

Our business model is built on a cost-based approach, where the focus lies on efficiently and accessibility. By strategically using advertisement on our platform, we can provide our app for free, reducing costs and ensuring a large user base. Our cost-based model allows us to optimize expenses, enabling us to offer our app at the lowest possible price. This cost optimization ensures that we can use our resources effectively, maximizing the benefit our users receive from the service we provide.

One of the key strengths of our business model is the balance between cost optimalization and value creation. While our model is cost-based, we never compromise on quality, innovation, or customer experience.

6 Closure

As developers, we recognized the pressing need for greater environmental awareness and sustainability, particularly considering the significant contributions the transportation sector makes to carbon emissions. With this in mind, we embarked on creating the Eco Tracker app. Our goal was to provide individuals, especially the younger demographic, with a tool that not only calculates their personal carbon emissions but also educates and empowers them to make more sustainable choices.

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