

# GDSC Project

## Team 4 – CarbonTrack

### Problem Statement:

It's not a surprise there's been an abundance of wildfires and extreme weather conditions in the past few months. In 2020, Canada alone emitted 17.8 tonnes of CO<sub>2</sub> per capita. During this time of escalating environmental challenges, many individuals are unaware of the impact their lifestyles are having on the environment. This lack of awareness results in unsustainable habits and hinders progress towards a greener future. There is an urgent need for a user-friendly and engaging platform that empowers individuals from all backgrounds to **easily track, understand, and take actionable steps towards reducing their carbon footprints.**

### Proposed Solution:

Our proposed solution is CarbonTrack, a user-friendly mobile app that would help individuals track and reduce their carbon footprint. Using CarbonTrack, users would obtain a comprehensive view of their carbon footprint based on their lifestyles (their food, energy and transportation habits). Based on that, CarbonTrack would generate a personalised carbon reduction plan, and would suggest practical steps to reduce their carbon footprints.

Users would earn XP (experience points) and badges for achieving specific carbon reduction milestones, such as reducing their original automobile emissions by 5% or opting for local products more often. CarbonTrack would provide both individual and community-based eco-friendly challenges that would motivate users to adopt sustainable habits and engage with a community of like-minded individuals. As a tool conveniently available at their disposal, CarbonTrack aims to encourage eco-consciousness in individuals of diverse backgrounds as a means to contribute towards a greener future and fostering a sense of collective environmental responsibility.

# Technical Stack

## Languages:

- TypeScript: Used to create the app's interfaces and define its structure.
- Python: Employed for backend development with the Flask framework.

## Frameworks:

- React Native: A cross-platform framework for building apps on iOS and Android.
- Flask: Will be used for backend work (i.e. fetching updated map, etc.)
- PyTest: Will be used to write comprehensive test cases for our features

## Database:

- MongoDB: A NoSQL database for flexible, document-based data storage.
- Mongo Realm: Utilised to integrate MongoDB with the React Native app as a serverless backend. It will be used to store a copy of the database on the phone.

## Materials:

- Google Cloud Platform (\$300 in GCP trial credits): Hosting the Flask server on GCP
- Smartphones (Provided by group members): Utilised for testing the app on real devices.

## Toolkit:

- WebStorm and PyCharm: Cross-platform IDEs compatible with MacOS, Windows, and Linux, access to all 4 group members.

# Non-Technical Stack

## Jira

- Backlog: Plan everything from the start and define clear MVPs for the practical project scope.
- Sprint Planning: Schedule sprints in 1-week intervals to accommodate the short semester duration.
- Jira Retrospective: Utilise retrospectives at the end of each sprint to discuss improvements for future sprints and enhance team performance.

## GitHub

- Will be used for storing all code/files related to the project
- Branching: Employ branching strategies to manage feature development, bug fixes, and code experimentation.
- Code Review: Conduct thorough code reviews to maintain code quality and identify potential issues early on.
- Pull Requests: Utilise pull requests to facilitate code collaboration and ensure changes are properly reviewed before merging. Make sure everyone on the team understands what is happening.

## Discord

- Team Meetings: Utilise Discord for conducting team meetings, and fostering effective communication and coordination among team members.
- Sharing Secrets: Securely share sensitive information like database URLs, server login credentials, and environment variables using Discord's private channels and direct messages, ensuring confidentiality and restricted access to authorised team members.

## UI

- Figma: UI/UX mock-up design
- MaterialUI: Export Figma designs into MaterialUI, simplifying the design process.

# Features Breakdown

## *Core features*

- An intuitive and user-friendly interface
- User can log into their account
- The ability for users to input and keep track of their carbon emissions
- The ability to generate personalised carbon reduction plans for users, based on their transportation, food, and energy consumption habits
- The ability for users to earn badges and XP by achieving carbon reduction milestones/challenges
- The ability for users to participate in collective eco-friendly challenges and activities

## *Good to have*

- The ability for users to have access to a marketplace of carbon offset projects and earn carbon credits by donating
- Include miscellaneous factors like shopping behaviour when generating personalised plans
- Have optional notifications to remind users of their green initiatives
- Access to an environmental education hub, which will feature a rich repository of articles, videos, and resources about climate change

# Team Members Bio

## Yazan Armoush

Software Engineer

### [Resume link](#)

- PEY Software Intern @ Flexiti from May 2023 to August 2023. Worked with the digital engineering team on the web. iOS, an Android Project
- Languages: Typescript, Rust, C/C++, Java, Python, JavaScript, HTML/CSS, Swift
- Frameworks: React, Node.js, Flask, JUnit, PyTest, Material-UI, Actix, Spring, .NET
- Participated in various hackathons including UofTHacksX, HTN, DeerHacks. Member of GDSC and UTM Robotics

## Ishav Sohal

Software Engineer

### [Resume link](#)

- Languages: Python, Java, C, HTML/CSS, JavaScript, TypeScript, XML, SQL
- Technologies/Frameworks: React, PyTest, NumPy, Pandas, Django, BS4, Flask, FastAPI, scikit-learn, TensorFlow
- Participated in DeerHacks hackathon
- Projects:
  - FaceVote
  - PriceHawk
  - Zoomer

## Eileen Chen

Software Engineer

### [Resume link](#)

- Languages: Python, Java, Javascript, C, MIPS Assembly Language
- Frameworks: PyTest, JUnit, Django
- Projects:
  - Tetris game
  - Simon

## Jasmine Guruparan

Software Engineer

### [Resume link](#)

- Languages: Python, Java, Javascript, HTML/CSS, C, C++(Arduino)
- Frameworks/Technologies: React(Native,Expo), Node.js, PyTest, JUnit, Firebase(Firestore)
- Events Coordinator of MCSS
- Logistics Executive for UofTHacksXI
- Projects:
  - LazyCook'sDirectory (recipes search app)
  - Tetris

# Milestones and Timeline

## Month 1: Planning and Preparation (Week 1-4) (Sep)

- **Week 1-2: Requirements Gathering**

- ☒ Define project objectives and goals
- ☒ Assemble project team
- ☒ Conduct initial research and gather resources
- ☒ Create a detailed project plan
- ☒ Meet with team and GDSC stakeholders to gather project requirements
- ☒ Identify key deliverables and milestones
- ☐ Establish project management tools like Jira for tracking progress, tasks, and milestones.
- ☐ Brush up the basics of React Native
- ☐ Learn the basics of Flask
- ☐ Develop a project timeline and start distributing tasks for the first sprint

- **Week 3-4: Project Kickoff**

- ☐ Create project mock-ups, which involve designing how all our app's pages, forms, etc., will look and function within the application using Figma.
- ☐ Establish repositories for the app's source code and configure a CI/CD pipeline on GitHub to facilitate a seamless development workflow.
- ☐ Set up the necessary technical stack, including React Native and Flask.
- ☐ Choose a user-friendly theme for the app, including colours, button styles, etc., and add them to the React Native repository as constants.
- ☐ Start the development work on various project components.
  - ☐ Setting up database and granting access to project members
  - ☐ Design and implement landing, login, and signup page
  - ☐ Create a help page that includes detailed instructions and possibly instructional videos to assist users in understanding and using the application effectively.

## Month 2: Execution and Development (Week 5–8) (Oct)

### ☐ Week 5-6: Design and Development

- ☐ Complete any outstanding tasks from the previous sprint.
- ☐ Start or continue development work on various project components:
  - ☐ User's Dashboard Page:
    - ☐ Users have the ability to add, remove, and update their personal information, including but not limited to age, gender, name, and other relevant details.
    - ☐ Users can add, remove, and update their environmental usage metrics, allowing them to monitor and manage their carbon footprint effectively.
  - ☐ Settings Page:
    - ☐ Develop a settings page that encompasses privacy and accessibility settings, such as enabling/disabling analytics, adjusting fonts, enabling high contrast mode, and toggling bold text, toggling dark/light mode, among other relevant options.

### ☐ Week 7-8: Design and Development

- ☐ Complete any outstanding tasks from the previous sprint.
- ☐ Start or continue development work on various project components:
  - ☐ User's Behavioral Recommendation Page:
    - ☐ Users will receive personalised recommendations based on the habits they have recorded in their dashboard.
    - ☐ Users will have the option to accept a recommendation. If they choose to do so, it will automatically update their dashboard. A history of accepted recommendations will be maintained to generate XP (experience) points.
  - ☐ Leaderboard page:
    - ☐ Users will be able to add friends to their network.
    - ☐ On the leaderboard, users can view and compare their XP (experience) points with those of their friends.
    - ☐ Leaderboard rankings will show XP points earned per week, month, and year.
    - ☐ Users can earn badges by completing recommendations, such as the "User Accepted First Recommendation" badge, which will be displayed on their profile.

## Month 3: Testing and Documentation (Week 9–12) (Nov)

### ☐ Week 9-10: Final Testing, Quality Assurance, and Documentation

- ☐ Thoroughly address any remaining issues and bugs.
- ☐ Conduct comprehensive and systematic testing of all project components and functionalities.
- ☐ Utilise various testing techniques, including functional, integration, and regression testing.
- ☐ Identify and prioritise any remaining issues, bugs, or inconsistencies.
- ☐ Collaborate closely with the development team to resolve identified issues promptly.
- ☐ Repeatedly test and validate the fixes to ensure the highest quality standards are met.
- ☐ Create comprehensive user documentation and manuals for the application.

### ☐ Week 11-12: Final Testing, Quality Assurance, and Documentation

- ☐ Thoroughly address any remaining issues and bugs.
- ☐ Develop clear and user-friendly guides with visuals, where necessary, to enhance user understanding (Help Page).

## Month 4: Delivery and Presentation (Week 13–15) (Dec)

### ☐ Week 13: Delivery and Installation

- ☐ Wrap up any remaining documentation and administrative tasks
- ☐ Conduct a post-project review and lessons learned session
- ☐ Make any final adjustments or refinements based on feedback
- ☐ Prepare for project launch on play store and app store

### ☐ Week 14: Presentation and Review

- ☐ Prepare for a formal presentation to professor
- ☐ Review project accomplishments and challenges
- ☐ Gather feedback and address any concerns



# Research for Carbon Footprint Calculation

*Simple BTS of some of the research done.*

“Top 10 Ways to Reduce Your Carbon Footprint and Save Money.” *Top 10 Ways to Reduce Your Carbon Footprint and Save Money* | *AustinTexas.Gov*, 2017, [www.austintexas.gov/blog/top-10-ways-reduce-your-carbon-footprint-and-save-money](http://www.austintexas.gov/blog/top-10-ways-reduce-your-carbon-footprint-and-save-money).

Provided tips to make things cleaner

- Reusable water bottle
- biking/walking/public transportation/carpool as opposed to car
- Turn off lights
- Use those bulk plugs
- Wash in cold in bulk
- Local produce
- 4 Rs (reduce reuse recycle repurpose)

Shabir, Irtiq, et al. “Carbon footprints evaluation for Sustainable Food Processing System Development: A comprehensive review.” *Future Foods*, vol. 7, 2023, p. 100215, <https://doi.org/10.1016/j.fufo.2023.100215>.

Research from a 2012 paper showed that substitution meat and dairy products with alternate food groups led to 19% reduction in GHG emissions. Furthermore, in 2021 it was reported 26% of the anthropogenic GHG emissions roots from the food supply chain. Also, fridges contribute a lot to the emissions due to their large amounts of energy consumption.

Hence, we should definitely consider food as data to collect from user (with consent of course!).

Harvey, Fiona. “Global Greenhouse Gas Emissions at All-Time High, Study Finds.” *The Guardian*, Guardian News and Media, 8 June 2023,

[www.theguardian.com/environment/2023/jun/08/global-greenhouse-gas-emissions-at-all-time-high-study-finds](https://www.theguardian.com/environment/2023/jun/08/global-greenhouse-gas-emissions-at-all-time-high-study-finds).

- “Only about 250bn tonnes of carbon dioxide can now be emitted, to avoid the accumulation of CO<sub>2</sub> in the atmosphere that would raise temperatures by 1.5C. That is down from 500bn tonnes just a few years ago, and at current annual rates of greenhouse gas emissions, of about 54bn tonnes a year over the past decade, it would run out well before the end of this decade.” (Harvey, 2023)

The paper goes over the progress (or depression) of the Earth’s health and how we’re handling the global warming *crisis*. Especially with this blurb from the text, it emphasises the importance of taking action, even if it's small. It's easy to feel helpless and think “if the big industries won’t change, why should I?” but there *are* things we can do as civilians. We don’t have a lot of time left (some articles say we’re beyond the point of redemption).

Government of Canada, Canada Energy Regulator. “Canada Energy Regulator / Régie de l’énergie Du Canada.” *CER*, Canada Energy Regulator / Régie de l’énergie du Canada, 24 Aug. 2023, [www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-ontario.html](https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-ontario.html).

Canadian government’s information on energy consumption (and can specify by region like Ontario).

“Canadians Are among the World’s Worst Carbon Emitters. Here’s What We Can Do about It | CBC News.” *CBCnews*, CBC/Radio Canada, 11 Oct. 2021, [www.cbc.ca/news/science/how-canadians-can-cut-carbon-footprints-1.6202194](https://www.cbc.ca/news/science/how-canadians-can-cut-carbon-footprints-1.6202194).

- “A study published by a Berlin think-tank says Canadians must cut their carbon footprints by 95 percent to help the world limit global warming to the 1.5 C goal set by the 2015 Paris Agreement. “
- “The average person in Canada produces an equivalent of 14.2 tonnes of CO<sub>2</sub> as of 2019, according to the findings. By comparison, the average per-capita footprint in Finland is 9.7 tonnes and in the United Kingdom it's 8.5 tonnes.”

When I was researching news or papers on correlation between carbon footprint and the climate crisis. This CBC article reports the 2015 Agreement stating the extreme carbon footprint goals (as detailed above) need to make progress on our Earth's health.

Canada, Environment and Climate Change. "Government of Canada."  
*Canada.ca*, / Gouvernement du Canada, 31 Aug. 2023,  
[www.canada.ca/en/environment-climate-change/services/environmental-indicators/global-greenhouse-gas-emissions.html](https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/global-greenhouse-gas-emissions.html).

Information on carbon emission statistics from the Canadian government. It details that the "17.8 emission 2020 GHG per capita (tonnes of CO<sub>2</sub>) for Canadian ". Which is 3 times higher than the global rate. This statistics alone is enough to prove a solution is urgently needed to tackle our high carbon footprint.

University of Michigan, Center for Sustainable Systems. "Carbon Footprint Factsheet."  
*Center for Sustainable Systems*, 2022,  
[css.umich.edu/publications/factsheets/sustainability-indicators/carbon-footprint-factsheet](https://css.umich.edu/publications/factsheets/sustainability-indicators/carbon-footprint-factsheet).

Below we jot-noted some primary factors into considering the calculations for a carbon footprint.

We will have our primary focus on the first three factors as they contribute more to one's footprint and there are more options for improvements in comparison to the other two. (For example, someone may be purchasing clothes that are cheap or not sustainable because of things out of their control (their financial situation).

- Factors of carbon emission
  - Food
    - What is it (meat bases? Vegan? etc.)
    - Where it's coming from (local or imported?)
  - Transportation
    - What do they use (hybrid? Gas-only? A truck? Public(subway or bus?)? etc.)
    - How many? (if they own transportation means)
    - Are you travelling?

- Energy consumption
  - Where are you living? House? Condo? Basement?
  - What are your bills looking like?
- <https://www.nature.org/en-us/get-involved/how-to-help/carbon-footprint-calculator/>
  - Spending habits (often are you buying things and from where --for example cheap quality are not sustainable for the environment as they are to your closet)
  - Services

We were considering different methods of implementation so we were searching for ML sources, APIs relating to carbon footprints, etc.

<https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/calculator/refs.cfm>

- Canada's Carbon Footprint Calculator

<https://towardsdatascience.com/how-to-mesure-the-carbon-footprint-using-vertex-ai-pipelines-3d6bc9695e7b>

- Python carbon footprint

<https://docs.carboninterface.com/#/>

- Carbon related API for energy/transportation

<https://open-meteo.com/en/docs/climate-api>

- Climate API

<https://github.com/KKulma/climate-change-data>

- Github of climate APIs/datasets