International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 12 | Dec - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

CARBONLY

Guide: Dr. V Siva Nagaraju, Professor, ECE & IARE

Vedanshu HS, Vasundara D

Vedanshu HS ECE & IARE
Vasundara D ECE & IARE

---***---

Abstract - This project focuses on the development and implementation of a Carbon Footprint App designed to empower individuals and organizations to track and reduce their carbon emissions. By providing real-time tracking, personalized recommendations, and engaging features such as gamification and community challenges, the app aims to foster sustainable practices and raise awareness about the environmental impact of everyday activities. The methodology involves collecting user data on energy use, transportation, food consumption, and waste management, converting this data into carbon dioxide equivalents, and offering actionable advice to lower emissions. The app is applicable across various sectors, including personal use, corporate sustainability, policy support, education, supply chain management, urban planning, and environmental certification. The results demonstrate that informed individual actions, such as skipping a weekly cup of coffee or reducing chocolate consumption, can collectively lead to significant reductions in carbon emissions. This project underscores the importance of individual responsibility in combating climate change and promotes a community-driven approach to achieving a more sustainable future.

Key Words: Carbon Footprint, Real-time Tracking, Gamification, Personalized Recommendations, Sustainability

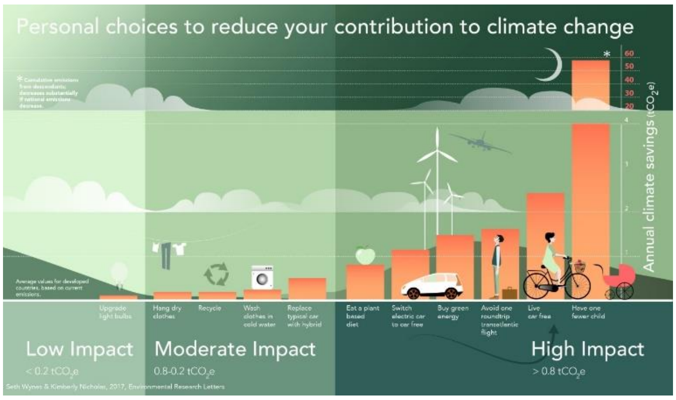
1.INTRODUCTION

The Carbon Footprint App project aims to empower individuals and organizations to track and reduce their carbon emissions. By providing real-time tracking, personalized recommendations, and engaging features such as gamification and community challenges, the app fosters sustainable practices and raises awareness about the environmental impact of everyday activities. This report details the architecture, process, advantages, applications, and anticipated changes brought by the project.

2. Body of Paper

Project Architecture System Components

1. User Interface (UI): Mobile app and web interface for user interaction.
2. Data Collection Module: Collects data on user activities such as energy use, transportation, food consumption, and waste management.
3. Carbon Calculator Engine: Converts collected data into carbon dioxide equivalents using established formulas and databases.
4. Recommendation Engine: Provides personalized tips and suggestions to reduce carbon emissions.
5. Real-Time Tracking Module: Integrates with smart devices and sensors to provide immediate feedback on carbon emissions.
6. Gamification and Community Features: Includes challenges, rewards, and social sharing to engage users.
7. Educational Content Module: Offers interactive materials to educate users on the impact of their activities.
8. Analytics and Reporting Module: Provides detailed visualizations and feedback on user progress.



DETAILED PROCESS

1.User Inputs

- Data Entry: Users manually input data about their daily activities, such as: Energy consumption (e.g., electricity, gas usage)

Transportation methods and distances (e.g., car, bike, public transit)

Food consumption (e.g., meat, dairy, plant-based foods)

Waste production (e.g., recycling, composting, general waste)

- Integrations: Optionally, users can connect the app to other devices or apps (e.g., fitness trackers, smart home devices) to automate data entry.

2. Data Collection

- Activity Logging: The app continuously logs user activities and stores the data in a secure database.
- Smart Device Integration: Integrates with smart meters, fitness trackers, and GPS for accurate data collection.
- APIs and External Data: Fetches additional data from external sources (e.g., weather conditions, public transportation schedules) to enhance accuracy.

3. Carbon Calculator

- Emission Factors: Utilizes emission factors from verified databases to convert user activities into carbon dioxide equivalents (CO2e).

For example, converting electricity usage into CO2e based on the user's location and the energy mix (coal, natural gas, renewables).

- Calculation Algorithms: Employs algorithms to calculate the carbon footprint of each activity, considering variables such as distance traveled, type of vehicle, and dietary choices.
- Data Normalization: Normalizes data to ensure consistency and accuracy in calculations.

4. Recommendation Engine

- Personalized Tips: Provides tailored suggestions for reducing carbon emissions based on the user's activity data. For instance, suggesting the use of public transportation instead of driving, or recommending energy-efficient appliances.
- Behavioral Insights: Analyzes user habits and trends to offer practical and achievable recommendations.
- Goal Setting: Allows users to set carbon reduction goals and track their progress over time.

5. Real-Time Tracking

- Instant Feedback: Uses data from smart devices and sensors to provide immediate feedback on activities. For example, alerting users when they reach a high level of energy consumption or providing real-time updates on their carbon footprint while traveling.
- Live Updates: Displays real-time updates and visualizations of the user's carbon footprint.

6. Gamification and Community Features

- Challenges and Rewards: Engages users with challenges and rewards for meeting carbon reduction goals. Examples include earning points for reducing energy use or completing sustainability challenges.
- Community Engagement: Enables users to share their progress and achievements with a community of like-minded individuals. Users can join groups, participate in community challenges, and share tips and successes.
- Leaderboards and Badges: Features leaderboards and badges to motivate users through friendly competition.

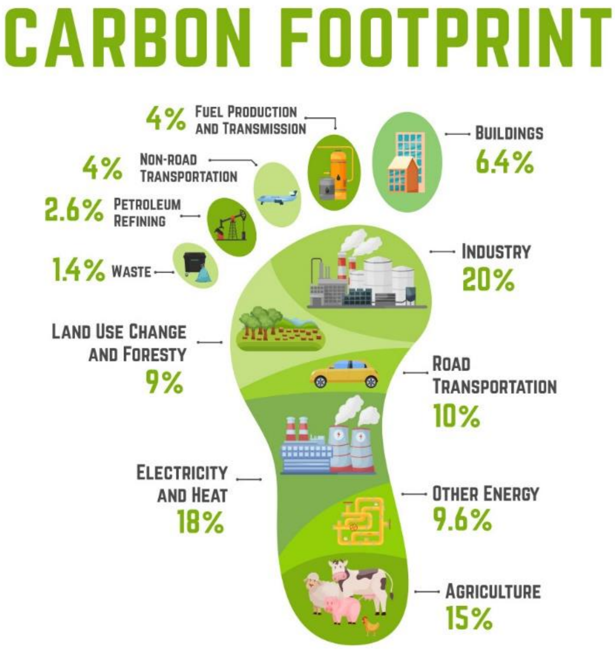
7. Educational Content

- Interactive Materials: Provides interactive content, such as quizzes, articles, and videos, to educate users on the impact of their activities. Topics may include the benefits of renewable energy, the impact of diet on carbon footprint, and tips for sustainable living.
- Simulations and Scenarios: Offers simulations that allow users to see the potential impact of different lifestyle changes. For example, a simulation showing the carbon savings of switching to a plant-based diet for a month.

8. Analytics and Reporting

- Data Visualization: Provides detailed visualizations of the user's carbon footprint, including graphs, charts, and timelines. Users can see their carbon footprint over different time periods (daily, weekly, monthly) and by category (energy, transportation, food, waste).
- Progress Tracking: Tracks user progress towards carbon reduction goals and provides insights into trends and patterns.

- Comparative Analysis: Allows users to compare their carbon footprint with others (e.g., average users, community members) and with global averages.
- Exportable Reports: Generates reports



FACTS

A single Google search generates about 0.2 grams of CO2? While this might seem negligible, with billions of searches happening daily, it adds up to a substantial amount.

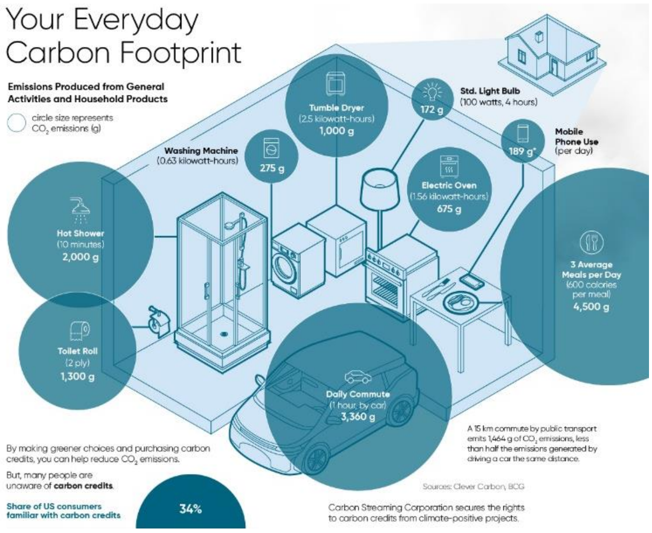
Chocolate production has a significant carbon footprint, largely due to deforestation and agricultural practices. For instance, producing one kilogram of chocolate generates approximately 19 kilograms of CO2 equivalents.

A single cup of coffee has a carbon footprint of about 0.25 kilograms of CO2 equivalents.

Sending emails contributes to carbon emissions. A typical email generates about 4 grams of CO2 equivalents, while emails with large attachments can generate up to 50 grams. Globally, email usage is estimated to produce as much CO2 as several million cars on the road.

A residential solar panel system can offset about 3-4 tons of CO2 per year, depending on the size and location of the system.

Switching to LED lighting is an easy way to reduce your carbon footprint. LEDs use about 75% less energy and last 25 times longer than incandescent bulbs, significantly cutting down on energy consumption and emissions.



STEPS

1. Data Collection: Implement methods for users to input data and integrate with smart devices.
2. Carbon Calculation: Develop algorithms to convert user data into CO2 equivalents.
3. User Interface: Design and develop an intuitive and engaging UI for mobile and web platforms.
4. Recommendation System: Build a system to provide personalized, actionable tips.
5. Real-Time Integration: Incorporate real-time tracking with smart devices and sensors.
6. Gamification: Add features for challenges, rewards, and community engagement.
7. Educational Content: Develop and integrate interactive educational materials.
8. Analytics: Create tools for detailed analytics and user feedback.
9. Testing and Iteration: Test the app with users and iterate based on feedback.

ADVANTAGES

1. Environmental Awareness: Raises awareness about individual contributions to climate change.
2. Sustainability: Promotes sustainable practices and reduces overall environmental impact.

3. Cost Savings: Identifies opportunities to reduce energy consumption and operational costs.
4. Compliance: Helps businesses comply with environmental regulations.
5. Reputation: Enhances corporate social responsibility (CSR) and brand reputation.
6. Innovation: Drives innovation in technology and processes to reduce carbon emissions.
7. Risk Management: Identifies and mitigates risks associated with climate change impacts.
8. Health Benefits: Improves air quality and public health by reducing emissions from polluting activities.

APPLICATIONS

1. Personal Sustainability: Individuals use the app to track and reduce their own carbon emissions.
2. Corporate Responsibility: Companies utilize the app for managing and improving their sustainability initiatives.
3. Policy Support: Governments rely on data from the app to inform environmental policies and regulations.
4. Education and Awareness: Educational institutions and environmental organizations use the app to raise awareness about climate change and sustainable living.
5. Supply Chain Management: Businesses integrate the app into supply chain operations to monitor and minimize carbon emissions across their operations.
6. Urban Planning: City planners utilize the app to design and develop sustainable urban infrastructure and transportation systems.
7. Certification and Compliance: Organizations seek certification and comply with environmental standards by implementing carbon footprint reduction strategies facilitated by the app.

CHANGES IT WILL BRING / FUTURE SCOPE

1. Enhanced Environmental Awareness: Users become more conscious of their carbon emissions and environmental impact.
2. Behavioral Change: Encourages users to adopt more sustainable habits and reduce their carbon footprint.
3. Community Engagement: Fosters a sense of community and collective action towards sustainability goals.
4. Informed Decision-Making: Provides users with data-driven insights to make informed decisions about their lifestyle and consumption patterns.
5. Policy Impact: Supports policy makers with data to create effective environmental regulations and initiatives.
6. Corporate Accountability: Increases corporate transparency and accountability in environmental impact reporting.

Looking ahead, the future scope of the Carbon Footprint App project includes expanding its capabilities through advanced AI and machine learning for personalized recommendations, specialized versions for corporate and institutional use. Integrating blockchain technology for data transparency, expanding data sources for real-time monitoring, and enhancing gamification and community engagement are also priorities. Collaborative partnerships with various organizations.

Table -1: Global metrics

Household Activities & Products	CO2 Emissions (g)
Standard Light Bulb (100 watts, four hours)	172 g
Mobile Phone Use (195 minutes per day)*	189 g
Washing Machine (0.63 kWh)	275 g
Electric Oven (1.56 kWh)	675 g
Tumble Dryer (2.5 kWh)	1,000 g
Toilet Roll (2 ply)	1,300 g
Hot Shower (10 mins)	2,000 g
Daily Commute (one hour, by car)	3,360 g
Average Daily Food Consumption (three meals of 600 calories)	4,500 g

*Phone use based on yearly use of 69kg per the source, Reboxed

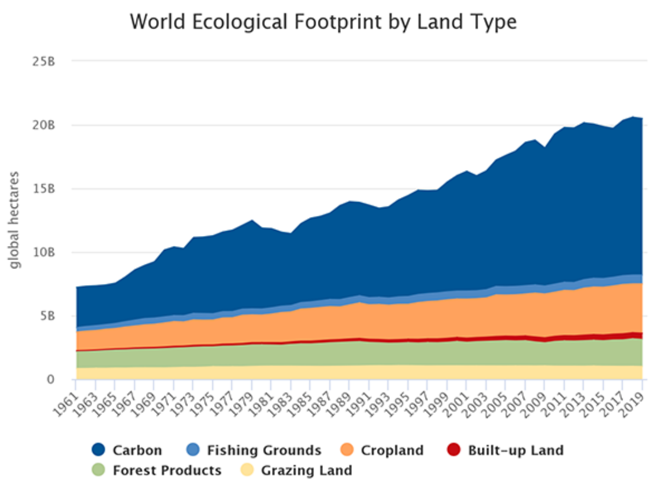
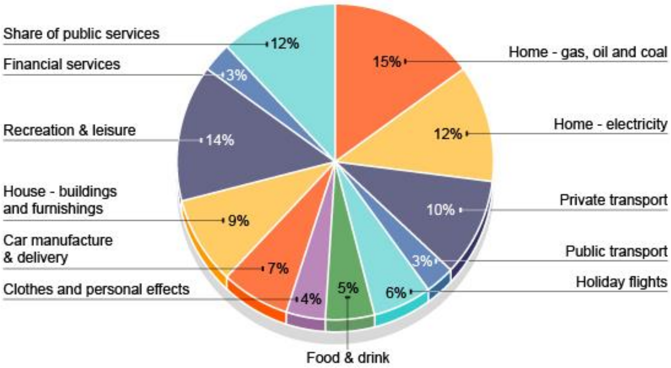


Fig -1: Figure

Charts



3. CONCLUSIONS

Understanding and managing your carbon footprint is crucial because even small changes in daily habits can collectively make a substantial impact on reducing carbon emissions. For instance, skipping one cup of coffee a week or reducing chocolate consumption can significantly lower your personal carbon footprint. Similarly, activities like online searches also contribute to carbon emissions, underscoring the importance of mindful consumption. This project highlights how individual choices can cumulatively contribute to environmental sustainability. Tracking and reducing carbon footprints not only benefit the environment by curbing greenhouse gas emissions but also promote responsible consumption and awareness of our ecological impact.

ACKNOWLEDGEMENT

This research and the development of Carbonly would not have been possible without the invaluable contributions of numerous individuals and organizations. We extend our deepest gratitude to our team members who tirelessly worked on data collection, application development, and user interface design. Special thanks to the research community whose prior work inspired and guided our approach, particularly in gamification, eco-feedback mechanisms, and sustainability practices. We also acknowledge the support of our beta testers and survey participants who provided critical insights during the testing phase. Finally, we are grateful for the encouragement and constructive feedback from our academic advisors and collaborators, whose expertise has been instrumental in shaping this project. This endeavor is dedicated to all those striving to make sustainability an achievable goal for everyone.

REFERENCES

For detailed information on the research, methodologies, and data used in this project, consider exploring the following sources:

1. Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. Journal of Environmental Psychology, 29(3), 309-317. (Focus on behavioral frameworks relevant to Carbonly.)
2. Gifford, R. (2011). The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation. American Psychologist, 66(4), 290-302. (Discusses barriers to sustainable behavior adoption.)
3. Whitmarsh, L., & O'Neill, S. (2010). Green identity, green living? The role of pro-environmental self-identity in determining consistency across diverse pro-environmental behaviours. *Journal of Environmental Psychology*, 30(3), 305-314. *(Explores self-identity in environmental action.)*
4. Hoolohan, C., McLachlan, C., & Larkin, A. (2018). 'Aha' moments in the water-energy-food nexus: A new morphological scenario method to accelerate sustainable transformation. *Technological Forecasting and Social Change*, 128, 19-30. *(Provides insights into sustainable transformation methods.)*
5. Milne, G. R., & Gray, R. (2013). Waking up to the sustainability opportunity. *MIT Sloan Management Review*, 54(4), 33-38. *(Focus on sustainability strategies.)*
6. Owens, S., & Driffill, L. (2008). How to change attitudes and behaviours in the context of energy. *Energy Policy*, 36(12), 4412-4418. *(Discusses energy behavior change techniques.)*
7. Thøgersen, J. (2009). Promoting public transport as a subscription service: Effects of a free month travel card. *Transport Policy*, 16(6), 335-343. *(Relevant to public transport and behavioral change.)*
8. Moura, P., Smith, M. J., & Henriques, C. O. (2015). Energy efficiency policies for transport in the European Union: A review. *Energy Policy*, 88, 345-361. *(Explores policies aligning with Carbonly's focus areas.)*

9. Ercin, A. E., & Hoekstra, A. Y. (2012). Water footprint scenarios for 2050: A global analysis. *Environment International*, 64, 71-82. *(Highlights the integration of water footprint metrics into sustainability tools.)*
10. Gössling, S., & Hall, C. M. (2019). Sustainable tourism: A global perspective. *Journal of Sustainable Tourism*, 27(7), 901-919. *(Explores gamification and its impact on behavior change in tourism, applicable to Carbonly's approach.)*
11. Kolk, A., & Pinkse, J. (2005). Business responses to climate change: Identifying emergent strategies. *California Management Review*, 47(3), 6-20. *(Covers corporate sustainability strategies aligning with app features.)*
12. Büchs, M., & Schnepf, S. V. (2013). Who emits most? Associations between socio-economic factors and UK households' home energy, transport, and overall carbon footprints. *Ecological Economics*, 90, 114-123. *(Analyzes socioeconomic drivers of emissions and behavior.)*
13. Geels, F. W. (2014). Regime resistance against low-carbon transitions: Introducing politics and power into the multi-level perspective. *Theory, Culture & Society*, 31(5), 21-40. *(Focuses on systemic barriers to sustainability, complementing Carbonly's user-centric model.)*
14. Hertwich, E. G., & Peters, G. P. (2009). Carbon footprint of nations: A global, trade-linked analysis. *Environmental Science & Technology*, 43(16), 6414-6420. *(Examines the global carbon accounting framework relevant to Carbonly's design.)*
15. Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211. *(A foundational theory on behavior change, underpinning user adoption models for sustainability apps.)*
16. Sovacool, B. K., & Brown, M. A. (2010). Twelve metropolitan carbon footprints: A preliminary comparative global assessment. *Energy Policy*, 38(9), 4856-4869. *(Compares carbon footprints across urban centers, offering insights relevant to localized app features.)*
17. Hickel, J., & Kallis, G. (2020). Is green growth possible? *New Political Economy*, 25(4), 469-486. *(Explores the feasibility of sustainable economic models and their alignment with behavioral tools like Carbonly.)*