Composting Education Program Composting Calculator – Iteration 2

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In collaboration with:

University of California Cooperative Extension Composting Education Program

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- Abstract (100-250 word summary of the report, single page - unnumbered)
  - An abstract is a concise summary of your project; it includes:
    - the objective/purpose (what you were trying to do)
    - the procedure/methods (how you went about it)
    - the results (what you found out)
    - the conclusion(s)/recommendation(s) (what it means)
  - The use of symbols, tables, graphics, references, etc. should be avoided
  - Usually written last as it summarizes the entire report

Our Composting Calculator, in collaboration with the UCCE Composting Education Program aims above all to promote composting within the Santa Clara community. We undertook this project with the objective of enhancing the functionality and contextualization of the former team's calculator, providing both meaningful visual and numerical context for composting contributions and inspiring users to engage in composting activities. By leveraging conversion formulas from the EPA, our tool successfully converts composting data into CO2 emissions and offers users a more complete understanding of their environmental impact. To address issues of user navigation and data reliability, a "How to Track Accurately" was created to guide users in accurately reporting their composting habits and better comprehend the direct correlation of these habits with climate change. Recommendations for future enhancements primarily include optimiming data management and privacy measures, as well as enhancing user engagement through additional interactie features. Ultimately, our goal is to empower individuals who visit the site to make informed, meaingful decisions about composting and environmental conservation efforts.

Deleted: In this paper we will discuss the initial design process, the implementation process, and our results for our product. In partnership with the University of California Cooperative Extension (UCCE) Composting Education Program, we move improvements to last year's implementation of a composting calculator hosted on the UCCE's website. Using JavaScript, HTML, and CSS, our objective was to provide meaningful representations on the calculator page and add an additional How to Track Accurately page. For the calculator page, this included creating pop-up windows, a more interesting visual lay out, descriptions that give context to all the calculations, and incorporating live data display on the site. Of this we were able to accomplish all the objectives except the live data due to incompatibility of their data and time restraints. _____SPACE FOR HOW TO TRACK ACCURATELY_____. ¶

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1. Introduction

1.1 Background and Motivation

Our project for our community-based engineering design project is in collaboration with the University of California Cooperative Extension (UCCE) Composting Education Program (CEP) with the intent of encouraging as many residents as possible to compost within the Santa Clara County region, as well as attend the CEP's free community workshops for compost-education. With climate change on the rise, composting education is more important than ever, and the UCCE seeks a means to encourage Santa Clara residents and any visitors to their website to become active composters.

1.2 Literature Review

While there exist many online tools to assess the carbon dioxide savings of various activities, there is a noticeable lack of less easily accessibly online resources dedicated to contextualizing the impact of composting in the reduction of greenhouse gases and climate change. Using conversion formulas sourced from the EPA carbon calculator (Sources of Greenhouse Gas Emissions | US EPA, 2023). In contrast to the EPA carbon calculator, which lacks conversions for food waste or yard waste into carbon dioxide savings, our calculator tool provides users with the means to convert their composting data into CO2 emissions. Compared to the EPA carbon calculator, where there no option for conversion from food waste or yard waste to carbon dioxide savings is given, our tool provides users a way to convert their composting data into CO2 emissions and other conversions such as miles driven or number of phones charged.

1.3 Project Objectives

Our primary objective is to provide users with an understanding of the benefits of composting to their community. We aim to enhance the functionality of the calculator by providing meaningful numerical and visual context for the conversions and inspire users to potentially expand their compost education with the UCCE. Currently, while the calculator offers functionality in converting inputted composting amounts into potential carbon dioxide saved and providing percentiles for average compost saved throughout Santa Clara County, it lacks accurate user input effective user engagement with meaningful visual representation or explanations for conversions (calculations like "tree seedlings grown in 10 years" hold little weight with users). Additionally, we plan to create a "How to Track Accurately" page in response to UCCE concerns about data accuracy, serving to guide users in accurately reporting their composting

habits. By improving user comprehension and data accuracy, this calculator strives to enrich the impact assessment of composting workshops conducted by the UCCE.

UCCE Composting Education Program requires a “How to Track Accurately Page” to enable users can report their composting data more accurately in their surveys. This enhancement will allow program managers to assess the impact of their workshops and derive insights for improvement. By providing clear, descriptive explanations for each conversion and offering statistics on collected data in comparison with their community, we aim to encourage composters to increase their composting.

Our project thus involves the creation of two pages: one which builds upon the previous UCCE group calculator and incorporates visuals and other aids, as well as a “How to Track Accurately” page which, along with instructing users on how to accurately report their composting data, aims to underline the environmental context of their contributions.

Over a ten-week period, our collaboration with the UCCE will focus upon finding ways to ensure reliable data sourced from Qualtrics, correctly calculate averages, medians, and means of individual composting contributions throughout Santa Clara County and implementing meaningful visual representation for individual composting contributions. Despite encountering several challenges in access to data and a limited team size of four, we recognize the scope of our project and have opted to leverage the existing website from the previous quarter and iterate on it. Additionally, we have encountered minor security issues concerning the former team’s use of Google’s API and the API keys which pull live data from Google Sheets, prompting us to develop workaround solutions allowing us to use essential data and prevent potential breaches. Our definition of success includes the seamless integration of our tool into the UCCE platform, providing real-time data accessibility – a task the previous group required assistance to accomplish. We aim to enhance user comprehension by integrating helpful visuals into both web pages, ultimately facilitating a clearer understanding of the displayed data.

1.4 Critical Customer

Our critical customers include site users, primarily Santa Clara Valley residents, and anyone interested in the UCCE, such as CEP workshop attendees. According to the essential goal of our project, one of the significant potential benefits is reducing landfill waste and educating residents about composting knowledge through our website. From the calculator on our website, the user can learn the specific details related to the amount of their composition. Suppose the users and

residents are encouraged to use our website and follow their composition routine. In that case, it will benefit the communities and individuals economically by reducing management costs on composting waste. Nonetheless, this project aims for long-term results to help the environment and younger generations by integrating environmental protection responsibilities into their daily lives.

1.5 Report Roadmap

The first part of the report details the project from the fall of 2023. As it was their data collection tool which our current project with the UCCE is built upon, the design strategies utilized by the front-end and back-end teams from last year are discussed in depth, as well as an analysis of both teams' successes and challenges. The report establishes our revised primary project goals and civic considerations for 2024, focusing on meaningful visual representation, user navigation, and community impact. The report then summarizes the research and discussion after establishing our project plan with the UCCE. A results and analysis section contains more technical details of the revised website and the completed final product. Towards the end of the report, we reflect on the project in the conclusion section. We also include an appendix section with additional information, including details for future teams updating the project.

- Discussion (follow the design process as applicable)
    - Should discuss the project specifications in context of alternative solutions, final design decisions, etc.
        - Review of existing solutions or partial solutions and key differentiator(s) for your solution (cite!)
            - Novel approaches/solutions to problems – compare to other important findings or literature/research
        - Initial analysis or testing which modified design during design process

2.1 Project Specifications

Initially we wanted to design a website that had a lot of interactive elements such a moving car, and customized animations whose quantity changed as different values were inputted into the calculator. We got this inspiration from the footprint calculator (cite here). Unfortunately, due to time restraints and our sparse experience with front end programming, we understood that these types of visual representations were not realistic. We also wanted to incorporate a type of map that showcased different communities' composting efforts. The idea was to use google maps API and be able to display the different statistics per each area within Santa Clara County. The reason

we passed on this idea was due to our unfamiliarity with CEP's dataset. To represent different places within the Santa Clara County, we would need a decent amount of data per each region, and it was apparent that there was not enough data from each region that make this possible. Similarly to the custom animations, we also understood that this would take a significant amount of time to figure out, due to the complexities of API, and we wanted to prioritize the main aspects of the site that needed improvement than adding an interesting, but ultimately unimportant tool to the calculator.

Finally, when we spoke to our company representative Victoria, it was clear that the biggest contribution she wanted to add to the cite was more context to calculator. To both ours and Victoria's impression of the website, the site was lackluster. The computations provided calculations but with no context, which made the calculator itself uninspiring. Our objective was for people to be visually stimulated by the website and want to click around or continue looking around the page to learn and find out new information. Thus, we decided that on the calculator page, we were going to incorporative better visual representation of the data as well as providing context so the calculator provides more use than only converting carbon dioxide to miles driven or gallons of gas consumed. When people click onto the site, they will be informed on the process of how composting affects CO_2 emissions and what this means in their day to day lives.

In addition to updating and creating new visuals for the calculator, our team planned to create a second website called How to Track Accurately. During the first mock-ups of the website the plan was to create an infographic looking site that would provide information on composting in a visual, effective way.

The goal of this page would be to educate and provide users with more information regarding how to compost and the impact that composting has on the environment. The page goes over how to effectively use the calculator to ensure that the data inputted into the calculator is accurate. In talking to Victoria and our team members, we concluded that one of the main roadblocks to composting is that people do not know the amount that they are supposed to compost in a week. This is why the How to Track Accurately page is very visual to ensure that users can get a visual sense of how much waste to compost. After researching, how much waste a person produces in a week, we concluded that, on average, a local Santa Clara resident produced 4.4 pounds of waste a week (cite). With this information, we were able to make comparisons in relation to the size of an average organic waste bin to give residents an idea of how much waste

they should compost a week a week. To gather inspiration to create this page we researched other climate change and carbon footprint calculators such as *cite name of calculator. From this site we gathered how critical visual aids were in keeping the user engaged and better displaying the data. Overall, the design and solution of the site stayed consistent throughout the coding process, and there was a minor change to the first solution of creating an infographic-like site.

- Relevant aspects regarding Civic Engagement (from reflections #1 & #2) which impact your project design or decisions - discuss any civic considerations that shaped project or solution design
  - What public organization played a role in your project.
  - What policies do they set for any aspects of your project?
  - Detail any civic issues that are related to your project and evaluate how they could be addressed.
  - Critically evaluate, and express reasoned opinions about, the role of public organizations (governmental, non-governmental, multilateral, or international) in civic life in your project

2.2 Civic Engagement

Many organizations play a role in determining public policy issues raised by our project. For our project specifically, one of the main concerns is data privacy. The UCCE collects composting data from their workshop attendees, which is then stored in their Qualtrics Data Base. To access the data necessary for displaying quantifiable composting contributions in Santa Clara (ie. percentiles and averages), we need top-level clearance, which we cannot have. The Federal Trade Commission (FTC) requires businesses to implement reasonable data security measures in order to protect sensitive information from unauthorized access. This would discourage us from posting all their data onto a Google Sheet, which the Google Sheets API could retrieve from. To continue researching the privacy and data security standards for our project we could find more information from organizations like the International Standards Organization (ISO), Electronic Frontier Foundation (EFF), and the National Institute of Standards and Technology (NIST). Many local organizations focused on environmental conservation, sustainability, and waste reduction may also provide valuable insights as to promoting composting initiatives, such as environmental nonprofits and community gardens. Local Santa Clara agencies responsible for waste management and environmental sustainability may also offer support for composting initiatives. By exploring partnerships with these organizations, our team may potentially broaden the impact of the composting tool and address interconnected environmental challenges more effectively.

Our design addresses several civic issues pertaining to the protection of the environment, including climate change and pollution concerns. The idea behind the Composting calculator and its accompanying How To Track Accurately Page is to inform and encourage Santa Clara Residents to compost more instead of throwing organic material into landfills. Organic waste in landfills leads to the slower decomposition of material and more dangerous gasses related to pollution concerns; as landfills expand or become more full of garbage, they become more hazardous to residents living around the landfill. This issue can only be solved by creating a new way to get rid of waste, which is an unrealistic solution; our website instead encourages people to throw away less waste and informs them of the benefits of composting, positively impacting the environment. Reducing landfills and encouraging people to compost and create less waste also falls into the bubble of climate change as reducing the amount of greenhouse gases would help slow climate change. So although the primary source of data for this project includes residents of Santa Clara County, it can be noted that these issues affect not just Santa Clara but communities worldwide.

Our project has several critical considerations to ensure compliance with regulatory standards and best practices. Firstly, in adherence to the California Consumer Privacy Act (CCPA), we are committed to protecting user data privacy. We will transparently disclose our data collection practices, detailing the types of data collected, their usage purposes, and users' rights regarding their data. Secondly, legal compliance concerning the use of APIs is paramount. We will secure the necessary licenses and adhere to the terms of service for utilizing UCCE's API, ensuring our use aligns with legal requirements and data usage policies. Accuracy and substantiation of our environmental claims are essential to avoid misleading information, in line with the FTC's Green Guides. We are committed to using reliable data from UCCE and employing EPA-recommended algorithms for our calculations, ensuring our information remains accurate and substantiated. Lastly, web accessibility is a priority. We aim to comply with WCAG 2.1 standards to the greatest extent possible, incorporating animated representations of data and other accessibility features to make our tool inclusive and accessible to all users.

3. Results and Analysis

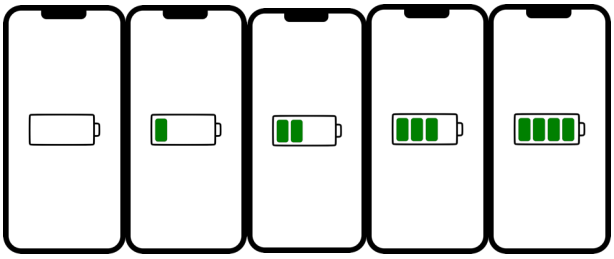
- Results and Analysis (derived from analysis of final design) – use the Appendix for any long lists or tables
    - Final product specifications (dimensions, features, etc.) - explain your solution!

        - Physical sketch/CAD drawings – include user scenario and scale!
        - Functional analysis – decomposition/lists of inputs and outputs/explanation of how it works
        - Include relevant figures and tables – always include explanation of any figures or tables used, avoid presenting the same information in two different ways
        - Explain how/if the solution meets success metrics, problem definition, project specifications, etc.
    - Implementation and testing
        - Tests done and why
        - Interpret the results – anything of technical interest
        - Supporting analyses and/or prototyping results
        - **Relate back to project constraints and criteria to analyze success of project!**
        - Make legitimate claims which can you explain and back-up
        - Customer feedback and satisfaction with solution
    - Budget - summarize project costs, include a full Bill of Materials in the Appendix
        - We had 100 dollars but since we used google api's and public domain images we did not have to pay any amount of money

3.1 Final Product Specification

- Meaningful Representation
    - Incorporated more interesting layout of the conversions
        - Three Stat Container
            - More than just a 2x1 container
            - Allows for two smaller containers to be stack vertically ontop of each other and one longer container to be horizontally adjacent to the stack
        - CO2DescriptionContainer
            - Container takes up 1/3 of the space and the description takes up 2/3 of the space
    - Pop-up descriptions
        - Code provided from youtube/github
        - https://github.com/WebDevSimplified/Vanilla-JavaScript-Modal/blob/master/index.html
        - Every composting conversion is followed by a pop-up window with a description explaining the meaning of it.
        - All the descriptions are referenced from United States EPA website. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator
    - Dynamic Animations
        - Sources are Youtube videos and stack overflow
        - https://stackoverflow.com/questions/49140448/how-do-animation-without-keyframes-but-with-transition
        - Most of the code is using html css and javascript, which does not directly correspond with how the previous team implemented the webstie. For the

sake of keeping the code consistent, we had to translate the html fully into javascript.
        - Created visuals using figma
            - Using a slideshow technique to switch from image to image

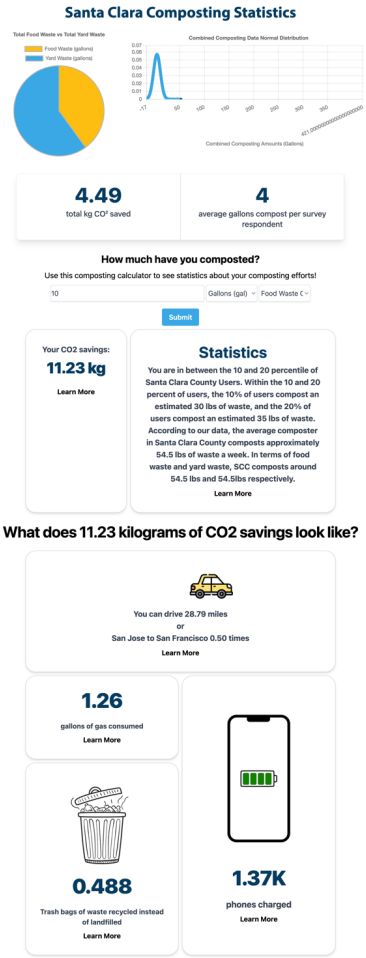


- How to Track Accurately
    - Infographic Layout
        - The data has been sectioned out into smaller boxes which makes the data easier to understand
        - There is a visual aid that goes along with almost every box
            - This makes each data point more engaging
            - All images on the site were pulled from public domain sites
    - Formatting
        - For the implementation of the site all the code was done in HTML or CSS
        - The format of the page is also dynamic which means that it can easily be used on a mobile device or on the web and keep the same formatting
- Explain how/if the solution meets success metrics, problem definition, project specifications, etc.
    - Meaningful Representation
        - We were able to provide a reason for people to explore around the website which allows for more engagement from the community on the calculator. The visuals make the calculator fun and interesting to look at and invites users to play around with it. While exploring they can familiarize themselves with what carbon dioxide savings looks like in day-to-day life. With our pop-up descriptions, we can provide more context on each conversion.
    - How to Track Accurately
        -

3.2 Implementation and testing

- Tests done and why
    - Screen display testing
        - Making sure this site is adaptable meaning that the objects contained in the site moves when the window size shrinks and grows, also for mobile testing we followed the format of the previous team and converted every container stack on top of the other.

- Interpret the results – anything of technical interest
    - Meaningful Representation:
        - We were able to incorporate almost all of the design mock up we were set on. The only feature we were not able to implement was having live data displayed on the site. This is due to the nature of the Qualtrics data. We finished the rest of the implementation around week 8 of the project and that's when we started incorporating talks of the google form to gather data that would be inputted from Victoria. The data was given in sentence format instead of numbers, and this would make it tedious for Victoria to gather the data that we would need for display. Hence we decided to scratch this last minute.
- Supporting analyses and/or prototyping results



- **Relate back to project constraints and criteria to analyze success of project!**
- Make legitimate claims which can you explain and back-up
- Customer feedback and satisfaction with solution

4. Conclusion and Recommendation

4.1 Conclusion

In conclusion, our collaborating project with the University of California Cooperative Extension (UCCE) is a Composting Education Program that aims to encourage Santa Clara County residents to compost their waste more actively by providing a calculation tool to convert their

composting waste to other uses. The project itself has two different pages, which are the “How to Track Accurately” page and the calculator tool. Although we were facing multiple challenges, including limited access to the previous back-end data, a constrained timeframe, and limited human resources, the project still accomplished its major objectives. We have successfully updated to include meaningful visual representations of our tool’s output by adding dynamic animations and contextual pop-up descriptions window. Such meaningful visual representation will make the website more appealing to engage users and provide them with a clear understanding of the impact of their composting efforts on reducing greenhouse gas emissions. Furthermore, the “How to Track Accurately” page was designed to teach users how to accurately report their composting activities, meanwhile enhancing the accuracy and reliability of our data collection.

4.2 Recommendations

- Enhance Data Integration: Explore avenues to access and integrate more extensive and varied composting data to enrich the calculator's insights and accuracy. This could involve partnerships with local waste management services or community-based composting initiatives.
- User Engagement Strategies: Implement additional strategies to increase user engagement and retention. This could include the introduction of gamification elements, regular updates on composting impact stories, and interactive community challenges.
- Expand Educational Content: Further develop the "How to Track Accurately" page with more comprehensive educational materials, including video tutorials, case studies, and expert tips on best composting practices.
- Accessibility and Inclusivity: Making sure the tool and its data remains accessible to all users, including the users who might have certain disabilities. Could add features on the website to let a larger diversity of users access the tool.

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