

PRACTICE OF SUSTAINABLE DESIGN

Business Development for a Sustainable Lifestyle App

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SD-7620-10-W14 The Practice of Sustainable Design

Assignment 15.1

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Defining the Problem

PROBLEM STATEMENT

Interest In Sustainability

Millennials, are a demographic researchers and popular media generally define as those born between 1981 to 1996.¹ An article from Business Insider, An Emerging Retail Trend Is Key for Attracting Millennials, suggested that millennials like to choose sustainable options more so over previous generations if they have the option, even if they have to work harder to do so. This article explained that through a series of focus groups “sustainability trumps convenience” for millennials.² On Pinterest, “Sustainable living is the most searched term around sustainability (+69% since last year), while searches for “sustainable living for beginners” are up 265%.”³ This statistic from Sustainable Brands, the premier global community of brand innovators working with business leaders to shape the future of commerce, suggests that there is an increasing demand for a means to teach sustainable living solutions. Millennials are showing an interest in living sustainably by looking for answers in the way they shop and popular platforms of their generation (i.e., Pinterest).

Where People Go To Get Information

Mobile phone devices are a daily contact point for most Americans and an easy access point to reach those seeking sustainability answers. Along with sustainability-focused apps, the current offerings that are accessible via mobile for sustainable education include: eco-conscious direct to consumer eCommerce brands, news, advocacy groups, blogs, magazines, and metric tools such as carbon footprint calculators. Even with all this information available at the fingertips of the public, few individuals implement sustainable changes into their daily lives. Why is that?

The eco-conscious direct to consumer eCommerce brands offer eco-friendly solutions for consumers. However, these commerce models lack follow-up to ensure effective habits are being molded and often sustainable legitimacy in their own systems and offerings (i.e., lifecycle analysis, material health, packaging sustainability, supply chain impacts, etc.). Carbon footprint calculators show impacts and emissions in a vague generalization of what a person’s actions produce. This resource does a poor job of offering information on what to do next; daily behavioral action items are missing. Therefore, the user experience is without direction and could lead to drop-off of attention spans. Sustainable education blogs are resources that create interest; however, they are delivered in one-off articles found via Google search, paid ads, or social media. A roadblock with this resource is that the person has to Google what they think they are looking for, sift through several links (not guaranteeing any valuable information will be gained), which may cause an overwhelming and unsure path.

All these routes above may be frustrating and overwhelming, which may deter people from attempting to understand and adopt an already complicated topic. These options, however informative, lack comprehensive guidance by only introducing readers to the issues without providing long-term behavior-changing techniques to act upon.

A MOBILE APP AS A TOOL

The How Hub*

From initial research and observation outlined in the introduction, it seems there needs to be a cross-over in approach between the current resources that provide a way for the general public to educate themselves about how to adopt a sustainable lifestyle and then make behavioral changes. Mobile use is a standard part of modern life. The internet, phones, and tablets should be utilized to provide a solution that will educate people on sustainability while teaching them what steps to take to make this transition.

Through the platform analysis, the How Hub was discovered, and market differentiators were identified:

- daily contact to reaffirm how the user's changing behaviors will positively impact the world
- simplified definitions and explanations that are relatable to a person's lifestyle
- visual metrics to contextualize and measure the impacts over time
- complex relationship explanations to show connection of all things in the biosphere

*The How Hub is a working title for this app idea and will be referred to by this name.



Photo by Igor Miske Tu / Unsplash

Brainstorm Ideas with Divergent Thinking Exercises

Exercise: Research Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis

S

Strengths

Apps are easily accessible tools.

This app would create a productive activity for the user to spend their phone time on.

This app would be a tool to make a positive change in the user's life.

The user will be able to choose the focus of topics in their daily life, i.e., food, water, shopping, transportation, etc.

Clear market differentiators are strongly defined to set this app apart in the market place.

Long-term benefits for user.

Apps are a form of habit-forming technology

W

Weaknesses

The app could fail if the user experience is not seamless.

Apps can easily have drop-off in a the saturated app market

App can seem illegitimate if app metrics are not thoroughly defined and sourced properly.

Knowing when patents need to be filed.

Ensuring that NDAs, DNCs, WFHs, and copyrights are set in place to protect intellectual property.

Need scientific and psychological reinforcement during app development.

O

Opportunities

This app could advance the control the user has on their behaviors and decision.

This app could create a network of sustainable thinkers by bringing them to create something greater together.

This app will educate user on sustainability.

Program incentives for the user to continue to use the app.

Designing with full intention and transparency opens to opportunities for innovation

Large sustainable impacts are possible.

T

Threats

Other sustainable apps that are more niche that focus just one way to be more sustainable, i.e., GreenChoice, a food and beverage analyzer to evaluate the sustainability of what you eat and drink.

Oversight during design and development.

Sustainable Lifestyle Apps competitors already on the market.

This app aims to offer lessons on all aspects of daily life which is a huge undertaking.

Stakeholders

Users of App
App Designers & Developers
Biosphere
Investors & Shareholders

Current issues (conventional)

Lack of productive time spent on phone
Non-cost-effective habits currently being practiced
Lack of organized, accessible, and vetted sustainable education

Current issues of unsustainable practice

Wasteful household habits
Wasteful energy use habits
Wasteful consumer habits
Wasteful water habits
Wasteful food storage habits
Wasteful end of use habits
Wasteful waste habits
Over use
Over consumption
Over spending

OPPORTUNITIES

Education of sustainability
Provide a resource for personal development
Create a productive app for people to spend their screen time using
Create a sustainable social network and community resource

Exercise: Observe / Focus Group

Participant Demographics:

The group had six participants; millennials; middle to upper class; Telluride, Colorado

Methodology Used:

D-school Bootcamp Bootleg All-In group brainstorming strategy.

A worksheet was prepared with general questions for each person to write down their answers and ideas, while also in an open discussion forum to verbalize thoughts with the group.

Outcome Goals of Focus Group:

- discuss roadblocks that hinder people from transitioning to sustainable habits
- reinforce demand research
- identify possible lifestyle categories
- raw ideation and input
- discuss apps on the market that participants use daily

Apps Used by Participants

Duolingo⁴
Carb Manager⁵
Pregnancy Tracker⁶

Framework

Quantifications

Feedback

Design For Empathy

The questions asked on the participant survey aimed to glean insight from participants perspectives of their current position on living a sustainable lifestyle:

Question 3, from survey:

What is the biggest grey area about becoming more sustainable?

Question 4, from survey:

Where would you start if you were to make your life more sustainable starting right now?

Question 5, from survey:

What incentive is in it for you personally to become more sustainable?

Question 6, from survey:

Why do you want to live a sustainable lifestyle?

*Insights regarding these answers will be analyzed on the next page.

Question 1, from survey:

On a scale from 1-10, how sustainable is your current lifestyle?

Mean: 5.3 / Mode: 4, 5, 7

Interestingly, none of the participants went high or low on this answer. Staying in the 4-7 range, it seems none of them thought their current lifestyle was drastically un-sustainable or sustainable.

Question 2, from survey:

On a scale from 1-10, how interested are you in living a sustainable lifestyle?

Mean: 9.7 / Mode: 10

Out of the entire group only one participant marked 7 for this question, the rest marked 10. The 7 participant also marked 5 for question 1. The rest of the answers from this participant seem generally aloof to the topic of sustainability. This would be the goal user the How Hub app would try to reach and convert.

Reaffirming app demand, the focus group seemed interested in using an app that helps them transition their lifestyles to become more sustainable.

The group continually brought up the importance of seeing the results of their actions in hard data. It was also concluded that they want these metrics so that they know what type of impact they are having and where they are improving.

In the question asked, "Why do you want to live a sustainable lifestyle?" The general answer was because they felt they have a responsibility to do so. Additionally, they want to do so to "feel good". It was concluded that "feel good" eludes to making a contribution towards a greater good.

The group was in agreement that they want the app to be supportive, to be easy to understand, and to have a component of social sharing. Whether that be through a wall where they can publicly share their goals or through communication and teamwork to work collectively towards goals. User to user empathy would be a vital aspect of the app.

The Power Of Metrics

Metrics tracking was particularly important to participants. This design feature will be ensured through metric boards.

The Power Of Information

Make lesson plans directly relate to easy touchpoints that users come into contact with daily (i.e., create context).

Focus Group Insights

The two ambiguous questions that need to be solved are:

“Why is it so hard for people to adopt new habits?”;

“Why is it so hard for people to implement sustainable behavior?”

Not only did the focus group reaffirm suspicions of why it is so hard to transition to long-term sustainable habits, but it also helped position the app categories.

Hypothesis Reaffirmed

It was reinforced through the open discussion during the focus group and reflecting on answers from the participant worksheets that people are interested in making sustainable transitions, but they either do not know where to start, do not have the right tools, or do not know where they will have the most significant impacts*. Additionally, the participants assumed the amount of effort required to start taking action was on the higher side of cognitive load (i.e., calling a congress representative or calling municipal utility companies).

*“Greatest Impacts” is an interesting topic to point out as a possible feature on the app: There could be a filtering system for the regimens the user is served where they can choose their level of impact (e.g. Level 1: I want to have impact on every aspect of my lifestyle; Level 2: I want to do the least amount of effort while making an impact, no matter how big or small; Level 3: I want to only focus on actions that make the biggest impact).

Category Positioning Guidance

This focus group took place in an affluent, progressive community where climate change, social welfare, and the greater good are common topics of discussion. However, even with that benefit, the participants still had no clue where to begin in making their transition. The quotes (to the right lined in pink) worked as guiding points for the topics that should be addressed on the app. The participants seemed aware of these topics but were unsure of what next steps to take.

Focus group inputs from individual survey worksheets:

Greater collective
Impact of my efforts
My carbon footprint
My civic duty
I want greater longevity for the planet
Irresponsible to have kids in the current climate
I don't know enough
I don't know where to focus
I don't know what to do
Cut back on water and electricity
Would love to carpool
Cost savings
Feel good
Do more good than harm
Save the environment
Shop local
Frequent data from utility companies
I care about the earth and life on it
I get joy from decreasing consumption
Investments in the future
Health of communities and planet

Takeaway

Sustainability is really a habit. Our impacts are directly related to the choices we make through the behaviors and awareness we act upon.

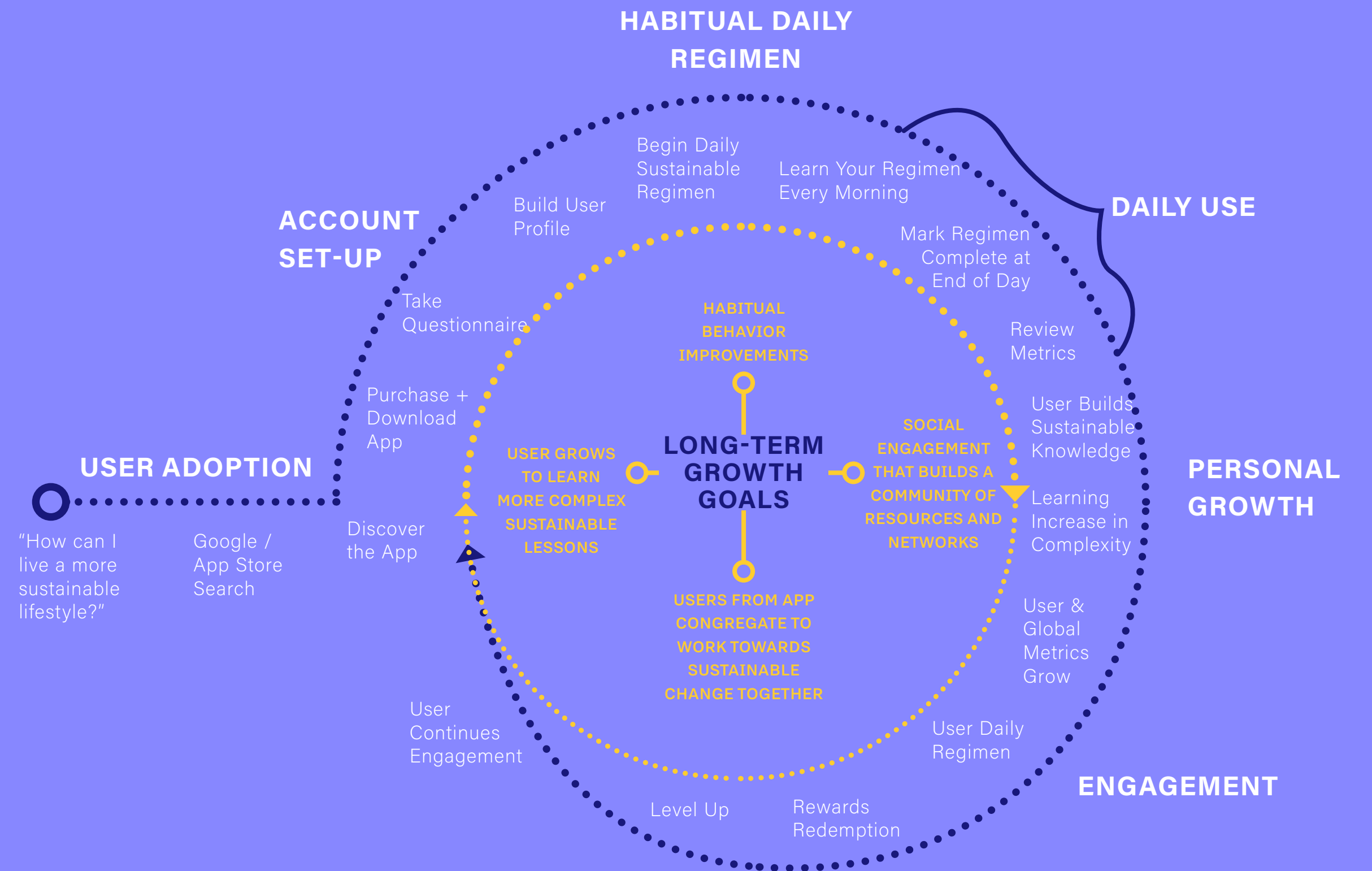
USER JOURNEY MAP

The User Cycle, Step by Step

Exercise: Organize and Synthesize

Through research, analysis, and discussion groups these are the categories that have been defined as the areas of daily life that the user can choose to have the app help them become more sustainable in:

- Food
- Water
- Utilities
- Transportation
- Shopping
- Clothing
- Household Products
- Personal Care Products



Exercise: Describe

People need help adopting a sustainable lifestyle because there is a difficult learning curve to overcome the transition away from unsustainable habits and behavior. A mobile application that provides a straight-forward daily regime while educating the user on the impacts of their actions would provide a means for individuals to make the transformation successful.

STAKEHOLDERS

Users of App
Investors
Shareholders
App Designers & Developers
Biosphere

KEY ISSUES

Habit change is hard.
Sustainability is an huge undertaking.

KEY DESIGN DRIVERS

People want to become more sustainable in daily life.
Apps are easy to access.
Apps are used regularly.
Apps have the ability to create external triggers to prompt use.

KEY DESIGN OBJECTIVES

Work within living systems.
Reverse climate change.
Cause no harm, create no new problems.
Manage common resources.
Consider future generations
Create green jobs.
Account for organization-wide approaches
Design to encourage low-consumption behavior.
App has external triggers (alerts, triggers, updates, etc.) to help behavior develop habit creation.

USER

People understand there is a global crisis, they are then overwhelmed with what to do next, “the world is ending, how do I make a difference?” Overwhelmed with products, articles, initiatives, they don’t know where to start. This tool is for the sustainably-curious but actively-stunned millennial.

NEED

A daily learning moment to teach them about a topic in the sustainable category they are interested in learning more about.

INSIGHT

People are interested in living a more sustainable lifestyle but they are unsure about how to take action. It then becomes overwhelming and people get discouraged.

Exercise: How Might We

Key Challenges: The behavior goals for this app
Key Challenges: Defining the main takeaways from behavior studies

How might we...

How might we design the app so that people engage with the app long enough to make permanent behavior changes?

How might we design the app to make people feel good while they use the app?

How might we design the app so the app experience makes it easier for people to change their habits?

How might we design the app to make the people look forward to using the app?

Key Challenge: A category's lesson design

How might we...

How might we design one of the daily lesson plans?

How might we design the app so users can easily start a lesson plan?

How might we design the app so the lesson plan be interesting?

How might we design the app so people work through the lesson?

How might we design the app so the lesson plans be positioned in an approachable manner?

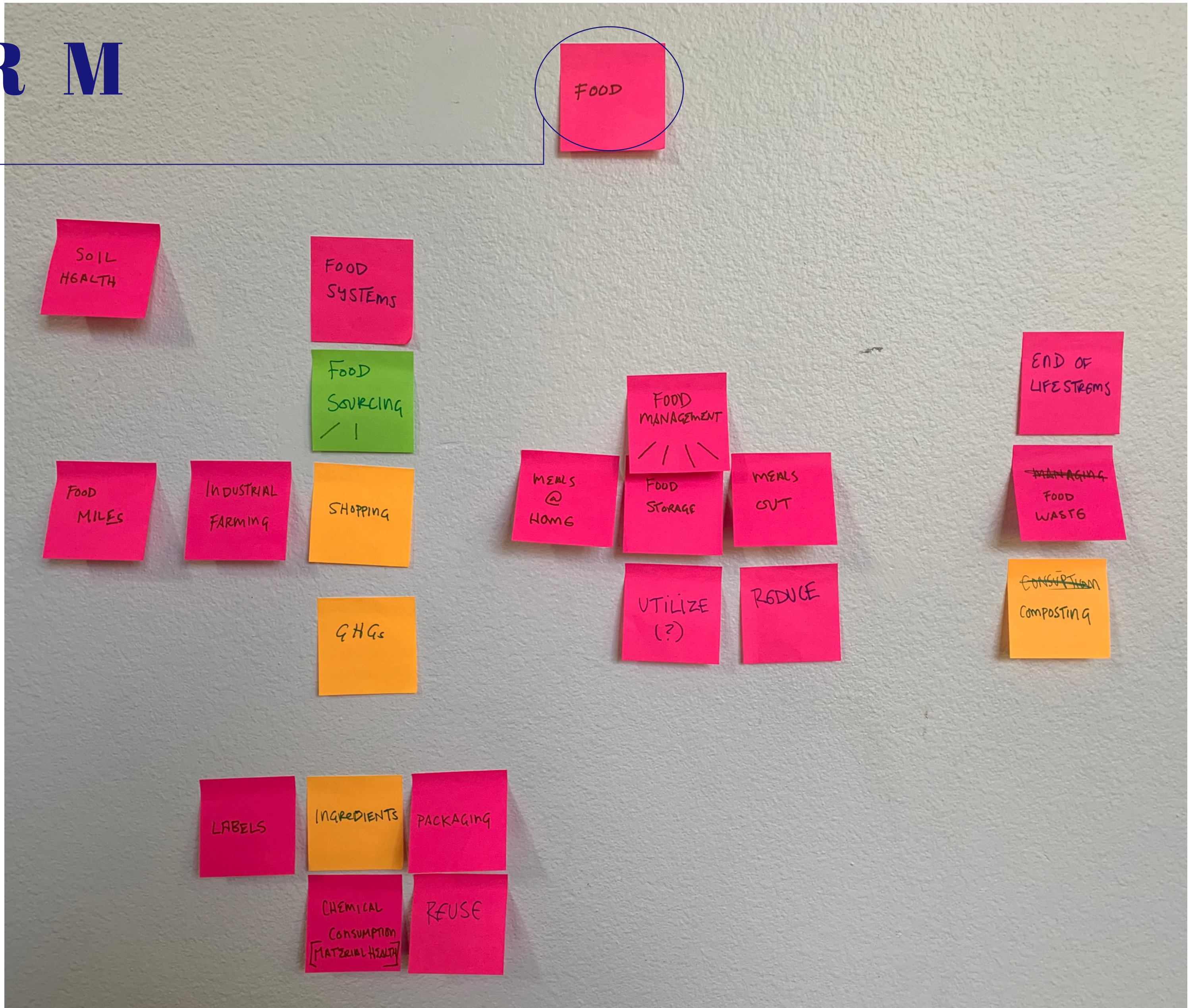
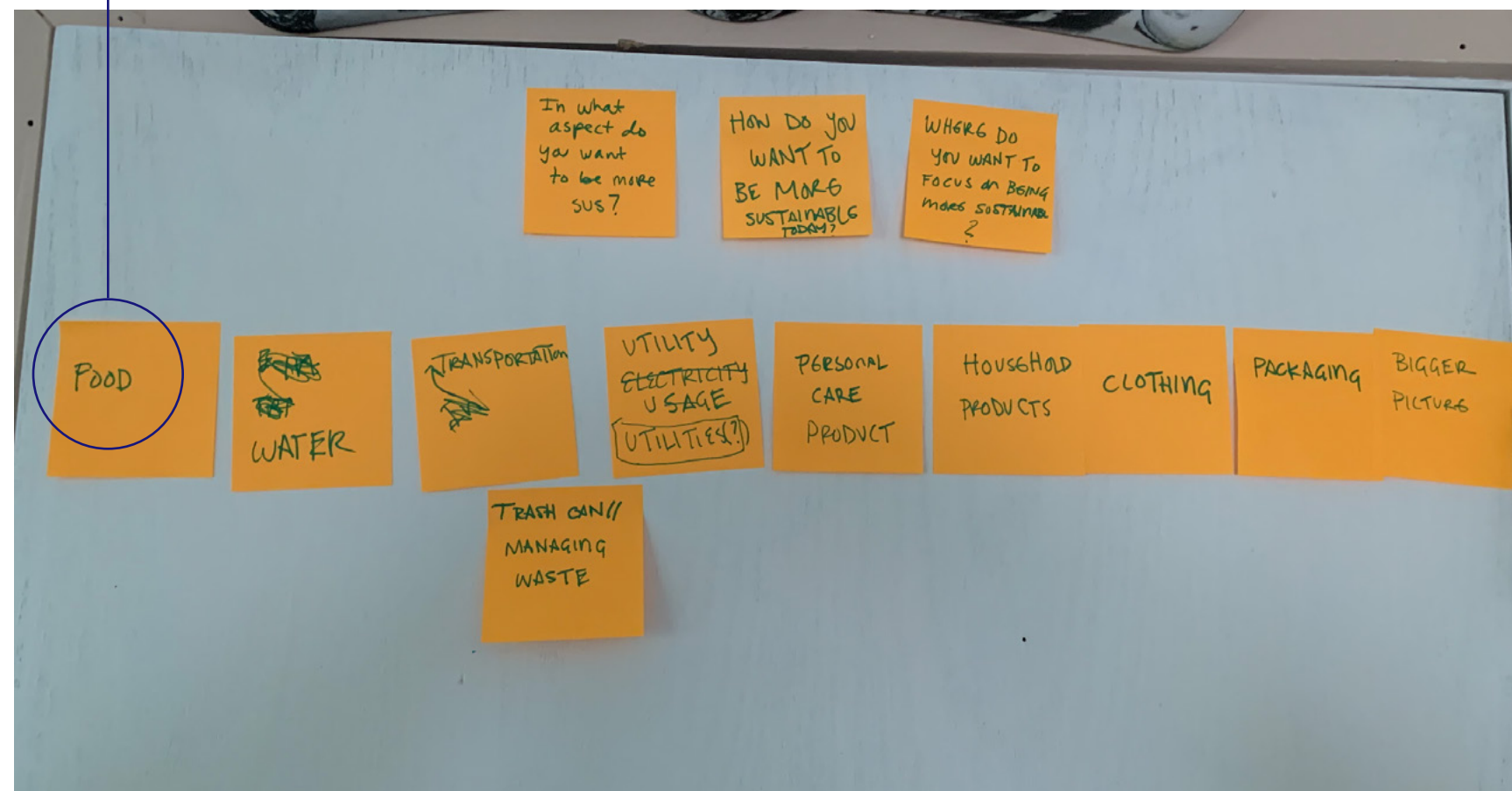
How might we design the category structures of the app?

BRAINSTORM

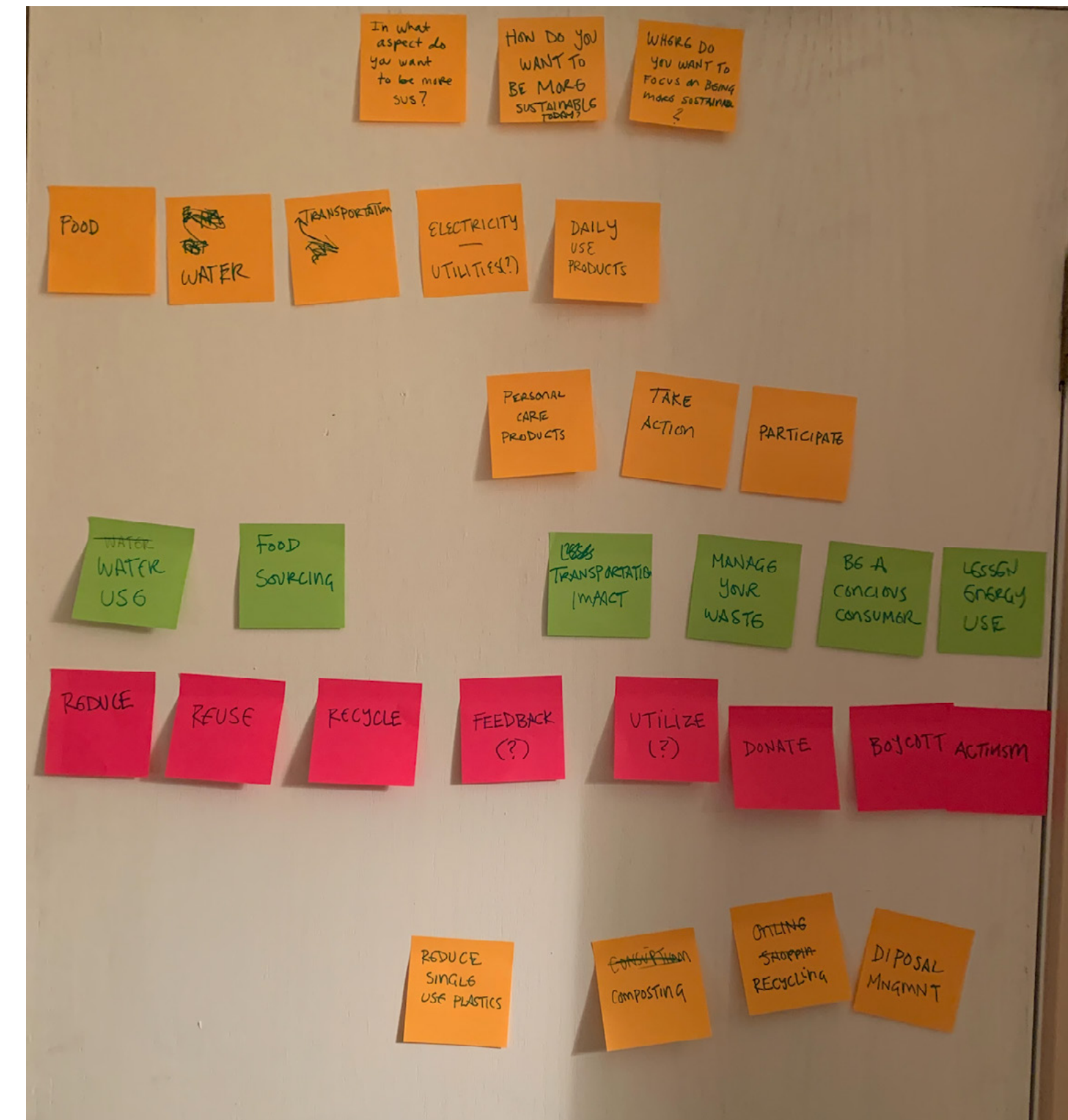
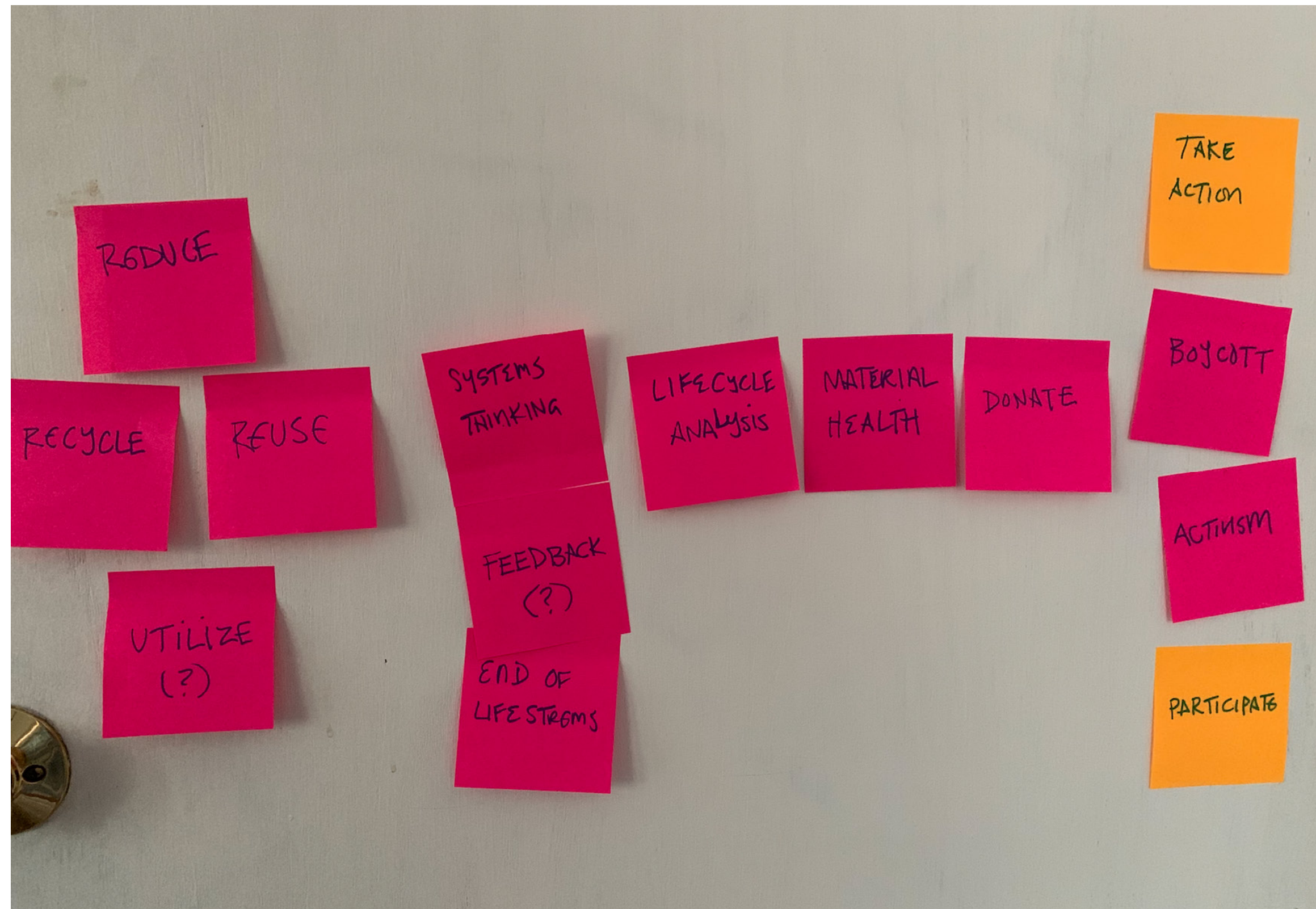
Attribute Change

Q: How might we design one of the category structures of the app?

Initial post-it note brainstorm on the category "Food".



Attribute Change Continued



Attribute Change

Q: How might we design the category structures of the app?

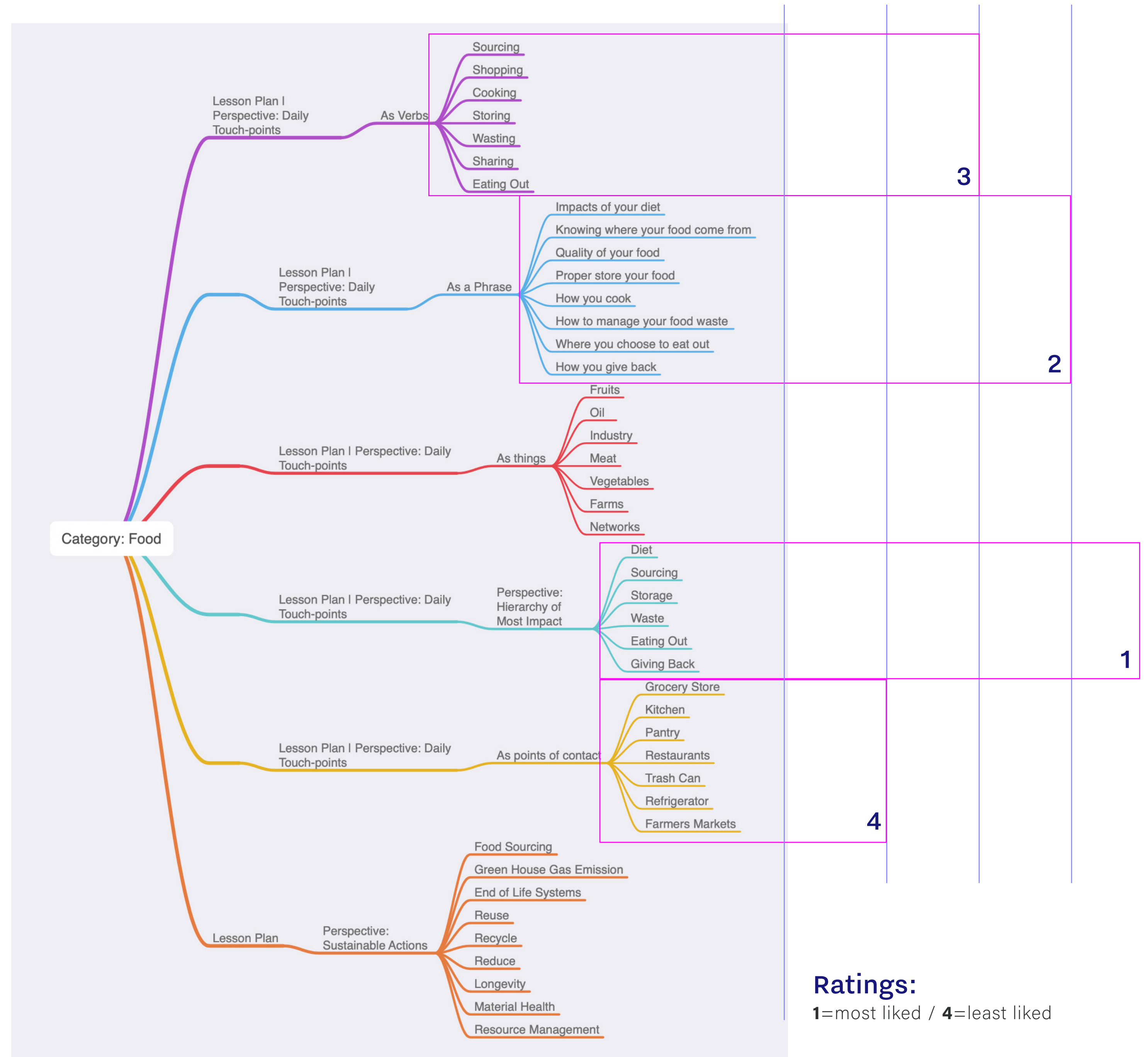
What if the category lesson plans were structured as **verbs**?

What if the category lesson plans were structured as **phrases**?

What if the category lesson plans were structured as **things**?

What if the category lesson plans were structured as **points of contact**?

What if the category lesson plans were structured as **sustainable actions**?



Gap Filling

Q: How might we design one of the daily lesson plans?

Outline the User Experience

Point A: User has chosen the lifestyle category they want to work on

Point B: Successfully completed a daily regimen

What is the gap that exists between Point A and B?

The user experience daily regimen journey.

What are all the things you need to fill up this gap?

Learning Moment

Action Item

Metrics

User Interactions [Notifications]

Language & Copy



Gap Filling (continued)

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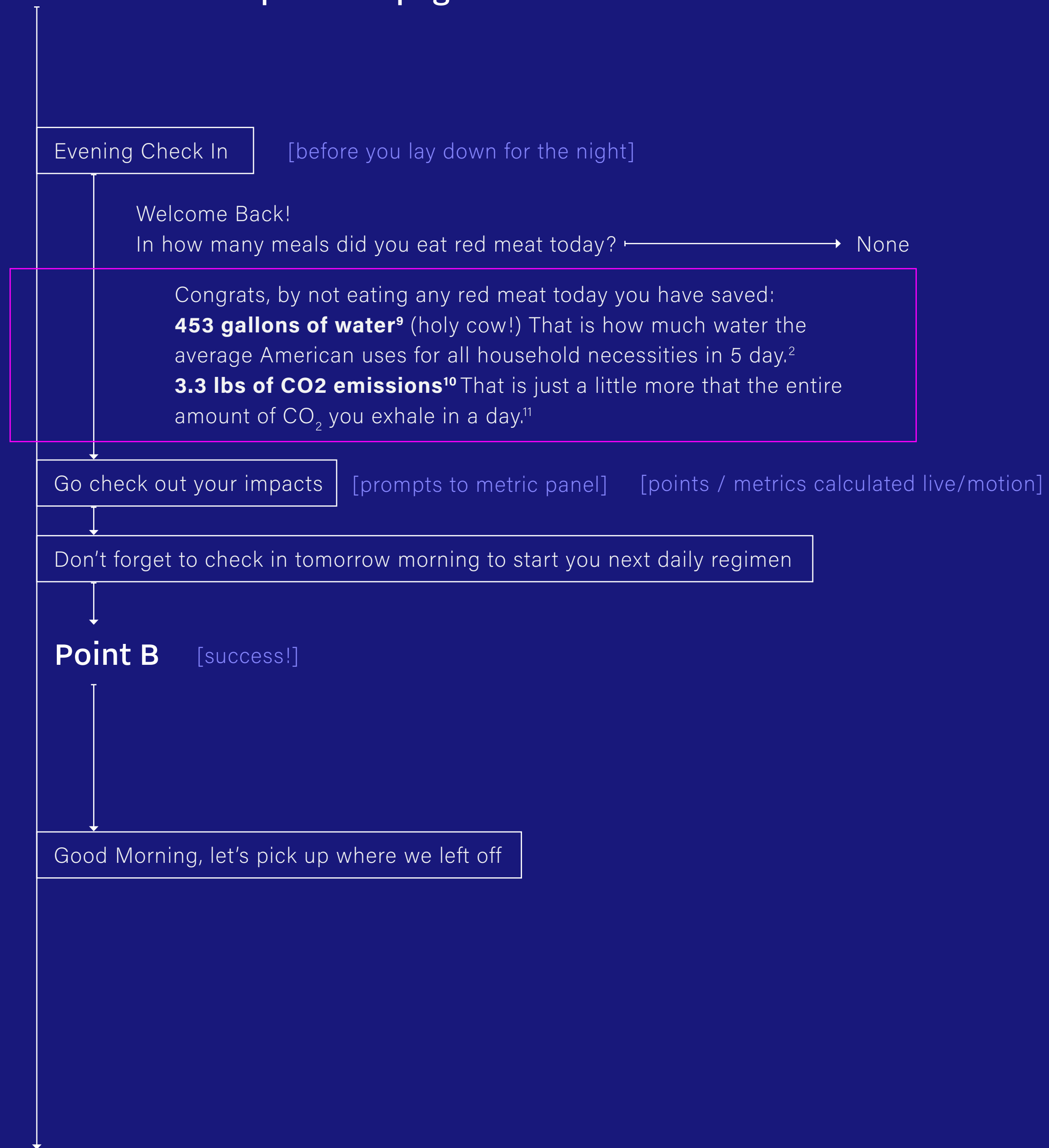
Action Item

Metrics

User Interactions [Notifications]

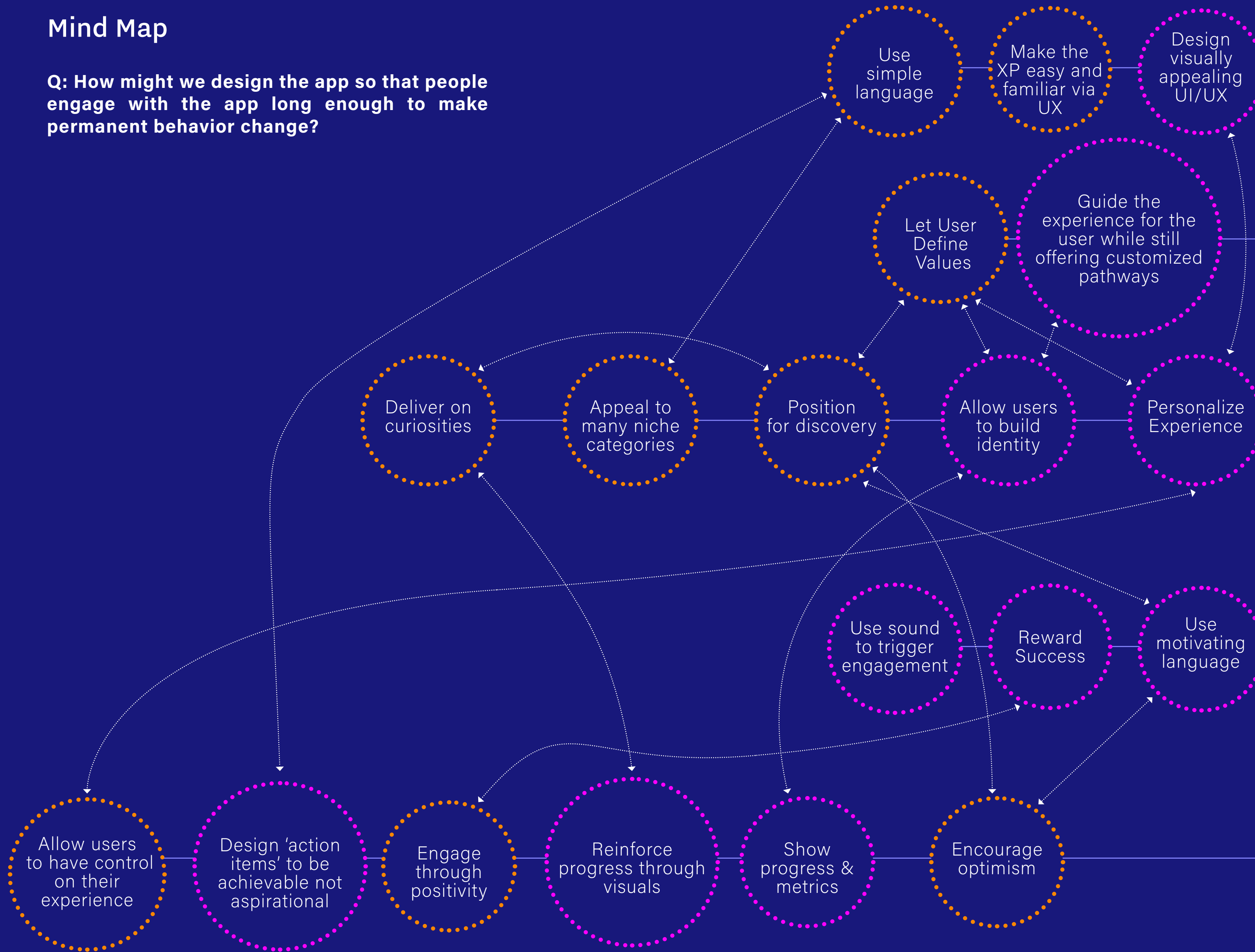
Language & Copy

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Mind Map

Q: How might we design the app so that people engage with the app long enough to make permanent behavior change?



Key Findings

Reduce the cognitive load to ease habit adoption.¹²

The shift of paradigms requires an expansion of our perceptions, ways of thinking, and values.¹³

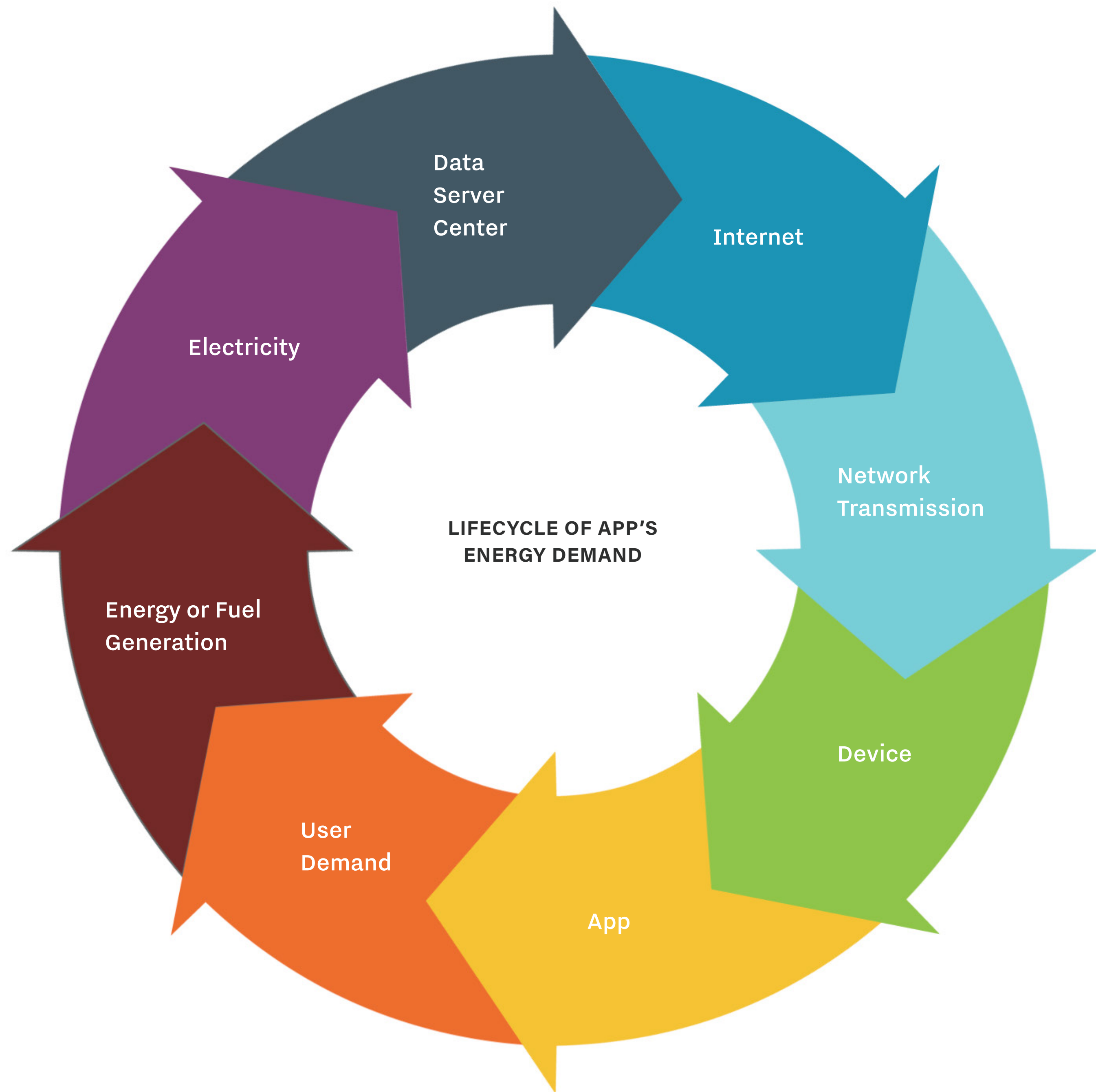
Horizontal Segmentation: embrace customer[user] diversity [of interests and personal values] to improve customer experiences. Embracing diversity goes by the name of horizontal segmentation, and it applies equally well to food products as it does to other customer experiences. Horizontal segmentation seeks to understand what customers want and then to deliver it.¹⁴

“For a target behavior to happen, a person must have sufficient motivation, a sufficient ability, and an effective trigger.”¹⁵

Transforming Consumer Behavior: Introducing Self-Inquiry-Based and Self-Experience-Based Learning for Building Personal Competencies for Sustainable Consumption - Takeaways:

- Make the user engage so that they are utilizing their competencies, especially motivating ones.
- Positive emotions Need to be activated prior, during, and after consumption.
- The feeling of achieving goals is important.
- Help people become aware without confronting, overwhelming or emotionally burdening them.¹⁶

Lifecycle Diagram and Process Flow Diagram



App Ecological Impact Lifecycle Diagram

Energy of Fuel Generation Scope

Energy demanded to power data centers
 Backup energy demanded to power data centers
 Manufacturers of fiber cables
 Transport App from cloud to device

Electricity Outputs

Data Centers
 Transmission of data from centers to devices

Data Server Centers Energy Sources

Powered by electricity
 Back-up power from diesel generators

Physical Internet

Fiber cable network
 Clouds a.k.a data centers

Network Transmission Material

Fiber cable network

Device Energy Source

*Powered by electricity

App Demands

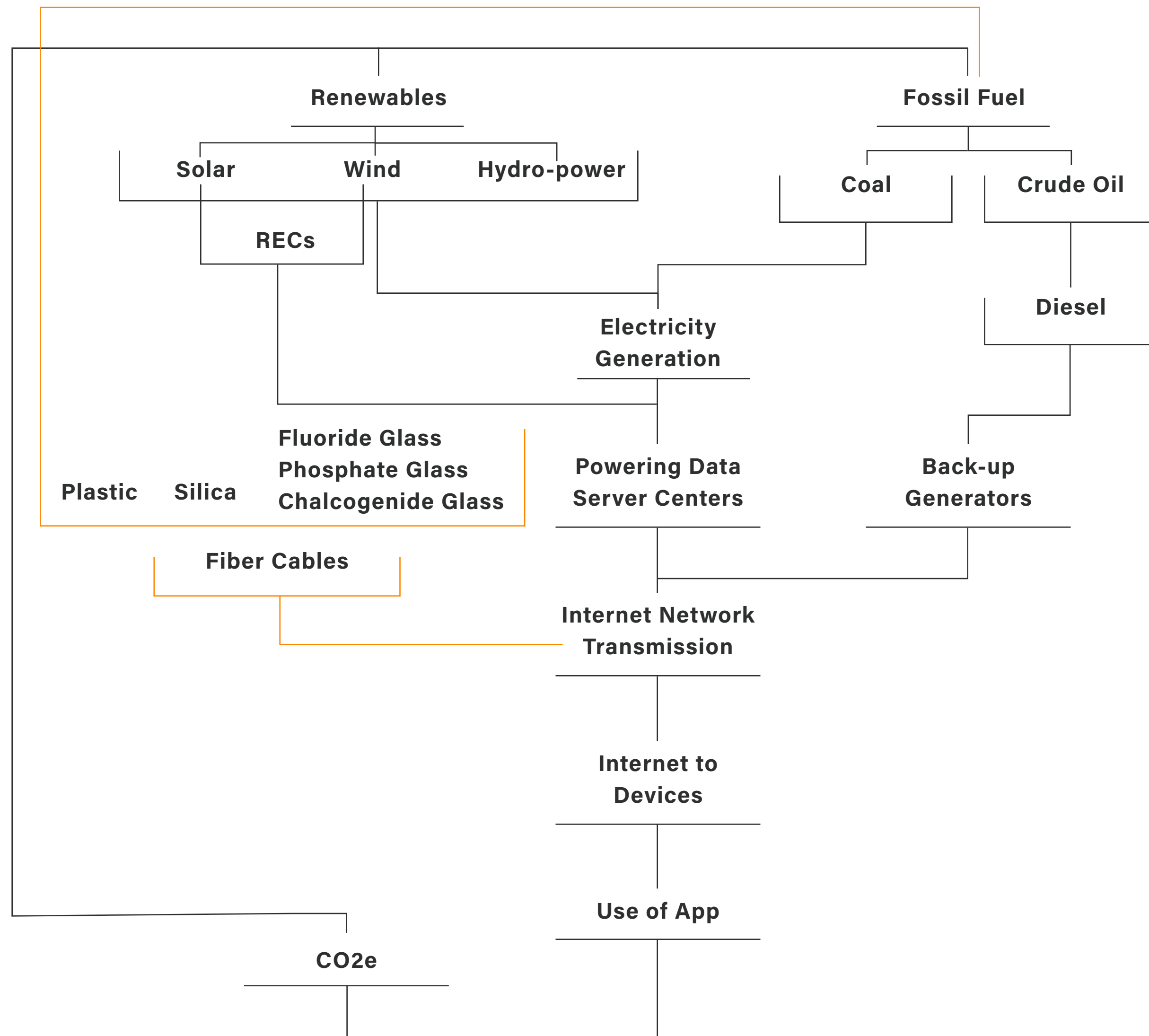
Provided from data center
 Powered by electricity on device

User Demand

Electricity demand to power device and internet

See Appendix A for Lifecycle Diagrams

**PROCESS FLOW:
PATH OF ELECTRICITY GENERATED**



App Ecological Impact Process Flow Diagram

BOUNDARY:

Electricity generated for the data center and transmissions networks to devices (within the USA).

Primary System / Elements:

The Information & Communication Technology Sector (ICT)

This sector includes devices, data centers, and network transmission. In the United States alone the ICT sector uses 1% of all electricity generated in the world. Additionally, 2-3% of all CO2 equivalent (CO2e) emissions in the world are produced by the ICT which, is equivalent to the amount of CO2e produced by to the shipping sector¹.

Data Servers Locations:

- West Virginia
- Iowa
- Washington
- Iceland

Possible Coal Source Locations:

- Iowa
- Virginia

Material:

Fiber Cables

United States fiber optic cable network follows the trans American railway system = trans American phone system = Fiber cable network Owned by three entities: US West, Southern Pacific, and Quest.¹⁷

Categories Of A “Lifestyle”

Approach For Developing Categories

The categories are curated to access people's immediate daily contact points so they can then customize their experience. The overall mission of the app is to build awareness of habits through behavior changes.

Example: By teaching a user to turn off the water while they brush their teeth, and adopt that practice day after day, the app is really teaching them to think about the resources they are using at different points in their life. Through repetition, the How Hub builds habits that can crossover into other aspects of everyday life. So now that the user turns off the water while brushing their teeth, they also may, through constant reinforcement, start turning off the water in between rinses when scrubbing dishes in the kitchen sink.

If successful, the new engagement of this behavior has reduced the amount of water the user is consuming overall because they now understand that potable water is a valuable resource that takes energy to produce, which creates greenhouse gases.

Sustainable Framework Principles Reviewed To Inspire App Categories:

These principles helped define what the guiding principles should be for the app. These guiding principals will continue to evolve with the sustainability movement and the development of the app. See next page for app categories and guiding principals.

Contemporary Sustainability: Three E's¹⁸

ecology/environment
economy/employment
equity/equality

Sustainability Principals: 5 Basic Categories¹⁸

community
commerce
natural resources
ecological design
the biosphere

Natural Capitalism¹⁹

human capital
financial capital
manufactured capital
natural capital

Cradle to Cradle²⁰

use current solar income
waste equals food
celebrate diversity

Three R's²¹

reduce
reuse
recycle

United Nations 17 Goals for Sustainable Development²²

- 1 No Poverty
- 2 Zero Hunger
- 3 Good Health and Well-Being
- 4 Quality Education
- 5 Gender Equality
- 6 Clean Water and Sanitation
- 7 Affordable and Clean Energy
- 8 Decent Work and Economic Growth
- 9 Industry, Innovation, Infrastructure
- 10 Reduced Inequalities
- 11 Sustainable Cities and Communities
- 12 Responsible Consumption and Production
- 13 Climate Action
- 14 Life Below Water
- 15 Life On Land
- 16 Peace, Justice, and Strong Institutions
- 17 Partnerships

App Sustainability Framework

The **guiding principles** developed, their definition, and the user facing **sustainable categories** are defined here through the market analysis and researched sustainable principles.

BOUNDARY

One individual; their daily touchpoints, habits, and products they consume

GUIDING PRINCIPALS FOR LONG-TERM SUSTAINABLE BEHAVIOR TRANSITION

*How the app is defining these terms

Ecological Footprint*:

Awareness of the ecological outputs and impacts of action that contribute to climate change and ecosystem disruptors.

Definition influenced by the Global Footprint Network definition of ecological footprint.

Conscious Consumption*:

Awareness of one's purchasing choices, the effects of the sourcing of that purchase, and the effects of the product on the biosphere and body.

Definition influenced by Natural Capitalisms 'True Costs' definition.

Circular Systems*:

Awareness of the outputs and inputs of ones actions (i.e., purchasing, discarding, and eating).

Definition influenced by the Cradle to Cradle definition of closed loop systems.

Material Health*:

Awareness of the chemical composition and ecological health of the products you put on your skin, into your body, and into the biosphere.

Definition influenced by the Design Guidelines for Sustainable Packaging definition of Material Health

Social Footprint*:

Awareness of the impact made on social systems, cultures, and communities

Definition influenced by the Triple Bottom Lines definition of Social Equity

USER FACING DAILY LIFESTYLE CATEGORIES

Food
Water
Transportation
Energy
Waste
Clothing
Household
Personal Care
On-the-Go
Internet

*These categories will likely evolve as the app is developed and user feedback is received.

CATEGORIES DEFINED

Key

Definition Of Category

As defined by and within the scope of the app's guiding principles outlined on page 20.

Example Topics Covered

The topics covered within each category are sub-categories of the lifestyle category and the focus of a daily regimen

Example Daily Regimens

Possible examples of regimen learning moments and action items. There are only three examples outlined for each category here, however, in the app there will be many regimens for each category.

	FOOD	WATER	TRANSPORTATION	ON-THE-GO	INTERNET	ENERGY	WASTE	CLOTHING	HOUSEHOLD	PERSONAL CARE
DEFINITION OF CATEGORY	The food system of the user.	The water used by the individual.	The transport methods of the user	The items used by the user when not at home	The impacts of the internet use & devices of the user	The utilities used within the household	Waste equals food & materials as circular systems	The clothing industry & purchasing option for user	The household as a system	The bath, bed, body as a system.
EXAMPLE TOPICS COVERED	Food Sourcing Diet Storage Composting Eating Out Food for Others	Home Utility Reduce Reuse // Grey Bottled River Networks Sources	Vehicle Impacts Commuting Alt Transport Health Affects of Alt. Transport	Single Use Reuse Reduce Restaurants	Data Use Home Use Electricity CO2e Impacts	Natural Gas Propane Water Electric	Home Disposal Product Labels Composting Reuse Recycling Upcycling	Slow Fashion Material Health Impacts The Industry	Impacts Home Products Cleaning Cooking Eco Design Packaging	Body Care Skin Products Oral Products Packaging OTC Material Health & Impacts
EXAMPLE DAILY REGIMENS <i>Note: the lesson plans will be dynamic providing crossover from one category of the app to another to convey, through user experience, how these categories are connected.</i>	1: Food Shopping Alternatives (i.e., CSA, Farmers Markets, Online) 2: Impacts of eating red meat 3: How to properly store your vegetables	1: Track water use in utility bill 2: Mindful water use i.e., washing dishes or brushing teeth 3: Grey water appliances & use	1: Idling Vehicle bad practices 2: Public Transportation 3: Health benefits explained of alternative transportation	1: How to transition away from single use 2: Awareness of consumer demand 3: How to responsibly choose were you eat out i.e., sustainable fish sourcing	1: Awareness of the CO2e impact of the internet 2: Awareness streaming video large impact 3: Screen consciousness i.e., what you are spending your screen time on	1: What renewable energy is and how you can utilize it in your household i.e., offset, solar install, wind install 2: Tracking utility bills, measure growth 3: Awareness of use. Turn off the lights when leaving a room	1: How to remove plastic from the house 2: Learning your municipal composting regulations 3: How to read product labels for proper end of life stream placement	1: How to shop responsibly 2: How the materials in your clothes affect your skin and body 3: Learn where your clothes are sourced from	1: What chemicals are harmful and how to access 2: How to shop responsibly 3: DIY eco design for the household	1: What chemicals are harmful and how to access 2: How the materials in your clothes affect your skin and body 3: Product impacts on the biosphere (i.e., antibiotics, hormones, and chemicals in the water stream)

Wireframes

SYSTEM DESCRIPTION

The app's functions and features:

BEHAVIOR

USER PROFILE

Personalized profile settings with avatar, about/bio section, and sustainable categories of user interest.

STRUCTURE

QUESTIONNAIRE

Through the initial questionnaire the user will define the user's profile in 15 question or less:

- Set a starting place where regimens per category will start (i.e., self assessment and level of knowledge of the sustainable revolution)
- Set sustainable categories of interest
- Set metrics of personal lifestyle

FEEDBACK

VIRTUAL ASSISTANCE

Virtual assistant feel to the user experience to keep you going and engaged. Notifications and positive reinforcement to continue daily regimen via email and phone notifications.

FEEDBACK + INTERCONNECTIONS

METRICS DASHBOARDS

INDIVIDUAL VIEW: Overall impact of individual to show how actions count. GLOBAL VIEW: All of the users on the apps progress to show how the little things, when people work together, make a large difference. The global view will have pattern filtering capabilities so the user can see impacts of city, state, nation, etc.

PATTERN

CATEGORIES

The categories that exist on the app to define to the user's aspect of life they will focus on. The user will be able to focus on categories of their choice.

FUNCTION

REGIMENS

A regimen = learning moment + an action item.

Reach weekly goals consistently and app will reward (see rewards & benefits)

Ratio = 1:1 (learning moment : action)

INFORMATION FLOW + STRUCTURE

LEARNING MOMENTS

A learning moment is the starting place for the user to be informed on what the daily regimen is teaching them. *Lessons will be served to the user as part of the "regimen" in combination with the related action item.

FUNCTION + BEHAVIOR

ACTIONS ITEMS

An action is the feasible challenge for the user to habitually act out through out the day, i.e., "today be conscious about how long you leave the water running and how much water is not used or wasted. Try to turn off the water when water is not needed." Opportunities for saving water are when you brush your teeth, when you do the dishes or watering your lawn (did you check the weather to see if it will rain today before you water?). *Actions will be served to the user after they have completed the corresponding learning moment.

FEEDBACK

IMPACT GOALS

The impact goals are the end results the user is working towards. These goals will be tracked through metrics, i.e., MT/CO2e, networks relationship, and cost savings

FEEDBACK + INTERNAL CONNECTIONS

SOCIAL COMMUNITY

User can connect with others that have the same sustainable categories of interest to compare their successes, compete on leader boards, discuss impact metrics with others, follow peoples' progress, private message or public message people to connect, and publish open topics on their profile to start conversations. The more interaction you have on the app the more points you get in the "community sharing" action item.

FEEDBACK

REWARDS & BENEFITS

Points will be gained for affiliate products for purchase that are recommended on the app. Promotions will be offered upon completion of milestones.

FEEDBACK

NOTIFICATIONS

Mobile push: Morning Reminder to check-in, afternoon reminder to keep going, evening reminder to check-in
Emails: progress reports, check-ins and updates.

INTERCONNECTIONS

THINK TANK

Once a user gets to a certain level of completion on the app they can contribute to the growth of the sustainable revolution by doing research on metrics, propose projects to work on, etc.
This aspect could be part of a bigger give back program where the app pays or rewards these people to do these efforts.

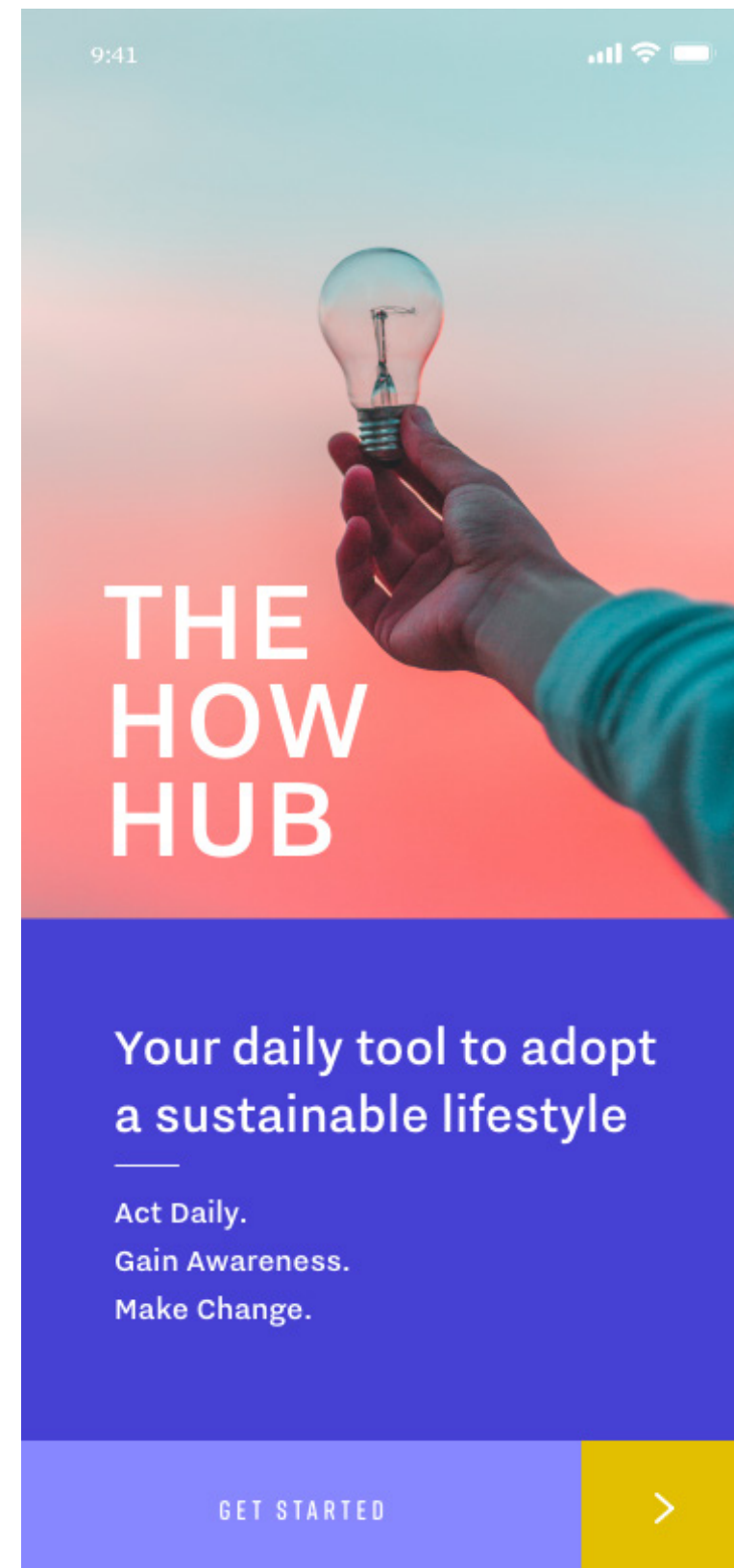
App Adoption

User will customize their profile with their categories selection, household metrics, and take the baseline questionnaire.

Regimen = 1 learning moment : 1 action item in a category.

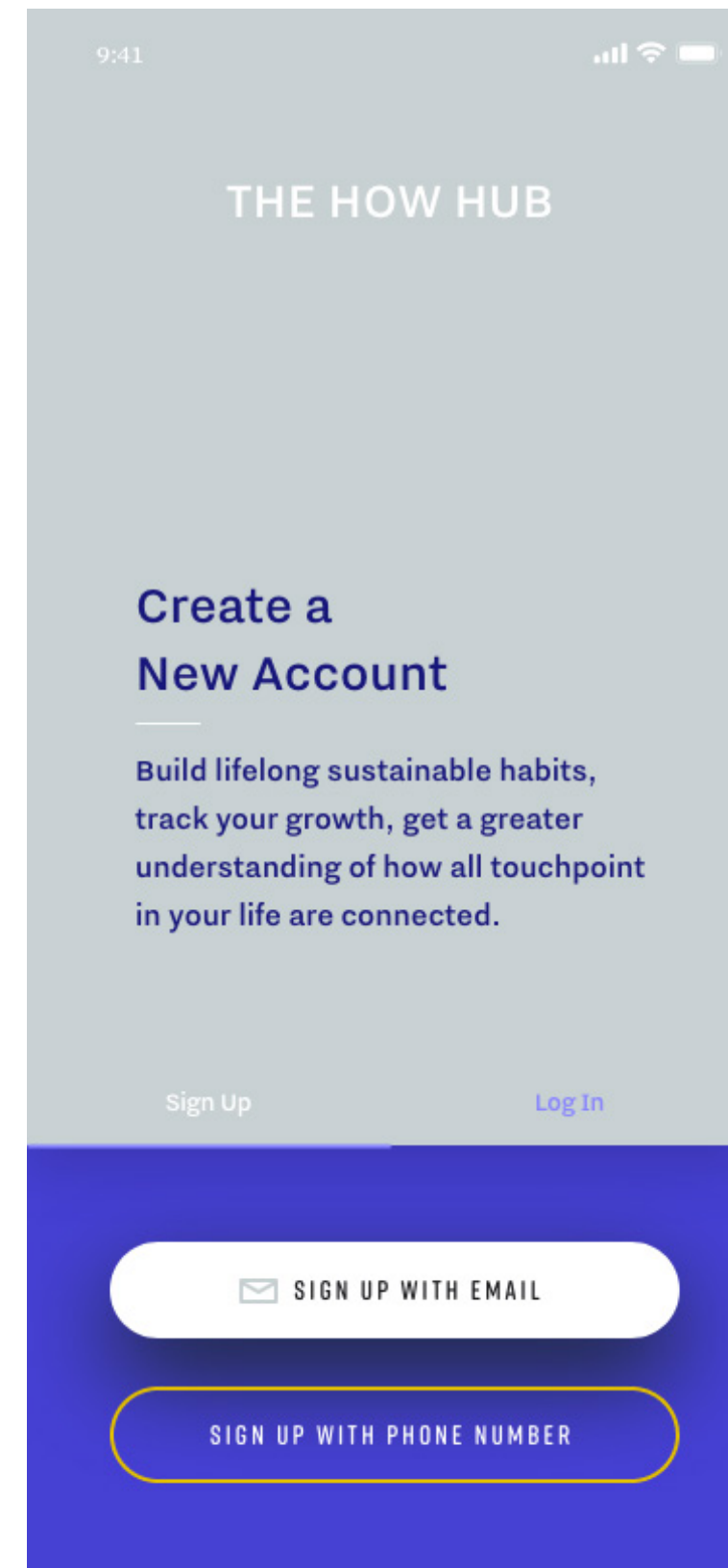
These wireframes are a rough idea of the user experience. More research and development is needed than the time constrictions of this thesis project allows.

Welcome Screen



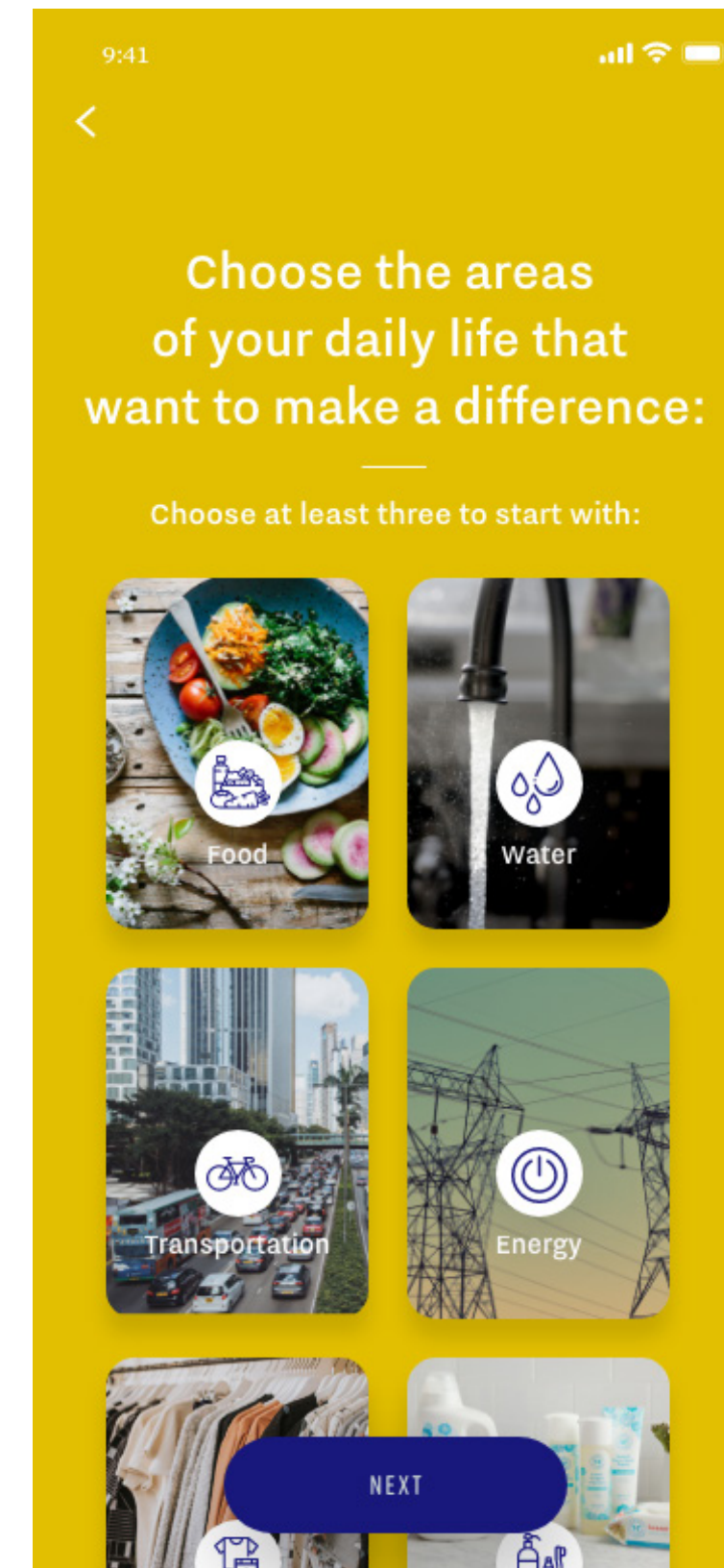
This is the first screen the user will see when they open the app.

Sign Up / Begin User Profile



This is the first screen the user will see when they open the app.

Categories Selection



The user will choose which categories they want to focus on at the start. There are no limits to how many categories they choose. They will be able to edit which categories they will learn about at anytime in their user profile.

Household Metrics



County municipal utilities used would be valuable to set to gather data on utilities.

Type of living situation could be valuable as well (i.e., roommates, family, etc) because it gives a greater insight on resource use.

These may be dynamic forms (i.e., depending on A answer than X or Y question will be served next).

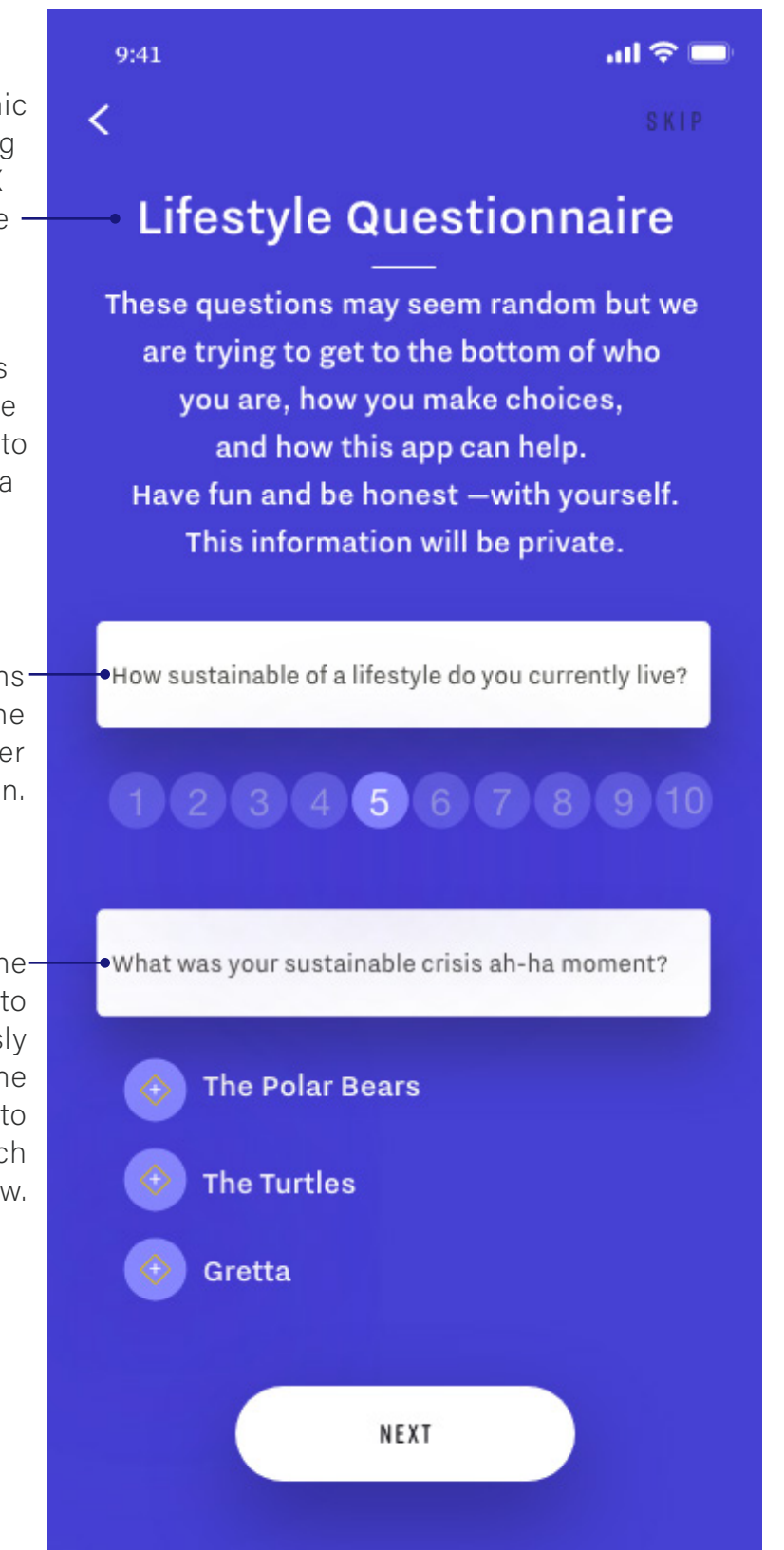
More visually stimulating graphics and forms experience need to be designed to engage the user on a deeper level.

These questions attempt to define the behavior sets the user currently acts upon.

Targets when the user started to learn or consciously become aware of the sustainable crisis to peg-point how much they may already know.

Setting a baseline is an important part of the on-boarding as it sets a starting point for the user to grow from.

Baseline Questionnaire



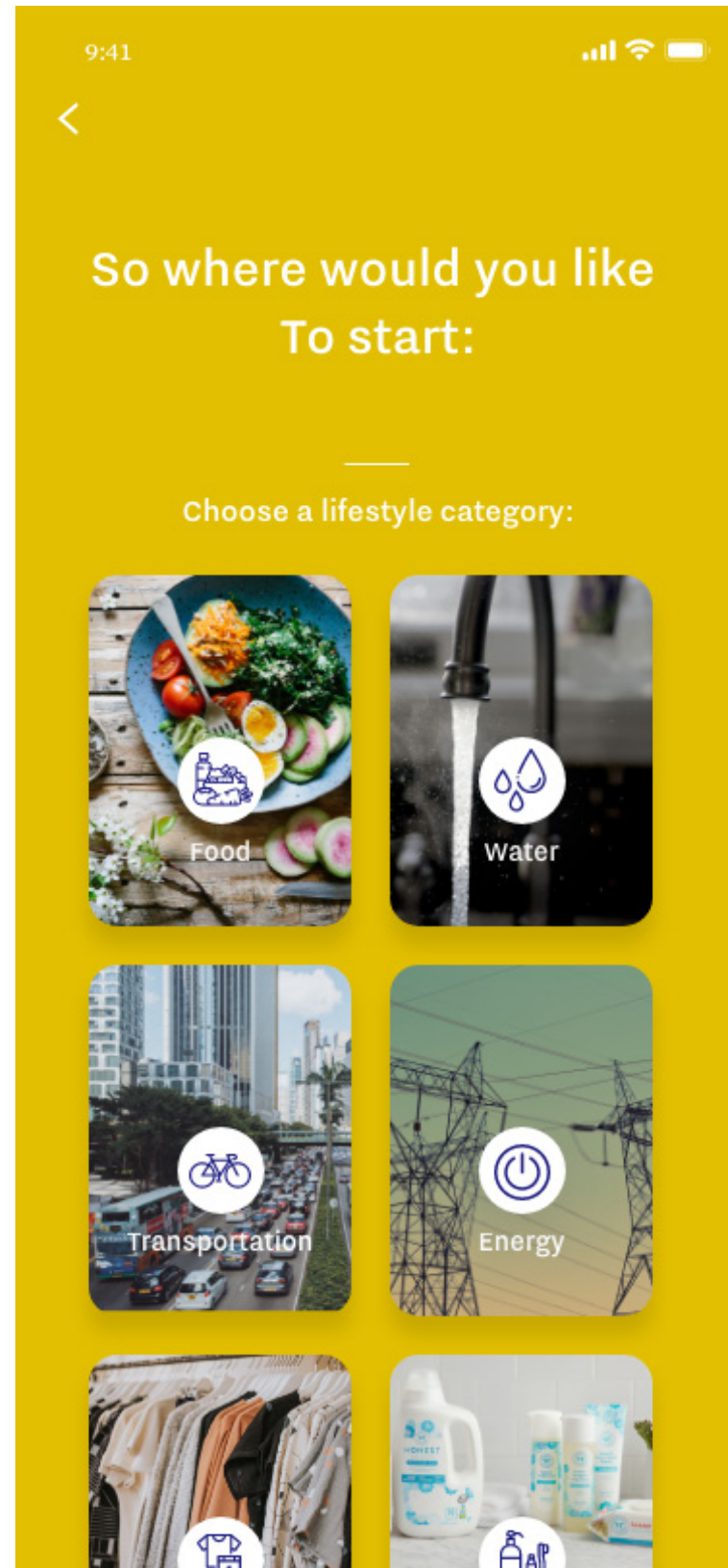
Along with the personal household metrics, the questionnaire will help set the baseline. This questionnaire will be between 8-15 questions to reduce cognitive overloading*, and be witty and fun to engage the user and set the tone for the app. *A psychologist may be appropriate to bring in to help build this.

A Daily Regimen

Categories like “Clothing” and “Food,” for example, are inherently different, especially in their metrics. The wireframe structure of each group must reflect that category’s

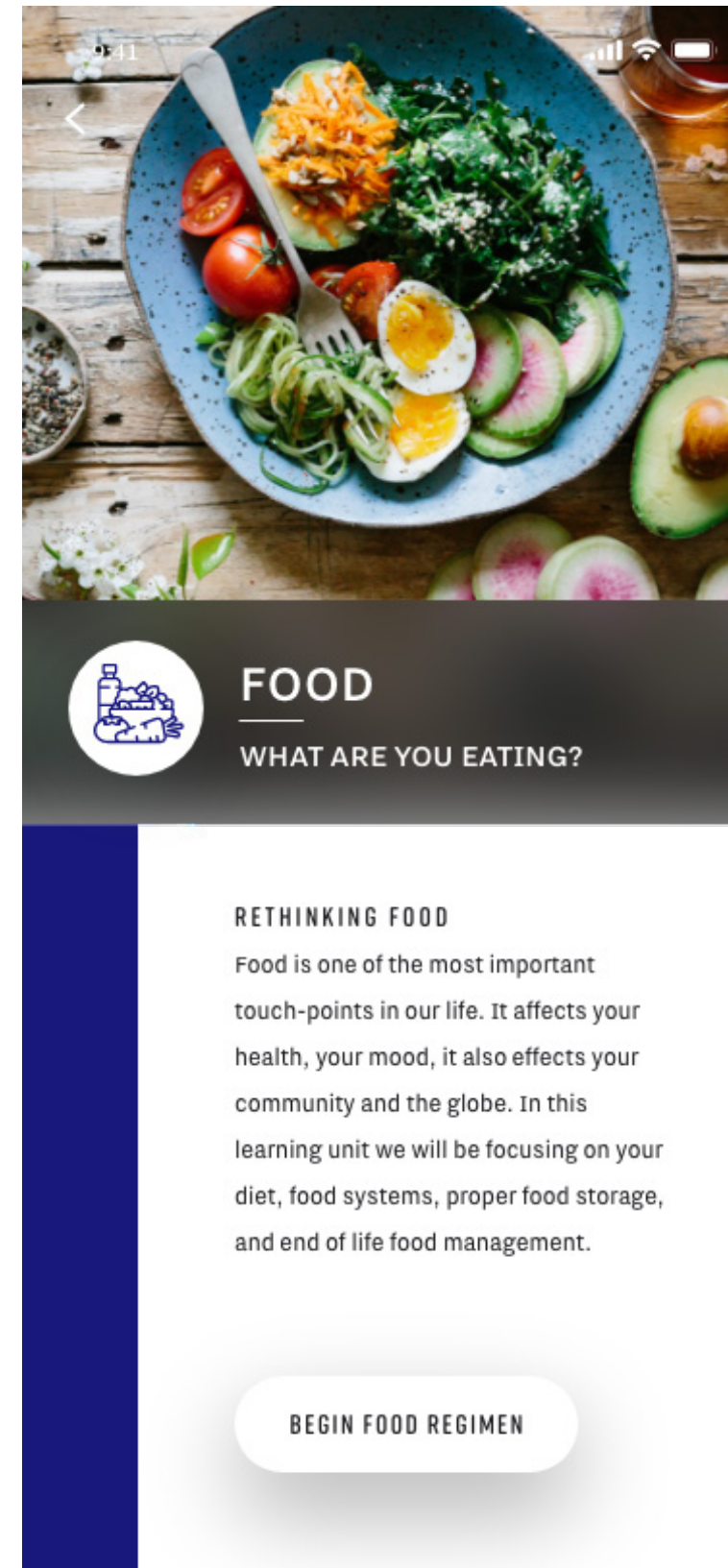
complexity. This page shows an example of the “Food” category’s “Diet” regimen.

Choose a Category



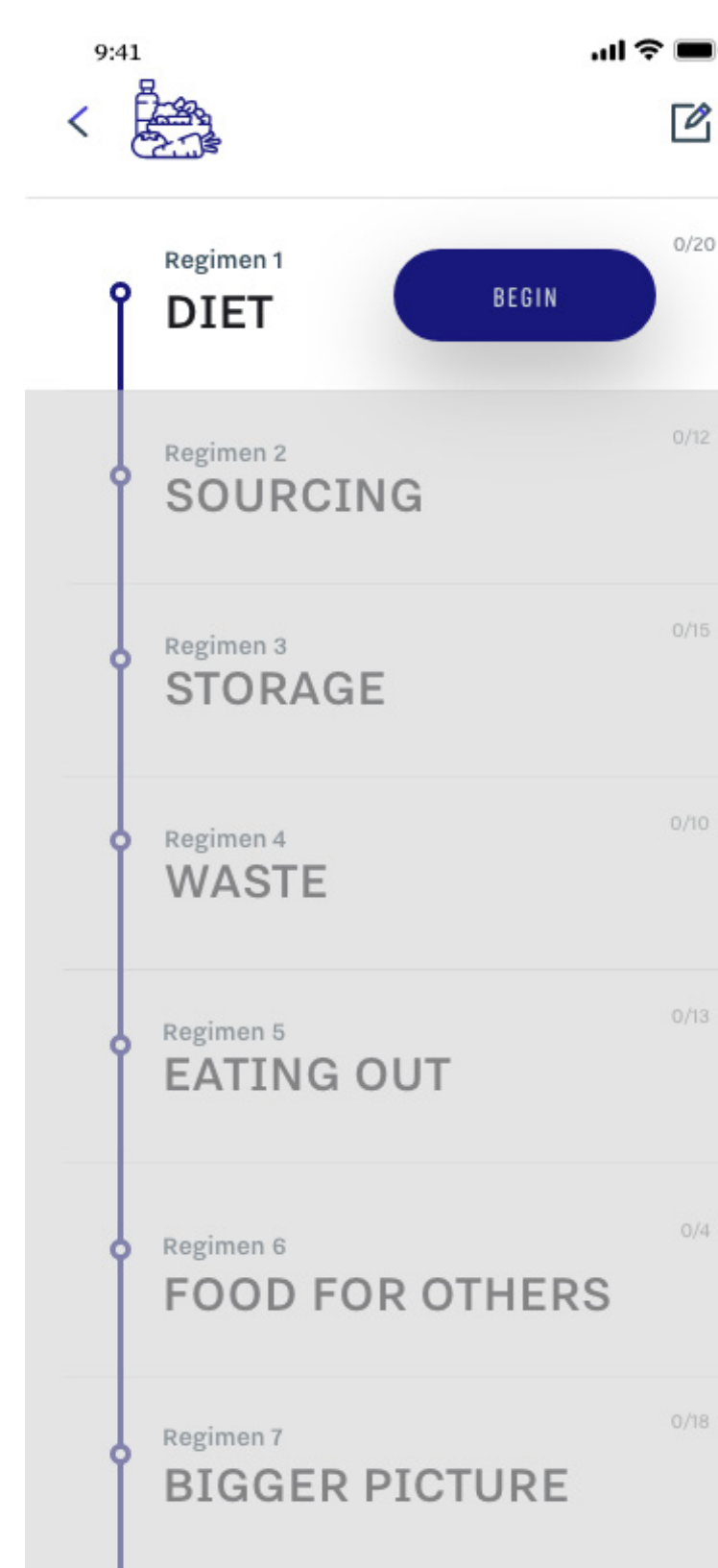
Now that the user has their profile set up and a high-level baseline set, they can begin their first regimen. To do so, they will start by choosing which of the categories they want to begin.

Intro of Sub-Categories



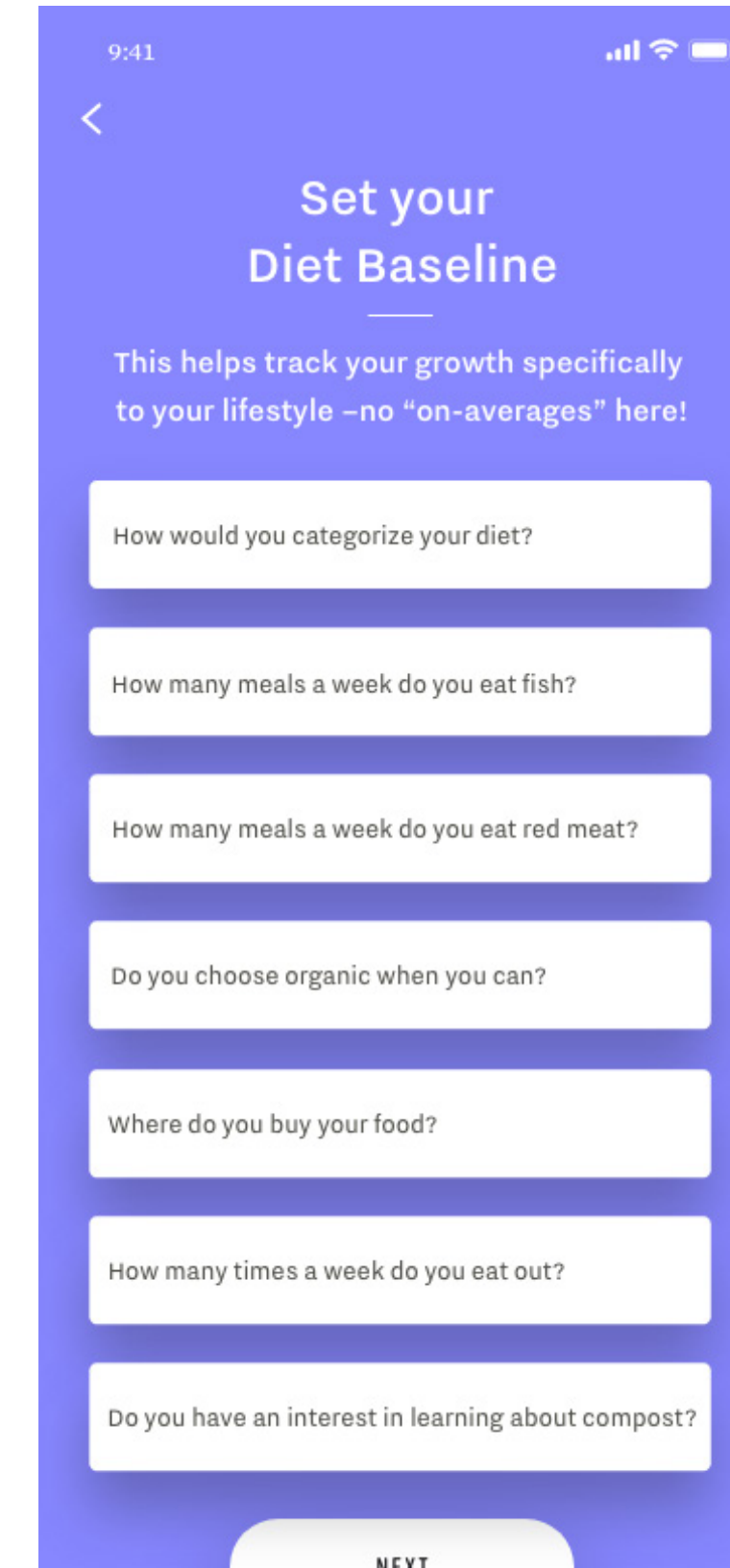
After selecting a category, they will be introduced to set the perspective or approach the app will take in teaching sustainable habits in that category. For “food,” for example, an introduction is necessary to set the framework for just how broad the scope is in this category.

Learning Plan Dashboard



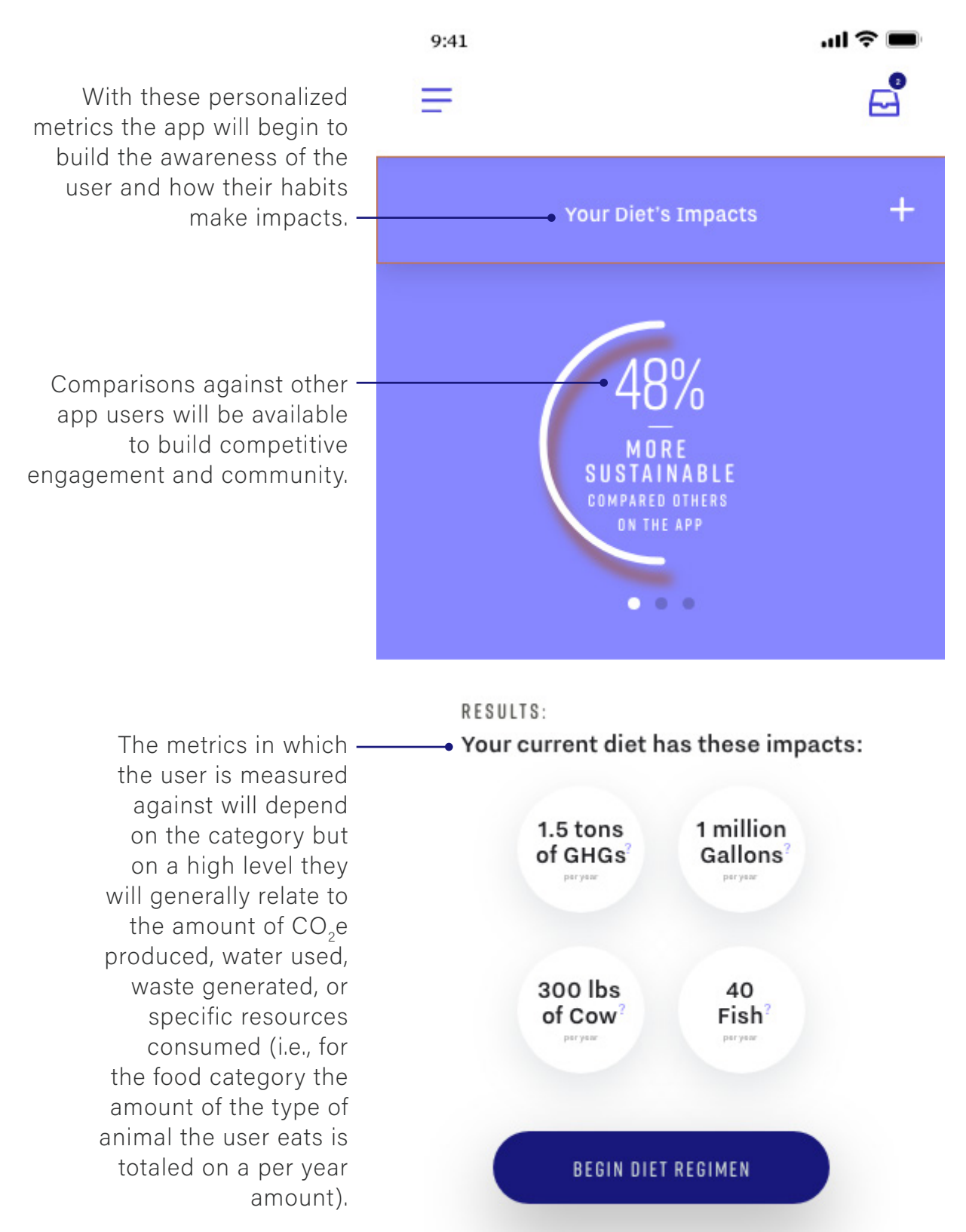
A significant differentiator feature of this app is that these category learning plans are controlled to produce a guided user experience. The user is not overwhelmed with deciding which path to take. In the category learning plan dashboard, it will show the regimen topic that they will start with and the path to come. Once they complete one regimen, they will have access to the topic following in a linear form.

Diet Baseline



Once beginning the first regimen of a category, some categories may need to set a deeper, more personalized baseline so that the individual will be able to track their progress and growth in-depth. It will also make sure that the app avoids serving the user information that does not apply to them. For example, if the user is a vegetarian, then it would be irrelevant to make them go through an entire regimen on why they should lessen their red meat intake.

User Diet Metrics Dashboard



With these personalized metrics the app will begin to build the awareness of the user and how their habits make impacts.

Comparisons against other app users will be available to build competitive engagement and community.

The metrics in which the user is measured against will depend on the category but on a high level they will generally relate to the amount of CO₂e produced, water used, waste generated, or specific resources consumed (i.e., for the food category the amount of the type of animal the user eats is totaled on a per year amount).

Each of these category-specific metric boards will visually illustrate the user’s baseline and a starting point. This is a necessary experience in the app so that the user can track their growth. Where the ‘?’ appear, the user can click to be provided resources to dig deeper on the topic and learn more.

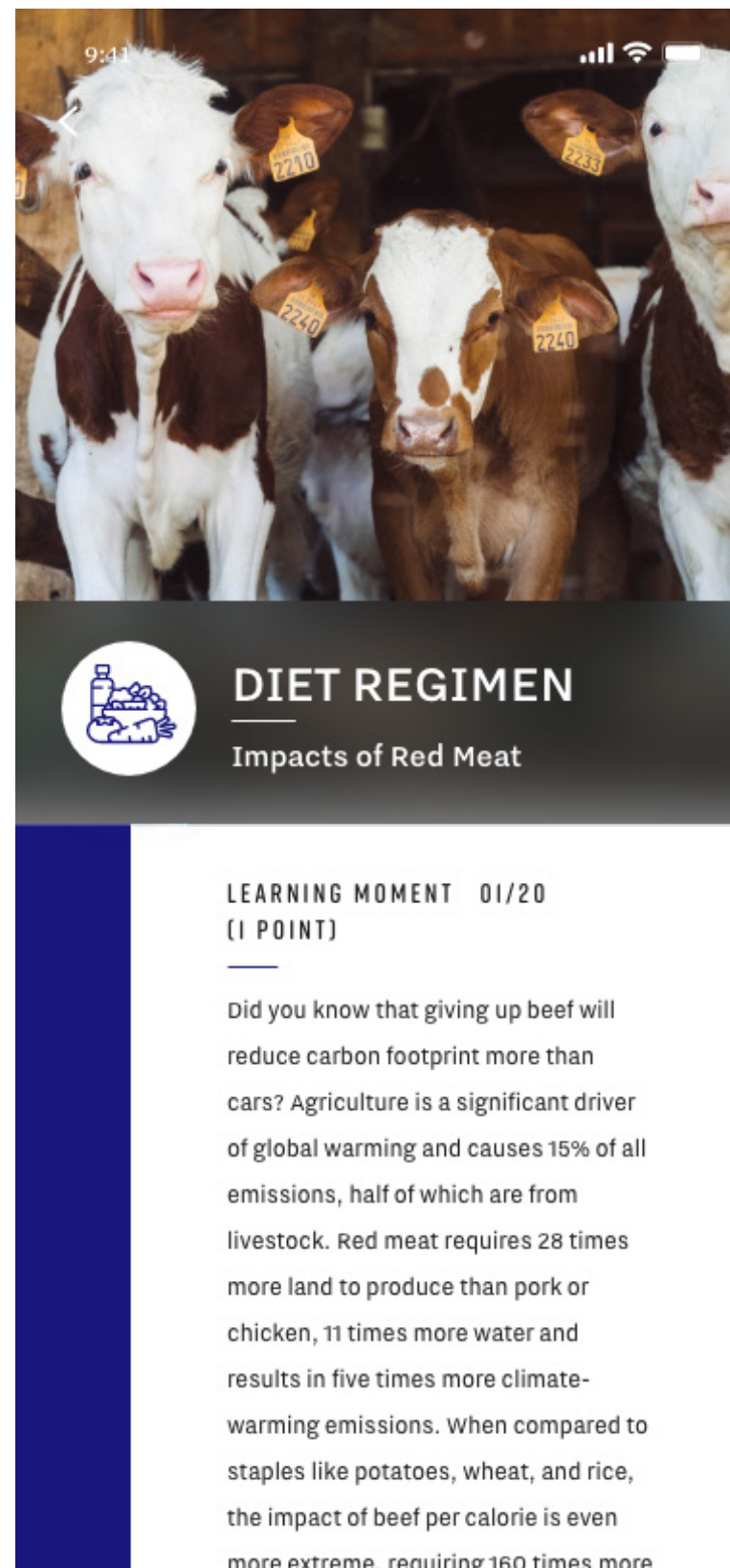
A Daily Regimen

The daily regimens are the structure of the sustainable curriculum. For every action item, a learning moment will be prefaced to give the user a background, reference,

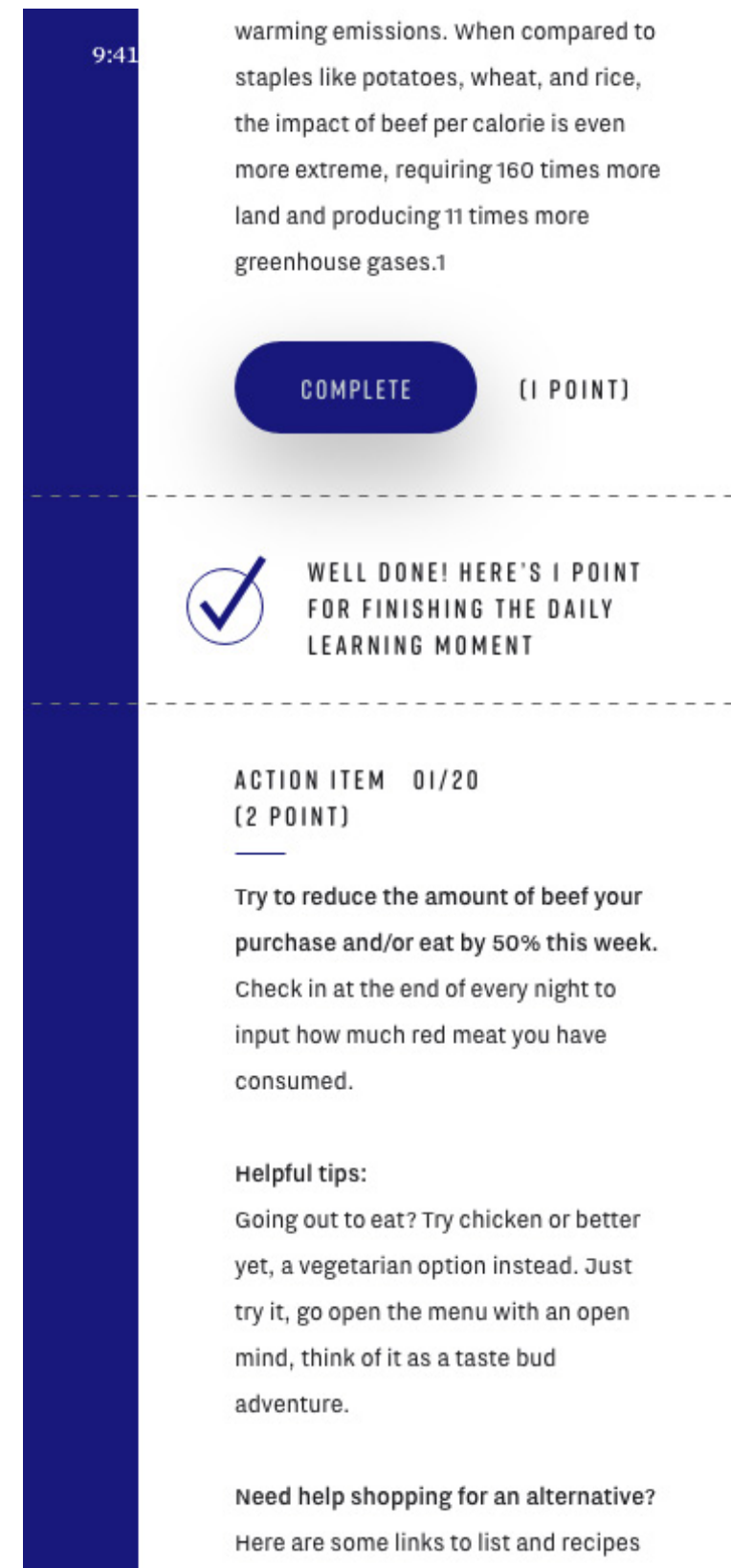
baseline, and fundamentals of the topic. The learning moment will then be directly related to the action item by providing a direct action.

Begin Daily Regimen (within a category)

Learning Moment (1:0) ————— Action Item (0:1)

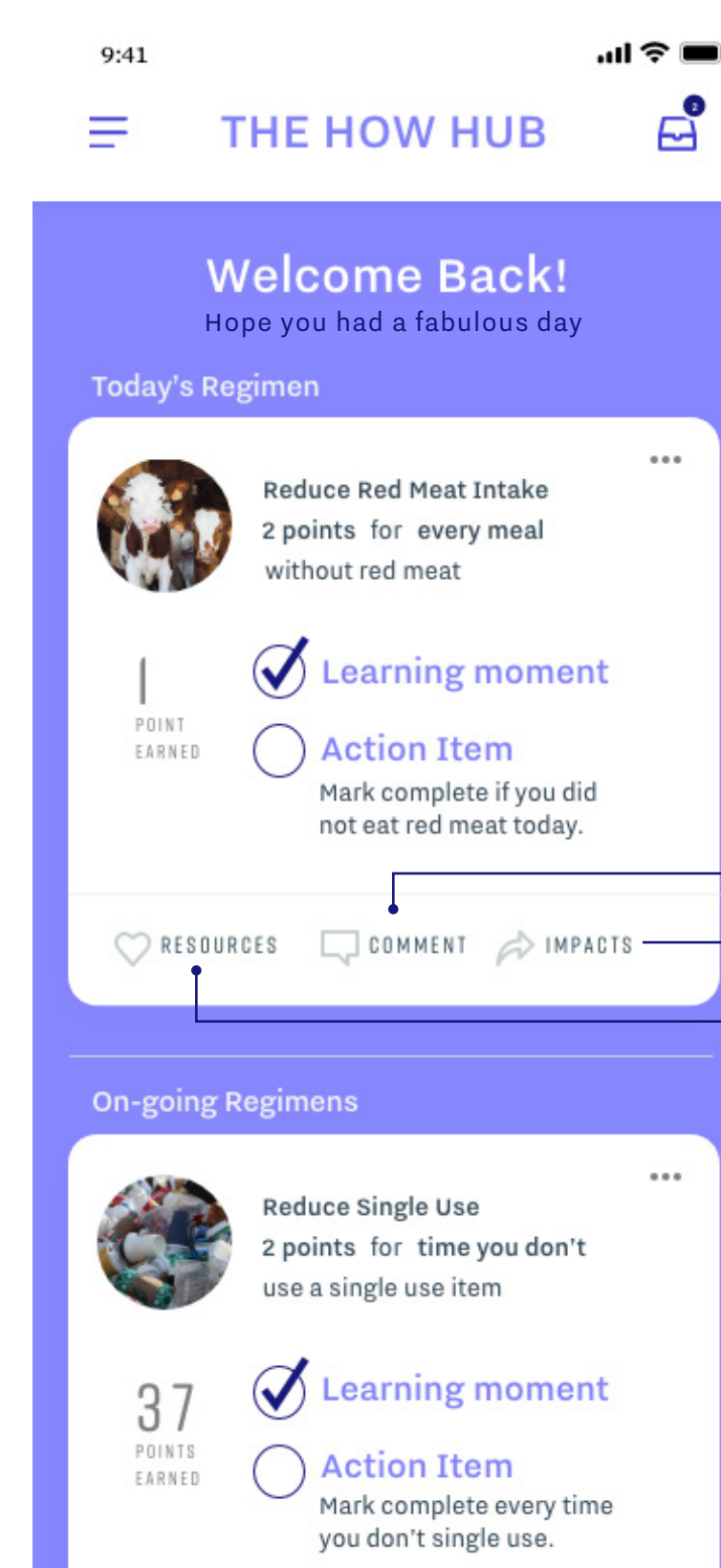


The learning moment component of each regimen plays a vital role in setting the context for the user to give them a greater awareness of their impacts. It will offer a short but informative reading and links to other learning resources (i.e., vetted articles, news, or blogs) if they want to learn more.



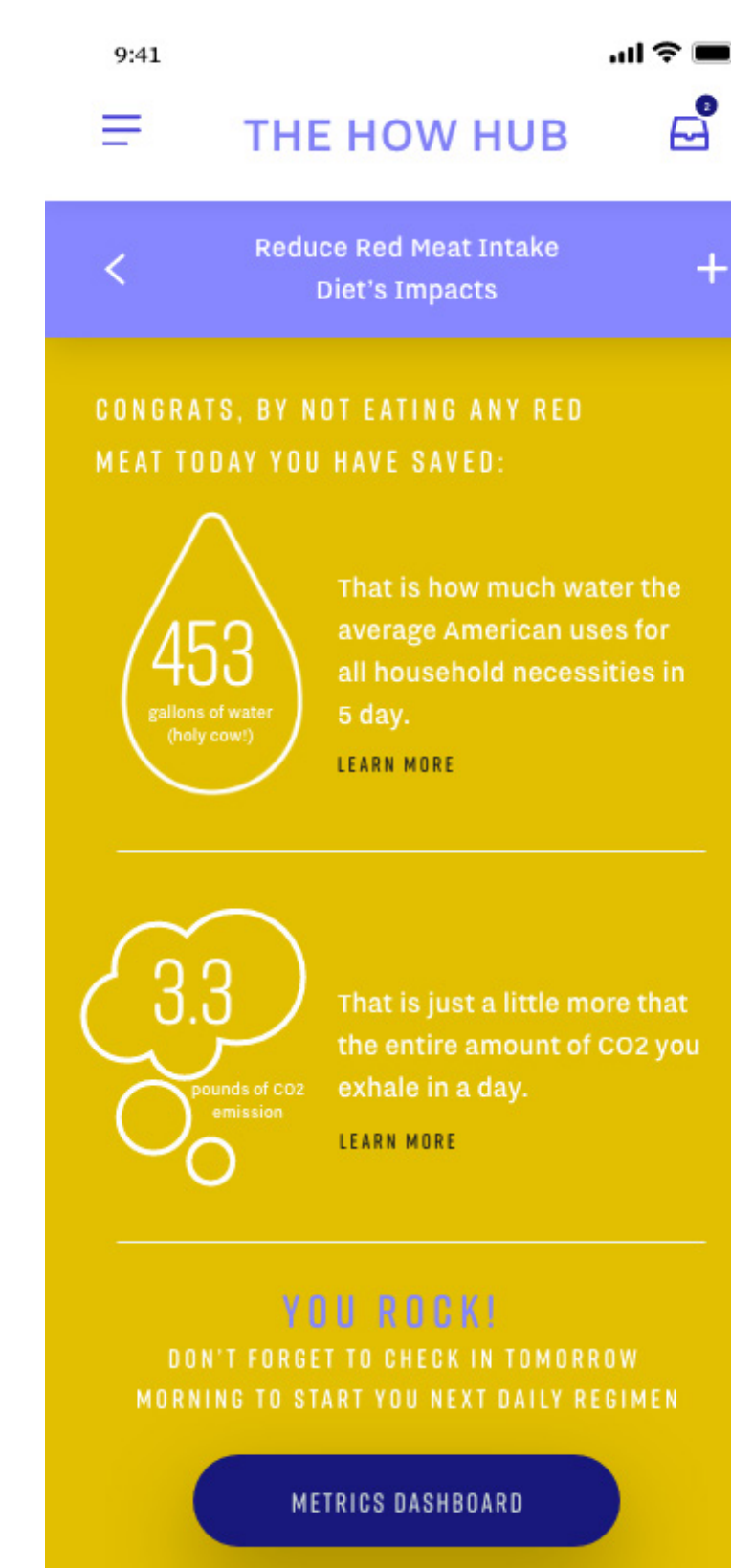
Once the user finishes reading the learning moment, they will mark it complete and earn the allotted points that are assigned to that learning moment. They will then begin their action item of the day. Completion of these two steps is the engagement goal of each day for the app per user.

Evening Check In



At the end of each day, the user will be prompted to return to the app via a notification (see page 27 for notification wireframes). Within this dashboard, they will check off the action items they completed for the day.

Impacts Explained Panel

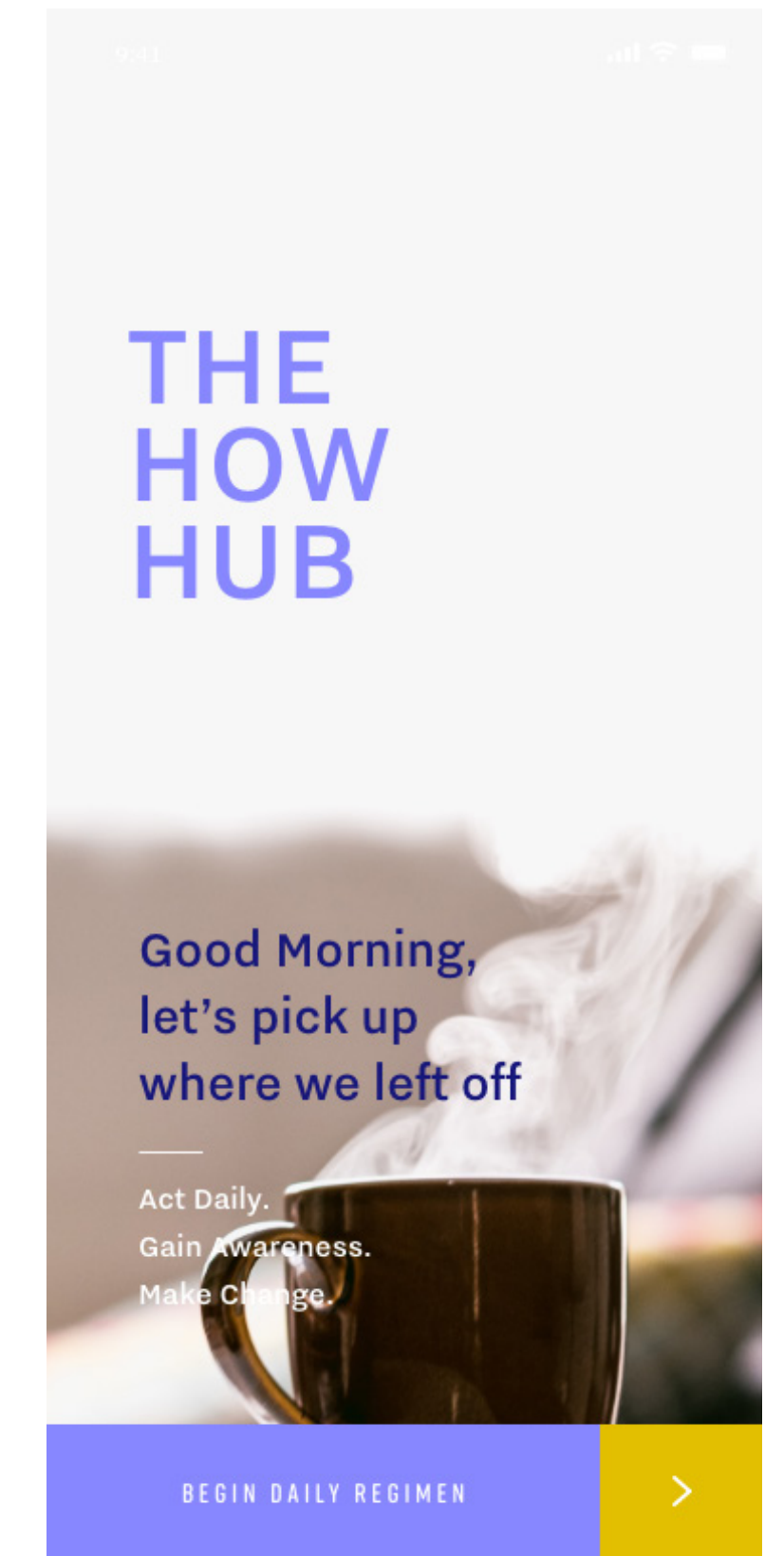


The impacts dashboard shows the relative metrics that relate to the specific regimen the user has just completed. Water, carbon equivalents, waste, fuel, and money saved are some examples of possible relevant metrics. Social metrics could also be considered here, such as a donation — more about metrics on page 25.

Users can comment on their experience or tag other users to connect with them.

Resources will be the index for the extra resources provided in this lesson plan.

Next Day Morning Greeting



Another strategy of the user behavior is to make an emotional connection to the user through personalized language, visually pleasing photography, illustrations, sound*, and motion*. *These aspects have not been defined within the scope of this project.

Lifecycle Inventory

LCI 1: Electricity - Impacts of Power Purchasing

Both data centers demand energy 365 days a year = 9,125 hours of power/year
 The functional unit is impacts per kilowatt hour
 This is a comparison of electricity location impacts

US Medium Voltage

Lifetime:
9,125 hrs/yr

Functional Unit:
Impacts / KWH
(kilowatt hour)

System Boundary:
Excludes hardware
Excludes cooling to offset heat generated

Materials:
US Med. V
230 V, with imported electricity

Manufacturing:
Non-Renewable Energy

Transport:
Grid

Disposal:
N/A

Input:
See Figure 1

Total Impacts:
1.0 Okala points/hour used

Euro Medium Voltage

Lifetime:
9,125 hrs/yr

Functional Unit:
Impacts / KWH
(kilowatt hour)

System Boundary:
Excludes hardware
Excludes cooling to offset heat generated

Materials:
Euro Med V.
230 V, with imported electricity

Manufacturing:
Non-Renewable Energy

Transport:
Grid

Disposal:
N/A

Input:
See Figure 2

Total Impacts:
0.7 Okala points/hour used

Okala Impact Assessment Form					date
designers Olivia Pedersen			product lifetime 9,125 hrs / 1 yrs		
product concept name Electricity Purchasing USA		system boundaries Excludes cleaning during use	functional unit (default: impacts/ hour) Impacts / Kilowatt Hour		
BILL-OF-MATERIALS	AMOUNT	UNIT x	OKALA FACTOR POINTS	UNIT =	OKALA IMPACT POINTS
US Medium V.	10,000	/KW-h -24hrs	0.92	/KW-h	9200
					Total impact / lifetime
$\frac{\text{Impacts / product lifetime}}{\text{lifetime hours}} = \text{Impact / hour}$ $\frac{9200}{9,125} = 1.008219178$					9200

Figure 1

Okala Impact Assessment Form					date
designers Olivia Pedersen			product lifetime 9,125 hrs / 1 yrs		
product concept name Electricity Purchasing Euro		system boundaries Excludes cleaning during use	functional unit (default: impacts/ hour) Impacts / Kilowatt Hour		
BILL-OF-MATERIALS	AMOUNT	UNIT x	OKALA FACTOR POINTS	UNIT =	OKALA IMPACT POINTS
Europe Medium Voltage	10,000	/KW-h -24hrs	0.66	/KW-h	6600
					Total impact / lifetime
$\frac{\text{Impacts / product lifetime}}{\text{lifetime hours}} = \text{Impact / hour}$ $\frac{6600}{9,125} = 0.7232876712$					6600

Figure 2

Conclusion

Hosting the app at a data center in Europe has proven to have a lesser impact (by almost a third) than data center electricity usage in the USA. A screening of the impacts of each country would be an effective tool to further weigh the location of the app's data center.

LCI 2: Electricity - Impacts of Power Purchasing

Both data centers demand energy 365 days a year = 9,125 hours of power/year
 The functional unit is impacts per kilowatt hour
 This is a comparison of electricity source impacts

US Medium Voltage

Lifetime:
9,125 hrs/yr

Functional Unit:
Impacts / KWH
(kilowatt hour)

System Boundary:
Excludes hardware
Excludes cooling to offset
heat generated

Materials:
US Med. V
230 V, with imported electricity

Manufacturing:
Non-Renewable Energy

Transport:
Grid

Disposal:
N/A

Input:
See Figure 1

Total Impacts:
1.0 Okala points/hour used

Wind

Lifetime:
9,125 hrs/yr

Functional Unit:
Impacts / KWH
(kilowatt hour)

System Boundary:
Excludes hardware
Excludes cooling to offset
heat generated

Materials:
Wind 800 KW

Manufacturing:
Renewable Energy

Transport:
Grid

Disposal:
N/A

Input:
See Figure 2

Total Impacts:
0.05 Okala points/hour used

Okala Impact Assessment Form					date
designers Olivia Pedersen			product lifetime 9,125 hrs / 1 yrs		October 30, 2019
product concept name Electricity Purchasing USA			system boundaries Excludes cleaning during use	functional unit (default: impacts/ hour) Impacts / Kilowatt Hour	
BILL-OF-MATERIALS	AMOUNT	UNIT x	OKALA FACTOR POINTS	UNIT =	OKALA IMPACT POINTS
US Medium V.	10,000	/KW-h -24hrs	0.92	/KW-h	9200
					Total impact / lifetime
$\frac{\text{Impacts / product lifetime } 9200}{\text{lifetime hours } 9,125} = \text{Impact / hour } 1.008219178$					9200

Figure 1

Okala Impact Assessment Form					date
designers Olivia Pedersen			product lifetime 9,125 hrs / 1 yrs		October 30, 2019
product concept name Electricity Purchasing USA Renewable			system boundaries Excludes cleaning during use	functional unit (default: impacts/ hour) Impacts / Kilowatt Hour	
BILL-OF-MATERIALS	AMOUNT	UNIT x	OKALA FACTOR POINTS	UNIT =	OKALA IMPACT POINTS
Wind 800 KW	10,000	/KW-h -24hrs	0.049	/KW-h	490
					Total impact / lifetime
$\frac{\text{Impacts / product lifetime } 490}{\text{lifetime hours } 9,125} = \text{Impact / hour } 0.05369863014$					490

Figure 2

Conclusion

Powering the data center(s) that hosts the app with wind energy would reduce impacts by 50%. By using renewable energy the impact of the data center is cut in half which is a sizable decrease in greenhouse gas emissions! Fully renewable powered data centers would be a goal to work toward and in the interim renewable offsetting would be an effective segue.

LCI 3: Transportation - Impacts of Furniture Shipping

Both chairs deliver 10,000 hours of use.
 The functional unit is impacts per cubic foot.
 The packaging of each chair is recycled after delivery.

Lumber Hardwood

Lifetime:

Home Office Chair
 1000 hours/year x 10 years =
 10,000 hours (of use)

Functional Unit:

Impacts / Cubic Feet

System Boundary:

Excludes cleaning during use
 Excludes assembly materials

Materials:

Wood - lumber

Manufacturing:

Rough, kiln dried

Transport:

Truck

Disposal:

Re-purposed, back to mfg

Input:

See Figure 1

Total Impacts:

0.007 Okala points/hour used

Timber Hardwood

Lifetime:

Home Office Chair
 1000 hours/year x 10 years =
 10,000 hours (of use)

Functional Unit:

Impacts / Cubic Feet

System Boundary:

Excludes cleaning during use
 Excludes assembly materials

Materials:

Wood - timber

Manufacturing:

Sawed, planned, dried

Transport:

Ocean Freight

Disposal:

Landfill

Input:

See Figure 2

Total Impacts:

0.03 Okala points/hour used

Okala Impact Assessment Form					
designers Olivia Pedersen					date October 30, 2019
product lifetime 10,000 hours (of use)					
product concept name Wood chair local (made in the USA)			system boundaries Excludes cleaning during use Excludes assembly materials	functional unit (default: impacts/ hour) Impacts / Cubic Feet	
BILL-OF-MATERIALS	AMOUNT	UNIT x	OKALA FACTOR POINTS	UNIT =	OKALA IMPACT POINTS
Lumber, Hardwood	4	/cu. ft.	4.3	/cu. ft.	17.2
Truck, 3.5-7.5t	50	/mile	1.1	/ton. mi.	55
Corugated Board, secondary	2	/lb	0.57	/lb	1.14
Wood Glue	0.5	/lb	1.1	/lb	0.55
					Total impact / lifetime
					73.89
$\frac{\text{Impacts / product lifetime (73.89)}}{\text{lifetime hours (10,000)}} = \text{Impact / hour (0.007389)}$					

Figure 1

Okala Impact Assessment Form					
designers Olivia Pedersen					date October 30, 2019
product lifetime 10,000 hours (of use)					
product concept name Wood chair local (made over seas)			system boundaries Excludes cleaning during use	functional unit (default: impacts/ hour) Impacts / Cubic Feet	
BILL-OF-MATERIALS	AMOUNT	UNIT x	OKALA FACTOR POINTS	UNIT =	OKALA IMPACT POINTS
Lumber, Timber	4	/cu. ft.	5.2	/cu. ft.	20.8
Ocean Freight	5542	/miles	0.053	/ton. mi.	293.726
Corugated Board, secondary	2	/lb	0.57	/lb	1.14
Wood Glue	0.5	/lb	1.1	/lb	0.55
					Total impact / lifetime
					316.216
$\frac{\text{Impacts / product lifetime (316.216)}}{\text{lifetime hours (10,000)}} = \text{Impact / hour (0.0316216)}$					

Figure 2

Conclusion

The number of miles the wooden chair has to travel is the biggest impact determiner. If a person could purchase a chair from a local carpenter (within 50 miles), a 50% less impact would result. The impact assessment shows that the truck has more of an impact however, because it travels less miles overall it has a drastically smaller impact.

The wood source is the next biggest impact determiner. If purchasing in the US, a chair built from US NW wood, would be the next detail to check for the purchaser. Sourcing US wood has a smaller impact than the overseas wood produces.

Design Development Metrics & Engagement

Metrics

The vision of the metrics on the How Hub app is a comprehensive tracker of all the impacts, outputs, and savings generated from the regimen actions. These metrics are a pillar of the user's success towards making behavioral transitions. As the behavior study proved, people need to feel that they are achieving goals as well as see the difference they are making as they grow.

Current sustainable metric or impact trackers were reference to guide and help design these metrics.

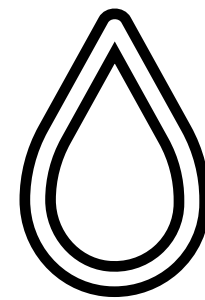
This list includes:

- Lifecycle Analysis see Appendix D, page 48-49
- Precautionary Principle
- Full lifecycle approach

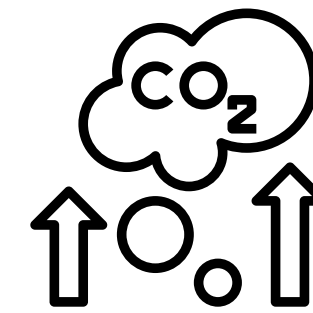
Metric: Functional Unit Measurement

The first level of measurement is the action's output or input measurement totals. These metrics will track the specific resources or impacts that their regimen actions result in (i.e. gallons of water saved, pounds of waste managed, etc.).

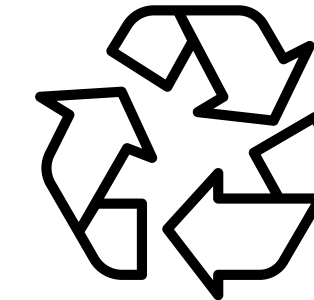
Note: these metrics will evolve and grow in complexity during the development of the app to make the metrics system as comprehensive and in-depth for continued user advancement.



Water Saved
by the gallon & ton



**Greenhouse Gas
Equivalents Reduced**
(CO₂ equivalents) by the
pound & ton



Waste Managed
by the pound & ton



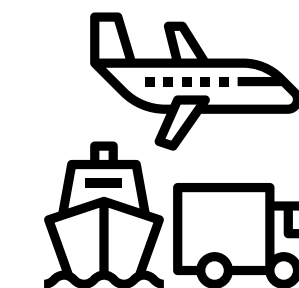
Compost Generated
by the pound & ton
(i.e. food saved)



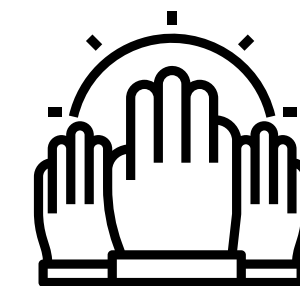
Money Saved
by the dollar
(i.e. utilities, appliances,
cost-effectiveness)



Single Use Avoided
by the pound & ton



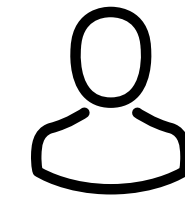
Transportation Offset
by the CO₂ equivalents
pound & ton



Donations Given
by the hour, pound,
or dollar

Metric: Actions Quantity

The second level of measurement is the action's quantity totals. This metric tracks the individual summary totals and compares it against different frequencies that the user could toggle through (i.e., individual, city, county, state, country, and global. Global meaning all users on app).



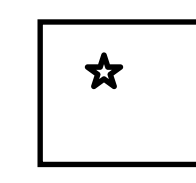
Individual



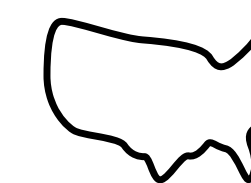
City



County



State



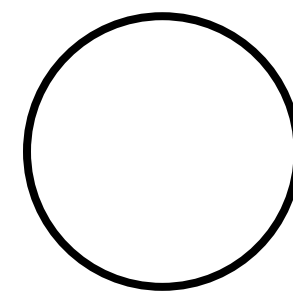
Country



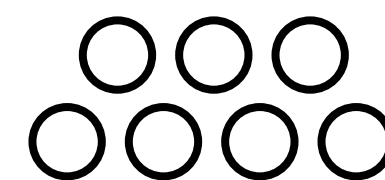
Global
(i.e. all app users)

Metric: Accumulative Totals

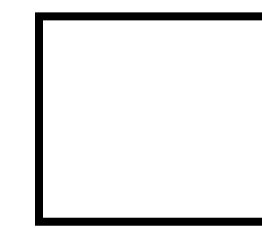
The third level of measurement is the action's accumulative totals. This metric tracks the individual growth from time of sign-up to date.



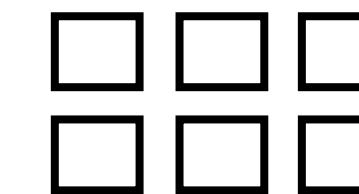
Day One
(the baseline, i.e. where the user started)



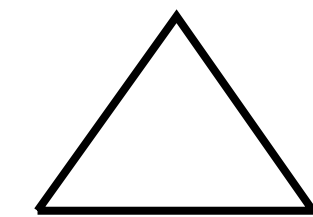
Milestone
(after one week of use)



Milestone
(after one month of use)



Milestone
(after one six months of use)



Milestone
(after one year of use)

Notifications System

Notifications are an important contact point for the user because they encourage and remind them to continue to use the app. Additionally, these notifications are important because they may be the only external contact the user could have with the How Hub tool. Currently, there are two forms of notifications that could be used to make continual contact with the user: phone push notifications and email notifications.



Photos credit left to right:
Jamie Street / Unsplash
Lloyd Dirks / Unsplash



Mobile Push Notifications

Morning Reminder: Check-In or Begin a New Regimen

Go to app to start a new daily regimen or continue a daily regimen already started.

Afternoon Reminder: Don't Forget to or Keep Going

Push notification as a reminder to stay focused and to remind them of what the regimen is for the day.

Evening Reminder: Check-In

Go to app to check-off completed action items, review metric boards or regimen impact panels.

Email Notifications

Welcome

This email congratulates the user on beginning their journey.

Features

This email explains all the app features, benefits, and outcomes.

Weekly Progress Reports

A weekly summary of how the user is doing, what they have accomplished, and review their metrics

Come Back // Continue

As in the Duolingo example below, this email would be an encouragement for a non-engaged user to start a new regimen.

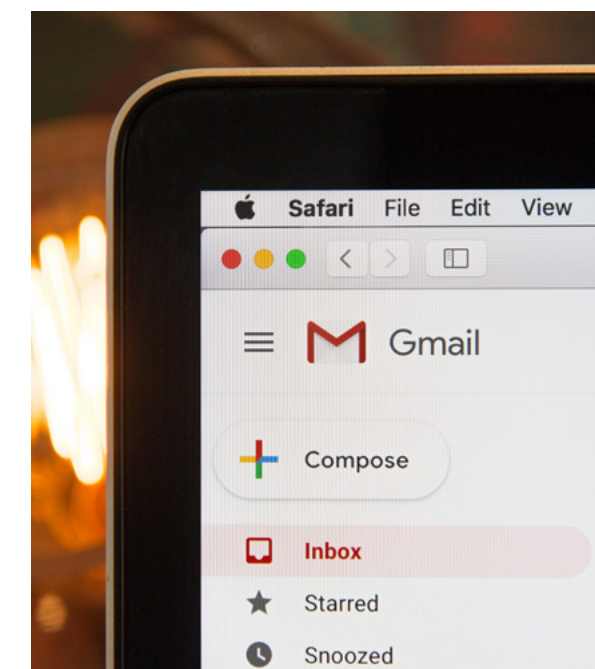
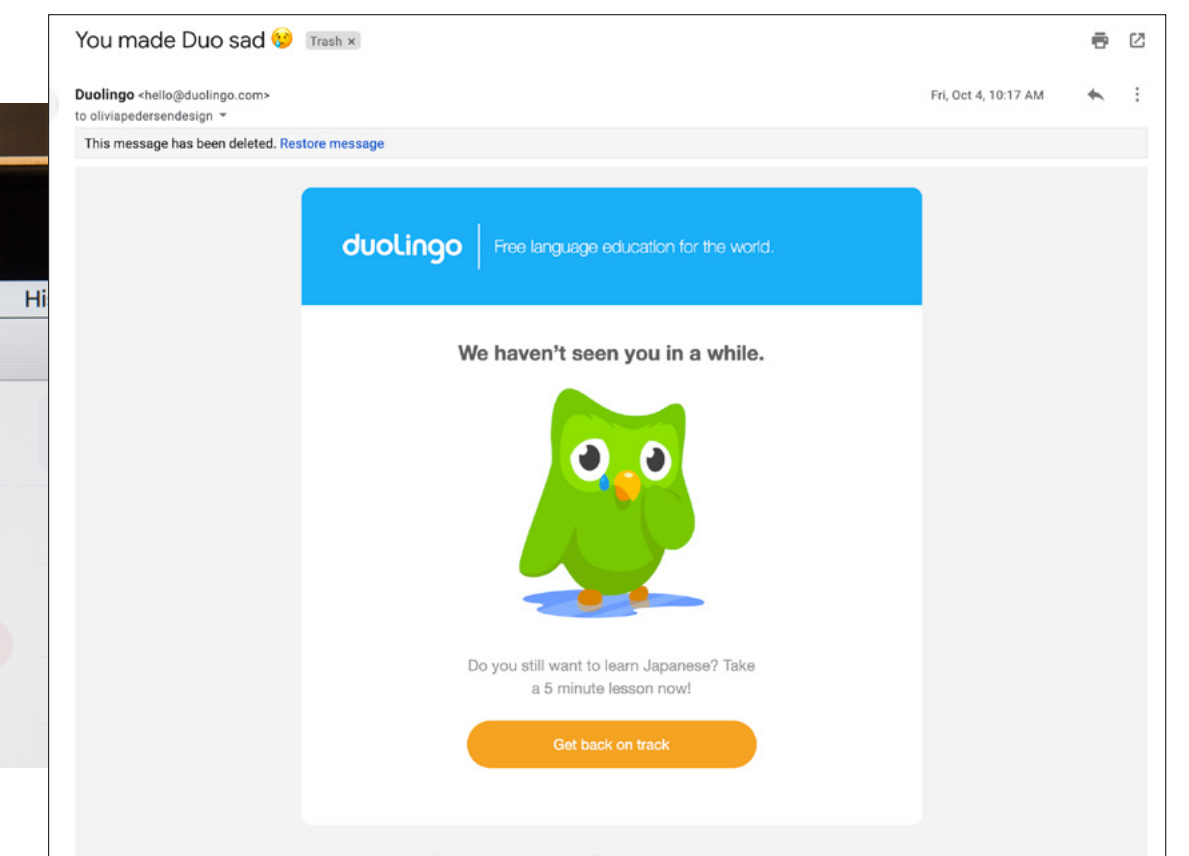


Photo by Web Hosting / Unsplash



R & D OF REGIMENS

R&D Categories Build Out: Food

Category	Topic (sub-category)	Guiding Principal	Lesson Plan = what / why	Action Item = How	Metric	Unit	Resources	Dig Deeper
FOOD		Not user facing (?)						
	Diet	Ecological Footprint	RED MEAT	Try to reduce the amount of beef your purchase and/or eat	Animal / H2O / GHG	points / gallons / pounds + tons	https://www.theguardian.com/environment/2014/jul/	Dig Deeper: Meat Calculator https://www.blitzresults.com/en/meat/
			FISH	consume only sustainable sourced fish / read consumer guide	Animal / H2O / GHG	points / gallons / pounds + tons	https://www.seafoodwatch.org/seafood-recommendations/	https://www.seafoodwatch.org/
	Sourcing	Conscious Consumption	Where you purchase from (industrial foods) CSA / Farmers Markets / Shared Value big box	Shop local	GHG / TF	points / pounds + tons / points	CSA : https://www.localharvest.org/csa/	Farmers Market Finder: https://www.yelp.com/search?find_c
	Storage	Conscious Consumption	Food storage in your home / what to store food	Get rid of single use / products you use to store food	RRR / MW	points / pounds + tons / points	https://earthhero.com/product-category/home/kitchen/food-storage/	
		Conscious Consumption	Food storage in your home / How to store food	Store fruits and vegetables properly	RRR / MW	points / pounds + tons / points	https://www.buzzfeed.com/peggy/27-ways-to-make-	https://www.self.com/story/genius-hacks-make-fresh-food-las
		Conscious Consumption	Seasonal food	long term food storage practices	MW	points / pounds + tons / points	https://homesteadlaunch.com/long-term-food-storage/	
	Waste	Circular Systems	Managing food waste	composting ? Upcycling? What to do with rotten food	MW	points / pounds + tons / points	https://www.wikihow.life/Manage-Your-Home-Waste	https://www.epa.gov/recycle/how-do-i-recycle-common-recycle
	Comparing Options	Material Health	GMOs explained: https://www.nongmoproject.org/	Look for labels of your food	TF	points	https://livingnongmo.org/	
			Understanding Food labels and certifications	Learn and look for these certs or labels	TF	points	https://foodtank.com/news/2015/10/ten-certification-agencies-creating-a-more-sustainable-food-system/	
	Eating Out	Social Footprint	Restaurants Certifications to look for	support shared values	TF	points	https://www.seafoodwatch.org/	https://www.dublininquirer.com/2017/01/31/mean-sustainable-dining/
		Conscious Consumption	Bring your own	ask for non-single use or byoTUBBERWARE	RRR // WM	points / pounds + tons / points	https://myplasticfreelife.com/2010/02/carrying-our-own-utensils/	https://www.foodandwine.com/news/california-bring-your-own-utensils/
	Food for Others	Social Footprint	Food crisis awareness	philanthropy action local philanthropy action national	DT or D\$	points / pounds + tons / points / -\$	https://www.worldhunger.org/world-hunger-and-poverty/	https://www.justfactsdaily.com/how-many-americans-go-hungry/

R&D Categories Build Out: Metrics Applied

Metrics Key	
Abbreviations	Metric
GHGs	Greenhouse Gas Emissions = CO2e
H2O	Water Saved
WM	Waste Managed
CG	Compost Generated
-\$	Money Saved
-1	Single Use Avoided
TO	Transportation Offset
D\$	Dontation Given
DT	Dontated Time
RRR	Reduce Reuse Recycle
TF // BP	Thinking Forward // Bigger Picture = Points for Affiliate Programs
SP	Social Pressure = Points to Affiliate Programs

CONCLUSIONS

Potential Impacts

In 2018, there were 500 million weekly visitors to the Apple App Store alone.²³ This number does not include other app stores, such as Google and Android. The app market is one of the biggest consumer bases, with a total of 194 billion app downloads in 2018.²⁴ If only 0.01% of total users downloaded and maintained engagement of the How Hub app, that is still roughly **19.4 million people using the app and making their lives more sustainable**. To further put this into perspective, if 19.4 million people engaged in a diet changing regimen of the app where they cut out red meat for only one day, that is roughly **8.7 billion gallons of water and 64 million pounds of CO₂e saved in just one day!** If that behavior were then repeated week after week, it would have tremendous results in resources saved. Duolingo, a language learning service app that falls into the tool category of apps (the same app category of the How Hub), hit 300 million users worldwide in 2018.²⁵ Even if the daily user count of the How Hub app were just 0.01% of the user quantity of Duolingo, the impacts would still be tremendous at 30 thousand users.

Next Steps

With the categories defined, mapping out the design of each category will be the next major step. All of the categories fall into their own ecosystems that will need to be addressed explicitly in the design of category-specific regimen structures. Regimens will teach users awareness in the guiding principals: ecological footprint, conscious consumption, circular systems, material health, and social footprint (discussed on page 13). To ensure this awareness, the design of each regimen structure will teach the user how to utilize one, if not all, of the principles. Building-out the app to a beta version so that user testing can begin will be vital to the final output of the app.

Bigger Picture

Near the end of the thesis research, it became clear that this concept is much bigger than just an app for its possible insights into user metrics, behaviors, and areas of development in sustainability innovation. However, the research, design, and development of the app will help make clear what the full potential is of this concept, especially once it is launched into the app market for user testing and feedback.

A sustainability innovation hub that focuses on building metrics and analyzing behavior changes to provide individuals with tools to help them make transitions towards sustainable futures is the long-term vision of this research project.



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T H A N K Y O U !

Business Development for a Sustainable Lifestyle App

Olivia Pedersen

SD-7620-10-W14 The Practice of Sustainable Design

Assignment 15.1

12/14/2019

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APPENDIX A

Component	Natural Environment		Raw Material Extraction			Material Processing		
Data Centers	Where does it come from?		Virgin Material	Input/Output	Detail	Process	Input/Output	Detail
Data Servers	Iowa, Virginia, So. Carolina		Land	Output	Paving the land for large server building/ energy storage	Electricity	Input	Electricity to power servers
				Output	70% of global internet traffic passes through here		Input	Cooling of data centers in hot and humid environments
				Input	Energy delivered, water for cooling		Input	
				Output	Heat from large servers running 24hrs a day		Input	
		Water		Input	Cooling		Input	
Component Manufacturing			Assembly & Packaging			Transport/Distribution/Purchase		
	Input/Output	Detail		Input/Output	Detail		Input/Output	Detail
Large computers	Output	Machines to serve data	Building	Input	Hosting huge quantities of racks	Utility power grid a	Input	Both A & B back up each other called a utility feed
Human work hours	Input	Security, privacy monitoring		Input		Utility power grid b	Input	
Racks	Output	Smaller individual servers = 1 unit/smaller servers		Input		OR Back up generator (replacing grid b)	Input	Diesel fuel. More affordable and common options
	Input			Input			Input	
Construction/Installation			Use Phase			Maintenance/Upgrading		
	Input/Output	Detail		Input/Output	Detail		Input/Output	Detail
AC switch gear	Input		Brown outs / black outs/ energy fluctuation	Input	Will turn on use of generators	Fans	Input	Cooling units, circulating air to keeps computers cool
	Input		UPS Batteries	Output	Backups to power generators	Heat	Output	Generated from racks constantly running
	Input		UPS Fly wheels	Output				
End of Life Scenarios								
	Input/Output	Detail						
Other	Input	Volts distributed						
Disassembly	Input							
Disassembly	Input							

Component Electricity	Natural Environment Where does it come from?	Raw Material Extraction		Material Processing	
		Virgin Material	Input/ Output	Process	Input/ Output
Incomes-Energy: Generation of the Incomes (primarily)	Virginia, Iowa	Coal	Input: Earth extraction, mining	Copper coils	Input: Coal and gas work in similar ways; they are both burned to heat water, which causes steam and turns the turbines
			Output: G-C emissions, we-mining and refining health		Input: Turbines
	West Virginia, Texas, Washington, Colorado	Lead	Output: Paving the road for large server building/energy storage	Turbines	Input: 70% of global internet traffic passes through it
			Output: 70% of global internet traffic passes through it		Input: Energy delivered, water for cooling
			Input: Energy delivered, water for cooling		Input: Heat from large servers running 24hrs a day
			Output: Heat from large servers running 24hrs a day		Input: Heat from large servers running 24hrs a day
	Natural Gas	Renewables	Input: Land reclamation	Renewable sources	Input: Solar panels
			Input: Solar		Input: Solar panels take photons from sunlight and convert it into electricity when semi-conductors
			Input: Wind		Input: Renewable energy sources such as hydropower and wind operate slightly differently; with either the water or the wind be used to turn the turbine and generate the electricity
			Input: Water/Wind		Input: Water/Wind

Component Manufacturing	Assembly & Packaging		Transport/Distribution/Purchase		
	Input/ Output	Detail	Input/ Output	Detail	
Electricity transport	Input: Electricity leaves generators and travels along power lines on the national grid	Generators stations	Output: Source energy delivered	Substation	Output: Electricity reaches a substation, where the voltage is lowered so it can be sent on smaller power lines
	Input: Electricity is made at a generating station by huge generators. Generating stations can use wind, coal, natural gas, or water.		Output: Distribution Lines		Output: It travels through distribution lines to server locations. Smaller transformers reduce the voltage again to make the power safe to use in homes. These smaller transformers may be metered
	Input: The current is sent through the wires to increase the voltage to push the power long distances.	Current	Output: Meter Measurement	Input: Connects to your building and passes through a meter that measures usage.	
	Input: no.t		Input: no.t		
	Input: no.t		Input: no.t		
	Input: no.t		Input: no.t		
Input: no.t	Input: no.t	Input: no.t	Service Panel		

Construction/Installation		Use Phase		Maintenance/Upgrading		End of Life Scenarios	
Input/ Output	Detail	Input/ Output	Detail	Input/ Output	Detail	Input/ Output	Detail
no.t	The electricity goes to the service panel	Output: no.t	Source energy delivered			no.t	Disassembly
Output: Electricity is demand	no.t	Input: no.t	The user is served by power			no.t	Disassembly
no.t		Output: Electricity travels through wires inside the walls to the outlets and switches				no.t	Disassembly
no.t		Input: no.t				no.t	Disassembly
no.t		Input: no.t				no.t	Disassembly
no.t		Input: no.t				no.t	Disassembly
no.t		Input: no.t				no.t	Disassembly

Component	Natural Environment	Raw Material Extraction			Material Processing		
Network Transmission	Where does it come from?	Virgin Material	Input/Output	Detail	Process	Input/Output	Detail
Transport of Internet/Data = Network Transmission	America, Europe		Input		Fiber Cables	Input	
	Iceland	Geothermal Energy	Output	Requires less electricity due to cold climate	Servers	Input	
			Input			Input	
			Input			Input	
			Input			Input	
			Input			Input	

Component Manufacturing			Assembly & Packaging			Transport/Distribution/Purchase		
Input/Output	Detail		Input/Output	Detail		Input/Output	Detail	
Input			Input					
IP Addresses	Contacts data centers servers and routers then to devices via IP addresses		Input					Packets
DNS			Input					
			Input		Fiber Cables	Output	Running through the ground, tractors and sea, ships	
			Input		Cell towers	Output	Electric magnetic waves	
			Input			Input		
			Input			Input		
			Input			Input		
			Input			Input		

Construction/Installation		Use Phase			Maintenance/Upgrading			End of Life Scenarios		
Input/Output	Detail	Input/Output	Detail		Input/Output	Detail		Input/Output	Detail	
Input		Input						Other	Input	
Output	Number does of 0's and 1's	Input	Protocols	Management of all data packets				Disassembly	Input	
Input		Input						Disassembly	Input	
Input		Input						Disassembly	Input	
Input		Input						Disassembly	Input	
Input		Input						Disassembly	Input	