ESG Home

Environment, Social, Governance and Home

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Abstract

As ESG and environmental issues stand out, not only companies and governments but also individuals' effort has been emphasized. Nevertheless, it's difficult to put into action due to not only insufficient will to act but also lack of real-life intimate measures. In terms of real-life pro-environmental acts, it has been proven that reducing 1 minute of shower for a year saves 4.3kg of CO2, which is the same as the carbon footprint 0.6 pine trees reduce. Thus, we propose a solution which is practical for individuals and has a positive effect on companies with respect to ESG. We suggest a system that reduces carbon emission through shortening shower time. The method's key function is to stimulate people to cut down their shower time by setting a limit of shower time. Based on personal data, our software can customize the analysis that predicts and sets every person's target shower time with regression models. Also with AI speakers and smart mirrors, we check, alarm and present shower time to the user. Afterward, people can check the total amount of reduced carbon emission through the application. By implementing our system, corporations can propose pro-environmental actions for individuals.

Role Assignments

Roles	Name	Task description & etc.
User	Choi HaYoung	She is interested in reducing carbon emissions at home. She uses a service that helps her reduce carbon emissions more easily in real life and checks if there are any inconveniences when actually using it.
Customer	Jang HyeongJun	After hearing the news about carbon emissions recently, he began to think about what he could do in his daily life. He looks for currently launched services that help reduce carbon emissions and compare and analyze similar services.
Software developer	Ko ByungChan	He is the one who plays the role of implementing the service as a real program. He focuses on writing codes to provide actual services.
Development manager	Yoon ChangIl	He manages the development schedule and organizes the service by reflecting the opinions of users and customers. Also

		he adjust the progress of the front and back ends based on the designed service.

I. Introduction

1. Motivation

Currently, the amount of all carbon emitted worldwide is very high. The emitted carbon itself cannot be recognized by human senses such as sight and touch. Therefore, even though a very large amount of carbon is being emitted, many people do not feel the need to actually reduce carbon. However, this large amount of carbon is causing abnormal climates and abnormal phenomena, causing direct damage to people. To solve this problem, many countries around the world are actively working to reduce carbon emissions. Each country is putting pressure on companies by implementing various policies for this purpose, and government-led projects are also making efforts to reduce carbon emissions. Thanks to these efforts, Korea, one of the countries participating in solving this problem, recorded 727.6 million tons of carbon emissions in 2018, the highest ever, 699.5 million tons in 2019 and 648.6 million tons in 2020. At this time, the most recent carbon emission in 2020 was reduced by about 7.3% compared to 2019, demonstrating that Korea is actively participating in reducing carbon emission. However, according to the data released by the Ministry of Environment, while the total emission decreased by 7.3%, the emission amount within each household increased slightly. This shows that efforts to reduce carbon emissions have only been made by governments and numerous companies. Therefore, our team thought that the results of these efforts would be very effective if we could reduce carbon emissions within each household as well as governments and businesses. For this, it is effective to use the fully automatic system of the developing IT technology, but it would be good if more people realize that the carbon emission problem is serious and that they can reduce the carbon emission at home through their very minor efforts.

Therefore, we investigated ways to reduce carbon emissions in the home. And there are many ways to reduce it at home, but we have chosen the list while considering our technology and the convenience of users. In addition, governments run systems advantageous to the people who're trying to reduce carbon emission. We can double the effect of our service with these systems.

1st, Reducing shower time
(reducing average shower time by 1 minute)
Annual carbon dioxide -4.3 kg per person. If 10% of the total population in Korea => about -22,000 tons.

01 People take a shower every day. In order to take a shower, it is necessary to use a boiler to warm the water and the water. Therefore, showers require a lot of energy consumption, and in general, people take showers without time limits, so they are used both in water and gas.

02 When taking a shower, the smart mirror is used, and when the user says that the user is taking a shower, the time of the smart mirror is changed to the target time timer. In addition, as time goes by, an alarm sounds periodically at a set time to give psychological pressure of time attack, and visually gives psychological pressure by changing the color displayed on the smart mirror.

2nd, Electric rice cooker insulation function
(9 hours a day on average)
(reduced by an average of 3 hours a day)
Annual carbon dioxide -142 kg & electricity bill save 4,710 won per month. And if 10% of the number of electric rice cookers supplied in Korea saves an average of 3 hours, carbon emissions of about 300,000 tons will be reduced.

01 In Korea, where rice is the staple food, it is used so much that 83% of electric rice cookers are supplied. And according to data from the National Statistical Office, each household

uses its thermal insulation function for an average of 9 hours a day.

02 If the cooked rice is subdivided and stored frozen, the time to use the thermal function can also be reduced.

3rd, Maintaining 60% of refrigerator capacity

If 60% of refrigerator capacity is maintained, the annual carbon dioxide emission per unit is reduced by 40 kg. And the electricity bill per unit is saved by 1,330 won per month. If 10% of the number of refrigerators supplied in Korea keeps this, annual emissions will be reduced by about 140,000 tons.

01 Refrigerators run 24 hours a day, 365 days a year, so they consume a lot of electricity.

02 The refrigerator is filled with 60% capacity so that cold air can circulate well, and the freezer is filled with cold air.

4th, Practice separate emissions

(calculated using greenhouse gas emissions when producing glass bottles, PET bottles, and cans) If separate emissions are well practiced, annual carbon dioxide emissions per person will be reduced by 88 kg. And if 10% of the domestic population keeps this, it will decrease by about 460,000 tons over a year.

01 Recycled wastes that are not properly separated and discharged are classified as remnants and incinerated or landfilled, so a lot of carbon is emitted during this process. If the quality of the selected products is improved by proper separation and discharge, high-quality recyclables are produced, incineration or landfilling is reduced, the recycling rate is increased, and the use of pay-as-you-go bags is reduced.(About 500 million won: 300 billion won worth)

02 Using methods related to separate discharge or separate discharge apps, they let you know the correct separate discharge methods for each recycled product.

< 재활용품별 분리배출 방법 >

투명페트병	내용물은 비우고 라벨을 제거한 후, 찌그러트려 뚜껑을 닫아 일반 플라스틱과 구분하여 배출
골판지박스	택배송장, 테이프 등 다른 재질을 제거한 후 접어 배출
신문·책자류	스프링 등 다른 재질을 제거한 후 배출
종이팩	일반 종이류와 구분하여 종이팩 전용수거함에 배출(수거함이 없는 경우 묶어서 종이류로 배출 가능)
플라스틱류	이물질·물기 제거 후 재질별로 분리배출(음료용기는 은박지뚜껑 제거, 몰티슈는 캡과 몸체 분리 등)
대형폐기물	가구, 전기장판, 옥매트, 악기, 안마의자 등은 대형폐기물로 지자체에 개인별 수거 신청(별도 처리수수료 부담)

• 재활용품으로 헷갈리기 쉬운 폐기물은 종량제봉투에 담아서 배출

씻어도 이물질이 제거되지 않는 용기류	치킨상자 속 기름종이, 컵라면 용기류, 음식물이 제거되지 않은 마요네즈·케찹통·기름통
오해하기 쉬운 분리배출 비대상 품목	과일망·포장재, 깨진병·판유리·조명기구, 도자기류(사기그릇), 고흡성수지 아이스팩, 보온보냉팩, 문구류(볼펜·사프·칫솔), CD·DVD, 고무장갑, 슬리퍼, 노끈, 기저귀·화장지 등
폐비닐류	음식물이 묻어 제거되지 않은 경우, 스티커 등 이물질이 붙어있는 경우, 은박비닐·이불커버·식탁보 등은 종량제봉투로 배출

참고 '내 손안의 분리배출' 앱

국민들이 헷갈리기 쉬운 재활용품의 올바른 분리배출 방법을 안내하기 위해 '내 손안의 분리배출' 앱 개발 보급(2018년 6월)

5th, Use of energy in each room

01 Control of proper temperature for cooling and heating : If the proper temperature for cooling and heating is automatically controlled, annual carbon dioxide emissions per household will be reduced by 167kg, and electricity bills will be saved by 3,417 won. If 10% of domestic households use it, emissions will be reduced by about 350,000 tons per year.

001 It is highly likely that the cooling and heating control was far from being used for the environment because it operated according to the user's will.

002 Since the energy control system built according to the smart home system automatically measures the amount of all energy used in each room, it is possible to control the indoor temperature and humidity by itself and reduce carbon emissions.

02 Shutting off standby power : If standby power is completely shut off, annual carbon dioxide emissions per household will be reduced by 82 kg, and electricity bills will be reduced by 2706 won. If 10% of domestic households use the system, it will reduce emissions by about 170,000 tons.

001 Regardless of the actual use of electronic products, there is power that is unnecessarily wasted even when the power is turned off.

002 In the energy control system built in accordance with the smart home system, since the amount of all energy used in each room is automatically measured, it is possible to reduce carbon emissions by blocking standby power by itself.

6th, Using low-carbon products

01 Installation of water-saving devices : Since water-saving devices can be saved from at least 20% to up to 66%, carbon dioxide emissions per household will be reduced by 26kg and water bills will be saved by 3,758 won per month. And if 10% of domestic households install water-saving devices, their emissions will be reduced by about 54,000 tons.

001 The amount of greenhouse gas generated until 100L of tap water is produced and supplied to households is 33g. According to data from the National Statistical Office, the daily water supply per person in 2019 is 347L. The annual greenhouse gas emissions per person to produce tap water are 42 kg.

002 Installation of water-saving facilities (finished products) such as water-saving showerheads and water-saving equipment (replacement or additional installation of accessories).

참고 절수 설비와 절수 기기의 비교

항목	절수 설비		절수 기기	
	(세면대) 센서형 절수 설비	(양변기) 소·대변 구분용	(세면대) 포말형	(양변기) 로탱크용
가격(원)	100,000~300,000 (제품에 따라 다양)	65,000	10,000	10,000
형태				
설명	인체감지 센서가 장착되어 감지될 경우에만 토출하는 설비	소변과 대변을 구분하여 토출할 수 있는 설비	토출되는 물의 양을 줄이는 동시에 수압은 일정하게 유지시키는 기기	양변기 내 사이펀기둥에 설치하여, 물을 내릴 때 같이 내려가 배수마개를 빨리 닫는 기기
고려사항	- 별도의 교체 작업이 필요하므로, 리모델링 시 적용 가능 - 별도의 공사비 소요		- 별도의 교체 작업이 필요하지는 않으나, 해당 설비에 맞는 제품인지 확인 필요	
절수효과	20~66% 절수	33~66% 절수	20~66% 절수	33~66% 절수

출처 : 한국기후·환경네트워크, 2017, 온실가스 감축 진단·컨설팅 매뉴얼

02 Using high-efficiency home appliances : Using each home appliance (air conditioner, refrigerator, electric rice cooker, television, washing machine, dryer, air purifier) as a first-class efficient product reduces 202kg of carbon dioxide annually and saves 6,878 won per month in electricity bills. If 10% of domestic households meet this condition, emissions of about 320,000 tons will be reduced. (The number of products supplied in Korea except for dryers and air purifiers already exceeds the number of households in Korea)

001 The number of home appliances is on the rise, and all home appliances used in the home actually generate the most electricity consumption. (The number of air conditioners per household is 0.65 in 2013 -> 0.93 in 2016)

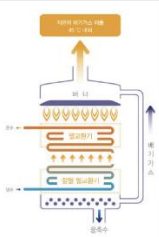
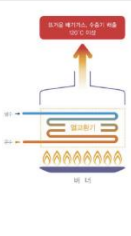
002 There are a total of 1 to 5 grades for efficiency grades, and the lower the number, the better the efficiency. Therefore, you can induce them to buy home appliances with a low number of efficiency grades.

03 Use of eco-friendly condensing boilers : If eco-friendly condensing boilers are used, carbon dioxide emissions per household will be reduced by 200 kg, and fuel costs will be saved by 10833 won per month. If 10% of detached houses in Korea use condensing boilers, emissions of about 130,000 tons will be reduced. (Considering that central heating and local heating are applied to apartment houses, statistics are applied only to detached houses.) (Additionally, the Ministry of Environment is carrying out a project to support the installation of low-nox boilers for households.)

001 Condensing boilers consume 28.4% less fuel than regular boilers and emit 79% less nitrogen oxides, the main cause of fine dust.

002 You can replace it with an eco-friendly condensing boiler.(200,000 won from the government)

참고 친환경 콘덴싱 보일러 특징

구분	친환경 콘덴싱 보일러	일반보일러
특징	- 미세먼지를 유발하는 질소산화물 배출을 저감하는 장치 장착 - 배출가스 열을 한 번 더 사용하여 에너지 효율 상승 - 응축수가 발생하여 보일러 설치 장소에 배수구 필요	- 응축수가 발생하지 않아 설치에 제한이 없음
질소산화물 배출농도(평균)	20ppm	173ppm
에너지효율(평균)	92% 이상	76~83%
구조		
환경표지	친환경	-

04 Using LED lights : Changing to LED lights will reduce carbon dioxide emissions per unit by 39kg per year, and save KRW 1,280 per month on electricity bills. If 10% of the number of fluorescent lamps supplied in Korea is replaced with LED lights, emission of about 520,000 tons will be reduced. (The total number of fluorescent lamps supplied in Korea is about 140 million and the number of households in Korea is about 20 million, so about 7 fluorescent lamps per household can be replaced with LED lights.)

001 Lighting is so high that it accounts for 30% of the total electricity consumed in buildings and houses. LED lighting can save up to 90% of power compared to existing lighting devices.

002 Light such as fluorescent lamps and incandescent lamps can be induced to be replaced with LED lights.

참고 LED조명 교체 관련 정보 <가정에서 사용하는 대표적인 조명형태와 대체조명>

기존조명				
구분	형광등			백열등
세부구분	직관형 형광등	콤팩트형 형광등	안정기 내장형 형광등	
조명형태				
소비전력	32W, 40W	36W, 40W	11W~30W	60W
가격(원)	3,000~4,500	2,000~5,500	3,000~5,000	판매중지
사용공간	거실, 방, 주방		화장실, 베란다, 현관	

▼

대체조명					
구분	안정기 내장형 LED (호환형)	안정기 외장형 LED	등기구 일체형 LED	등기구 일체형 LED	전구형 LED (안정기 내장형)
조명형태	직관형, 콤팩트형	직관형, 콤팩트형	직관형, 사각형, 원형, 십자형 등	원형 등 (직부형, 센서등)	전구형
안정기 결합형태	조명+안정기	등기구+안정기	조명+ 등기구+안정기	조명+ 등기구+안정기	조명+안정기
교체내용	등기구: 기존 조명: 교체	등기구: 교체 조명: 교체	등기구: 교체 (조명 포함됨)	등기구: 교체 (조명 포함됨)	등기구: 기존 조명: 교체
소비전력	16~27W	14~23W	14~60W	12~15W	8~15W
가격(원)	10,000~50,000	10,000~50,000	15,000~200,000	10,000~30,000	5,000~15,000
상세사진	(1)	(2)	(3)	(4)	(5)

05 Using low-carbon certified products :

001 Using low-carbon products : Using low-carbon products (when only bottled water is statistically calculated) reduces annual carbon dioxide emissions by 3 kg per person. If 10% of the domestic population uses it, it will reduce emissions by about 140,000 tons. (The Ministry of Environment is implementing the green card business and low-carbon product certification system.)

0001 Among the products that provide consumers with information on carbon emissions from production to disposal, the government certifies that greenhouse gas emissions are low-carbon products if they are below a certain standard and continuously reduce greenhouse gas emissions. Therefore, even if a product of the same item is purchased, purchasing a low-carbon certified product reduces carbon emissions.

0002 It encourages you to purchase products with a low carbon certification mark and allows you to check the list of low carbon certification products in the app. In addition, it provides consumers with information on carbon emissions generated throughout the entire process from production to disposal of products or services to consumers to feel the carbon reduction effect.

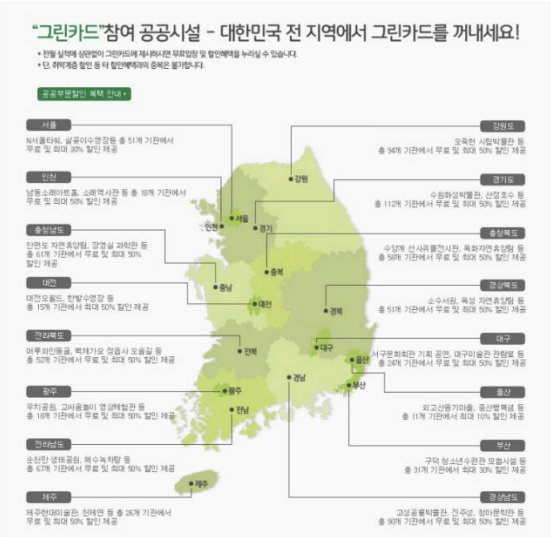
002 Low-carbon certified agricultural and livestock products : Using low-carbon certified agricultural and livestock products (when only apples are statistics) reduces annual carbon dioxide emissions by 1.4 kg per person. If 10% of the domestic population uses it, emissions of 0.70,000 tons will be reduced. (The Ministry of Agriculture, Food and Rural Affairs is implementing a low-carbon agricultural product certification system, and the Ministry of Environment is conducting a green card business.)

0001 Applying low-carbon agricultural technology reduces the input of energy and agricultural materials required during the entire production process, and using agricultural and livestock products that reduce greenhouse gas emissions reduces carbon emissions even with the same food ingredients.

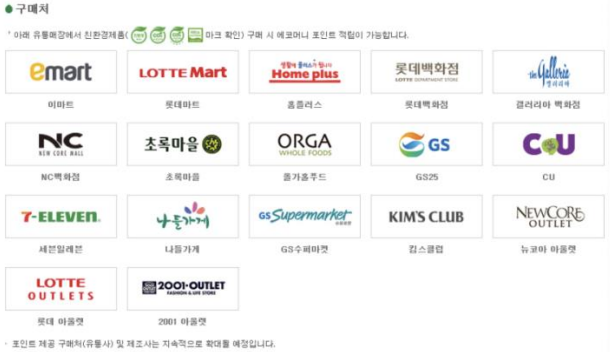
0002 It induces consumers to purchase foods labeled with low-carbon certified agricultural and livestock products, and allows consumers to recognize the carbon reduction effect on the products.

[Appendix] Economical rewards (eco-money and green card business)

1. Seoul Eco Mileage
(Program operated by Seoul Metropolitan Government) Earn up to 100,000 points per year when total household electricity, gas, and water consumption for 6 months is reduced by 15% compared to the previous 2 years (1 point = 1 won)
2. Carbon point system
(a program operated by the Ministry of Environment, nationwide except for Seoul) Earn up to 70,000 points per year when total household electricity, gas and water consumption is reduced by 10% compared to the past two years (1 point = 1) one)
3. Free admission or discount for public facilities
Presenting a green card when using public facilities nationwide provides free admission and various discounts.



4. Offline eco-money points accumulation
When you purchase eco-friendly products while shopping offline, eco-money points are accumulated on your green card.



In terms of individuals, each person can reduce carbon emission by various actions, such as shortening shower time, cutting out the energy use of their room and ect. For instance, everyone's daily shower requires a lot of water and gas to turn the water into hot water. Therefore, if users shorten their shower time, they will reduce both water and gas. According to the government agency related to carbon emission, if one user reduces the average shower time for a year by 1 minute, 4.3 kg of carbon is reduced. This is to create the carbon reduction effect that three pine trees produce for one year if all four-member families, the most common type of family, reduce by one minute on average. Also, people usually shower for an unlimited amount of time because there is no time limit when taking a shower. We hit that point. Each user set a customizable timer when taking a shower, and while taking a shower, an alarm sounds at predetermined intervals to feel a time attack. And when the user runs out of time, the result is notified as success or failure, and if successful, less time is given for the next shower turn. Even if the time given to the user is exceeded, this alarm does not actually give a penalty, so the user will not feel any physical discomfort. Also, according to a paper that studies the relationship between time limit and psychological pressure, there is a time attack no matter what action you take, and just by periodically recognizing it, psychological pressure is created, and time is reduced.

When it comes to the household, family members can reduce carbon emission through many ways, such as cutting down warming time in electric rice cookers, keeping the relevant amount of food in the refrigerator, recycling and using low-carbon products. Among them, the first method has the biggest effect on reducing carbon emission. Most Korean households use an electric rice cooker every day. This is because Koreans, whose staple food is rice, use an electric rice cooker to cook rice, and can eat warm rice at any time by using the electric rice cooker's warming function. However, it has been found that this rice cooker

consumes the most electricity for a year among all the electronic products used at home because of its warming function that allows you to eat warm at any time. According to the Ministry of Environment's announcement, if the electric rice cooker's warming function is used for 1 hour every day, 142 kg of carbon is emitted per year. In addition, it is stated that each household uses the rice cooker's warming function for an average of 9 hours a day. Therefore, if rice is made and stored frozen without using the keep-warm function, about 426 kg of carbon will be emitted less for a year. This warming function can be reduced by refrigerated storage after making rice. (For reference, it is said that the more food the freezer is filled with as much food as possible, the lower the carbon emission.) It is said that frozen rice can be thawed in a microwave at any time and eaten, can be stored for a long time, and it is more delicious because the moisture in the rice is preserved than rice using the keep-warm function. In order to induce this, it is linked with the electric rice cooker so that the weight inside the rice cooker can be detected. And when the rice is made, the weight of the inside of the rice cooker can be grasped in real time so that the user can transfer the amount of rice as desired.

2. Problem Statement (client's needs)

a. According to the Greenhouse Gas Information Center in 2018, it emitted an average of 14.1 tons of carbon per person. Compared to the 1990s, the rate of increase is 107%.

b. ESG, especially environmental issues are one of the key elements in corporate evaluation. It means that companies' environmental responsibilities are strengthened and thus they are trying to promote such projects.

c. 75.4% of the respondents said they are interested in environmental improvement. Nevertheless, domestic carbon emissions are constantly increasing which means the common people are having difficulty practicing carbon-neutral life.

d. 90.5% of the public are taking the climate change problem seriously and 41.6% of the public are aware that carbon emission from energy usage is the main reason. Although, only 58.7% of the public are striving to confront the situation. Most of the public are thinking about the carbon emission issue seriously, but their knowledge is not put into practice.[1]

e. It will ease people to put pro-environmental behaviors into action by helping individuals recognize the viable act and reminding it.

f. Applications that help reduce carbon emissions require users to remember and record all actions on their own which is too much of a hassle. It is needed to process all these indirectly and automatically.

g. We are going to get individual's personal information from the users and suggest customized eco-friendly actions that they can put into actions in daily lives.

h. Our software presents the overall amount of reduced carbon dioxide emission in each household through the application, which can lead to more effort of people in carrying out the pro-environmental acts we propose.

i. For instance in household actions' effect, cutting down one minute shower time, it reduces carbon emissions by about 4.3kg.

j. Our ultimate goal is to reduce carbon dioxide emission. Moreover, the company that conducts our software can have a positive effect on the environment and their ESG. Also, individuals can solve their frustration derived from being unable to put their thoughts into action.

3. Related Software

a. Time Your Shower

Time Your Shower helps users to spend less time in the shower. Users can insert their average shower time and goal shower time. It beeps every thirty seconds to alert users. By using this app repeatedly, naturally, users can expect to reduce shower time and quickly become a habit.

It is designed to be very intuitive and easy for anyone to use. However the developer should have added more functions to be more complete. It is almost the same as a regular smartphone timer which users would not feel the need to download.

b. NMF.earth

NMF.earth is a nonprofit and community driven project. The goal of this app is to understand and reduce people's carbon footprint. The founders know that tracking CO2 emissions is not a new idea, but the aim is to create an enjoyable and user-friendly interface, an app that is easy to use for everyone. To be specific, it tracks and calculates emissions related to transport, food, electricity and streaming. When users record their behavior, the amount of carbon emissions is calculated and it's able to check how much carbon they emit every day. Furthermore, NMF.earth provides a sustainable guide to reduce carbon emissions.

The project was initiated by Pierre Bresson and 25 developers, 4 designers and 10 translators have built the application. They are self-funded via Kickstarter and sponsored by the people which means that making money is not the main purpose.

The fatal disadvantage is that users have to record each and every action themselves. Not only does it come as an inconvenience, people who are not interested in the environment are bound to give up. Plus, there will be a lot of errors in the recording process. Compare to us, we automatically identify and record the user's behavior to record carbon emissions. Based on this, it provides customized guides for reducing carbon emissions and guides users in practical helpful directions.

c. Capture : Carbon Footprint & CO2 Tracker for Travel and food

Capture is a free0to-use CO2 tracker that helps users to learn more about emissions from everyday mobility and dietary choices. Using a GPS-based algorithm, with users' permissions, it automatically calculates the amount of carbon emitted in the process of moving by taking users' location information whether users are taking a car, bus, plane or bicycle. After calculating the carbon emissions, users are able to check the average monthly carbon footprint and how much users decrease emissions compared to last month. Moreover, offset purchases with carbon offset effects such as planting trees are possible. It also provides guidance on carbon emissions and environmental news so that users can learn more and get closer about carbon emissions.

Capture was launched in 2019 by CoFounders Aziz and Josie. The pair set-out to build a tool that would empower the growing number of people around the world who aspired to live a more sustainable life. They have six angel investors and three advisors that help with the operation. Their main profit structure is taking a 10% transaction fee on offsets.

Recording automatically through users' movements is a great advantage. What is unfortunate is that it is too limited. And when users use transportation like subways, where GPS signals do not work well, the application will not be able to record properly. Since the app is capturing users' GPS signals, ethical problems related to personal information may arise. Above all, it shows only the amount of carbon emissions, it does not provide a fundamental solution to how and what to reduce it. Users have to make their own decisions, but it is questionable whether it will be effective in emitting carbon.

II. Requirement Analysis

1. Main

As the user downloads our application and starts, the application presents the initial main page. Initial main page is shown only at the first execution of the application. It shows a tutorial slide, which explains the application's main functionality and effectiveness. After the user finishes reading the tutorial, the default main page is displayed. The default main page consists of sign in and log in buttons.

a. Tutorial Slide : prints out the main characteristics of the application.
   i. household-centered management
   ii. Carbon emission-cutting actions recommendation based on analysis on the user's life pattern
   iii. Brief visuals on the amount of the reduced carbon emission by the user, compared with previous usage.
   iv. Clicking '시작하기' button on the last slide of tutorial will advance the user to the main page.

b. Sign Up & Log in
   i. Main page consists the logo of the application and 2 buttons - '가입하기' and '로그인'.
   ii. Each button leads to '가입하기' and '로그인' page respectively.

2. Sign in

There are 2 options to sign in and authentication is conducted in the process. After signing in and authentication, the application will advance the user to the Home page.

a. Kakao log in
   i. Click the consent button for privacy in the KakaoTalk authentication page.

b. Application member log in
   i. ID and password input box : restriction on password (must include upper class, lower class and number & not less than 8 letters)
   ii. Automatic Log-in check box (default : uncheck)
   iii. Search for password : move to password searching page
   iv. Login button : log in when conditions are satisfied. (ID and password must be both entered)

3. Sign up

There are 2 ways to sign up. The sign up page consists of buttons for each way to register - new household register and participate in existing household. New registration registers a new household that registers for the first time. The number of family members are inserted in this case. If a new household is registered, the members of the household can participate in the household through 'register in the existing household'. ID, password and detailed information are entered during the registration. After the registration, user is moved to log in page.

a. New household registration
   i. Insert ID and password of the household registrant
      1. ID double-check
      2. Check the password restriction (must include upper class, lower class and number & not less than 8 letters)
   ii. Detailed information of the household registrant
      1. Name, age, sex and occupation
      2. Life pattern, such as shower and electricity

usage are inserted through the survey. The survey's objective is to check the amount of carbon emission in the household.

iii. Insert the family member's information
   1. Number of the family members
   2. New block appears if the user clicks a button for adding the family member

iv. Click register
   1. Error pop-up is shown when the ID and password restrictions are not satisfied

b. Participate in existing household
   i. Input box for household characteristic code
   ii. Insert ID and password of the present registrant
   iii. Insert detailed information of the present registrant
   iv. Click register

4. Home

Navigating page after login. Information on overall carbon emission reduction is presented.

a. Tab navigation bar located at the bottom of the page : Navigation bar that can locate user to the main functions(recommended act, records and user information)
   i. Navigation stacks are initialized when they are moved from the login page to the home page, so that users cannot go back to the login page.
   ii. If the user clicks the 'go back' button two times, the application is terminated instead of the navigation stack initialized twice.

b. Visual of overall carbon emission reduction : Overall reduced amount of carbon emission is displayed at the center of the page. Amount of real time carbon emission from the life pattern and the amount of reduced carbon emission are presented at the lower part so that users can compare them.
   i. Amount of carbon emission that the household has reduced is displayed.
   ii. If the reduced amount of carbon emission is zero, slogans that encourage users to do the conductions are presented.

c. Amount of total carbon emission is updated real-time so that users can notice their usage of energy.

5. Recommended action

Based on the detailed information which has been received at the time of registration, the application recommends customized practical actions that users can do in their home.

a. List of recommended actions : Recommended actions are displayed in list format. Users can check details of the action as they click an action block.
   i. When the action block is clicked, guidance of the action is explained : trigger expression for NUGU speaker and ways to check the amount of carbon emission reduced by the action.
   ii. Also, the user can check the average and user's carbon emission of the item he or she clicked. Bottom part displays the effect induced by the action.
   iii. By comparing the average carbon emission and the user's emission of each item, urgency is expressed by visual effects, such as colors.

b. Each action is linked with a NUGU speaker and smart electronics, so that practicing the actions are convenient.

c. Recommendable actions
   i. Shower
      1. When the user starts shower, he/she speaks to the NUGU Speaker and it starts 'one minute'.
      2. The NUGU speaker receives the user's target shower time from the server and

speaks to the user.

3. Simultaneously, a smart mirror presents left-over shower time with a timer.
4. Left-over shower time is periodically noted to the user.
5. Smart mirror displays various colors to give an awareness to the user.
6. At the last minute, the NUGU speaker speaks and the smart mirror shows that one minute is left
7. If the user finishes the shower in the target time, the NUGU speaker stops the timer
8. If the user exceeds the target shower time, the NUGU speaker notifies unsuccessfully.
9. User's shower time is sent and recorded to the server.
10. If successful, the NUGU speaker praises the user for reducing carbon today. And a thick tree appears on the smart mirror.

ii. Rice cooker
iii. Fridge
iv. Recycling
v. Low-carbon products

d. Following page only notifies the recommended actions. Actual practices are recorded through the verbalness to the NUGU speaker.

i. NUGU speaker notifies the start of action to the server when the user speaks trigger expression to NUGU speaker.
ii. Server activates the following function of the action and sends a corresponding reply to the NUGU speaker.
iii. When a NUGU speaker receives that reply from the server, the NUGU speaker notifies the user that the action is normally started.
iv. When the action is over, NUGU notifies it to the server.
v. Server manages the related information such as the duration with the time of request receipt, calculates the amount of reduced carbon emission and saves the information in the database.

6. Records

Page that displays an overall reduced amount of carbon emission. Users can check the monthly reduction with a calendar and pie chart shows the amount of reduction intuitively. Also the details of each item are displayed under the pie chart.

a. Calendar : It is located under the top tab bar and the daily reduced carbon emission is recorded in the calendar. Users can check which month to display the month's monthly reduced carbon emission.

i. There is a arrow button located at right and left end that can shift the month. User can alter the month by clicking the button. Current displaying year and month is shown at the center, in format 'yyyy.mm'.
ii. When the user chooses the month, the amount of reduced carbon emission of the month is displayed.

b. Pie chart : Reduced amount of carbon emission is visualized in pie chart.

i. Each action's proportion of reduction is shown in the pie chart.
ii. Each action has separate background colors
iii. If the month's reduction is zero, an exception slogan and blank chart is printed.

c. Details of each item : Amount of cut out carbon emission of each action in the selected month is specifically explained.

i. They are listed in descending order, depending on the proportion in the pie chart.
ii. Reduced carbon emission is precisely shown with their units.

7. MyPage

This is a page where you can view and edit the

information of all members of your household. Of all lists of members, users can click on a specific member to view detailed information.

a. Members : All household members are displayed.
   i. Only a household registrant who first registered the household can delete the member of the household. When the user clicks a member block. modal shows the specific information of the member. The delete button resides at the bottom of it.
   ii. Users can add household members by clicking the add button in the upper right corner.
   iii. The total number of household members is shown at the top of the page.
   iv. Members who have not joined yet appear as empty blocks.
   v. Users can invite members through the household's characteristic code shown at the top of the page.

b. Information : Users can check their information by clicking on the block of corresponding name in the list.
   i. Displays information such as name, age, and gender.

c. Setting : Users can edit their information by clicking the gear icon located at right side of the top tab.
   i. Users can modify the information by clicking the relevant information. The information block changes to the input text box.
   ii. Modified contents are saved when the user clicks the save button located at the upper right side of the tab bar.
   iii. Modified contents are saved only when the restrictions are satisfied. (blank disallowed)

III. Development Environment

1. Choice of software development platform

a. development platform
   i. Windows 10 : Windows are most commonly used operating system in Korea. Among them, Windows 10, is used since Windows 11, the latest version, currently has stability problems.
   ii. Mac OS Monterey : It is a Unix-based operating system and it used to use the Xcode. Xcode verifies that the application is operating in an iOS environment.
   iii. Android 6.0 & up (api version 23 & up) : Application test environment, developed with React Native, which is a cross platform. Minimum version follows Kakao Talk, which is supported in Android 6.0 & up.
   iv. iOS 11 & up : Among the application environments, iOS is used. Minimum version follows Kakao Talk, which is supported in iOS11 & up.
   v. Linux Ubuntu server 20.04 : Server environment which is driven by Amazon ec2 cloud computing service. Linux is optimized for running server in multi user operating system

b. Language / Framework
   i. Python / Django :

   Python - multi-paradigm programming language that supports both procedure-oriented and object-oriented programming. Also, quick development can be made through simple grammar, dynamic typing and garbage collectors.

   django - Through the vast amount of libraries that already exist, it is possible to develop repeated core functions quickly. In addition, user can solve problems quickly via official documents and other communities . It reduces the user's workload by creating database

tables as classes.

ii. Javascript / React Native v0.66 :

Javascript - Javascript is an interpreter or JIT compilation programming language that is widely used in script language for pages and non-browser environments such as Node.js. Users can obtain lots of reference materials in that javascript is the most commonly used programming language.

React Native : React Native is a cross-platform development tool that satisfies the conditions for supporting both Android and iOS operating systems since the expected application user is a household unit. With the concept of a component that emphasizes V among mvc patterns, fast development through code recycling is possible. Because it is client side rendering, front end developers can easily and actively develop. With large community, it is possible to solve problems quickly.

iii. SQL : SQL is created to manage data in a relational database system, which is used to directly access the database and modify data.

c. Software

i. Visual Studio Code : Widely used code editor, developed by Microsoft. It is a scalable code editor that provides convenient functions that exceed the level of code editors through a wide variety of extensions. We will be using extensions related to Django, Javascript and React.

ii. Android Studio : Integrated development environment for Android development. We don't use Android studios to write code, but we're going to use Android simulators to be sure it works in Android. Or if it is necessary to utilize the Android native functions within React Native, we will use Android studio only in that part.

iii. Xcode : Collection of OS X's development tools developed by Apple. It will be used to test code written reactively in an iOS environment using an iOS simulator in it.

iv. Git & Github : Git is a distributed version management system that manages file change and tracking multi user's access, and Github is a web service that hosts these flag stores. Since we are developing both front and back ends by two team members, collaboration is important. So to prevent code collisions, we must check each other's code. We will periodically integrate and manage code at remote storage through Github. Also, we will use git flow strategy to securely protect the integrated development code while sustaining concurrency

v. Github Action : Github Action is a tool that automates CI/CD. Currently, we do not need to deploy continuously and thus we will mainly use CI automation. When a commit is detected, the committed code is inspected through a preset process to help continuous code integration management. Also various test sets already existing in Github Action enable CI automation.

vi. Swagger : Swagger is an open source software framework supported by a large tool ecosystem that helps developers design, build, document and consume REST web service. Since REST api does not have standardized conventions, front end developers should always check the specifications of api according to back-end developers. We will define api standards more easily and check api standards through swagger.

vii. Notion : Multipurpose recording tools can create their own systems for knowledgement management, memo writing, data management and project management. We will manage the schedule using our own project schedule management template in Notion. We plan to adopt the agile method and build new

sprints every 3 days for speedy development.

viii. MySQL8.0.27 : Relational database system which has a framework for storing data. Since our application stores a large amount of user carbon emissions in format, MySQL has advantages. Also, MySQL is a frequently used program among RDBMS and since we learned this in our major, we can implement it quickly.

ix. MySQL workbench : Program that can manage database creation in MySQL and single development integration environment via GUI. It can develop databases easily through graphic based interaction and database schema through reverse engineering.

x. Tensorflow : Tensorflow is an open-source machine learning system developed by Google in 2015. Python allows you to develop artificial intelligence easily and quickly, and you can easily develop top artificial intelligence models through a large amount of libraries that already exist. It is also suitable for our team, which needs to be developed quickly as a platform that is very good for abstraction and visualization.

xi. NUGU playbuilder : NUGU playbuilder is a tool that helps developing service that executes in NUGU speaker. It enables machine learning by setting indent and entity inside conversation, actions on conversation and expected conversation during the development. Since every procedure of service is in GUI, developers who are not used to AI development can easily work on the service.

2. Software in Use

a. capture

Capture predicts monthly carbon emission based on car usage and diets and suggests 7% of deduction. It has similarity with our service in that it predicts the emission and suggests goal deduction. But our service not only proposes goal reduction but also recommends practical actions and provides contents that help put it into action. Also our service communicates with AI speakers in the process, which brings out the action more effectively.

3. Cost

4. Task distribution

IV. Specifications

1. Main

2. Sign in

3. Sign up

4. Home

5. Recommended action

6. Records

7. MyPage