

# Introduction

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In 1896, the Nobel Prize winner Svante Arrhenius first calculated how an increase in CO<sub>2</sub> levels could have a warming effect on our global climate (Anderson, Hawkins and Jones, 2016; Wulff, 2020). 120 years later, the Paris Agreement came into effect, with countries agreeing on non-binding targets on how to keep CO<sub>2</sub> levels 1.5 °C below pre-industrial levels (United Nations, 2016). While awareness of Earth's warming climate was growing, the CO<sub>2</sub> emissions kept rising too. The hockey-stick growth of CO<sub>2</sub> concentration since the industrial revolution is clear in the data from 1958 onward, following a steady annual increase, called the *Keeling Curve* (Keeling and Keeling, 2017). Written records of global temperature measurements are available starting from the 1880s when documentation of temperatures become available in ship records (Brohan et al., 2012). Temperature estimations from tree-trunks allow some temperature comparisons with the climate as far back as 2000 years ago (Rubino et al., 2019).

In 1938, Guy Stewart Callendar was the first to demonstrate the warming of Earth's land surface as well as linking the production of fossil fuels to increased CO<sub>2</sub> and changing climate (Hawkins and Jones, 2013). By the latest data from 2022, the current world population of 8 Billion people emitted 37.5 gigatonnes of CO<sub>2</sub> per year, the highest emissions recorded in history (Statista, 2023). To limit global warming to 1.5 °C as agreed by the world nations in Paris, removal of 5-20 gigatons of CO<sub>2</sub> per year would be needed according to reduction pathways calculated by the Intergovernmental Panel on Climate Change (IPCC) (Wade et al., 2023). Yet, most countries are missing the mark. Given this model of climate change, the G7 countries (Canada, France, Germany, Italy, Japan, United Kingdom, United States) are heading for 2.7 °C of warming by 2050 (CDP, 2022). The monumental task of removing several gigatons of CO<sub>2</sub> from the atmosphere requires massive policy shifts and collaboration across countries and industries (Mackler, Fishman and Broberg, 2021).

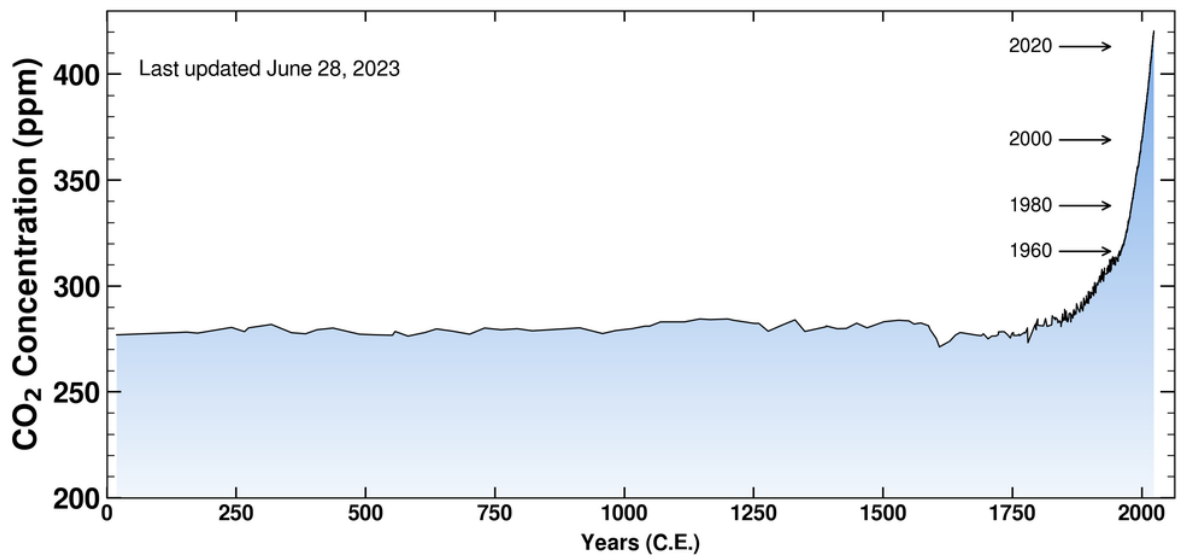


Figure 1: CO<sub>2</sub> concentration in the atmosphere. Image Credit: Scripps Institution of Oceanography at UC San Diego.

In addition the enormity of emissions, humanity is facing other massive problems. The Stockholm Resilience Centre reports we have already breached 4 out of our 9 planetary boundaries: in addition to climate change, biodiversity loss (Extinctions per Million Species per Year aka E/MSY), land-system change (deforestation, land degradation, etc), and biogeochemical flows (cycles of carbon, nitrogen, phosphorus, etc); on a positive side, the challenges of fresh water use, ocean acidification and stratospheric ozone depletion are still within planetary limits; atmospheric aerosol loading and the biodiversity intactness index (BII) have not yet been fully quantified (Persson et al., 2022).

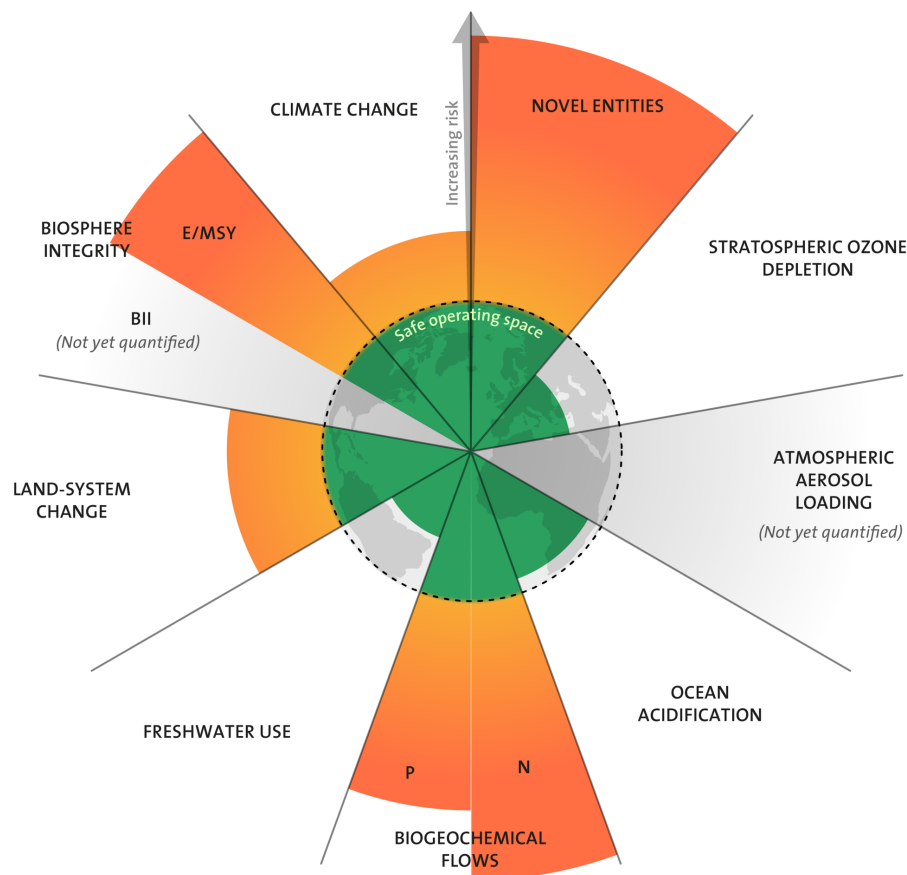


Figure 2: Planetary Boundaries. J. Lokrantz/Azote based on Steffen et al. 2015

## Research Relevance

If used wisely, money can help build communities of sustainable impact.

Defining the Problem Space.

This research is timely in 2023 because of the convergence of five trends:

Table 1: Current trends backing the relevance of this research project.

Trend
Growing environmental degradation
Young people demand for sustainability
Intergenerational money transfer to Millennials; relatively young people have money
Appearance of sustainability metrics and instruments such as ESG, B Corp, Green Bonds, etc

**There’s evidence young people have money.** In the U.S. alone, the combined annual consumer spending of generation-z and millennials was over 2.5 Trillion USD in 2020 (YPulse, 2020). Over the decade from 2020 to 2030, in the U.S., UK, and Australia, Millennials are projected to inherit 30 trillion USD from their parents (Calastone, 2020). There’s also some evidence of investment interest, however there’s large geographic variance. According to a Calastone (2020) study (n=3000) surveying people in the millennial age group between ages 23 and 35 in Europe (UK, France, Germany), U.S.A., Hong Kong, and Australia, 48% of respondents located in Hong Kong owned financial securities (such as stocks) while the figure was just 10% in France.

Table 2: From millennial investors (Calastone, 2020).

Place	Percentage of Financial Security Ownerneship
Hong Kong	48%
France	10%

Does individual climate action help?

- Gen-Z college students (target users) may not have the capital to make a financial dent today however they can be early adopter and they will be the decision-makers in a few years.
- “Like climate change, the focus on individual actions as a solution is often misplaced, though it remains a focus of media and industry. For decades, the petrochemical industry has offloaded responsibility onto individuals through promoting concepts such as the”carbon footprint”, championed in a 2004 advertising campaign by British Petroleum” Lavers, Bond and Rolsky (2022).
- Individual efforts are too small to matter unless they’re inspired by Community a effort
- atmospheric pollution and climate change
- The latest IPCC report Calvin et al. (2023)
- Dimock (2019)
- kora 95% <https://kora.app/>
- I, as the researcher, am similar to the blind people in the elephant story; focusing on greening shopping, saving, and investing are only the trunk of the enormous elephant that is environmental disaster unfolding in front of our eyes.

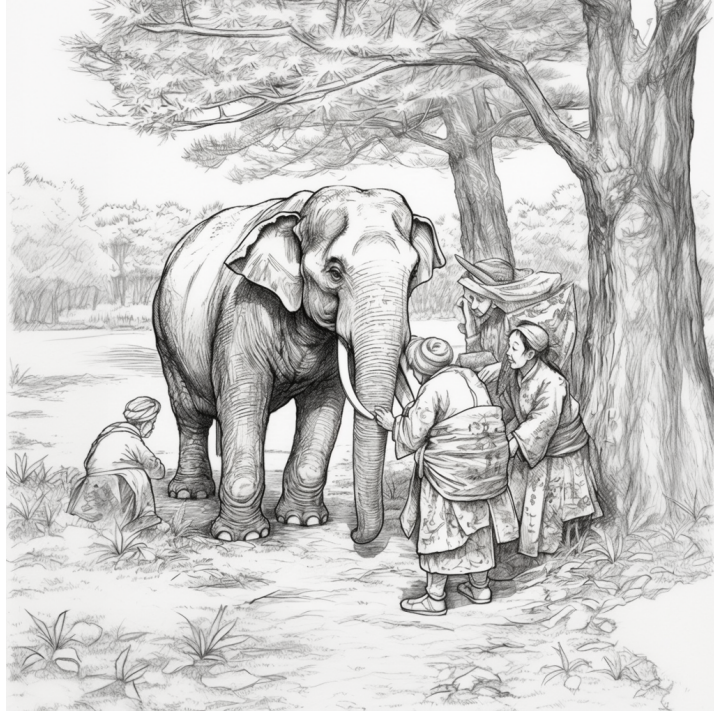


Figure 3: Illustration of the Jainist parable Anekāntavāda also known as “Blind Men and an Elephant”. Generated by Midjourney on August 17, 2023. Prompt: “A simple pencil-drawn illustration of the the story”Blind men and an elephant. The man touching the elephant’s trunk is a research scientist. Ohara Donshu, Itcho Hanabusa, Japanese woodcut Edo style”

## Research Background

I grew up reading science fiction books and their influence on my outlook towards future possibilities continues until present day. Star Trek has a portable device called a *tricorder* (fig. 1), which enables imaginary future humans fix all kinds of problems from scanning for minerals inside a cave to scanning human bodies for medical information. I would love to have such a device for consumer choices and financial decisions - to know what to buy and which businesses to do business with. Robots are already integral part of our lives; this thesis proposal was partially written using Google’s and Apple’s Voice recognition software, allowing me to transcribe notes with the help of an AI assistant.



Figure 4: Captain Sulu using a Tricorder (Star Trek) - Photo copyright by Paramount Pictures

As a foreigner living in Taiwan, I've relied extensively on Google Maps (which can be considered a type of AI assistant) to move around efficiently, including to find food and services, when writing in Chinese, Apple's text prediction algorithms translate pinyin to 漢字. Even when we don't realize it, AI assistants are already helping us with many of our mundane tasks. While it takes incredibly complex computational algorithms to achieve this in the background, it's become so commonplace, we don't even think about it. From this point of view, another AI assistant to help us with greener shopping decisions, saving CO<sub>2</sub>, and investing in more eco-friendly businesses doesn't sound so much of a stretch.

## Research Motivation

- This research takes place at the intersection of Taiwanese college students, sustainability, finance, AI, and design.

For the average person like myself, my experience with money is mostly limited to buying things at the supermarket. Food, clothes, furniture, soap, mobile phone. This leaves very few options on how to start with something new like saving and investing.

- Could the Green Supermarket become the entry point to Green Savings and Green Investing?
- Onboarding more people for sustainable practices is a complex interaction design issue hindered by ambiguous data (what is sustainable?) and messy human motivations (we love buying things).
- What can people who want to preserve Earth's environment, exactly do? How can networks of people come together?

- Health tracking apps paired with connected devices such as Apple Watch filled with sensors provide one model for simple interactions to dynamically track digital health data - also known as a quantified self. This data allows apps to provide tips how to improve health outcomes through small daily actions such as climbing more stairs. Small interactions allow users to align their goals with their actions.
- What would be a good interface to track sustainability? What is the user interface at scale, useful for billions of people?
- One way to influence societal outcomes is to decide where to put our money. While our financial decisions are a vote towards the type of businesses we want to support, is it enough?
- While some people are demanding sustainability, and some governments and companies are announcing green investment opportunities, how can consumers discover the most suitable investment options for their situation?
- How can retail investors access and differentiate between eco-friendly sustainability-focused investable assets?
- The level of knowledge of and exposure to investing varies widely between countries and people.
- Could linking green consumption patterns with sustainable investing provide another pathway to speed up achieving climate justice as well as personal financial goals?
- In this simplified scenario, I'm in a physical offline store, doing some shopping. When putting a bottle of Coca Cola in my basket, my ***AI companion Susan*** will ask me a personalized question:

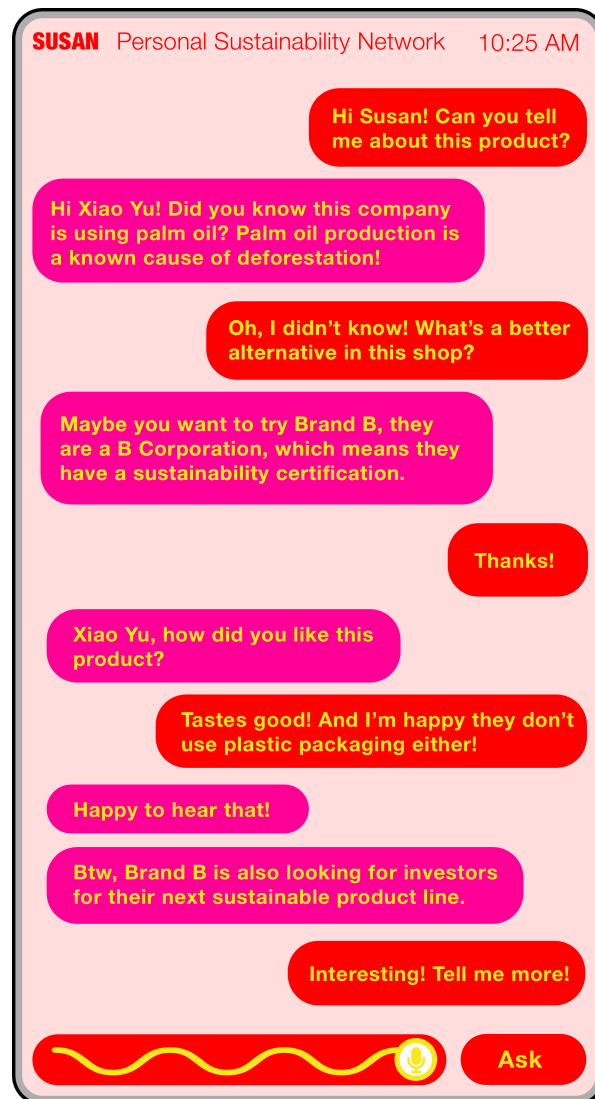


Figure 5: Early prototype of my Sustainable Finance AI Companion

## Research Objective

The study presents an AI companion design which seeks to help people build relationships with sustainability-focused companies. The major contribution of this study is an interactive artefact (a prototype) informed by design research.

It seems impossible to know which company is more sustainable than the other. We don't really know what's green, unless we spend a lot of time looking at the data. Environmental issues are caused by production and manufacturing processes of the companies that make the



products we consume on a daily basis. The companion enables people to be more transparent and responsible in their consumption behavior.

My interest lies in understanding how AI assistants can help conscious consumers become sustainable investors. The purpose of this study is to explore how to provide the best user experience to potential sustainable financial AI companion users. In their sustainability report every company looks perfect. How can people shop, save and invest sustainably? Where does our money go and what are some greener alternatives?

## Research Demographics

My research targets potential respondents according to the following criteria.

Criteria	
Location	Taiwan
Population	College Students
Count	700

Interviews with experts in finance and design, and a including a choice experiment between potential feature sets in consumption, savings, and investment.

Criteria	
Location	Global
Population	Experts
Count	5

## Research Questions

My research aims to answer the following questions.

Table 5: Table of research questions.

Nº	Question	Methods
1	How can artificial intelligence help college students take environmentally sustainable financial actions?	Literature Review
2	How can design assist sustainability?	Expert Interviews

№	Question	Methods
3	How to simplify AI interfaces help college students take sustainable financial action?	Student Survey