Introduction

Introduction

Consumer lifestyle contributes to environmental destruction. Ellen MacArthur Foundation, Material Economics (2019) models show 45% of CO2 equivalent emissions come from our daily shopping, produced by companies that make the products we consume.

- A survey of 1.2 million people by United Nations showing the percentage of people agreeing climate change is an **emergency** "The Peoples' Climate Vote | United Nations Development Programme" (n.d.)

Age	Percent
18-35	65%
36-59	66%
Over 69	58%

- In Anthony Leiserowitz et al. (2022), another large scale study on Meta's Facebook (n=108946), "Respondents in Spain (65%), Sweden (61%), and Taiwan (60%) are the most likely to say that climate change is mostly caused by human activities".

- The hockey-stick rise of CO2 concentration since the industrial revolution. Data from 1958 onward in Keeling & Keeling (2017) and estimations going back 2000 years from Rubino et al. (2019).

While people express eco-conscious ideas, it's non-trivial to practice sustainability in daily life.

Oboarding 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).

Health tracking apps paired with connected devices such as Apple Watch filled with sensors provide one model of simple interactions to build a **quantified self** in a dynamically track health data.

This data allows apps to provide tips how to improve health outcomes through small daily actions such as climbing more stair or drinking more water. Small interactions allow users to align their value with their actions.

What would be a good interface to track sustainability?

"Mapping the Gap" (2016) The global financing gap for low-carbon energy production in 2016 was 5.2 Trillion USD. The Rockefeller Foundation (2022) estimates the financing gap to be 2.5-3.2 Trillion USD in 2022. "Mobilizing Capital Into Emerging Markets and Developing Economies" (2022) The lack of funding especially affects emerging economies.

The theme for Earth Day 2023 was "Invest In Our Planet". *Earth Day 2023 - Earth Day* (n.d.)

Institute (2023) As on June 2023, fossil fuel based energy makes up 82% of energy and is still growing.

The Policy Context in Europe From 2023 to 2030

We have an opportunity to re-imagine how every product can be an eco-product and how they circulate in our circular economy.

Timeline of the Policy Context:

- In 2019 by the von der Leyen commission adopted the European Union (EU) **Green Deal** strategy.

- In 2021 the Commision proposed a goal of reducing CO2e emissions by 55% by 2030 under the *Fit for 55* policy package consisting of a wide range of economic measures.

- In November 2022, the proposal was adopted by the EU Council and EU Parliament with an updated goal of 57% of CO2e reductions compared to 1990. This proposal is set to become a binding law for all EU member countries (European Commission (2019b); European Commission (2019a); *EU Reaches Agreement on National Emission Reductions* (2022); European Council (2022)).

- In March 2022, the EU Circular Economy Action Plan was adopted, looking to make sustainable products *the norm* in EU and *empowering consumers* as described in European Commission (2022). Each product covered by the policy is required to have a ***Digital Product Passport*** which enables improved processing within the supply chain and includes detailed information to empower consumers to understand the environmental footprint of their purchases. It's safe to say the large majority of products available today do not meet these criteria.

European Green Deal

- *A European Green Deal* (2021)
- Switch2Green (2023)

It's up to legislators to provide sustainable products on our marketplace... but until we do, use the green filter.

- One of the EU goals is reducing consumption
- Tacking our consumption habits
- Europe is the hotbed of sustainability
- Iman Ghosh (2020)
- Lamoureux (2018) Florida sustainable companies
- MICHAEL HOULIHAN & BONNIE HARVEY (2018) customers prefer sustainable companies
- Rajagopalan & Landrigan (2023): In the US, the *Inflation Reduction Act* provides funding to development of decarbonizing technologies and includes plans to combat air pollution, reduce green house gases and address environmental injustices.

Ecodesign as Key Policy Tool

A large part of the proposal by Commission et al. (2014) is **eco-design**, as a large part of product lifecycle environmental impact is defined in the design process.

Table 2: The framework proposes 9 values to strive for in high quality products.

Quality		
Durable	Reparable	Easy to recycle
Reusable	Easy to maintain	Energy efficient
Upgradable	Easy to refurbish	Resource efficient

Research Relevance

- and protecting biodiversity
- Make a 'Sustainability Flywheel' graphic, like that of Amazon's

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

- Youth demand for sustainability
- Intergenerational money transfer to the youth
- AI user interface availability
- ESG instruments

- The current environmental upheaval, led by Generation Z, followed by Millennials, and the business adaptation (or lack thereof) to sustainable economic models, taking into account the hidden social and environmental costs we didn't calculate in our pricing before. The award-winning economist Mariana Mazzucato argues we have to include more into how we value unpaid labor (in Gupta (2020)), relating to the social (S in ESG).
- We also need to consider environmental effects (E in ESG). We haven't taken into account the whole cost of production, leading to the wrong pricing information. To achieve this, we need expert governance (G).

There's evidence young people have money:

- In the U.S. alone, the combined annual consumer spending of Millennials and Gen-Z was over 2.5T USD in 2020 (see YPulse (2020)).
- Calastone (2020): Over the coming decade, in the U.S., UK, and Australia, Millennials are inheriting 30T USD from their parents.

Mainstream technology penetration worldwide

- 80% of world population has a smartphone according to BankMyCell (2022) while 98% of Generation Z owns smartphone Global Web Index (2017)

- The latest IPCC report

- d@eyangeorgievGenStatisticsWhat2023: Only 30% of Gen-Z believe tech can solve all problems.

- Dimock (2019)

- kora 95%

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 imagined 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 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.

- As a foreigner living in Taiwan, I've relied extensively on Google Maps' AI assistant to move around efficiently, including to find food and services, when writing in Chinese, Apple's text prediction translates pinyin to hanzi. Even when we don't realize it, AI assistants are already helping us with many 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 linked to eco-friendly investing doesn't sound so much of a stretch.

In 1896, the Nobel Prize winner Svante Arrhenius first calculated how an increase in CO2 levels would have a warming effect on our global climate. 120 years later, in 2016, the Paris Agreement came into effect, with countries agreeing on non-binding climate targets, which a majority of countries are failing to meet. In August 2018, Greta Thunberg skipped school to start a climate strike in front of the Swedish parliament Riksdag. Millions of people joined Fridays for Future protests around the world (Deutsche Welle (2019)) and Time magazine named Thunberg person of the year in 2019 for *creating a global attitudinal shift* (Time (2019)). While awareness of Earth's operating systems is growing, the CO2 emissions keep rising.

- In January 2022, the Stockholm Resilience Centre reported that humanity had breached 4 out of our 9 planetary boundaries (Persson et al. (2022)). In addition to climate change, biodiversity loss, land-system change, and biogeochemical flows.

- Given these facts, what can people who want to preserve Earth's human-friendly environment, exactly do? How can networks of people come together solve climate change, curb deforestation, support mobility and green buildings, etc?

- One way to influence societal outcomes is to decide where to put our money. What is the user interface at scale, useful for billions of diverse users to make a meaningful impact? While our financial decisions are a vote towards the type of businesses we want to support, it's not enough to **switch to green**.

For the average person, our experience is limited with buying things at the supermarket. Food, clothes, furniture, soap, mobile phone.

- Green Supermarket
- Green Savings
- Green Investing

Research Motivation

- First, while young people are demanding sustainability, and progressive governments and companies are increasingly announcing green investment opportunities, how can consumers discover the most suitable investment options for their situation? How can potential sustainability-focused retail investors access and differentiate between eco-friendly

investable assets? The level of knowledge of and exposure to investing varies widely between countries.

- According to a Calastone (2020) study surveying 3000 Millennial people 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 or shares) in comparison with just 10% in France.

- Secondly, could linking green consumption patterns with sustainable investing provide another pathway to speed up achieving climate justice as well as personal financial goals? For example, 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 ***financial AI advisor Susan*** (fig. 2, above) will ask me a personalized question (fig. 3):

AI: "Kris, do you still remember Coca Cola's packaging is a large contributor to ocean plastic? You even went to a beach cleanup!" Me: "That's so sad but it's tasty!" AI. "Remember your values. Would you like to start saving for investing in insect farms in Indonesia instead? Predicted return 4% per year, according to analysts A and B." If I'm not so sure, I could continue the conversation. Me: "Tell me more" AI: "A recent UN study says, the planet needs to grow 70% more food in the next 40 years. Experts from 8 investment companies predict growth for this category of assets." Me: "Thanks for reminding me who I am" … Moments later. AI: "This shampoo is made by Unilever, which is implicated in deforestation in Indonesia according to reporting by World Forest Watch. Would you consider buying another brand instead? They have a higher ESG rating."

Figure 3: Speculative scenario of an interaction between a human user and a robo-advisor through the interface of chat messages in the context of retail shopping for daily products.

Research Objective

Where does our money go and what are some greener alternatives?

This is largely due to the production and manufacturing processes of the companies that make the products we consume on a daily basis.

- As people become aware of the impact their shopping is having on the environment, they become interested in finding alternatives to big brands and large companies. GreenFilter provides designers an AI companion design which helps people build relationships with sustainability-focused companies by providing personalized recommendations, giving product reviews and helping them shop sustainably. This new tool will empower consumers to make greener choices throughout their lives.

- An AI companion app that seeks to help people build relationships with sustainability-focused companies and enables people to be more transparent and responsible in their consumption behavior.

- GreenFilter introduces a novel, interactive point-of-sale technology that helps people make greener shopping decisions. The platform uses artificial intelligence to suggest green alternatives for products on your shopping list, and will also help you to find other companies that can make sustainable versions of the product you are buying.

- How can people shop, save & invest sustainably? 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.

- Green Filter helps you discover how to save money and the planet with your daily shopping. By providing an easy way for people to learn about and shop with sustainable companies, we imagine a world where people invest in their future, find great deals on responsibly-made products, and get useful discounts from socially responsible brands.

- GreenFilter is a product that combines AI, design and marketing to help people manage their social impact throughout the stages of their lives, from young adult years to retirement. Its primary goal is to give people the tools they need to invest responsibly in sustainable companies, while also educating them on this topic. Our project offers a responsive website and mobile app that leverages AI and other advanced technologies. In addition, our prototype includes a reality-based virtual assistant with voice command capabilities which can provide customers with new insights into the world of green finance

- My thesis is that a lot of people want to do good, shop eco-friendly, invest green, etc. But they don't believe the solutions work. They don't have trust. This is a user interface issue. How to build trust.

- Q: "it seems impossible to know which company is more sustainable than the other" we don't really know what's green?

- in their sustainability report every company looks perfect

- Better management of planet Earth

- How can wee Shop, Save, Invest in line ecologic principles and planetary boundaries? individual action doesn't move the needle. how to group together

- Individual efforts are too small to matter unless they're inspired by Community a effort

- App to build community

- Life within planetary boundaries

- Currently it seems there's a secret around how things are produced we want to increase transparency

- Companies that have nothing new nothing to hide should welcome this opportunity to mark themselves to keep a conscious consumers and investors.

- We want to create competition around sustainable practices enter widespread adoption

- Cigarettes and pictures of lung cancer every product should be required to have photos of production conditions switch such as Rainforest and deforestation the products that include Palm oil.

Research Demographics

- Branka Vuleta (2023)

- Deyan Georgiev (2023)

- 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.

- User survey with potential users, defined as living in Taiwan, in the age range between 18 and 35.

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

Survey respondents:

Key	Value
Location	Taiwan
Age	18-35
Occupation	Students

Research Questions

- My research aims to explore the following 3 research questions.

- What is the UI/UX of the green transformation?

№	Question	Methods
1	How can AI assistants empower sustainable shopping, saving, and investing?	Literature Review + Expert Interviews

№	Question	Methods
2	How to design an intuitive sustainable shopping, saving, investing app?	Literature review + Survey
3	What features do potential app users rate as the highest priority?	Survey + Prototype Testing with Focus Group

References

A European Green Deal. (2021). https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en.

Anthony Leiserowitz, Jennifer Carman, Nicole Buttermore, Liz Neyens, Seth Rosenthal, Jennifer Marlon, J.W. Schneider, & Kelsey Mulcahy. (2022). *International Public Opinion on Climate Change 2022.* Yale Program on Climate Change Communication.

BankMyCell. (2022). *How Many People Have Smartphones Worldwide.* https://www.bankmycell.com/blog/how-many-phones-are-in-the-world.

Branka Vuleta. (2023). Generation Z Statistics. In *99firms.* https://99firms.com/blog/generation-z-statistics.

Calastone. (2020). *Millennials and investing: A detailed look at approaches and attitudes across the globe.*

Commission, E., Energy, D.-G. for, Enterprise, D.-G. for, & Industry. (2014). *Ecodesign your future : How ecodesign can help the environment by making products smarter.* European Commission. https://doi.org/doi/10.2769/38512

Deutsche Welle. (2019). *Fridays for Future global climate strike.* https://www.dw.com/en/fridays-for-future-global-climate-strike-live-updates/a-50505537.

Deyan Georgiev. (2023). *39+ Smartphone Statistics You Should Know in 2023.*

Dimock, M. (2019). Defining generations: Where Millennials end and Generation Z begins. In *Pew Research Center.*

Earth Day 2023 - Earth Day. (n.d.). https://www.earthday.org/earth-day-2023/.

Ellen MacArthur Foundation, Material Economics. (2019). *Completing the picture: How the circular economy tackles climate change.* https://circulareconomy.europa.eu/platform/en/knowledge/completing-picture-how-circular-economy-tackles-climate-change.

EU reaches agreement on national emission reductions. (2022). https://ec.europa.eu/commission/presscorner/de

European Commission. (2019a). *A Sustainable Europe by 2030.* https://ec.europa.eu/info/publications/reflectio-paper-towards-sustainable-europe-2030_en.

European Commission. (2019b). *The European Green Deal.*

European Commission. (2022). *Circular Economy Action Plan: For a cleaner and more competitive Europe.*

European Council. (2022). *Fit for 55 - The EU's plan for a green transition.* https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/.

Global Web Index. (2017). *98% of Gen Z Own a Smartphone.* https://blog.gwi.com/chart-of-the-day/98-percent-of-gen-z-own-a-smartphone/.

Gupta, A. H. (2020). An "Electrifying" Economist's Guide to the Recovery. *The New York Times.*

Iman Ghosh. (2020). *Mapped: Where Are the World's Most Sustainable Companies?* https://www.visualcapitalist.com/most-sustainable-companies/.

Institute, E. (2023). Energy system struggles in face of geopolitical and environmental crises. In *Energy Institute.* https://www.energyinst.org/exploring-energy/resources/news-centre/media-releases/ei-statistical-review-of-world-energy-energy-system-struggles-in-face-of-geopolitical-and-environmental-crises.

Keeling, R. F., & Keeling, C. D. (2017). *Atmospheric Monthly In Situ CO2 Data - Mauna Loa Observatory, Hawaii. In Scripps CO2 Program Data.* UC San Diego Library Digital Collections. https://doi.org/10.6075/J08W3BHW

Lamoureux, E.-C. (2018). Notable Sustainable Companies in Florida. In *L'Autre Couleur.*

Mapping the Gap: The Road from Paris. (2016). In *BloombergNEF.*

MICHAEL HOULIHAN, & BONNIE HARVEY. (2018). *It's Official: Customers Prefer Sustainable Companies | Entrepreneur.* https://www.entrepreneur.com/growing-a-business/its-official-customers-prefer-sustainable-companies/324001.

Mobilizing Capital Into Emerging Markets and Developing Economies. (2022). In *BloombergNEF.*

Persson, L., Carney Almroth, B. M., Collins, C. D., Cornell, S., de Wit, C. A., Diamond, M. L., Fantke, P., Hasellöv, M., MacLeod, M., Ryberg, M. W., Søgaard Jørgensen, P., Villarrubia-Gómez, P., Wang, Z., & Hauschild, M. Z. (2022). Outside the Safe Operating Space of the Planetary Boundary for Novel Entities. *Environ. Sci. Technol.*, *56*(3), 1510–1521. https://doi.org/10.1021/acs.est.1c04158

Rajagopalan, S., & Landrigan, P. J. (2023). The Inflation Reduction Act – implications for climate change, air pollution, and health. *The Lancet Regional Health - Americas*, *23*, 100522. https://doi.org/10.1016/j.lana.2023.100522

Rubino, M., Etheridge, D., Thornton, D., Allison, C., Francey, R., Langenfelds, R., Steele, P., Trudinger, C., Spencer, D., Curran, M., Van Ommen, T., & Smith, A. (2019). *Law Dome Ice Core 2000-Year CO2, CH4, N2O and d13C-CO2* (pp. 255.62 KB). CSIRO. https://doi.org/10.25919/5BFE29FF807FB

Switch2Green. (2023). *The EU Green Deal – a roadmap to sustainable economies.* https://www.switchtogreen.eu/the-eu-green-deal-promoting-a-green-notable-circular-economy/.

The Peoples' Climate Vote | United Nations Development Programme. (n.d.). In *UNDP.* https://www.undp.org/publications/peoples-climate-vote.

The Rockefeller Foundation. (2022). *What Gets Measured Gets Financed.*

Time. (2019). *Greta Thunberg: TIME's Person of the Year 2019.* https://time.com/person-of-the-year-2019-greta-thunberg/.

YPulse. (2020). *Millennials & Gen Z Teens' Combined Spending Power Is Nearly $3 Trillion in 2020.* https://www.ypulse.com/article/2020/01/09/millennials-gen-z-teens-combined-spending-power-is-nearly-3-trillion-in-2020/.