Web3

Provenance & Traceability

- "Reality Labs Research at Meta Connect 2022" (2022)
- Katie Gustafson (2022) proposes a **"Uniform traceability system for the entire supply chain"** for seafood
- Muñoz et al. (2023) Is there such a thing as sustainable fishing? Bottom trawling is the worst and should be banned.
- *Real Time ESG Tracking From StockSnips* (2021) "Real Time ESG Tracking From StockSnips"
- Mamede et al. (2022) proposes *Seafood tracing*: Fingerprinting of Sea Urchin.
- Waters (2015) **(Need access!)**
- Cawthorn & Hoffman (2016) **(Need access!)**
- Gamborg & Jensen (2017) **(Need access!)**
- Bailey & Eggereide (2020) shows how the Norwegian government plans to increase salmon production 5x by 2050. How can this be sustainable?
- Neethirajan & Kemp (2021) using biometric sensors to track livestock sustainability.
- Ray (2023) comprehensive overview of Web3.
- Patel et al. (2023) livestock products are 15% of agri-foods valued at €152 billion in 2018.
- Inc (n.d.)
- Tim Nicolle (2017)

***Design Implications*:**

- App shows traceability.
- Help consumers to demand more.

Supply Chains

Circular design is possible if supply chains become circular.

- Wagenvoort (2020) Self-driving supply chains.. (contact japanese factory?)

- Dutta et al. (2020) hundreds of paper researching blockchain use in supply change operations since 2017.
- Van Wassenaer et al. (2023) Compares use cases for blockchains in enhancing traceability, transparency and cleaning up the supply chain. There are several technologies for tracking goods across the supply chain, from shipping to client delivery.
- Ashraf & Heavey (2023) Solana blockchain and Sigfox internet of things (IoT) Integration for supply chain traceability.
- Several startups are using distributed ledgers (blockchains) to track source material arriving to the factories and product movements from factories to markets. While blockchains enable securely tracing data, which is immutable (no possible to change the same record, only add data in new records).
- Blockchain ledgers are useful for data sharing and auditing, as the time and place of data input can be guaranteed, and it will be easier to conduct a search on who inputted incorrect data, however the system still relies on correct data input. As the saying goes, "garbage in, garbage out".

Table 1: Blockchain supply chain companies as of summer 2023 include.

Company	Link	Literature	Comments
Ocean Protocol	oceanprotocol.com		
Provenance	provenance.io		
Ambrosius	ambrosus.io		
Modum	modum.io		
OriginTrail	origintrail.io		
Everledger	everledger.io		
VeChain	vechain.org		
Wabi	wabi.io		
FairFood	fairfood.org		
Bext360	bext360.com		
SUKU	suku.world	Miller (2019) SUKU makes supply chains more transparent	Seems to have pivoted away from supply chains

- Traceability and animal rights. Animal rights vs animal welfare. Ethereum blockchain and animal rights. "Blockchain can provide a transparent, immutable record of the provenance of products. This can be especially useful for verifying claims made about animal welfare. For example, products claiming to be"free-range," "organic," or "sustainably sourced" could have their entire lifecycle recorded on the blockchain, from birth to shelf, allowing consumers to verify these claims."

- Another aspect of supply tracing is the treatment of workers and working conditions. Companies that intend to 2give supply chain a voice" by connecting workers directly to the consumer (even in anonymously, to protect the workers from retribution), include *CTMFile* and *Alexandria*.
  - "Worker Voice" (2022) Worker Voice apps.
  - Tim Nicolle (2021) and PrimaDollar Media (2021) PrimaDollar Realtime ESG Give supply chain a voice by connecting workers directly to the consumer.
- Matthew Gore et al. (2022) reports the International Maritime Organization (IMO) targets cutting CO2 equivalent emissions in shipping 50% by 2050 compared to 2008.
- Sepandar Kamvar (2022) "A blockchain is a database without a database admin"
- Verra (2023) Verra new Methodology Announcement Webinar
- Eisenstein?: "Money is a technology".
- Eisenstein (2011): 5 things, UBI, demurrage, …
- "Blockchain Companies Team Up To Track ESG Data" (2021)
- Ganu (2021)
- Improve product ***provenance***, blockchains offer this transparency

Oracles for Sustainability Data

Intersection with finance and Real World Data.

A data oracle is the concept of a source of real-world data which can be ingested through an application programming interface (API) by, for example, a blockchain system. There are many databases of sustainability information which could serve as an oracle for "green filter", including carbon labeling, packaging, transportation, consumption, and waste.

- Ethereum (2023)
- Caldarelli et al. (2020) notes it's a challenge to ensure the accuracy and trustworthiness of real-world data from Oracles.
- Brady Dale (2021) and Chainlink (2022): The largest Oracle provider ChainLink founder Sergey Nazarov believes the collaboration of oracles and blockchains can make carbon credits more trustworthy.
- IPCI OpenLitterMap G.I.D Coin Regen Network
- (**positiveblockchainBlockchainSDGsHow2021?**): Positive Blockchain Database of blockchain for good projects

Ethics & Cruelty

Can data transparency provide tools for reducing cruelty.

- Cruelty free brands
- BCorp
- ESG
- Trash found in ocean / nature etc
- Increase your investment point by matching with your contribution /.
- Point of Sales integration (know the SKU you buy). Integrate to the financial eco footprint (no need to scan the product). What's the name of the startup that does this?
- Precision Fermentation and Cultivated Meat: Meat products without farm animals

***Design Implications*:**

- Rank companies based on sustainability
- Help you to decide: what to buy, how to save, where to invest

Open Data

- When will Bolt show CO2 emissions per every trip?
- Sustainable finance data platform:
- How CO2 is shown by Google starts hiding emissions? "Google 'Airbrushes' Out Emissions from Flying, BBC Reveals" (2022)
- Sarah Perez (2022) shows how google added features to Flights and Maps to filter more sustainable options
- Justine Calma (Oct 6, 2021, 10:01 AM GMT+3) *Google UX eco features*
- Google VERY IMPORTANTT Google (2021)
- "Google mostrará por defecto la ruta más 'verde' en su GPS y ordenará los vuelos según su impacto ambiental" (2021) Google green routes
- Wizzair Check carbon impact *Offset Your Flight with WIZZ* (n.d.)
- WikiRate (2021) WikiRate defines 7 Data Sharing Archetypes

Type	Example
Transparency Accountability Advocate	
Compliance Data Aggregator	
Data Intelligence Hub	
Worker Voice Tool	Caravan Studios (2022): **"Worker Connect"**
Traceability tool	trustrace.com
Open data platform	
Knowledge sharing platform	business-humanrights.org

- WikiRate is a tool for checking green credentials Transparency
- Laureen van Breen et al. (2023)
- Wikirate (2022a)
- *Home - ChainReact* (n.d.)
- "Sveriges Dataportal" (n.d.) Swedish open data portal

***Design Implications*:**

- Make open data easy to use in everyday life.
- The key idea is making CO2 Visible.

Emissions

Data about green house gas emissions.

Crippa et al. (2022) shows average global emissions are 4.81 tonnes of CO2 per capita.

Table 3: World Resources Institute (2020) shows the top 5 largest per capita CO2 emissions come from Oil Producers. Total CO2 emissions from European Commission. Joint Research Centre. (2022).

Per Capita (2020)	Total (2021)
Qatar	China
Kuwait	U.S.A
Bahrain	European Union
United Arab Emirates	India
Brunei Darussalam	Russia
	Japan
	Iran
	South Korea
	Indonesia
	Saudi Arabia

Ivanova et al. (2020) shows the average per capita carbon footprint of North America 13.4, Europe 7.5, Africa and the Middle East 1.7 tonnes of CO2 equivalent per capita.

Carbon Labels

Adding CO2 labels for consumer products have been discussed for decades (Adam Corner (2012)). Cohen & Vandenbergh (2012) argues carbon labels do influence consumer choice towards sustainability. Academic literature has looked at even minute detail such as color and positioning of the label (Zhou et al. (2019)). There is some indication consumers are

willing to pay a small premium for low-CO2 products (Xu & Lin (2022)). All else being equal, consumers choose the option with a lower CO2 number (Carlsson et al. (2022)). Nonetheless, the idea of *Carbon Labelling* is yet to find mainstream adoption.

There's some evidence to suggest labeling low CO2 food enables people to choose a *climatarian diet* in a large-scale study Lohmann et al. (2022) of UK university students, however the impact of carbon labels on the market share of low-carbon meals is negligible. Labels alone are not enough. underlines Edenbrandt & Lagerkvist (2022) in Sweden in a study which found a negative correlation between worrying about climate impact and interest in climate information on products, suggesting a need for wider environmental education programs. Asioli et al. (2022) found differences between countries, where Spanish and British consumers chose meat products with *'No antibiotics ever'* over a *Carbon Trust* label, whereas French consumers chose CO2 labeled meat products.

Brian Kateman (2020): Carbon labeling is voluntary and practiced by only a handful of companies. The U.S. restaurant chain *Just Salad* , U.K.-based vegan meat-alternative *Quorn* and plant milk *Oatly* provide carbon labeling on their products. ClimatePartner (2020): Companies like ClimatePartner and Carbon Calories offers labeling consumer goods with emission data as a service. The Carbon Trust (n.d.): The Carbon Trust reports it's certified 27 thousand product footprints.

- Digitalisation *Digital Receipts and Customer Loyalty in One Platform | ReceiptHero* (n.d.) Digital Receipts to be able to track your carbon footprint
- Ivanova et al. (2020) "establish consumption options with a high mitigation potential measured in tons of CO2 equivalent per capita per year."
- 55% of emissions come from energy production.
- Carto (2023) Making advanced maps to convince people to make changes

Digital Product Passports

It's a further development of the idea of carbon labels.

- Nissinen et al. (2022) reports The European Commision has proposed a *Digital Product Passports* to help companies transfer environmental data. Carbon labels are needed for green transformation.
- Reich et al. (2023) "Information gaps are identified as one of the major obstacles to realizing a circular economy."
- Jensen et al. (2023) "support decision-making throughout product life cycles in favor of a circular economy."

- King et al. (2023) "influence consumer behavior towards sustainable purchasing and responsible product ownership by making apparent sustainability aspects of a product life cycle."x m
- Berger, Rusch, et al. (2023) "support Sustainable Product Management by gathering and containing product life cycle data. However, some life cycle data are considered sensitive by stakeholders, leading to a reluctance to share such data."
- Plociennik et al. (2022) "Digital Lifecycle Passport (DLCP) hosted on a cloud platform and can be accessed by producers, users, recyclers"
- Berger, Baumgartner, Weinzerl, Bachler, & Schöggl (2023) challenges with Electric Vehicle Batterys. Berger, Baumgartner, Weinzerl, Bachler, Preston, et al. (2023) proposes Digital Battery Passports
- Van Capelleveen et al. (2023) literature overview
- Sustainable Product Management: Korzhova (2020)

Industry Cases

Conversations about sustainability are too general and one needs to look at the specific sustainability metrics at specific industries to be able to design for meaningful interaction.

- There are many domain-specific research showing how varied industries can develop eco-designed products. For example, Duriez et al. (2022) shows how simply by reducing material weight it's possible to design more sustainable transportation.

Design Implications: focus on specific industries.

Fashion

Sustainable Fashion, Textile Design

"Young Consumers' (Complicated) Love For Fast Fashion In 3 Stats" (n.d.): Young people are the largest consumers of fast fashion. In European Environment Agency (2022), European Environment Agency (EEA) estimates based on trade and production data that EU27 citizens consumed an average 15kg of textile products per person per year.

- Millward-Hopkins et al. (2023) shows how half of the textile waste in the UK is exported to other countries.

Across industries, reports are saying there isn't enough transparency.

- **Problem**: Emily Chan (2022a) report says there's not enough transparency in fashion:

- Fashion greenwashing, fashion is 2%-8% of total GHG emissions, 2.4 Trillion USD industry, 100B USD lost to lack of recycling, contributes 9% of microplastics: Adamkiewicz et al. (2022)
- Centobelli et al. (2022) per year uses 9B cubic meters of water, 1.7B tons of CO2, 92 million tons of textile waste.
- Köhler et al. (2021): Globally 87% of textile products are burned or landfilled after 1st consumer use.
- Marrucci et al. (2020) Italian retail supermarkets carbon footprint?
- Leung & Luximon (2021) There's a growing know-how on how to produce sustainably and which materials to use. "Handbook of Footwear Design and Manufacture" Chapter 18 - Green design.
- Emily Chan (2022b) New Standard Institute's proposed "Fashion Act" to require brands doing business in New York City to disclose sustainability data and set waste reduction targets.
- Wikirate (2022b): "Among the Index's main goals are to help different stakeholders to better understand what data and information is being disclosed by the world's largest fashion brands and retailers, raise public awareness, educate citizens about the social and environmental challenges facing the global fashion industry and support people's activism."
- Mabuza et al. (2023) shows consumer knowledge of apparel coloration is very limited.
- Gyabaah et al. (2023) research across several dumpsites across Ghana revealed up to 12% of the landfill consisted of textile waste.
- imperfectidealist (2020) Fashion sustainability vs greenwashing
- "Transparency and Sustainability Platform - Renoon" (2023) Ethical Shopping
- "Sheep Inc. - Softcore Radicals" (2023) Ethical brand?
- Good On You (2023) Sustainable fashion company evaluations
- *Lily | Mindful + Active Living on Instagram* (n.d.) Garment Worker's rights
- Emily Chan (2022c): fashion companies can't be held accountable for their actions (or indeed, their lack of action).
- WikiRate (2023)
- *Instant Gratification for Collective Awareness and Sustainable Consumerism* (2022): "Political consumerism", "Instant Gratification for Collective Awareness and Sustainable Consumerism"
- FashionChecker (2023)
- Eesti Disainikeskus I Estonian Design Centre (2021) Circular textiles
- (**EKAArendasEuroopa2022?**) Sustainable Fashion education
- Fashion Revolution Foundation (2022) Fashion transparency index
- "Clean Clothes Campaign" (n.d.)
- "The mainstream fashion industry is built upon the exploitation of labor, natural resources and the knowledge of historically marginalized peoples."
- *Textile Genesis* (n.d.)
- "Secrecy is the linchpin of abuse of power…its enabling force. Transparency is the only real antidote." Glen Greenwald, Attorney and journalist.

- Stand.earth (2023)
- "New Standard Institute" (n.d.)
- *BGMEA | Home* (n.d.) Bangladesh Garment Manufacturers and Exporters Association
- ERR (2022) European Commission wants to reduce the impact of fast fashion on EU market.
- Minimize shopping, buy quality, save CO2, invest.
- Textile Exchange (2023) Ethical fashion materials matter
- Textile Exchange (2021): Policy request
- Free clothes
- Vanish UK (2021) "Generation rewear" documentary, sustainable fashion brands
- Storbeck (2021) and Remington (2020): Zalando says Fast fashion must disappear
- Infinited Fiber (2023)
- Cleantech Group (2023) Global cleantech 100
- *SOJO - Door-to-Door Clothing Alterations and Repairs* (2023) Alterations and repairs made easy
- "Good On You - Sustainable and Ethical Fashion Brand Ratings" (2023) Ethical brand ratings

Food

- (Santos et al., 2023): complex supply chains make seafood (marine Bivalvia, mollusks) logistics prone to fraud, leading to financial losses and threats to consumer health. The same is true for cocoa beans, which are at risk from food fraud (Fanning et al., 2023).
- Nabipour Afrouzi et al. (2023): "The agricultural sector contributes to approximately 13.5% of the total global anthropogenic greenhouse gas emissions and accounts for 25% of the total CO2 emission."
- Yap et al. (2023) Singapore disposes of 900,000 tonnes of plastic waste out of which only 4% is recycled.
- Kiessling et al. (2023) Single-use plastics make up 44-68% of all waste mapped by citizen scientists.

There are several initiatives to reduce food waste by helping people consume food that would otherwise be throw away.

Name	Link
Karma	apps.apple.com/us/app/karma-save-food-with-a-tap/id1087490062

Name	Link	
ResQ Club	resq-club.com	Kristina Kostap (2022) ResQ Club in Finland and Estonia for reducing food waste by offering a 50% discount on un-eaten restaurant meals before they are thrown away.
Kuri		Haje Jan Kamps (2022) Less impact of food
Social media groups (no app)		

- Poore & Nemecek (2018) suggests 26% of carbon emissions come from food production. Saner et al. (2015) reports dairy (46%) and meat and fish (29%) products making up the largest GHG emission potential. Springmann et al. (2021) proposes veganism is the most effective decision to reduce personal CO2 emissions.
- Röös et al. (2023) identified 5 perspectives in a small study (*n=106*) of views on the Swedish food system:
- IARC warns aspartame could cause cancer.

Perspective	Content
"The diagnostic perspective"	"*All hands on deck to fix the climate"*
"The regenerative perspective"	"*Diversity, soil health and organic agriculture to the rescue"*
"The fossil-free perspective"	"*Profitable Swedish companies to rid agriculture and the food chain of fossil fuel"*
"The consumer-driven perspective"	*"A wish-list of healthy, high-quality and climate-friendly foods"*
"The hands-on perspective"	"Tangible solutions within the reach of consumers and the food industry"

- ***Design Implication***: Where to shop rankings for groceries — list worst offenders in terms of products — shop and invest according to your values.
- Kommenda et al. (2022) Carbon Food Labels
- Food Sovereignty: "The global food sovereignty movement, which had been building momentum since its grassroots conception in the late '90s, quickly gained traction with its focus on the rights of people everywhere to access healthy and sustainable food. One of the pillars of the movement lies in using local food systems to reduce the distance between producers and consumers."

- CAITLIN STALL-PAQUET (2021): "We can grow foods just as well in the inner city as we can out in the country because we're agnostic to arable land," says Woods. "Because we grow indoors and create our own weather, [climate change] doesn't affect our produce."
- Renée Salmonsen (2018): Vertical farm in Taoyuan
- Catherine Shu (2023): *Intensive Farming Practices vs* Farm to table
- Akshat Rathi (2021) and Lowercarbon Capital (2023) climate startup funding.
- Only make what is ordered.
- Farm to Fork Financial Times (2022)

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