Sustainability

Ecological Indicators

Sustainability was first mentioned in (Hannß Carl von Carlowitz, 1713) in the context of forestry and discussing sustainable forest management in his seminal book *Sylvicultura oeconomica*.

Sustainability can be measured using a variety of ***ecological indicators***.

The field is known today as *sustainable yield* of *natural capital* required to maintain *ecosystem services* (Peter Kareiva et al., 2011).

Climate data visualization has a long history, starting with ***Alexander von Humboldt,*** a founder of climatology, who revolutionized cartography by inventing the first isothermal maps around the year 1816, showing areas with similar temperature, variations in altitude and seasons in different colors (Honton, 2022). Humboldt's isotherms are now available as 3D computer models in (*Alexander von Humboldt's Original Isotherms Circa 1838*, 2023). 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).

- Industrial revolution: Pearson & Foxon (2012): "transition to a low carbon economy presents challenges and potential economic benefits that are comparable to those of previous industrial revolutions"
- Tragedy of the commons: Meisinger (2022) and Lopez et al. (2022) and Murase & Baek (2018)

- (Keeble, 1988) reported in April 1987 that *'residents in high-income countries lead lifestyles incompatible with planetary boundaries'*. While my home Estonia at the time was considered low-income, a small nation on the verge of poverty behind the Iron Curtain occupation of the Soviet Occupy, we now in 2023, have indeed reached high-income status.

- (Korosec, 2021) reports that Amazon's 2B USD to a Climate Pledge Fund earmarked to fix climate problems is invested in energy, logistics, and packaging startups, which will reduce material waste. "Good intentions don't work, mechanisms do," Amazon's

founder Bezos is quoted in (Clifford, 2022). It's an example of how money marketed as climate funding by the retail conglomerate means focus on reducing operational cost of running their business through automation and material savings.

- Aldo Leopold proposed the ideas of land ethics. "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise." in A Sand County Almanac (Leopold, 1972).
- Ecological Indicators (I like the name Ecomarkers) for Earth are like Biomarkers in human health.
- (Sarah Ludwig Rausch & Neha Pathak, 2021): "Human health is central to all sustainability efforts.", "All of these (food, housing, power, and health care), and the stress that the lack of them generate, play a huge role in our health," Hollis says."
- *Public Health Linkages with Sustainability* (2013)
- Guidotti (2015)
- "Sustainability is important for many reasons including: Environmental Quality – In order to have healthy communities, we need clean air, natural resources, and a nontoxic environment."

Design Implications:

- Blood testing and biomarkers allow people to track their health. I'm introducing the concept of 'eco-markers' to follow the sustainability of human activities.

Ecosystem Services

- Daily (1997) proposed the idea of ecosystem services and Costanza et al. (1997) attempted to assess the amount of ecosystem services provided.
- Han & Chen (2022) identifies nature-based solutions "land re-naturalization (such as afforestation and wetland restoration)"

Table 1: From Han & Chen (2022)

Non-Exhaustive list of
Afforestation
Wetland restoration

- Bousfield et al. (2022) reports there's evidence paying landowners for the ecosystem services their forests provide may reduce deforestation.

- Le Provost et al. (2022) study shows *biodiversity* as one key factor to maintain delivery of ecosystem services.
- Noriega et al. (2018) attempts to quantify the ecosystem services (ES) provided by insects. While it can be assumed much of the flora and fauna are crucial for Earth's systems, science is still in the process of understanding and quantifying its contributions.
- Meanwhile the destruction pressure on ecosystems is rapidly increasing (cite A B C).
- Espinosa & Bazairi (2023) marine ecosystem services **(need access)**
- Chen et al. (2023) Ecosystem vulnerability **(need access)**
- Zhang et al. (2023) Integrating ecosystem services conservation into urban planning **(need access)**
- Li et al. (2023) tourism is a large industrial sector which relies on ecosystem services. In Taiwan, (Lee et al., 2021) developed a framework of indicators to assess sustainable tourism.

Environmental Degradation

Growing Population

Earth's population reached 8 Billion people In November 2022 (The Economic Times, 2022) and population projections by (United Nations Department of Economic and Social Affairs, Population Division, 2022) predict 8.5B people by 2030 and 9.7B by 2050. (Hassoun et al., 2023) forecasts increase of global food demand by 62% including impact of climate change.

- While population growth puts higher pressure on Earth's resources, some research shows the effect is more from wasteful lifestyles than the raw number of people (Cardinale et al., 2012) **???. NEED ACCESS!!**
- Bowler et al. (2020) Anthropogenic Threat Complexes (ATCs):

Overconsumption

- Overconsumption is one of the root causes of climate change
- Ivanova et al. (2020): "Around 2/3 of global GHG emissions are directly and indirectly linked to household consumption, with a global average of about 6 tonnes CO2 equivalent per capita."
- Overconsumption is also one of the root causes of marine plastic pollution. Ford et al. (2022) and Lavers et al. (2022) suggest strong linkage of climate change and marine plastic pollution "along with other stressors that threaten the resilience of species and habitats sensitive to both climate change and plastic pollution".
- Moberg et al. (2019) reports daily human activities emission contribution on average in France, Germany, Norway and Sweden:

Table 2: Daily human activities emission contribution on average in France, Germany, Norway and Sweden.

Emission Share	Category
21%	Housing
30%	Food
34%	Mobility
15%	Other

- According to Debnath et al. (2022) 39% of global CO2 emissions comes from the building sector.
- Eesti Vabariigi Valitsus (2022) Estonian Green Deal Action Plan (Eesti Rohepöörde Tegevusplaan).
- Armstrong McKay et al. (2022) discusses tipping points

Biodiversity

- Biodiversity loss is linked to overconsumption.
- May (2011) argues biodiversity loss is a concern for 3 points of views
  - Narrowly utilitarian: biodiversity is a resource of genetic novelties for the biotech industry.
  - Broadly utilitarian: humans depend upon biodiverse ecosystems.
  - Ethical: humans have a responsibility to future generations to pass down a rich natural world.
- Almond, R.E.A. et al. (n.d.) reports, the number of species killed, mass destruction of nature. "69% decline in the relative abundance of monitored wildlife populations around the world between 1970 and 2018. Latin America shows the greatest regional decline in average population abundance (94%), while freshwater species populations have seen the greatest overall global decline (83%)."
- WWF (2022) case study highlights how 4 biodiverse regions Cerrado in Brazil, Chaco in Argentina, Sumatra in Indonesia, and the Cuvette Centrale in Democratic Republic of Congo are experiencing rapid destruction due to consumer demand in the European Union.
- Meanwhile, there is some progress in biodiversity conservation. UEBT (2022) reports "Biodiversity awareness is now at 72% or higher in all countries sampled, compared to only 29% or higher across countries sampled in 2009."

- Unit (2023): The history of the United Nations Convention on Biodiversity goes back to 1988, when the working group was founded. UNEP (Tue, 12/20/2022 - 07:44): The Convention on Biodiversity 2022 (COP15) adopted the first global biodiversity framework to accompany climate goals.

Forest

Deforestation is widespread all around the world.

- Frédéric Simon (2022) Due to deforestation, Europe rapidly losing its forest carbon sink.
- Burning of biomass undermines carbon capture.

Water

- Clean water and water pollution
- Koch (2022) (**Need access!)**

Air

Air pollution is so widespread. Clean air is a requirement.

- Grounbreaking research by Lim et al. (2022) analyzed over 400000 individuals in England, South Korea and Taiwan establishes exposure to 2.5 m PM (PM2.5) air pollution as a cause for lung cancer. Bouscasse et al. (2022) finds strong health and economic benefits across the board from air pollution reduction in France.
- In Hannah Devlin (2022), prof Tony Mok, of the Chinese University of Hong Kong: "We have known about the link between pollution and lung cancer for a long time, and we now have a possible explanation for it. As consumption of fossil fuels goes hand in hand with pollution and carbon emissions, we have a strong mandate for tackling these issues – for both environmental and health reasons."
- MARIA LUÍS FERNANDES (2023) EU has legislation in progress to curb industrial emissions.

Design Implications: *People live in the polluted areas are so used to it. What app to wake them up? "You live in a highly polluted area. Here's the TOP 10 companies causing pollution. Here's what you can do."*

Disasters

Large ones that get international news coverage:

- Chernobyl
- Exxon Valdez
- Deepwater Horizon
- the Great Pacific Garbage Patch
- Fukushima
- Volkova et al. (2021) increased risk of wildfires due to climate change.
- Martinez-Alier (2021) and Martinez-Alier et al. (2022) as well as Scheidel et al. (2020) cover how EJAtlas tracks environmental justice cases around the world. Dispues in Eerola (2022).

Agroforestry & Permaculture

- Food forests for regenerative food systems.
- Ruba & Talucder (2023) agroforestry plays an active role in achieving Sustainable Development Goals (SDGs)
- Irwin et al. (2023)
- Yadav et al. (2023)
- G. Low et al. (2023)
- Ollinaho & Kröger (2023) "bioeconomy is not inherently sustainable and may pose considerable risks to biodiversity."
- De Queiroz-Stein & Siegel (2023)
- Gamage et al. (2023) "Organic food and drink sales in 2019 totaled more than 106 billion euros worldwide."
- "Would you rather buy a DogeCoin or a regenerative food forest token?" Curve Labs founder Pat Rawson quotes Shiller (2019) in ReFi podcast about Kolektivo. ReFi DAO (2022) (Use as a question for the survey?)

Biodesign

- Neri Oxman, biomaterials MIT media lab, 15. sept. 2020
- Neri Oxman's expressions: "ecology-indifferent", "naturing", "mother naturing", "design is a practice of letting go of all that is unnecessary", "nature should be our single client".
- Use imagination

- Societal movements change things: implication for design: build a community
- Processes sustain things: implication for design: built an app

Quality of Life

- Kaklauskas et al. (2023)
- Fabris & Luburić (2022)

Digital Twins

- We can use all the data being recorded to provide a Digital Twin of the planet, nature, ecosystems and human actions to help us change our behavior and optimize for planetary wellbeing.
- The EU is developing a digital twin of Earth to help sustainability prediction and planning, integrating Earth's various systems such as climate, hydrology, ecology, etc, into a single model Hoffmann et al. (2023) and *Destination Earth | Shaping Europe's Digital Future* (2023).

Mitigation & Adaption

Emissions Trading Schemes

- There isn't a single global CO2 trading market but rather several local markets *International Carbon Market* (n.d.)
- New Zealand Rontard & Reyes Hernández (2022) (need access)
- EU: Araújo et al. (2020)

Place	Launch Date
European Union	2005
South Korea	2015
China	
United States (no country-wide market but local markets in California, Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont)	2013
New Zealand	2008
Canada	2013

- (Sipthorpe et al., 2022) compares traditional and blockchain-based solutions to carbon trading.
- (H. Liu, 2021) and (Ivy Yin, 2023) China's national emissions trading scheme (ETS) started in 2021 priced at 48 yuan per tonne of CO2, averaged at 58 yuan in 2022.
- (United Nations Environment Programme (UNEP), 2021) report. "The Emissions Gap Report (EGR) 2021: The Heat Is On shows that new national climate pledges combined with other mitigation measures put the world on track for a global temperature rise of 2.7°C by the end of the century. That is well above the goals of the Paris climate agreement and would lead to catastrophic changes in the Earth's climate. To keep global warming below 1.5°C this century, the aspirational goal of the Paris Agreement, the world needs to halve annual greenhouse gas emissions in the next eight years.
- (United Nations Environment Programme (UNEP), 2021) report "If implemented effectively, net-zero emissions pledges could limit warming to 2.2°C, closer to the well-below 2°C goal of the Paris Agreement. However, many national climate plans delay action until after 2030. The reduction of methane emissions from the fossil fuel, waste and agriculture sectors could help close the emissions gap and reduce warming in the short term, the report finds. Carbon markets could also help slash emissions. But that would only happen if rules are clearly defined and target actual reductions in emissions, while being supported by arrangements to track progress and provide transparency."
- (United Nations Environment Programme, 2022) 2022 Emissions Gap report.

Fossil Fuels

- (see IEA, 2022) reports "Global CO2 emissions from energy combustion and industrial processes rebounded in 2021 to reach their highest ever annual level. A 6% increase from 2020 pushed emissions to 36.3 gigatonnes"
- Crippa et al. (2022) reports latest figures from the EU's Emissions Database for Global Atmospheric Research (EDGAR)
- Daniel Värjö (2022): The EU Copernicus satellite system reveals new greenhouse emissions previously undetected
- "Transport greenhouse gas emissions have increased every year since 2014" *Climate Change Mitigation* (2023)

Fossil Fuels and Energy

There's evidence from several countries suggesting moving to renewal energy brings benefits:

- Amin et al. (2022) suggests "removing fossil fuel subsidies and intra-sectoral electricity price distortions coupled with carbon taxes provides the highest benefits" for both the economy and the environment in Bangladesh.
- S. Low et al. (2022) finds considerable uncertainty exists among experts which CO2 reduction methods among nature-based and technology-based are the most effective.

- Luo et al. (2022) suggests using reinforcement learning to reduce energy use in cooling systems.
- The true cost of products is hidden. The work is hidden.
- Tilsted et al. (2023) expects the fossil fuel industry to grow even faster.

Emission Scopes

- National Public Utilities Council (2022) The U.S. National Public Utilities Council (NPUC) decarbonization report provides a useful categorization of ***emission scopes*** applicable to companies and useful for organizing emission reduction schemes.

Table 4: From National Public Utilities Council (2022)

Scope	Source
Scope 1	Direct emissions
Scope 2	Indirect electricity emissions
Scope 3	Value chain emissions

Cap & Trade

- The share of CO2 emissions among people is highly unequal across the world (termed ***Carbon Inequality***). Chancel (2022) reports "while one-tenth of the global population is responsible for nearly half of all emissions, half of the population emits less than 12%".
- One example is the ICT sector.
- Bajarin (n.d.) Over 300 million PCs sold in 2022
  - *GreenDice - Reinventing the Idea of a Computer-Related Tech Purchase* (2021) Estonian company "sustainable lifecycle management of IT equipment"
  - Ärileht (23.09.2022, 12:53) Recycle your phone, FoxWay and Circular economy for PCs.
  - Zhou et al. (2022) ICT is an example of inequality, while emerging economies bear 82% of the emissions, developed countries gain 58% of value.

Carbon Credits

- In Estonia, startups Arbonic and Single.Earth are trialing this approach in several forests.
- Carbon Credit Retirement?

Carbon Capture

- Vitillo et al. (2022) illustrates how direct air capture of CO2 is difficult because of low concentration and CO2 capture at the source of the emissions is more feasible.
- Gaure & Golombek (2022) simulate a CO2 free electricity generation system in the European Union where "98% of total electricity production is generated by wind power and solar; the remainder is covered by a backup technology.". The authors stipulate it's possible to power the EU without producing CO2 emissions.
- **Important: "creating sustainability trust in companies in realtime"**
- Howard et al. (2017) argues Oceans play crucial role in carbon capture.

Social Cost of Carbon

- Kornek et al. (2021) and Zhen et al. (2018) suggest "The (Social Cost of Carbon) SCC measures the additional damage caused by an extra unit of emissions" with variations between countries (Tol (2019)) and regions (Y. Wang et al. (2022)). Stanford University (2021) defines the social cost of carbon "the cost of the damages created by one extra ton of carbon dioxide emissions"
- Stern (2022) reports carbon-neutral economy needs higher CO2 prices. Rennert et al. (2022): Carbon price should be 3,6x higher that it is currently (2022). Ritz (2022) argues optimal CO2 prices could be highly asymmetric, low in some countries and high (above the social cost of CO2) in countries where production is very polluting.
- As shown in the Phillipines by Cheng & Han (2022), with increasing extreme weather events, "businesses are more likely to emerge in areas where infrastructure is resilient to climate hazards". Jerrett et al. (2022) says, In California, "Wildfires are the second most important source of emissions in 2020" and "Wildfires in 2020 negate reductions in greenhouse gas emissions from other sectors."
- Lin et al. (2022) says, apart from CO2, reduction of other atmospheric pollutants, such as non-CO2 greenhouse gases (GHGs) and short-lived climate pollutants (SLCPs) is required for climate stability.
- T.-P. Wang & Teng (2022): Quantifying climate damage proposes scenarios of climate damage.

Nationally Determined Contributions

- Climate Analytics & NewClimate Institute (2023) Climate Action Tracker data portal allows to compare countries.

Table 5: Climate Action Tracker's country comparison of the 10 top polluters' climate action.

Country or Region	**NDC target**
China	Highly insufficient
Indonesia	Highly insufficient
Russia	Critically insufficient
EU	Insufficient
USA	Insufficient
United Arab Emirates	Highly insufficient
Japan	Insufficient
South Korea	Highly insufficient
Iran	Critically insufficient
Saudi Arabia	Highly insufficient

- UNFCCC. Secretariat (2022)
- The State of Nationally Determined Contributions: 2022 Fransen et al. (2022) notes that the majority of Nationally Determined Contributions (NDCs) are dependent on financial assistance from the international community.

TODO

- "triple turn"
- lack of transparency
- Call for GOP contributors' transparency

Eco-Design

Designing for Sustainability aka Circular Design or Eco-Design encompasses all human activities, making this pursuit an over-arching challenge across all industries also known as circular economy. Assuming that as individuals we want to act in a sustainable way, how exactly would be go about doing that?

- "Evolution of design for sustainability: From product design to design for system innovations and transitions"

Circular economy is a tiny part of the world economy. Circle Economy (2022) reports only 8.6% of world economy is circular and *100B tonnes of virgin materials* are sourced every year.

- McDonough & Braungart (2002) book
- McGinty (Thu, 08/06/2020 - 11:25): How to Build a Circular Economy
- Dull (2021) book

- Chapman (2009) argues in his seminal paper (and later in his book) for ***"Emotionally Durable Design"***, the simple idea that we hold to things we value and thus they are sustainable. We don't throw away a necklace gifted to us by mom, indeed this object might be passed down for centuries. Rose (2015) has a similar idea, where ***"Enchanted Objects"*** become so interlinked with us, we're unlikely to throw them away.
- Growing public understanding of how nature works and intersects with our use of money.
- Hedberg & Šipka (2021) argues digitization and data sharing is a requirement for building a circular economy.
- Gupta et al. (2023) argues software is key to building more sustainable products, already for decades. More recently, companies like AutoDesk are putting CO2 calculations inside their design software.
- "Sustainability Starts in the Design Process, and AI Can Help" (n.d.): "Sustainability starts in the design process, and AI can help".
- iGenius (2020)
- Very simple. "Carbon pricing is not there to punish people," says Lion Hirth Lion Hirth (n.d.). "It's there to remind us, when we take travel, heating, consumption decisions that the true cost of fossil fuels comprises not only mining and processing, but also the damage done by the CO2 they release."

Design Implications:

- AI can help us make sense of the vast amounts of sustainability data generated daily.

Policy Context

- European Parliament (2022) proposal "On 30 March 2022, the European Commission put forward a proposal for a regulation establishing a general framework for setting eco-design requirements for sustainable products, repealing rules currently in force which concentrate on energy-related products only."
- *EU Taxonomy for Sustainable Activities* (n.d.) report: The EU has a ***taxonomy of environmentally sustainable economic activities*** published by the Technical Expert Group (TEG) on sustainable finance.
- Virginijus Sinkevičius, EU Commissioner for the Environment, Oceans and Fisheries, is quoted as describing eco-design "respects the boundaries of our planet" European Commission (2022b)
- The proposal for a Nature Restoration Law by the European Commission requiring member countries to restore 20% of EU's degraded ecosystems by 2030 and full restoration by 2050 has not yet passed *Scientists Urge European Parliament to Vote for Nature Restoration Law* (2023) and is facing a backlash David Pinto (2023).
- Manzardo et al. (2021) **(need access!)**
- Iñarra et al. (2022) **(need access!)**
- Munaro et al. (2022) **(need access!)**

- Bassani et al. (2022) **(need access!)**
- Van Doorsselaer (2022) **(need access!)**
- de Otazu et al. (2022) **Life Cycle Assessment and environmental impact analysis are needed to provide eco-design scenarios.**
- Nuez et al. (2022) shows how electric vehicles may increase CO2 emissions in some areas, such as Canary Islands, where electricity production is polluting.
- Rossi et al. (2022) shows how introducing sustainability early in the design process and providing scenarios where sustainability is a metric, it's possible to achieve more eco-friendly designs.
- Tiernan et al. (2022) microplastics are a real concern
- Arranz et al. (2022) developing circular economy is really complex
- Cheba et al. (2022)
- Ruiz-Pastor et al. (2022)
- Miyoshi et al. (2022) takes the example of ink toner bottles and shows in a case study how standardized compatibility between older and newer systems can save resources and results in sustainability savings.

Again, AI has the potential to provide the parameters for sustainability.

- Singh & Sarkar (2023) proposes an AI tool for deciding the suitable life cycle design parameters.
- Finding green products and supporting companies making them
- Supporting legislative changes
- Track you consumption, saving, investing. Shift balance towards saving and investing.
- Nastaraan Vadoodi (2022)
- European Commission (2022a) Ecodesign for sustainable products

Extended Producer Responsibility

One type of legislation that works?

- Steenmans & Ulfbeck (2023) Argues for the need to engage companies through legislation and shift from waste-centered laws to product design regulations.
- Peng et al. (2023) finds that the Carbon Disclosure Project has been a crucial tool to empower ERP in Chinese auto-producers.
- K. Liu et al. (2023) reports, e–waste is growing 3%–5% every year, globally. Thukral & Singh (2023) identifies several barriers to e-waste management among producers including lack of awareness and infrastructure, attitudinal barriers, existing *informal* e-waste sector, and the need for an e-waste license.

- In Europe, there's large variance between member states when in comes to textile recycling: while Estonia and France are the only EU countries where separate collection of textiles is required by law, in Estonia 100% of the textiles were burned in an incinerator in 2018 while in France textiles are covered by an Extended Producer Responsibility (EPR) scheme leading to higher recovery rates (Ibid).
- Christiansen et al. (2021): Nonetheless, EPR schemes do not guarantee circularity and may instead be designed around fees to finance waste management in linear economy models.
- Jacques Vernier (2021): French EPR scheme was upgraded in 2020 to become more circular.
- In any case, strong consumer legislation (such as EPR) has a direct influence on producers' actions. For example, in HKTDC Research (2022)@, the Hong Kong Trade Development Council notified textile producers in July 2022 reminding factories to produce to French standards in order to be able enter the EU market.

Design implications: *ERP and CDP data should be part of Green Filter.*

Return, Repair, Reuse

- There's a growing number of companies providing re-use of existing items.
- *SmartSwap* (n.d.) For example, Swap furniture in Estonia

Bring back your bottle and cup after use.

- (**pastorProposingIntegratedIndicator2023?**) proposes a **product repairability index (PRI)**
- Formentini & Ramanujan (2023)
- Recycling (Lenovo, 08-29-22) "rethinking product design and inspiring consumers to expect more from their devices"
- "design is a tool to make complexity comprehensible" like the Helsinki chapel. there's either or a priest or a social worker. it's the perfect public service. "limit the barrier of entry for people to discover". elegant.
- Zeynep Falay von Flittner (n.d.)

Packaging

Packaging is a rapidly growing industry which generates large amounts of waste Ada et al. (2023). Bradley & Corsini (2023): "Over 161 million tonnes of plastic packaging is produced annually."

- "Challenges and Opportunities in Sustainable Packaging Today" (2022)

- "Protein Brands and Consumers Alike Focus on Sustainability" (2022)
- "Detail-Rich Sustainable Packaging Product Database Is an Industry First" (2010)
- Lerner (2019) Coca Cola plastic pollution
- "Sulapac – Replacing Plastic" (n.d.)

Factories

- Transparency about the polluting factories where the products come from.. the product journey
- virtual factories
- Tracing emissions from factory pipes… what's the app?
- Factories should be local and make products that can be repaired.
- Carbon-neutral factories "made in carbon-neutral factory" list of products
- Stefan Klebert (2022)
- VDI Zentrum Ressourceneffizienz (2020)
- *CO2-neutral Factories* (n.d.) and *Innocent Opens £200m Carbon-Neutral Factory in Rotterdam - Investment Monitor* (n.d.) CO2 neutral factories?
- *Make Your Website Carbon Neutral and Enhance Your Brand | CO2 Neutral Website* (n.d.) CO2 neutral websites
- Eric fogg (2020) Lights-Out Manufacturing
- Mowbray (2018) "World's first free digital map of apparel factories"
- "FFC - Fair Factories ClearingHouse - Compliance Solutions" (n.d.) Factory compliance - Fair Factories
- Planet Factory
- *To the Companies We Have Unveiled in the Plastic Waste Makers Index* (n.d.) Plastic waste makers index, sources of plastic waste

Conclusion

- A wide range of legislative proposals, targets, organizations, and goals already exists across the Europepean Union. Upcoming laws will harmonize approaches to sustainability and raise standards for all members countries, in turn influencing producers who wish to sell in the EU common market.
- In unison, the reviewed technologies and practices move us closer to enabling *realtime ESG*: up-do-date transparent information about how our product are produced. Realtime ESG is a building block to enable consumers and investors make more accurate, real-world purchase decisions.

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