Material Dialogues

An information exhibition by Emma Olbers.
Stockholm Furniture Fair, February 2025

Solutions to Battle Climate Change in Our Industry

We have just left the first year ever with a global average temperature increase of more than 1.5 degrees behind us.[1] Only five years remain until 2030, the year when global greenhouse gas emissions should be halved compared to 1990, according to the Paris agreement. The curves are pointing in the wrong direction, and it goes without saying that it's now time for bold decisions and action. The solutions exist, many more of us just need to start using them. So here are the three most important transformations[2] to start with:

1. Lower greenhouse gas emissions, rapid transition away from fossil fuels.
2. Transition towards circular business models.
3. Transition towards healthy diet and a sustainable food system.

Let us have creative conversations, find new collaborations and increase the work pace for sustainability, circularity and freedom from fossil fuels.

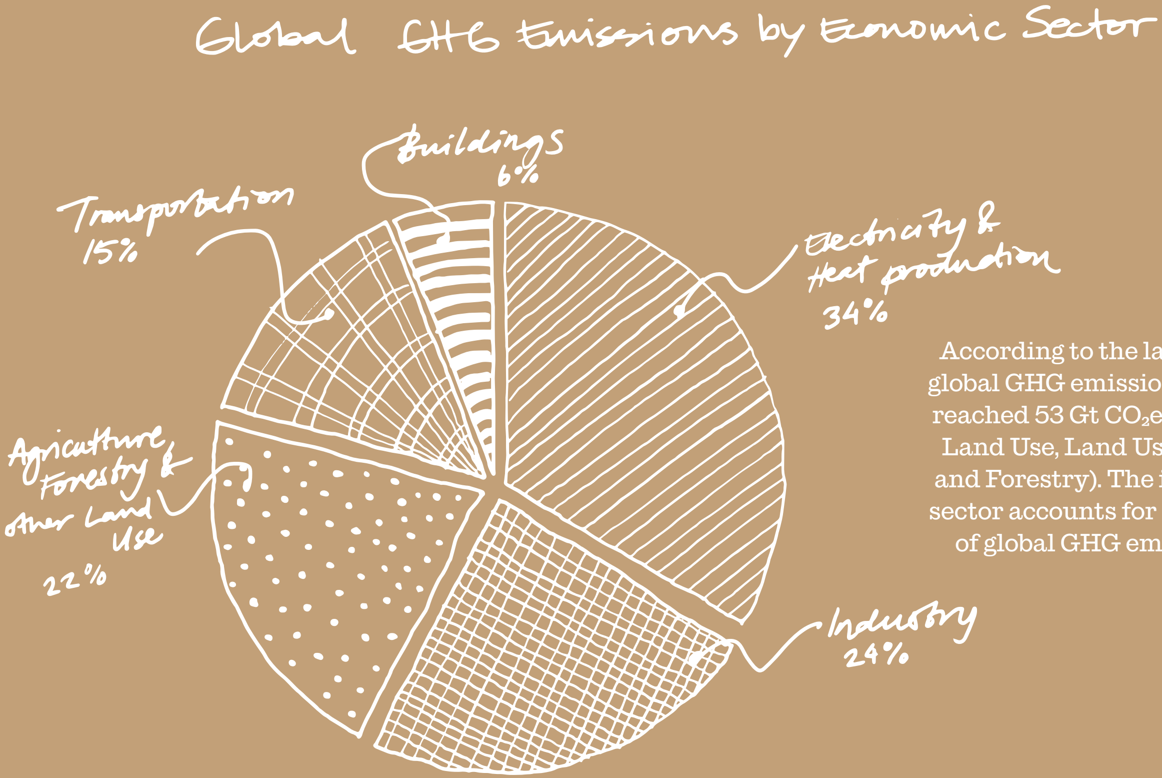
Warm welcome!
Emma Olbers and all collaborators

1 https://www.copernicus.eu/en/news/news/copernicus-global-climate-report-2024-confirms-vlast-year-warmest-record-first-ever-above
2 TED talk by Johan Rockström – The Tipping Points of Climate Change and Where We Stand

1 How to Lower Greenhouse Gases?

As greenhouse gas (GHG) levels in the atmosphere rise, temperatures increase, leading to a more unstable climate. Over the past 11,000 years, the Holocene, average temperatures have fluctuated no more than ± 1°C.[3] This stable climate allowed the development of agriculture, cities, and civilizations. The scary thing now is that we are sliding out from this 11,000 years stable period.

So, how do we reduce emissions? A good starting point is understanding where GHG emissions come from and their relative impact. See the first illustration below.



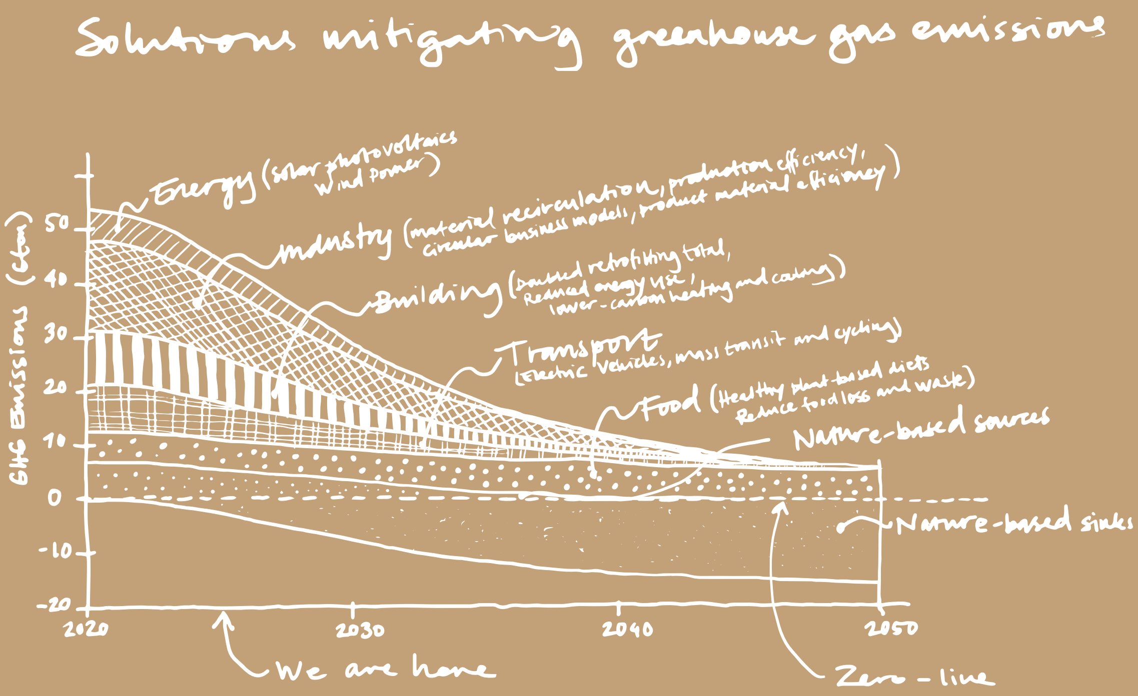
According to the latest data, global GHG emissions in 2023 reached 53 Gt CO_2e[4] (without Land Use, Land Use Change and Forestry). The industrial sector accounts for about 24% of global GHG emissions.[5]

3 Johan Rockström, sommar i P1 2015 – https://sverigesradio.se/avsnitt/johan-rockstrom-2015?utm_source=chatgpt.com
4 https://edgar.jrc.ec.europa.eu/report_2024
5 IPCC AR6 Climate Change 2022 Mitigation of Climate Change, Chapter 2 page 238 - https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_FullReport.pdf

It's also important to grasp how carbon dioxide (CO_2), the primary GHG, moves through the carbon cycle.[6]

The second illustration highlights a desirable path forward according to Exponential Roadmap.[7] Nature-based carbon sinks in trees, wood in buildings and furniture and wetlands, store carbon long-term. You can think of carbon like money: above the zero-line is our debt, and below is our savings. The goal is to reduce carbon debt and increase savings. The carbon cycle can be divided into a fast biogenic cycle (1–100 years) and a slow fossil cycle (millions of years), making time a key factor. If a tree takes 70 years to grow, a chair made from it should ideally last at least that long. A shorter lifespan increases our carbon debt, while a longer one boosts our savings.

On the tables, different materials are displayed, each shown in equivalent amounts to 1kg CO_2e. Imagine if CO_2-equivalents were a currency and if we had a bank to store carbon — well, we already do!



6 Alasdair Skelton – https://vimeo.com/manage/videos/846841441

7 https://exponentialroadmap.org/wp-content/uploads/2020/03/ExponentialRoadmap_1.5.1_216x279_08_AW_Download_Singles_Small.pdf

Carbon Cycle

Carbon is all around us and within us. When it reacts with oxygen, it forms carbon dioxide (CO_2), one of the greenhouse gases driving climate change. The flow of carbon on Earth is described by the carbon cycle, which varies in duration: days (photosynthesis and respiration), years (organic decomposition), centuries (carbon stored in trees), and millions of years (fossil material). These cycles can be divided into two main types: the biogenic cycle, which operates over shorter timescales, and the fossil cycle, which spans millions of years.

There is no chemical difference in biogenic compared to fossil carbon atoms, they are exactly the same. Biogenic carbon cycles naturally between living organisms and the atmosphere, historically keeping CO_2 levels stable. However, human activities have disrupted this balance, now necessitating an urgent 50% reduction in greenhouse gas emissions by 2030 compared to 1990 levels.[8]

The sun powers the carbon cycle via photosynthesis, which transforms CO_2 into carbon-rich molecules in plants. As trees grow, they store carbon in their wood, roots, and the soil's mycorrhiza, with about 45% of a forest's carbon stored underground.[9] A natural carbon storage. Fossilized material also serves as carbon storage, but problems arise when it is extracted and burned, releasing carbon into the atmosphere.

8 https://www.ipcc.ch/sr15/faq/faq-chapter-1/

9 https://www.nature.com/articles/s41586-023-06723-z


Carbon Cycle
FOSSIL CARBON
100 YEARS
MILLIONS OF YEARS
20 MINUTES
FOSSIL CARBON
FOSSIL CARBON
BIOGENIC CARBON
1 MINUTE
BIOGENIC CARBON
10 MINUTES
200 YEARS
FOSSIL CARBON
BIOGENIC CARBON

When we cut down a tree and turn it into a product, such as a chair, its carbon remains locked in the material until it decomposes or is incinerated. When we humans interfere, it is important that we try to mimic the timescales of nature, to keep the biogenic carbon cycle as balanced as possible. For example, a branch that fall from a tree and remain on the ground will release its carbon (CO_2) continuously during 10–20 years[10] until it is decomposed. Therefore, if we instead produce something from these branches, we want it to stay intact and not release its carbon content until within 10–20 years. Or even better, if the product lasts much longer. Time is everything!

The same principle applies to fossil carbon: it should ideally remain sequestered for millions of years. Given the current atmospheric carbon surplus, extending the lifespan of carbon-storing products is essential.

The IPCC highlights key strategies for balancing the carbon cycle: increasing carbon storage in restored wetlands and forests (20%), transitioning to renewable energy and circular material flows while reducing consumption (70%), and implementing carbon capture and storage (10%).[11]

10 https://www.naturvardsverket.se/amnesomraden/klimatomstallningen/omraden/klimatet-och-skogen/biogena-koldioxidutslapp-och-klimatpaverkan/

11 Alasdair Skelton – https://www.youtube.com/watch?v=Uq-xu7D6lfw

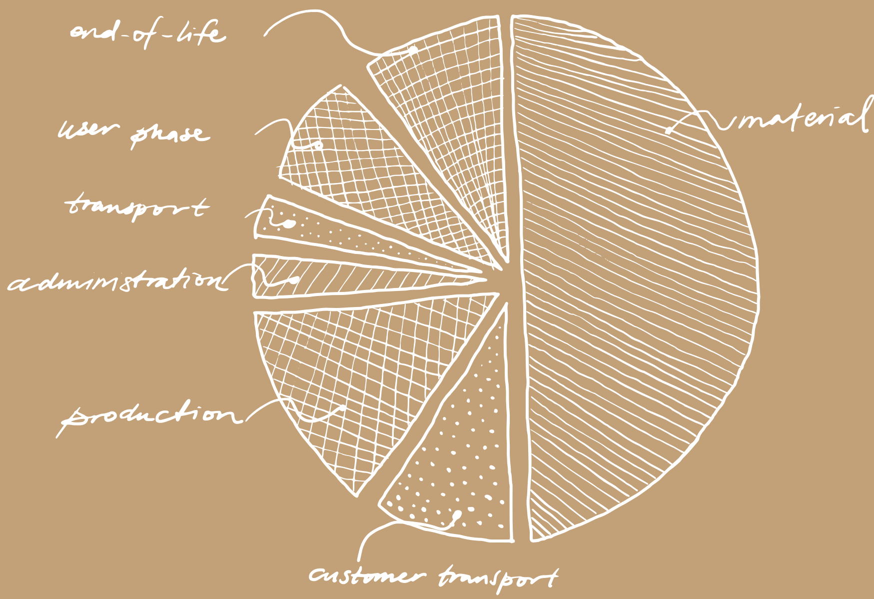
1kgCO_2e

Each material displayed on this table is shown in the amount of material that you would get for one kilogram of greenhouse gases counted as carbon dioxide equivalents CO_2e.

Carbon dioxide equivalents, CO_2e, is a unit that is used to standardize the climate effects from various greenhouse gases.

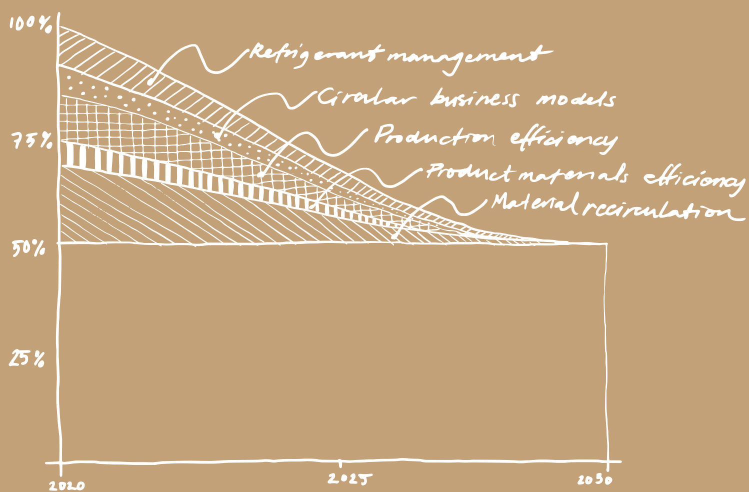
Why Material?

If we generalize, at least 50% of the carbon footprint for furniture comes from the materials in the product. This is why we have dedicated this part of the exhibition to materials and the differences between them.



Solutions

According to the carbon law[12] we need to cut emissions by half every decade to achieve climate safety and net zero by 2050. Exponential Roadmap has made a roadmap with solutions for how to lower the emissions for every sector until 2030. For our sector, the industry, key opportunities to reduce emissions are, material recirculation, product material efficiency, production efficiency, circular business models and refrigerant management.[13]



12 Carbon Law – https://www.stockholmresilience.org/research/research-news/2017-03-23-curbing-emissions-with-a-new-carbon-law.html
13 Exponentiel Roadmap – https://exponentialroadmap.org/exponential-roadmap/

How to Calculate the Climate Footprint of Furniture?

Measuring a product's climate footprint means assessing greenhouse gas (GHG) emissions across all life cycle stages — from material extraction and production to end-of-life. For furniture, the highest impact typically comes from materials and production, while for internal combustion engine cars, the majority of emissions occur during the use phase.

The standard method for calculating GHG emissions is by stating them as Global Warming Potential (GWP) in carbon dioxide equivalents (CO_2e). In this exhibition, we have calculated GHG emissions for materials and furniture using a cradle-to-gate approach. This methodology includes all emissions from raw material extraction, transportation, and manufacturing — up to the point where the product is ready for sale at the factory gate.

The Ecodesign for Sustainable Products Regulation (ESPR), effective July 18, 2024, sets new standards for circularity and eco-friendly design, making sustainability a core requirement for product development across industries in the EU.

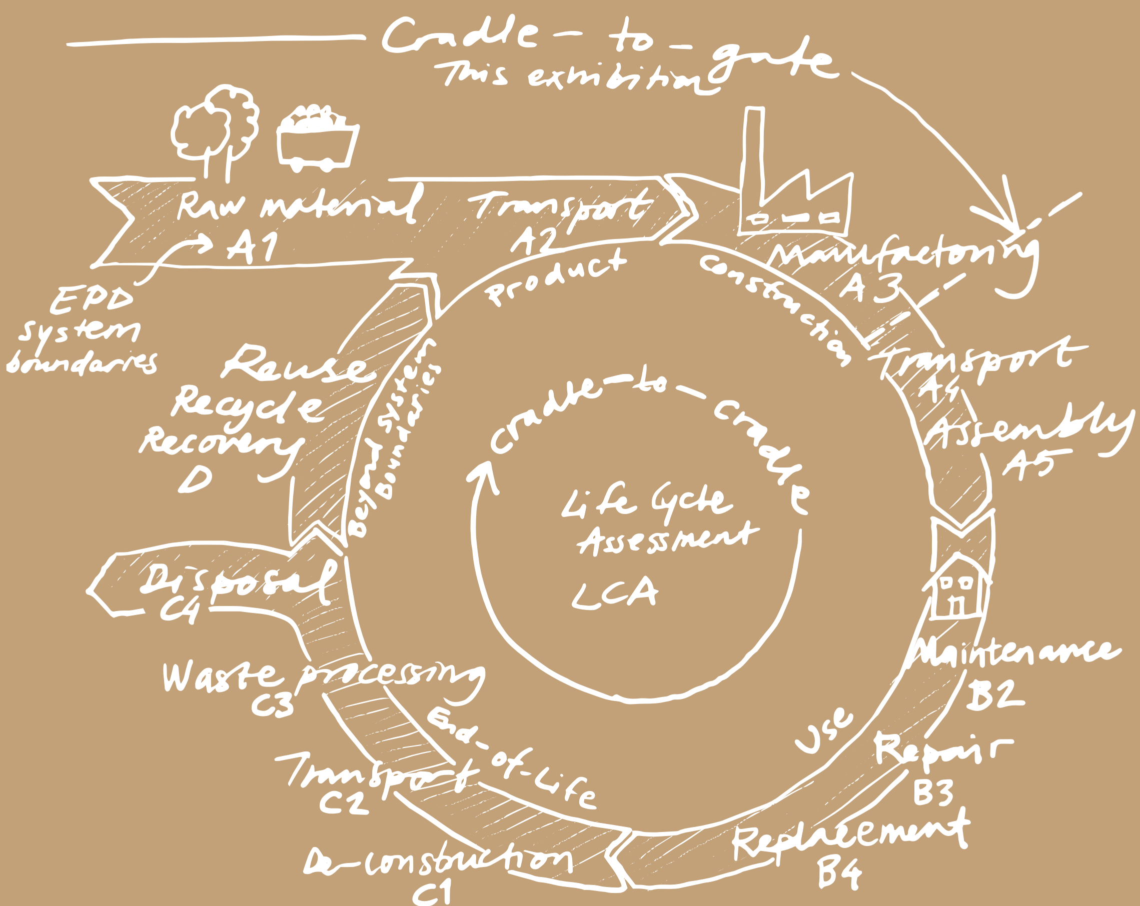
In addition to calculating the carbon footprint of products, large companies are (as of 2024) required to report their total emissions to comply with EU sustainability regulations (Corporate Sustainability Reporting Directive — CSRD). This EU-regulation will extend also to many small- and medium-sized companies in 2025–2026.

Methodology Overview

The climate impact data in this exhibition comes from Variable, a software platform that helps companies develop low-carbon products and decarbonize their value chains to gain a competitive edge.

Key data sources include industry-standard databases like Ecoinvent and peer-reviewed research. Most emissions data reflect industry averages, but when unavailable, alternative sources such as third-party validated company- and product-specific data (Environmental Product Declarations (EPDs)) and academic research are used. In some cases, multiple sources are cross-referenced for greater accuracy.

Biogenic carbon—stored in trees and plants during growth—is excluded from calculations. Unlike fossil carbon, which releases long-stored CO_2 into the atmosphere, biogenic carbon follows a shorter cycle, captured by plants and released when biomass decomposes or burns. Since this study covers only cradle-to-gate emissions and not the full life cycle, biogenic carbon is omitted. Additionally, uncertainties around its assumed climate neutrality further justify this exclusion.



2 How does Circularity Work in Reality?

Most products in today's society are still designed for a linear lifecycle, where planet Earth's resources are extracted, used, and then discarded. The circular economy, however, is a system where materials never become waste. Products and materials are kept in circulation through processes such as maintenance, reuse, repair, refurbishment, remanufacturing, recycling, and composting. Keep it in the loop for as long as possible!

Globally, about 100 billion tonnes of material are consumed annually,[14] including raw materials such as minerals, metals, fossil fuels, and biomass. However, only 7.2% of this massive consumption is recirculated, meaning that each of us generates around 11.5 tonnes of waste that could be put to better use. This underscores the urgent need to enhance material circularity. To address this, all EU countries have committed to a 55% material recycling target by 2025.[15] So there is still significant progress to be made.

As producers, architects, and designers, we have a unique opportunity to drive the circular economy forward, because so much of it is driven by design. By designing for the right circular loops, eliminating waste, enabling maintenance and repair, and choosing the right materials, we can make a significant impact. Now our goal is to close the loop, reuse the materials we already have — and become 100% circular.

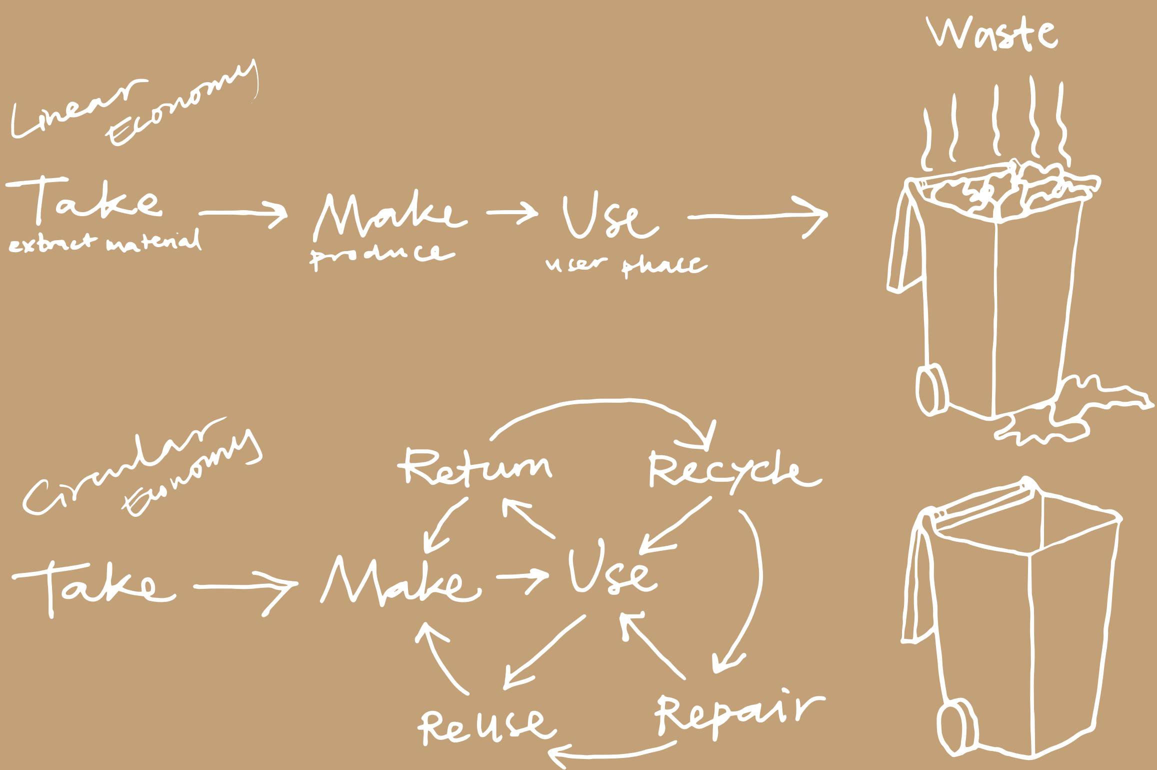
14 https://www.circularity-gap.world/2024
15 EU-legislation – https://www.naturvardsverket.se/data-och-statistik/avfall/kommunalt-avfall/

Keep It in the Loop

Priority one is to keep products in the loop for as long as possible. The easiest way to achieve this is by purchasing or producing items designed for longevity and ease of maintenance, repair, reuse, refurbishment, and remanufacturing. For example, finishes play a crucial role in how well a product ages and how easily it can be maintained. However, refurbishing large batches of products can be challenging. A system where manufacturers could refurbish each other's products would be highly beneficial. Will we be the first country in Europe to implement such a solution?

Secondly, understanding the recyclability of different materials is essential. For instance, metals can be recycled indefinitely, whereas most plastics can typically be recycled only about seven times before they start to degrade. A good help is Ellen MacArthur's[16] Butterfly diagram, where she explains the biological cycle and the technical cycle. Today, in Sweden it is not possible to recycle mixed material (from both cycles).

Finally, designing out waste and pollution from the outset is crucial. This means selecting materials that are recyclable so they don't end up in incineration or landfills.



16 https://www.ellenmacarthurfoundation.org/circular-economy-diagram

Material Cycle

Businesses embracing true circularity unlock substantial financial and environmental benefits. In a circular economy, interconnected cycles keep products, components, and raw materials in use, maximising resource efficiency and value retention.

For finite resource, strategies like repair, reuse, and refurbishment offer the most potential. While every product needs an end-of-life plan, recycling should remain a last resort.

The shift requires more than just product design changes; it demands a holistic approach that considers real-world systems to enable material circulation in practice. For example, mapping a product's end-of-life can reveal tangible opportunities. Understanding whether components are manually disassembled or products mechanically recycled can help improve recovery rates, while minimising downcycling, energy recovery, and landfill.

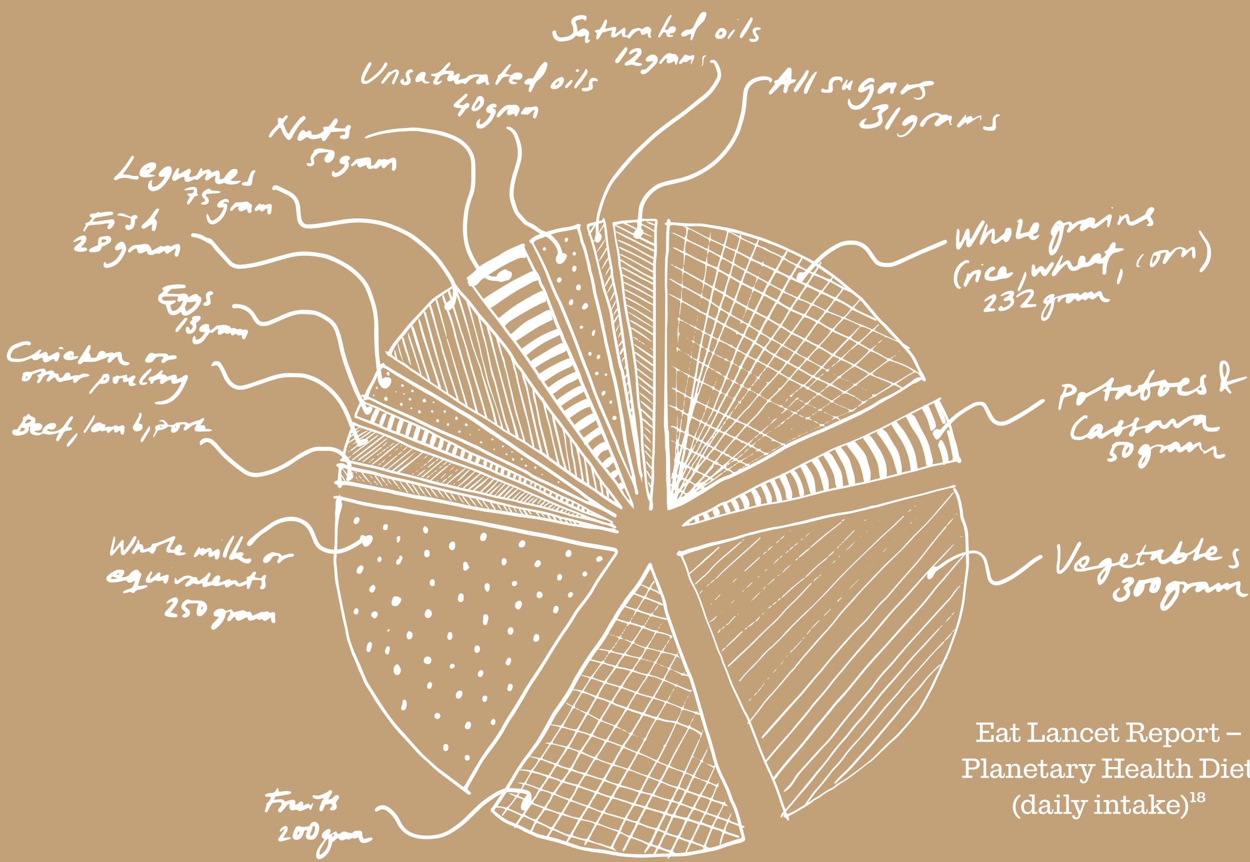
Capture value beyond resources, illustrated by Stena Circular Consulting and Emma Olbers.

Keep it in the Circle
Material Cycle
VIRGIN MATERIALS
RENEWABLE
FINITE
DOWNCYCLING/ REPURPOSING
INCINERATION
DESIGN
RECYCLED METAL
LANDFILL
PRODUCTION
RECYCLING
TRANSPORT
REFURBISH
MECHANICAL SORTING
REUSE
REPAIR
STORE
USER PHASE
SIZE REDUCTION
COLLECTION
RECYCLED PLASTIC
INSPECTION AND DECONTAMINATION
DISHES
BOTTLES

3 How Does It Work in the Food Sector?

The food sector accounts for 22%[17] of global GHG emissions, which is why it is so important to be innovative, thoughtful, and considerate — without compromising on great taste. Put simply, food must not only leave a good taste today but also a good aftertaste for tomorrow.

Food influences emissions at many stages, in primary production, transportation, processing, and in its afterlife phase.



Eat Lancet Report – Planetary Health Diet (daily intake)[18]

17 Source: Data from IPCC (2022); Based on global emissions from 2019, details on the sectors and individual contributing sources can be found in the Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Mitigation of Climate Change, Chapter 2.

18 Eat Lancet Planetary Health Diet - https://eatforum.org/eat-lancet-commission/the-planetary-health-diet-and-you/

Eating more vegetables produced locally, in a resource--efficient way, drastically reduces your climate footprint. If you diversify your protein intake from mostly meat-based to a 50/50 mix of meat and plant-based proteins — or entirely plant-based proteins — it makes a significant difference.

However, the most important factor is how food is produced and ensuring minimal losses along the way. The most unsustainable practice is throwing away produced and processed food, as it has already consumed significant resources, only to end up providing neither nutrition to people nor benefits to nature. This is why circular cooking is the model of the future — a smarter and more economical way to meet the Paris Agreement goals.

At our café, sustainability chef Paul Svensson and Mässrestauranger, would like to share some practical tips on how to put this into action.

Enjoy your meal — and eat it all!

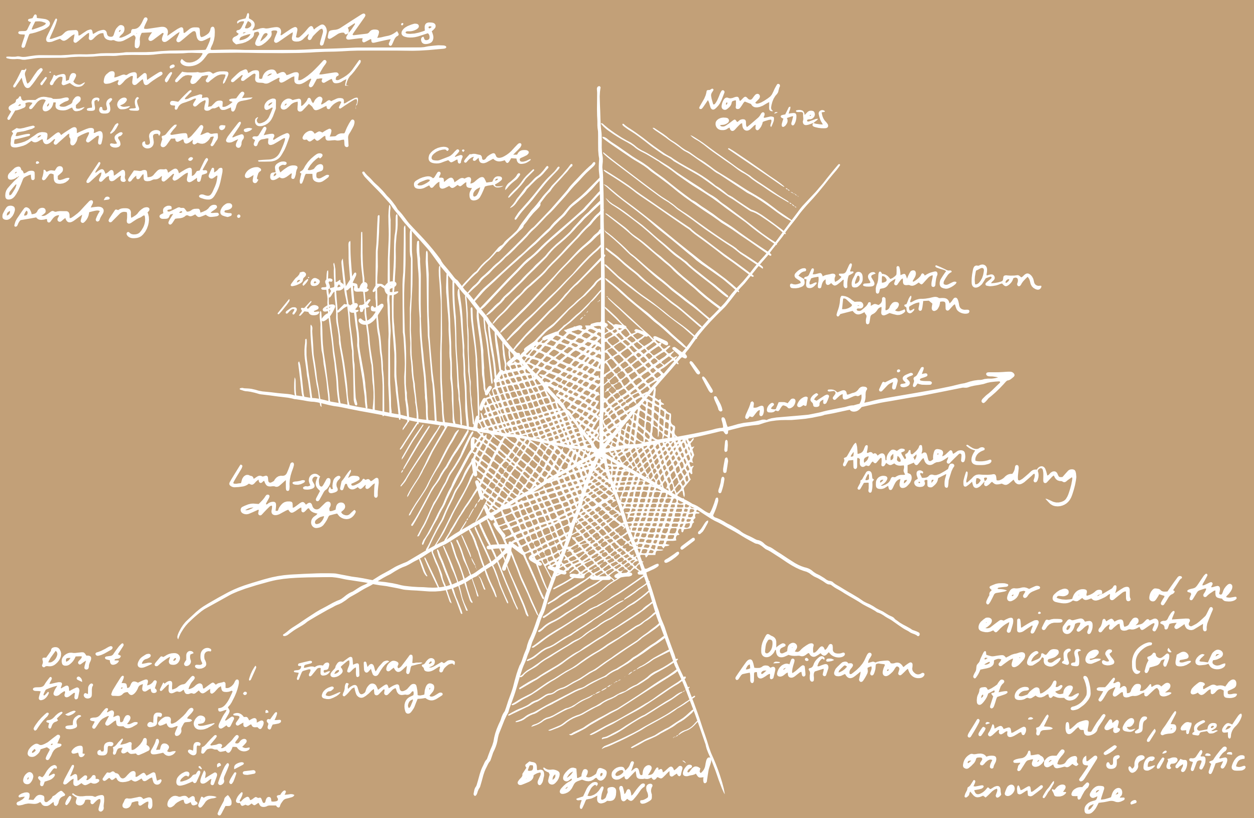
A Step Towards Fossil Free Interior

As we developed this exhibition, our goal was to minimize emissions, work circularly, and transition to fossil-free solutions. To achieve this, we have borrowed all the podiums, lamps and furniture, including the lightweight wooden furniture from Tre Sekel, the benches made of fossil-free steel from Vestre, and the textiles from Ludvig Svensson.

To determine the emissions we have generated, we calculated the exhibition's total footprint (GWP in CO_2e). You can read about the results in another part of the exhibition. See also the tags on the furniture for more detailed information.

The biggest challenge has been the temporary constructions, such as the kitchen room. Wooden studs are reused by Stockholmsmässan. However, paint is difficult to reuse. Most conventional water-based and acrylic wall paints on the market today have a petroleum base, but we found Toniton, which produces a completely fossil-free alternative.

My design method is based on the Planetary Boundaries, A Safe Operating Space for Humanity.[19] Simply put, the planetary boundaries are environmental thresholds within which humanity can survive, develop and thrive for generations to come. Crossing these thresholds come at the risk of abrupt and irreversible environmental change. All nine planetary boundaries are important and need to be considered in the design process. This exhibition primarily focuses on climate change, a boundary where impact is also reasonably easy to quantify.



19 Planetary Bounderies – https://www.nature.com/articles/461472a

1. Design for circularity

- Keep the product in the circular loop as long as possible, so designing functional, high-quality products that age gracefully, are easy to maintain, upgrade and repair.
- Incorporate second-hand parts.
- Think backwards, design for recycling with good separability and design out waste.

2. Materials x 6

- Use materials with low carbon emissions, fast growing or recycled are usually the ones.
- Use a small amount of material.
- Use mono-materials, as mixed materials are harder to recycle within either the technical or biological cycle.
- Use high quality material that age with dignity.
- Keep track of origin.
- Keep track of chemicals and dangerous substances.

3. Use renewable electricity in both production and transport but remember to still reduce overall energy consumption.

4. Calculate the product's emissions in CO_2e


WE DESIGNED
THE SYSTEM,
WE CAN
REDESIGN
IT NOW, FAST
1KG
CO₂e

Huge thanks to all collaborators,
without you, this had not been possible:

Paul Svensson, Stena Circular Consulting, Variable, Ludvig Svensson, Vestre, Tre Sekel, Professor of Geochemistry and Petrology Alasdair Skelton, PaperShell, Karl Stefan Andersson, Enkei, ToniTon, Byarums Bruk, Svenskt Tenn, Blå Station, Karl Andersson & Söner, Hässelby Blommor, Mattias Käll, Houdini, Syre, Flokk, Arper, Balzar Beskow, Swedese, Paebbl, Act of Caring, Asket, HOL, Fabric Forest, Agoprene, Hydro, SSAB, Stora Enso, ITG, Rosendals Trädgård, Arena Textil, Axfoundation, Dahl Agenturer, Mässrestauranger, Collection Apart, Stockholm Furniture Fair and Stockholmsmässan with team.

Photo: Andy Liffner

→ For more information about the exhibition and its participants, please visit www.emmolbers.com