Economic Introduction to the Ecological Crisis

Economy Studies Essential Lecture

Instructor's Guide

Economy Studies Essential Lectures

These teaching packs are designed for 90-minute (online or offline) sessions that can be added to existing courses. They help students become familiar with an important topic that is often neglected. At some universities lectures and sessions are typically longer than 90 minutes and at others shorter. Feel free to adjust the material to make it with your context and purpose.

Introduction

From our earliest days, humans have changed the earth's ecosystem in order to meet our needs and wants. In the last century, however, our capacity to produce and consume has been turbo-charged, allowing us to change the earth at a truly industrial scale. Unfortunately, this capacity is not limitless as the planet has a number of physical and biological limits past which the core systems that humans rely on will start to break down. Many of these planetary boundaries are currently being exceeded by the global economy, creating a state of ecological crisis in which a number of crises and challenges must be addressed simultaneously. To resolve this crisis, our economic system will need to transform to fit within the limits set by the earth's ecosystem. The framing of planetary boundaries of the global economy is complementary to the externalities approach, as well as providing greater depth and nuance to environmental issues.

This lecture lays out the foundations and current state of the ecological crisis, its main drivers and who is responsible for this. Students are very likely to encounter at least some aspects of the ecological crisis in their future careers, so it is crucial for them to develop a deeper understanding of this problem, regardless of the industry they later choose to enter. We take a problem-based learning approach to better transfer both skills and knowledge to students, and in acknowledgement that an understanding of the general problem is likely to be more valuable to them than knowledge of specific solutions.

It is crucial for students to develop a deeper understanding of the problem they are likely to encounter in their future careers, before getting into various economic policies or solutions to this pressing issue. Thus, using a problem-based learning approach to better prepare students to develop a better understanding and solutions for the future.

This class is designed for introductory undergraduate classes such as Principles of Economics, Macro 1 or Micro 1, to be the first time that students come across environmental or ecological issues in their degree programme

Lesson Plan – Overview

Learning Outcomes
• Understanding the multifacetedness of the ecological crisis, extending beyond climate change • Understanding the limits and boundaries of planetary systems • Developing analytical skills to evaluate the different factors and actors when it comes to environmental degradation
Transferable Skills Developed
• Problem-solving skills • Analytical skills • Understanding of the environment
Prior to session
Readings: • The nine planetary boundaries by the Stockholm Resilience Centre

Plan of Activities

Duration	Teacher Activity	Student Activity	Handouts, resources & bookings needed
2 min	Introduce the lecture and let students know what they can expect to see/learn		
5 min	Introduce Part 1: What are the main ecological challenges we face? Activate students through posing this question, preferably through a word cloud (e.g. using mentimeter.com) so they can see what their peers think.	Engage with the question, reflect on the ecological challenges and share with peers.	E.g. Mentimeter, Slido etc.
5 min	Briefly introduce the various concepts of limits and boundaries.		

5 min	Introducing climate change, what will the various increases in temperature lead to?		
10 min	Introduce planetary boundaries, briefly explain each one and the impact it has.		
5 min	Class activity in small groups or in plenum: have students try to identify what of the planetary boundaries have been exceeded, and how they are linked together.	Identify what of the planetary boundaries have been exceeded, and how they are linked together.	
5 min	Ask students to report back from their discussion, and sum up key points and answer the question. Emphasise how climate change is only one of six planetary boundaries that we have exceeded, and one of nine that we have to operate under.	Report back the main points from the group.	
5 min	Go a bit more in-depth in the most crucial planetary boundary: climate change.		
5 min	Trade-offs when it comes to the environment and issues related to this view.		
5 min	Introduce Part 2: What are the main drivers of environmental degradation? Here we suggest a wordcloud to reactivate students.	Contribute to the discussion.	
5 min	Show the production process for physical material. Have the students link the different parts of the production chain to different planetary		

	systems.		
2 min	Emissions by sector: show how most emissions come from energy, manufacturing and agriculture (livestock).		
2 min	Breakdown of land use and connect it to the land-system change boundary.		
3 min	Biodiversity loss: why it is important and show the main drivers and link to previous materials.		
2 min	Introduce part 3: Who are responsible for the crisis, and who should be held responsible? (E.g. Word Cloud)	Engage with the question	
2 min	Briefly link back to the production process, but this time from the perspective of responsibility and apply to countries and supply chains.		
5 min	Show how countries can be held responsible based on total levels of emissions/emission flows, cumulative emissions (historical), per capita etc.		
5 min	Introduce the concept of the Anthropocene, humans in general are responsible.		
5-10 min	Carbon emission inequality		

Lesson Plan – Detail

Homework

A reading that can be given is an overview and explanation of the 9 planetary boundaries, as a framework for the students to hold when thinking about environmental policy. A more simplified explanation video (less scientific) can be found here. An additional possible explanation video for students could be: The Brink of Climate Catastrophe by David Wallace-Wells.

Part 1: What are the main ecological challenges?

The economy is embedded within social and ecological systems, and these have limits and tipping points. The first part of this lecture is about the ecological limits that our global economy sits within. These limits are often referred to as planetary boundaries or ecological ceilings. They are the thresholds within which humanity can survive, develop and thrive into the future, determined by the carrying capacity of the Earth's natural systems. We are currently breaching many of these limits, causing severe damage to our environment, societies and economies. Lastly, these limits also provide students with a specific tool to quantify and analyse the ecological/planetary damage that is being caused.

Introducing planetary boundaries

Planetary boundaries were introduced as a framing in 2009 by Rockström and his team (2009), referring to the limits within which human societies can operate safely and sustainably on the Earth. The concept has inspired a range of global sustainability policies and theories. Economists such as Herman Daly and Kate Raworth centre these limits in their work, but planetary boundaries have not yet been incorporated into the mainstream of economic research and practice. Perhaps the best known of the planetary boundary is keeping average global temperature within 1.5°C of pre-industrial levels, a target that was set by the Intergovernmental Panel on Climate Change (IPCC, 2018).

Including climate change, we are currently exceeding 6 planetary boundaries, with the others being: biodiversity loss, nitrogen and phosphorus cycles (also known as biogeochemical flow), land use (also known as land-system change), chemical pollution, and freshwater use. Other boundaries not yet exceeded include: air pollution, ocean acidification, and stratospheric ozone depletion.

All of these planetary boundaries are interconnected, and exceeding one can lead to negative impacts on others. For example, climate change can lead to biodiversity loss and ocean acidification, and land use changes can lead to both biodiversity loss and freshwater use issues. It is therefore essential to address these ecological challenges in a holistic manner, rather than treating them as separate issues. The planetary boundaries also illustrate that the problem at hand is larger and more complex than just co2 emissions.

Climate change

Although planetary boundaries illustrate that the issue of ecological degradation goes beyond climate change, it is widely recognised as one of the most important planetary boundaries that we must be concerned about. Climate change is particularly important because it has the potential to disrupt virtually all aspects of human life on Earth, from agriculture and water resources to human health and security. The burning of fossil fuels and other human activities have already caused the Earth's temperature to rise by about 1°C above pre-industrial levels, and the impacts are already being felt in many parts of the world, including more frequent and intense heat waves, droughts, floods, and storms. Lastly, climate change is also one of the easiest to quantify and is closely linked to several other planetary boundaries such as biodiversity loss.

To stay within the safe planetary boundary for climate change, the world must limit global warming to well below 2°C above pre-industrial levels and pursue efforts to limit warming to 1.5°C. However, the last IPCC synthesis report (2023) estimates that current policy may lead to warming as high as 3.2°C. The predicted outcomes are far more extreme and unpredictable the further the global average temperature rises. Thus, it's not just about staying under 1.5 or 2°C, but rather minimising the damage by keeping the warming as low as possible. See slides and slide notes for more details.

Tradeoff between mitigating ecological challenges and the economy

Economists often study the tradeoff between the cost of mitigating emissions and the potential foregone consumption using models that account for the costs and benefits of different policy options. These models can help policymakers make decisions about how to allocate resources to achieve emissions reductions in the most cost-effective way possible. In order to reduce greenhouse gas emissions and other forms of environmental degradation, it is often necessary to make investments in new technologies, infrastructure, and practices. Simultaneously, it is necessary to reduce or stop several types of industry and consumption in order to mitigate. These investments and adjustments can come at a cost, which may be borne by individuals (e.g. job losses), businesses, or governments (reduced economic output).

However, it is important to recognise that the tradeoff between the cost of mitigating emissions and foregone consumption is not just an economic issue, but also a social and political one. Different stakeholders may have different priorities and values when it comes to balancing the costs and benefits of environmental policy. Ultimately, finding a sustainable and equitable solution to the tradeoff between the cost of mitigating emissions and foregone consumption will require a combination of economic, social, and political factors to be taken into account

While the concept of tradeoff between the cost of mitigating emissions and the potential foregone consumption can be useful in framing the issue of environmental policy, it can also be limiting in some ways.

Firstly, the tradeoff assumes that economic growth and consumption are the primary goals of society, and that any reductions in these metrics must be justified by the benefits of environmental protection. This framing can obscure the fact that

environmental degradation can also have significant economic and social costs, which may be difficult to quantify.

Secondly, the tradeoff assumes that the costs and benefits of environmental policy are distributed evenly across society. In reality, the costs and benefits of environmental policy are often unevenly distributed, with certain groups bearing a disproportionate burden of the costs while others reap the benefits. This can create significant political and social tensions, particularly in cases where vulnerable communities are disproportionately impacted by environmental degradation.

Finally, the tradeoff assumes that there are limited resources available to address environmental challenges, and that these resources must be allocated efficiently. While it is true that resources are finite, this framing can obscure the fact that there may be alternative economic and political structures that could enable more sustainable and equitable resource use.

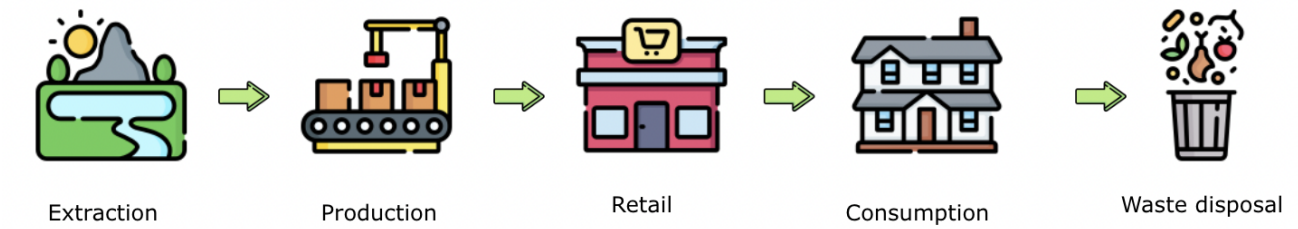
Overall, while the concept of tradeoff can be a useful starting point for thinking about environmental policy, it is important to recognise its limitations and the broader social and political factors that shape environmental policy decisions. It can also get to a point where it will not be a trade-off between the two, not mitigating the effect will lead to dammace hurting the economy as much as the environment. For example, when there's enough air pollution, you're not just trading off human lives against company profits, you're also costing the health service so much that it's not economically viable. Same for global heating and all the other boundaries.

Part 2: What are the main causes/drivers of environmental degradation?

This part addresses the drivers of environmental degradation through looking at drivers of emissions, biodiversity loss, and land-use change. These are just a few of the drivers, but together they make up a large part of the main issues we face.

It is important for economics students to understand the drivers of environmental degradation because the environment is a crucial factor in economic development and well-being. Natural resources, ecosystem services, and environmental quality are all important inputs to economic production and consumption. In short, understanding the drivers of environmental degradation is important for economics students because it can help them to better understand the complex relationship between the economy and the environment and develop solutions to promote sustainable development and economic growth.

Production Process as a driver

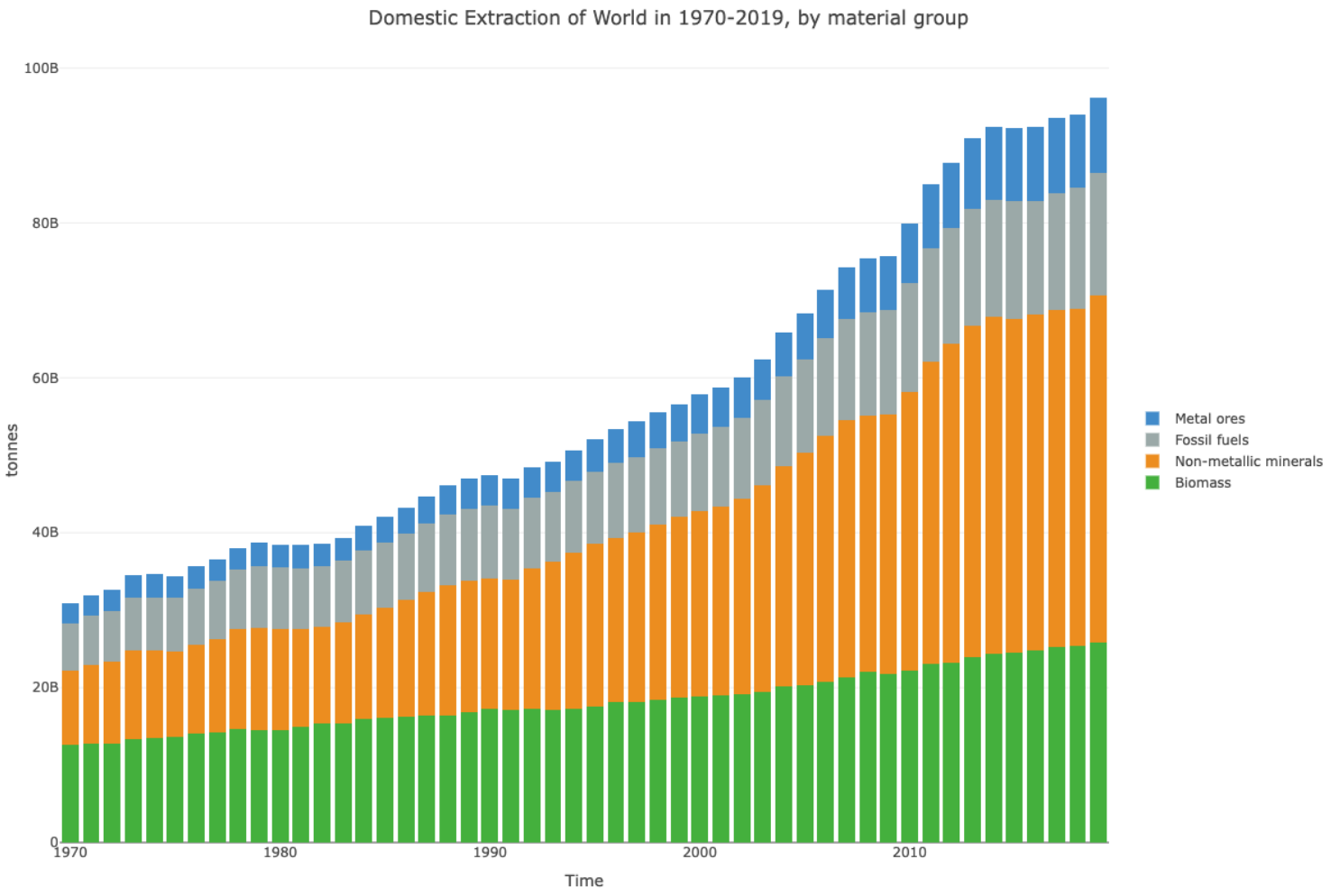


The linear production process is a linear model that describes the flow of goods and materials through the economy, from extraction to disposal. The process consists of five main stages: extraction, production, retail, consumption, and waste.

The extraction stage involves the removal of natural resources, such as minerals, oil, and gas, from the Earth's crust. These resources are then transported to production facilities, where they are transformed into finished goods through various manufacturing processes. Once the goods are produced, they are distributed to retailers, who make them available for purchase by consumers. The consumption stage is when the goods are used or consumed by individuals or businesses. Finally, at the end of their useful life, the goods become waste, which is either disposed of in landfills, incinerated, or recycled. Unfortunately, much of the waste generated in this linear process ends up in landfills or the environment, contributing to pollution and resource depletion.

Endless of tons of physical material added each year (after removing things that are recycled etc.). However, as shown in Part 1, we have a biophysical limit, and everything we produce uses energy and resources (nature and ecosystems) where almost all of it ends up as waste. Some scientists estimate that our limit of yearly material flows

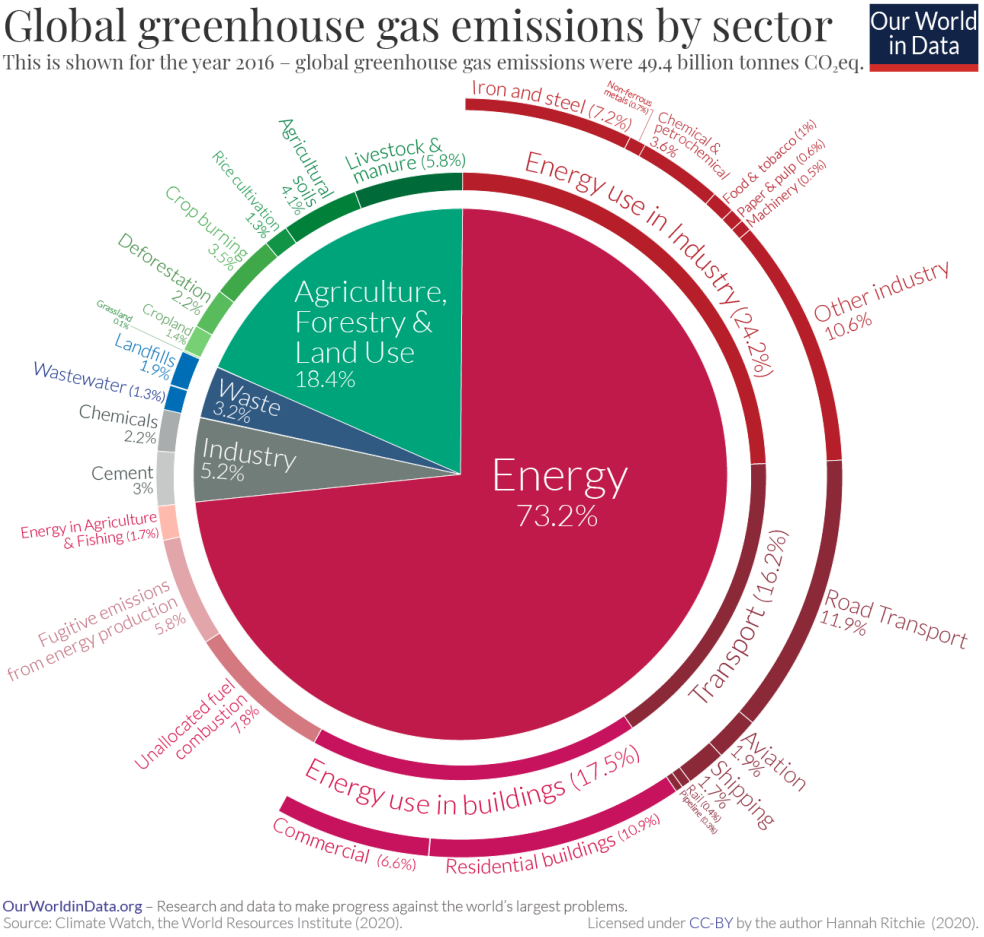
should be 50 billion tonnes a year, which we surpassed in the mid-1990s and have been increasing since.[1]



[1] Another limit/measure that we can use is ecological footprint, "a measure of human demand for natural capital. Or, in other words, the quantity of "nature" it takes to support a given population or economy" (Earth4all) . Since the 1970s our global ecological footprint has exceeded biocapacity, leading to a systematic deficit.

Sectors

Within economics it is important to understand what sectors and industries are the most harmful. One way to measure this is through greenhouse gas emissions. The energy sector, including electricity generation, transportation, and heating and cooling, is responsible for the largest share of greenhouse gas emissions. Fossil fuels such as coal, oil, and natural gas are major sources of emissions in this sector. However, this can be linked to various sectors. However, in terms of sector manufacturing is one of the largest emitting sectors, followed by agriculture. See the slides and the figure below for more details.



Drivers of biodiversity loss

"Biodiversity is essential for the processes that support all life on Earth, including humans. Without a wide range of animals, plants and microorganisms, we cannot have the healthy ecosystems that we rely on to provide us with the air we breathe and the food we eat. And people also value nature of itself."

– The Royal Society

Land-use change is currently the largest driver of biodiversity loss, contributing to 30% of all the loss. However, many models predict that climate change will soon become the largest driver. All the top three drivers of biodiversity loss (land-use change, overexploitation, and climate change) can be directly linked back to the economy and the production process.

Land usage

How we use the earth's land area is also very important for understanding the connection between economy and environment. Land-use changes contribute a lot to emissions as well as disturbing ecosystems and biodiversity. As shown by the land infographic, the largest share of our habitable land is used for agriculture, which again consists mostly of livestock.

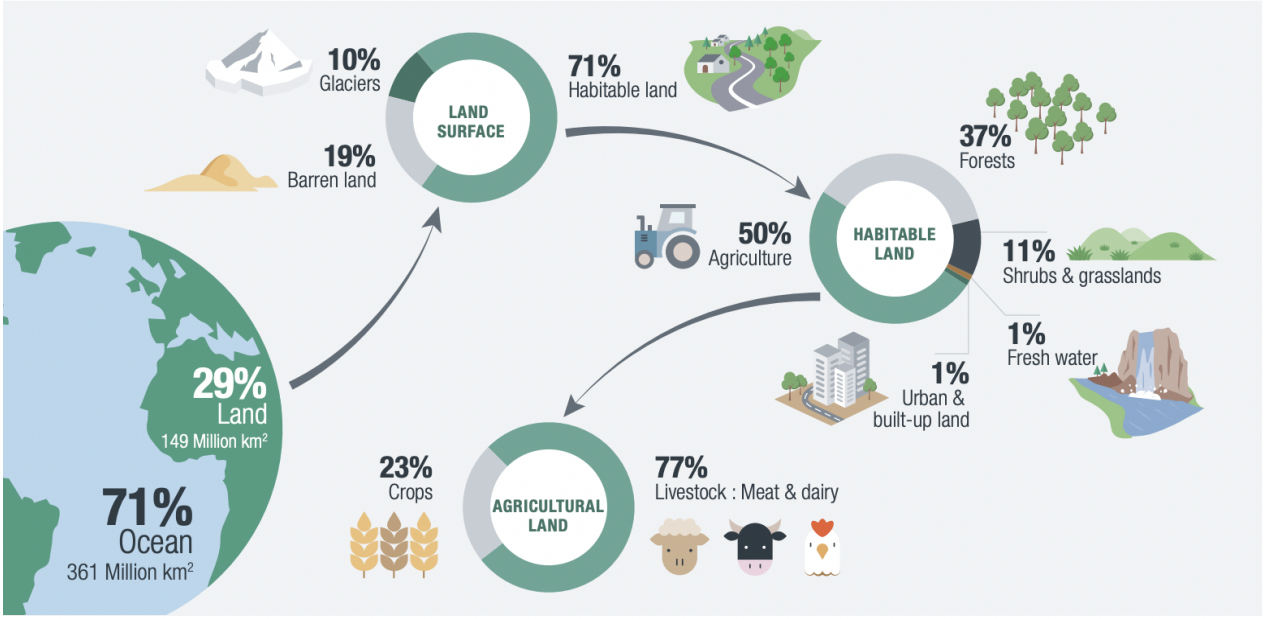


FIGURE 1 How the land is used (~2015). Although human settlements (cities, towns and villages) only take up about 1% of the total ice-free land surface, we use the land for many different purposes.

UN Food and Agriculture Organization (FAO), Licensed under CC-BY by the authors Hannah Ritchie and Max Roser in 2019. Adapted from an infographic by Azote.

Part 3: Who is responsible for the ecological damage

There are numerous factors that are responsible for ecological damage. From individuals, industries, countries, regions as well as social, political, and economic systems. However, are some more responsible than others? It is also worth noting that the impact of ecological damage is often felt by those that contributed the least.

Production Process

Each step of the process has responsibility (extractor, producer, seller, consumer, or disposer) with a given impact (land, water, and air pollution). The different parts of the process also take place across countries. For example, what country is responsible for the emissions if the raw materials were extracted in Australia, produced in India, sold and bought in the USA, and its waste ended up in Senegal?

Countries/Regions

When looking at cumulative CO2 emissions from 1750 till now, the EU and the USA account for more than half of the total emissions. Per capita emissions is another way to evaluate what countries are most responsible for emissions. Hickel (2020) also has a specific method to quantifying national responsibility for climate breakdown.

Anthropocene

As human beings we are only one form of life living on this planet. In the early history of humankind this meant that we had to adapt to our environment. Later, we learned how to adjust our environment to serve our needs. This process has gone so far that many scientists have proposed naming the current ecological era "the Anthropocene", implying that human beings are currently the main cause of changes in the Earth's natural systems. But how can we best understand the relationship between humans, their economic activities and the natural world around them? How does nature influence the economy and what role do natural resources and land play in the economy? And currently also very important: how does the economy influence nature?

The Anthropocene is characterised by a variety of human activities that have had a significant impact on the Earth's ecosystems, such as climate change, deforestation, pollution, and the extinction of species. These activities have resulted in changes to the Earth's atmosphere, oceans, and land surface, and have caused a variety of environmental problems such as sea level rise, ocean acidification, and loss of biodiversity. In other words, humans are responsible.

The concept of the Anthropocene is important because it highlights the significant impact that human activities are having on the planet, and the urgent need for action to address the environmental problems that we face. By recognising our role in shaping the Earth's ecosystems, we can take responsibility for our impact and work to create a more sustainable future for ourselves and for the planet. However, not all humans have contributed equally.

Global carbon inequality

The inequality of emissions is not distributed evenly around the world. In fact, a small percentage of the world's population is responsible for the majority of greenhouse gas emissions, while the majority of the world's population emits relatively little.

This inequality is largely driven by differences in economic development and lifestyle choices. Developed countries tend to have higher levels of greenhouse gas emissions due to their greater reliance on fossil fuels and higher levels of industrial production. Within developed countries, wealthier individuals tend to have larger carbon footprints due to their higher consumption of goods and services that are carbon-intensive.

Meanwhile, many people in developing countries emit very little greenhouse gases, largely due to lower levels of industrial production and consumption. However, these same individuals often bear the brunt of the impacts of climate change, such as increased flooding and droughts, even though they have contributed very little to the problem.

Socio-economic inequality of emissions

The socio-economic inequality of emissions refers to the fact that greenhouse gas emissions are not only distributed unevenly around the world, but also within societies, with certain groups emitting much more than others. This inequality is often linked to broader patterns of socio-economic inequality.

In many countries, the wealthiest individuals and households tend to have much larger carbon footprints than the poorest, largely due to differences in consumption patterns. An Oxfam report showed that the richest 10% of the world's population (c.630 million people) were responsible for 52% of the cumulative carbon emissions.

Wealthier individuals tend to consume more energy-intensive goods and services, such as large homes, frequent air travel, and energy-intensive forms of transportation, whereas poorer individuals often have to prioritise basic needs over energy-intensive consumption. Furthermore, certain marginalised groups, such as low-income communities, often live in areas with higher levels of pollution and are more vulnerable to the impacts of climate change, despite contributing less to the problem.

Addressing the socio-economic inequality of emissions is crucial for achieving a more just and sustainable future. This includes policies that address broader patterns of socio-economic inequality, such as improving access to clean energy and sustainable transportation options for marginalised communities, as well as efforts to promote more sustainable consumption patterns among the wealthiest individuals and households. Ultimately, creating a more equitable and sustainable future requires addressing both the global and socio-economic inequality of emissions.