Reducing **the ecological footprint** through eco-awareness

# CHANGE STARTS WITH EDUCATION NOW!

**FOLLOW US ON FACEBOOK AND INSTAGRAM**

Supported by:

Federal Ministry for Economic Affairs and Climate Action

on the basis of a decision by the German Bundestag

European Climate Initiative EUKI

refeproject.eu

# FOREWORD

The development of human society has been based on two principles: Humans are the dominant species and the resources needed are unlimited.

However, the world changes in recent decades have proven these principles wrong. The problem is that resources are undoubtedly limited while humanity's demands continue to grow. Technical progress interferes with natural development and causes serious interference with the environment. The United Nations Agenda 21 for Sustainable Growth (1992) states: "Man is at the centre of everything and should lead a healthy life, in harmony with nature." This raises the question of how we should use and at the same time preserve the resources we have at our disposal.

These teaching materials are designed to answer questions and deepen knowledge. The knowledge presented in the core chapters (sustainability, soil, water, air) can be expanded and consolidated in the broader thematic sub-chapters.

We took steps to address the various topics as objectively as possible. We hope that by learning from these materials, students will not only become aware of their environmental footprint, but also of the many things they can do to mitigate it. In addition, we hope to stir enthusiasm for the environment and the mysteries of nature, which is why the last chapter includes a wonderful 'journey into a tree'.

May the tree of interest and knowledge grow from this seed.

CONTENTS


| | | |
|---|---|---|
| **1.** | **UNDERSTANDING THE ENVIRONMENT** | **4** |
| 1.1 | WHAT IS SUSTAINABILITY? | 4 |
| 1.2 | WHAT ARE RESOURCES? | 6 |
| 1.3 | WHAT IS ECOLOGY? | 7 |
| 1.4 | WHAT IS THE ECOLOGICAL FOOTPRINT? | 7 |
| 1.5 | VIRGIN FORESTS IN ROMANIA | 10 |
| **2.** | **ABOUT SOIL** | 12 |
| 2.1 | SOIL EROSION | 12 |
| 2.2 | SOIL SEALING | 13 |
| 2.3 | LIMITED RESOURCES | 14 |
| 2.4 | THE EFFECT OF FARMING ON LAND | 14 |
| **3.** | **ABOUT WATER** | 17 |
| 3.1 | WATER DEFICIT | 17 |
| 3.2 | SEA AND OCEAN LEVEL RISING | 19 |
| 3.3 | OVERFISHING | 19 |
| 3.4 | RIVER AND WETLAND ENGINEERING | 21 |
| **4.** | **ABOUT AIR** | **22** |
| **5.** | **ABOUT PLANTS AND ANIMALS** | **25** |
| 5.1 | WHY DO SPECIES BECOM EXTINCT? | 25 |
| 5.2 | CONSEQUENCES OF SPECIES EXTINCTION | 26 |
| **6.** | **IMPROVING THE ENVIRONMENT** | **28** |
| 6.1 | FOOD | 28 |
| 6.2 | HOUSING AND ENERGY | 30 |
| 6.2.1 | HOT WATER AND HEATING | 34 |
| 6.2.2 | ABOUT CONSTRUCTIONS | 35 |
| 6.3 | MOBILITY AND TRANSPORTAT | 41 |
| 6.4 | TECHNOLOGY AND COMPUTERS | 42 |
| 6.5 | HYGIENE | 44 |
| 6.6 | CLOTHING | 47 |
| 6.7 | WHAT IS WASTE? | 50 |
| **7.** | **A JOURNEY INTO THE TREE** | **55** |
| | CHARTS | 58 |
| | FURTHER READING | 59 |

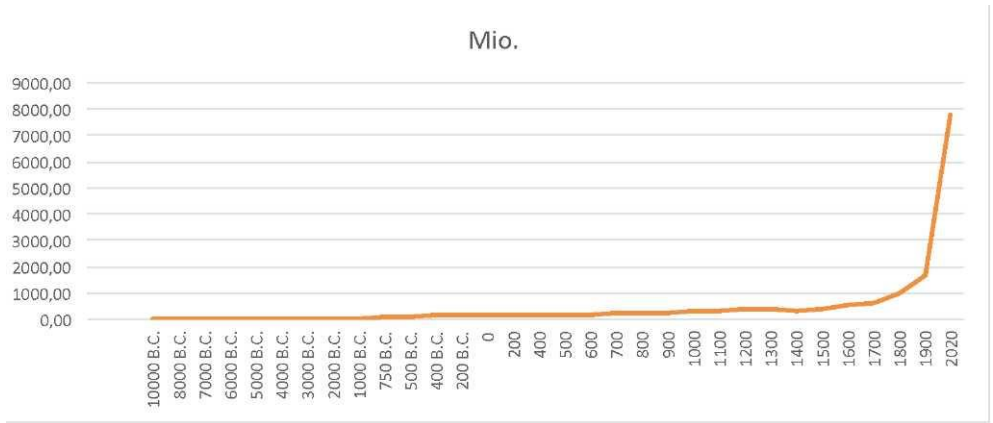
# 1. UNDERSTANDING THE ENVIRONMENT

### WHAT IS SUSTAINABILITY? WHAT SUSTAINABILITY IS NOT?
### WHY SUSTAINABILITY IS ACTUALLY IMPORTANT?

As we will show you in the next chapter, the world is changing. The cause of this change is humans who, through their way of life, damage the environment to such an extent that it can no longer recover.

We are part of nature and we should change our behaviour to avoid profound negative developments. We must learn to manage the resources we have, because if all 7.8 billion people in the world consumed as much as we Europeans do, these developments would become unstoppable. For this to happen, governments first need to work together, and individuals have to rethink their behaviour. Below we will take a closer look at these behavioural changes.

First, we will clarify what sustainability really means and explain why it is so important. In the following, we will show some examples of the current state of our planet and the unsustainable way of life that is affecting it. In the next chapter, we will discuss what everyone can do to protect the planet by living in an environmentally friendly manner.




*Population growth*

## 1.1. WHAT IS SUSTAINABILITY?

Sustainability describes a behaviour that ensures that no more is consumed than can be regenerated or recovered on its own.

The term sustainability was first coined in the 18th century by Hans Carl von Carlowitz. At that time, many forests in Europe were cleared to meet the energy needs of cities.

The area cleared was larger than the area reforested, resulting in a shortage of wood for future years and generations. Hans Carl von Carlowitz was the first to call for sustainable forest management to counter this long-term problem.

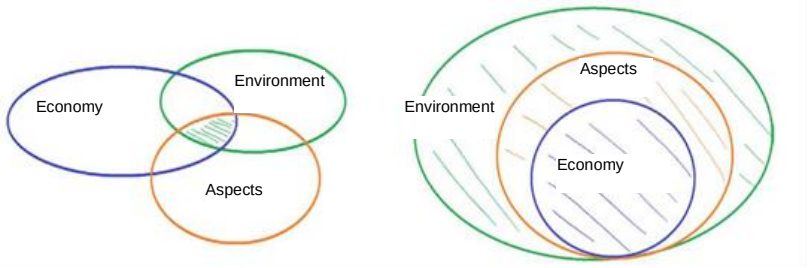
Over the years, the meaning of the term expanded and now refers to all the resources we use. Sustainability is of particular importance in three areas of life: ecology, economy and society.

The environmental dimension includes both nature, i.e. the environment, and natural resources.

In society, it influences knowledge and guidelines and institutional, governmental and healthcare processes.

In the economy, sustainability should determine the basis for resource management, mutual trade and transport.

All three areas are paramount and therefore equally important pillars of sustainability. If sustainability improves in one area of life, it has an impact as a whole. The interpretation of sustainability depends very much on what people mean by it. Critics therefore often refer to such an interpretation as "weak sustainability".




*"Weak" sustainability*

*"Strong" sustainability*

"Weak sustainability" stands in contrast to "strong sustainability".

In "strong sustainability", the 3 areas of life are not considered to be of equal value, but they rely on each other.

Nature and natural resources underpin everything, because the economy and society would not exist without them. It is them that drive the social and cultural life of people. The sustainability of the economy is considered the least important, as it is only possible within the social structure of people. "Strong sustainability" is therefore also much more stringent in terms of resource use, as both the social and the economy function within the environment.

**What we learn from this:**

**Sustainability consists of social, environmental and economic aspects.**

**Within the 'strong' sustainability that we are striving to achieve, the social and ecological areas fall within the ecological limits.**

The United Nations has proposed a 17-point plan for guaranteed sustainable development, the "17 Sustainable Development Goals".

**What we learn from this:**

**UN seeks to create more sustainability through the 17 Sustainable Development Goals**


These 17 objectives cover environmental, social and economic development. We will focus first on the following objectives:

**RENEWABLE ENERGY**
**RESPONSIBLE CONSUMPTION**
**CLIMATE PROTECTION**
**AQUATIC LIFE**

## 1.2. WHAT ARE RESOURCES?

The term 'sustainability' is closely related to resources. The word comes from French and means source or means. A resource is therefore a means to a specific end. If our goal is to eliminate hunger, then grains, fruit, vegetables or other foods are our resources. If our intention is to build a house, wood, stone or cement are our means to that end. In turn, we need other elements to generate certain resources. To grow vegetables, for example, we need water and soil resources. The soil resource refers either to the area we need to grow vegetables on or the nutrients in the soil that plants need to grow.

If we want to produce items in a factory, we need many different resources, depending on the type of item. Energy is a basic resource that is needed in all situations and which in turn is obtained from different resources, namely sources.

However, the production process generates, among other things, unusable exhaust gases. These exhaust gases are absorbed by trees and the sea and become harmless or turn back into air. For a long time, resources like air and water seemed unlimited. But in the meantime, we learned these resources are becoming increasingly scarce because of flue gas and waste water pollution. Agricultural land is also a scarce resource, as it is needed not only for growing vegetables, but also for growing animal feed, plants for biofuel production and clothing.

To make people more aware of this resource consumption, the so-called notion of ecological footprint came into being.

**What we learn from this:**

**Resources are limited, so we need to reduce their consumption.**

## 1.3. WHAT IS ECOLOGY?

The term comes from ancient Greek and means "the study of one's house". Ecology studies the interactions between the animate and inanimate environment, namely between living organisms and soil, water and air. It is a branch of biology.

We are particularly interested in environmental sustainability, how we humans interact with the environment in the long term without harming it. The term 'ecosystem' describes a living community made up of several species and their environment.

## 1.4. WHAT IS THE ECOLOGICAL FOOTPRINT?

The ecological footprint is a measure of a person's consumption of resources.

Picture our whole planet as a farm. We need building materials to construct the buildings and stables and wood for heating. Both resources must be procured in advance. It's the same with food: everything people want to eat must first be grown or raised and slaughtered. The ecological footprint was designed to illustrate all these processes and effects and to apply them to the individual.

This makes the environmental human impact measurable and is based on the first principle of sustainability developed by Hermann Daly:

**The use of resources must not exceed their regeneration capacity.**

The term itself was coined in 1994 by William Rees and Mathias Wackernagel. The ecological footprint is a method of calculating the human impact on our planet. It measures the productive area of land and water a human needs to produce resources and the area needed to absorb waste.

**The ecological footprint therefore compares consumption in global hectares with biocapacity.**

## WHAT IS THE GLOBAL HECTARE?

**What we learn in this context:**

**The ecological footprint is a method of representing our consumption.**

**The unit of measurement is the global hectare.**

One global hectare (gha) corresponds to one biological hectare with average productivity. This unit of measurement helps to compare areas of land with different levels of productivity.

**For example:**

- One hectare of cereals is equivalent to 2.1 hectares overall;
- 1 hectare of grassland equals half a hectare overall;
- 1 hectare of forest equals 1.4 hectares overall,
- 1 hectare of fishing area, on the other hand, represents only 0.4 hectares overall;
- One hectare of crop land is equivalent to 2.2 global hectares overall, etc.
- Therefore 1 hectare of productive land is not equal to 1 hectare of desert land.

## SO HOW DO THESE GLOBAL HECTARES APPLY?

**By way of example, let's compare the bus and the car.**

The energy required for transport over a distance of 10 km per day per person is as follows:

- Bus: 301 $m^2$.
- Car: 1,442 $m^2$.

This means that the car consumes five times more global hectares than the bus.

## WHAT IS BIOCAPACITY?

Biocapacity is biological capacity. This is the capacity of an ecosystem to produce biological material and to absorb the waste produced by humans.

## OVERSHOT DAY

The result of the calculation of the ecological footprint is the so-called Overshot Day. This is the day on which the natural regeneration capacity is exceeded. The Overshot Day of 2021 was 29 July. Overshot Day is determined by the Global Footprint Network, and it is now moving nearer to the start of the year.

**Notes:**

# 10 TIPS TO EFFECTIVELY REDUCE YOUR ECOLOGICAL FOOTPRINT

**Global footprint: Major factors**

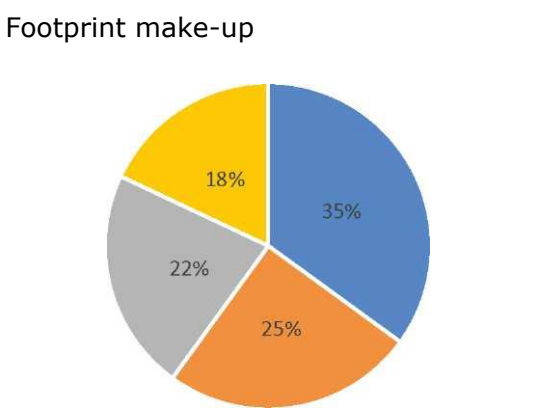
**The ecological footprint is made up of four areas.**

FOOD

HOUSING AND ENERGY

CONSUMPTION

TRANSPORTATION AND MOBILITY




## IF WE CHANGE OUR BEHAVIOR IN THESE FOUR CATEGORIES, WE CAN SAVE THE WORLD!

> Do we save the world with a veggie burger?
Read more in the chapter on nutrition.

> Do we save the world if we lower the room temperature by 2 degrees?
Read more in the chapter on housing and energy.

> Do we save the world if we travel by train instead of plane?
Read more in the chapter on mobility and transportat.

> Do we save the world by not buying the latest smartphone?
Read more in the chapter on technology and computers.

## 1.5. VIRGIN FORESTS IN ROMANIA

Romania has always been a heavily forested country, with many deciduous and coniferous forests. Virgin forests are particularly interesting in this context. These are forests that have not been exploited by humans.

Although there are hardly any virgin forests left in Europe, some of them can still be found in Romania, most of them being virgin beech forests. Beeches are deciduous trees with slightly reddish wood and smooth bark.

*The beech and its leaves*

Almost half of these ancient forests have been cleared since 2005. Austrian logging companies with large lumber mills were also involved in these clearings. Because these are natural treasures, the pressure to stop this deforestation is very high.

**Illegal deforestation is also taking place in the Maramures area.**

It is estimated that almost one tenth of Romanian forests is virgin forest. This means that every tenth tree should be protected. These old trees can cope with global warming better than conifers, which are often planted in place of felled trees. It would be better to leave the forest as it has been for centuries.

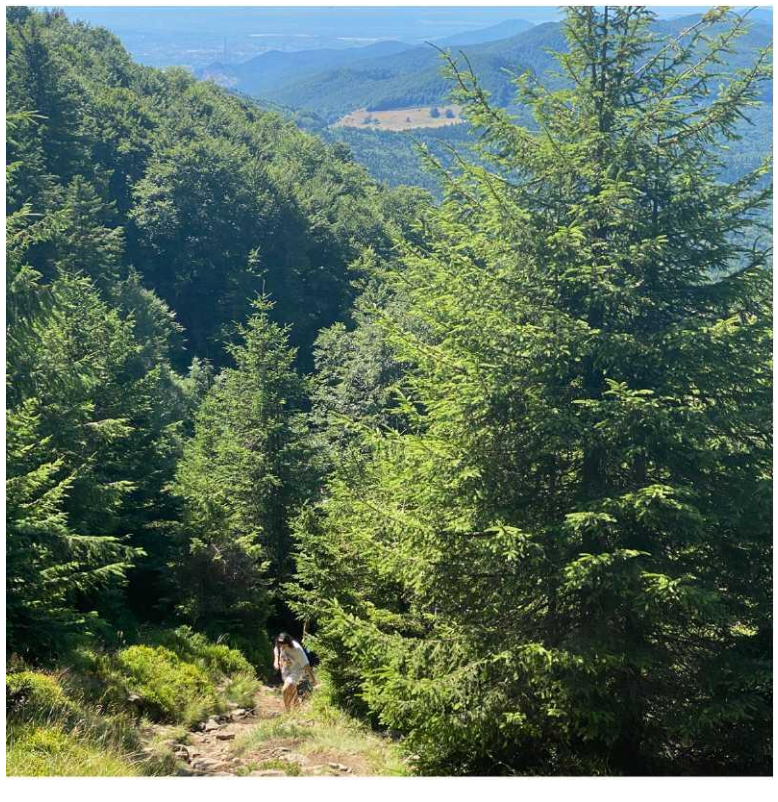
**Virgin forests are forests that have remained largely untouched by human influence. Because Europe is so densely populated, their numbers are very small.**

We remind that there are extensive forested areas not only in the Amazon region but also in Romania. And these are really very old forests that we should protect.

Every piece of wood we buy must be labelled with an FSC mark. FSC stands for Forest Stewardship Council and means that the wood comes from sustainable forestry.

Burning wood only releases the amount of CO2 that the tree has stored during its lifetime! That's why heating with wood is beneficial. And if you use wood to build a house, you will even contribute to the absorption of CO2 from the environment. It is subsequently absorbed for a period of time as long as the house is standing. From an environmental point of view, wood is therefore the best building material, but only as long as it comes from sustainable forestry.

Sustainable forestry means that only as much wood will be felled as will be replanted. In this way, the forest is conserved and new trees are planted in place of felled trees. Each hectare can yield about 5.6 cubic metres of wood each year (H.-W. Roering 2001). One cubic metre of wood sequesters almost one tonne of CO2. On the other hand, concrete generates CO2 from its production. Thus, if a beneficial contribution to the climate is desired, wood constructions will have to be built.



*Spruce forest in Maramures*

**What we learn from this:**

**Wood is an excellent building material that can absorb CO2.**

**There are very few virgin forests in Europe, and many of them are found in Romania. Those forests that still stand should be preserved. Consumers should look for the FSC seal when buying and, if possible, only buy wood from sustainable forestry.**

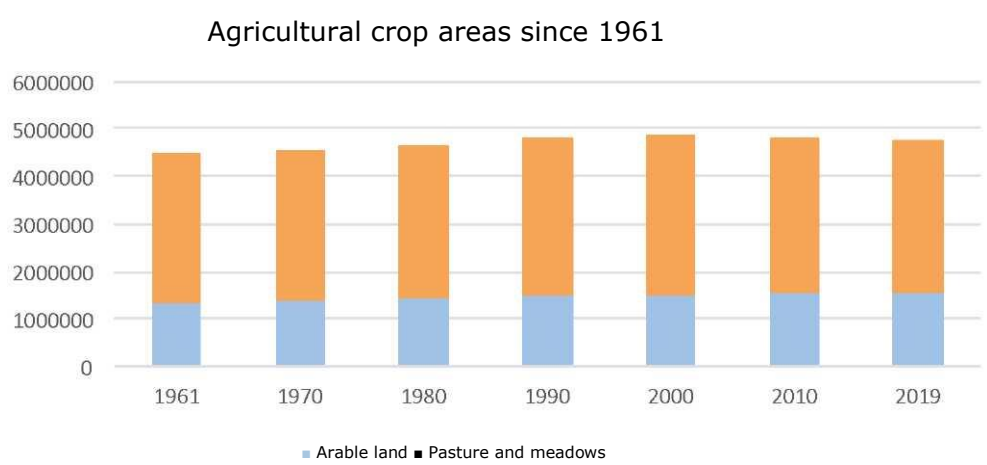
**Notes:**

# 2. ABOUT SOIL

"Buy Land, They Ain't Making Any More ...." Mark Twain

Land is one of the most important resources we have. We raise our buildings on land and much of our food and raw materials come from the land.

Land is generally very limited, but the land we use for agriculture is more limited, but even more limited are the resources we extract from the soil. This is why they are also called mineral resources. So we should take better care of our soil. In fact, the opposite is true: more soil is destroyed every year. In this way we also destroy the nature that grows on the land and the agricultural areas that serve as our livelihood.




*The picture shows that almost no agricultural land was reclaimed (fao.org).*

29% or 149 million km$^2$ of the planet's surface is dry. We humans use a lot of this land, but we are unable to exploit all of it. We can live on 71% of these areas, the remaining 29% being deserts, mountains or glaciers. Half of the habitable land is fertile and used for agriculture. Most of it, i.e. more than 77% of fertile land, is used for livestock and only 23% for growing cereals and vegetables.

Therefore, we humans claim a very large part of the earth for ourselves, mainly through the livestock industry and related consumption of meat and dairy products. Our way of life and our survival depend on our land. We have to be careful with it.

## 2.1. SOIL EROSION

Soil erosion means that the topsoil is being lost. This can be caused, for example, by rain, wind or gravity. The top layer of soil, also called the humus layer, is the most important layer for agricultural use.

It is where most of the nitrogen is stored, as well as many other important elements that plants need to grow.

*The heavy rains caused a torrent to form which led to significant damage.*

Soil erosion is a natural process that can be worsened by agricultural practices. For example, if a field is abandoned for several months, which means that no plants are grown on its surface, the soil can erode more easily because nothing can hold it in place. Fields on hillsides are particularly exposed, because the earth can easily slide from the top to the bottom. Once the soil is eroded, it takes a long time to be restored. Without good soil, agricultural yields also fall.

An additional problem can occur in hot, dry regions: salinisation of the soil. This means that the humus becomes unusable if the salt concentration is too high. This phenomenon occurs when the soil continues to be heavily irrigated during the dry season and more water evaporates than would be naturally replenished later. As a result, salinity in the water and soil increases sharply.

## 2.2. SOIL SEALING

Not all soils are the same. The most fertile soils are often those on which we built our cities. This is because, throughout history, people have settled where there was fertile soil to benefit from the opportunity to farm. Since then, towns and villages have continued to expand, so that more and more land has been covered by houses and streets. For this reason, agricultural production has to be relocated to less fertile soils. And on those areas people are again settling, and agriculture has to be relocated to even less fertile soils.

**If the soil is sealed, it loses its ability to store water and CO2. Soil also plays an important role in temperature regulation.**

A city where everything is covered in asphalt and concrete a few degrees warmer than in nature, because on one hand the ground cannot cool and, on the other, concrete and asphalt store heat.

People often prefer country life to city life, which is why sprawling suburbs have formed around cities. Because of these suburbs, however, large areas of land are sealed, as new roads must be built for all those houses.

In addition, there are also many cars, since public transport cannot fully serve all the new neighbourhoods. Many cars means high demand for parking spaces, which implies a worsening of land subject to sealing.

## 2.3. LIMITED RESOURCES

Our modern society needs large amounts of resources, and many of these come from land. Coal and oil are widely mined. Above all, coal mining means that whole villages have to give way to mining and that nature and useful landscapes are destroyed. In addition to our need for energy, our modern technology also needs large amounts of resources. Our smartphones and computers in particular require a multitude of elements, many of which are in the rare earth category. They are not necessarily so rare because they are available in small quantities, but because they occur in such low concentrations that they are difficult to extract. Rare earths are often mined in crisis areas under inhumane conditions. In addition, there is high environmental pollution as raw materials are extracted from the ores by using chemicals. However, careful management of these raw materials and a recycling process have not yet been implemented

## 2.4. THE EFFECT OF FARMING ON LAND

**POLLUTION**

**INCREASED INFERTILITY / SOIL DEPLETION**

**LOSS OF HABITATS**

**SPECIES EXTINCTION**

**DESTRUCTION OF ENTIRE ECOSYSTEMS**

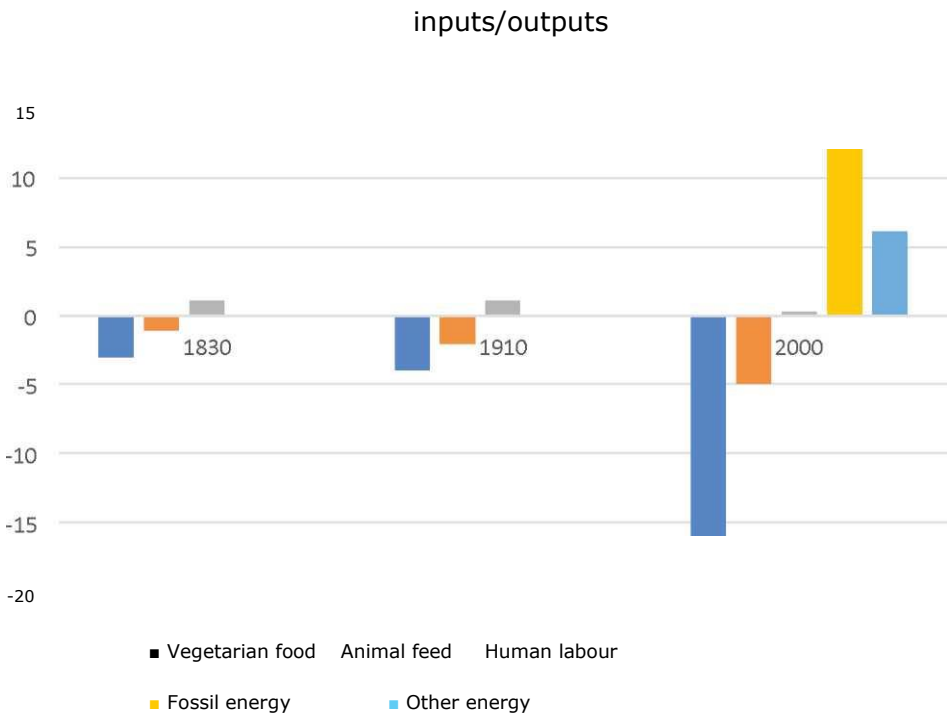
**OVERFISHING**

The way we use soil to grow food has a huge impact on soil performance and nature. It can be roughly said that only one third of our land has remained healthy and fertile. One third is damaged and the last third is almost completely depleted. Depletion means that there are not enough nutrients in the soil for plants to grow. This is especially true for our agricultural plants, which have very high nutrient requirements. A depleted soil should be allowed to regenerate.

This means not sowing useful plants and allowing natural vegetation to develop.

The prevalent form of agriculture today is industrial agriculture, also called conventional agriculture. It is characterised by a high use of energy, machines and large areas, which are standardised like machines in a factory. When several agricultural areas bear the same fruit year after year, we speak of monoculture. Such agricultural areas contribute most to soil depletion.

However, in industrialised agriculture, not using resources is not an option. This is why mineral fertilisers are employed to ensure that the soil is permanently fertile. Nowadays, a lot of energy is consumed in our fields in the form of fertilisers, machinery and packaging. The energy harnessed in this context is largely based on oil. This contrasts with traditional agriculture. The latter was done using animals to pull the plough, as has been done for centuries. In traditional agriculture, more energy is extracted in the form of food than is put into human labour. Industrial agriculture can produce more food with fewer people, but it is very inefficient in terms of energy use. Industrial agriculture results in the highest consumption of oil and a very high volume of associated emissions.




*Inputs/outputs in food production in G/Y, Kraussmann, 2005*

This figure shows that the ratio of agricultural inputs to outputs was better in the past. Compared to the energy input, harvests were higher than today.

## HOW SENSITIVE IS THE USE OF BIOENERGY TODAY?

Extensive monocultures are, on the one hand, very practical for industrial farming machinery, but on the other hand, they are a feast for pests. Instead of struggling to find the next plant to eat, pests can simply migrate from one plant to another. To combat the spread of pests, large quantities of pesticides are used against fungi, insects and weeds. Sadly, pesticides not only affect pests, but also all other animals in and around the field.

While some pests can be kept under control with pesticides, large monoculture fields harm many other species. Hedgerows and small forests, which provided habitats for many species and connected habitats to each other, had to make way for extensive fields. This resulted in the loss of habitat for many species of animals and plants.

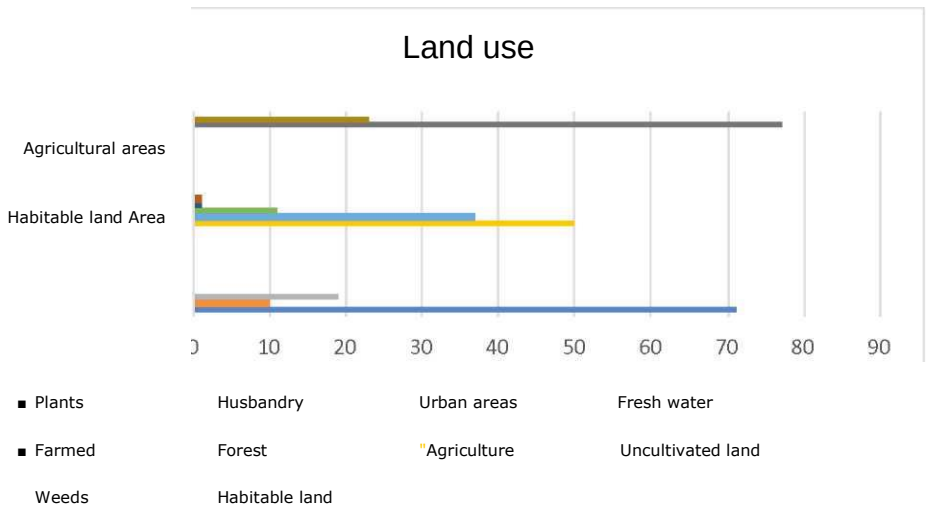
**What we learn from this:**

**Fertile soil is a limited resource. As little as possible should be built on such areas. 70% of agricultural land is used for meat production.**

**We need a new awareness to preserve fertile soils and to improve the quality of 'sick' soils.**

Large amounts of chemicals are applied to the soil using pesticides. Up to 3 kg per hectare. In the last 10 years alone, the quantity per hectare has increased by almost 1 kg. This means that almost 480 000 tonnes of pesticides are used in the EU. The highest amount of spraying is applied to apples and vines, followed by potatoes and hops.

385 million people, mainly farmers, suffer from the consequences of these poisons.




*This chart shows the agricultural areas*

**Notes:**

# 3. ABOUT WATER

**"WHEN THE WELL IS DRY, WE KNOW THE WORTH OF WATER." BENJAMIN FRANKLIN**

71% of the earth's surface is covered by water. And man is about 70% water. Every single life form in the world needs water to survive. Most water is found in the seas and oceans. Only 3% of the water is freshwater, and two-thirds of it is locked in polar ice caps and glaciers. The small amount of freshwater that remains must be shared by humans, animals and plants to survive.

Even though the water in the seas and oceans cannot be drunk, it provides the basis for many people's existence. Fish and other marine animals serve as a source of food for many civilisations living on coasts.

River water can serve as a source of energy. In its simplest form, it drives water mills or powers huge dams that generate electricity through turbines. Water also helps us save energy because we can transport large quantities of goods across rivers and seas with relatively little effort.

However, water is not always just a source of life, it can often be destructive. Floods and tsunamis can destroy cities and have already claimed many human lives.

It is therefore important to pay special attention to the Earth's water and take care of it. This is the only way we can continue to use this resource without restrictions in the future. For now, we are not giving the water the attention it deserves, which creates a number of problems.

## 3.1. WATER DEFICIT

Compared to seawater, there is very little drinking water in the world and it is very unevenly distributed. While some regions have more than enough water, others are often affected by drought.

Water is very precious and is the only resource we need to green the desert. In recent years this situation has worsened. Due to climate change and poor water management, more people are now affected by water scarcity than ever before. Due to global warming, on the one hand, more water is evaporating and, on the other hand, it is raining less in some areas, but the rains are much heavier. Too much water at once is almost as bad as no rain, because everything is flooded for a short time and then the water disappears.

The situation is worsening due to poor water management. In the Middle East, the Jordan River was once a great river that flowed into the Dead Sea. Due to unsustainable use over the decades, only a small stream remains and the Dead Sea is in danger of drying up.

Some arid regions, for example in the eastern US or Mexico, have switched to using large quantities of groundwater from wells. However, this approach uses a very high amount of groundwater, without the possibility of its natural replenishment. This water is also called fossil water. Once this is exhausted, there will be a water shortage in these regions. The use of fossil water sources can also have other consequences. Mexico City, for example, has sunk by 10 metres in 60 years, as groundwater reserves are about 70% depleted. The submergence of the 21 million people's habitat is causing cracks in the water supply pipes, making the situation even worse.

A sad example of falling water levels is the Aral Sea. This was an extensive lake that lost much of its surface area in the 20th century. Due to the irrigation of the cotton fields, the water level continued to drop and the lake lost most of its water volume. The fishing boats that now lie on the dry bottom of the lake are famous.

*Aral Sea dried up*

## 3.2. SEA AND OCEAN LEVEL RISING

*Sea levels will continue to rise in the coming years*

Some regions are affected by drought and others by excess water. Due to rising temperatures and melting ice caps, sea levels rise by about 3.2 mm every year. Experts estimate that by the year 2100, sea levels will rise by 1.3 to 1.8 m if the intensity of fossil greenhouse gas burning is not reduced.

Some inhabitants of the islands are already losing their homes due to rising sea levels. By the end of the century there could be several million people leaving coastal areas and seeking refuge inland or in another country. High sea and ocean water levels are dangerous not only because they cause an increase in flooding, but also because higher water masses in coastal regions also lead to higher erosion on land. Seawater is increasingly penetrating groundwater, leading to a shortage of drinking water.

Sea level rise is leading to the disappearance of large areas of woodland because trees in coastal regions cannot tolerate salt water and no longer benefit from fresh water. This phenomenon can currently be observed on the east coast of North America.

Since 1993, the sea level has risen by about 3 mm annually, and this process could become worse by 2100. It should also be noted that 640 million people live in regions up to ten metres above sea level.

## 3.3. OVERFISHING

Modern fishing pushes nature to its limits. One third of all commercially exploited fish stocks are considered overfished, meaning that more fish are caught than they can reproduce. As a result, stocks are dwindling.

The other two-thirds of fish stocks are approaching the point of overfishing. At present, so much is being fished that there is only enough juvenile fish to prevent the stock from being depleted. The fish caught today are, on average, much smaller than those we used to catch a few decades ago. Also, fish are not reaching the maturity and size they should.
If we continue to fish as we do now, we will run out of fish. As a result, larger fish, sharks, dolphins

*The seas are overfished*

and whales will run out of food and disappear. Many coastal residents depend on fishing for food.

In many cases, it is not they who are exploiting the fish stocks, because they only fish on a small scale and selectively, but the fishing fleets, mostly from Europe, the US or Japan, which catch huge quantities of fish. Deep-sea fishing methods are very dangerous for other inhabitants of the marine environment. Trawlers are hundreds, sometimes thousands of metres long and catch everything in their path. In addition, trawlers are pulled directly to the seabed, which they destroy and thus eliminate habitats for many species. The nets float hundreds of kilometres on the surface of the water for several days. Fish, turtles and even birds get caught and die in agony.

In modern deep-sea fisheries, not only are fish for food caught, but many other species are also caught indiscriminately. As a result, some shark species are significantly endangered and certain species are threatened with extinction. It is calculated that for every 1 kg of edible fish, there are 2 kg of by-catch.

Sustainable fishing is easy to do and would be good for both nature and the people who depend on it. At the same time, sustainable fishing would mean that there would not be so many species of fish in the supermarkets of Europe and America and that they would be available at a much higher price. Our current fish consumption is only possible because of the huge fishing fleets that exploit our seas.

## 3.4. RIVER AND WETLAND ENGINEERING

Natural rivers meander through the landscape, carrying large amounts of water and sediment. If sediment is deposited, either islands begin to take shape or the river changes direction. In addition, new fertile soil is formed, providing many plants and animals with a suitable habitat.

A few years later, this land will be swept away again by the river waters and such features will form in another place. If the river overflows, it distributes sediment and the nutrients it contains to the surrounding area. This is the natural dynamic of rivers. However, river engineering and dam construction are preventing this natural phenomenon.

*A river that made its way through the rock*

**What we learn from this:**

**Water is particularly important to us.**

**Due to global warming, water resources are becoming increasingly scarce.**

**To save water, we should only take short showers and, if possible, choose the water-saving programme for all household appliances.**

Engineered river courses are better for navigation and floods can be better controlled. The nature around the rivers is altered and destroyed by the rivers themselves. Dams prevent sediment from flowing downstream. Sediment then disappears from the lower course of the river, so it digs deeper into the ground. Dams also prevent fish from migrating upstream to spawning grounds. The aids used for river ascents, which should prevent this phenomenon, are usually not suitable for larger fish such as sturgeon. In this case, water power, which is one of the renewable energy sources, becomes a major threat to the fauna and flora of rivers and their surrounding landscape.

Marshes and swamps are very special habitats that have formed over millennia. They are home to many unique creatures that cannot survive anywhere else. In the past, they were often drained for agricultural use or as building land. It is only in recent decades that we became aware of the need to conserve these habitats was realised.

# 4. ABOUT AIR

Our atmosphere

The Earth has only a very thin atmosphere. Essentially, it does not exceed a thickness of **15 kilometres.** Planes fly at the upper limit of this troposphere. Mount Everest, the world's highest mountain at 8,848 metres, is so high that climbers can hardly breathe at the top. However, 8,000 metres is not much compared to the diameter of the planet.

You can imagine how vulnerable this thin protective layer around the planet is. In comparison, it is thinner than a peach skin.

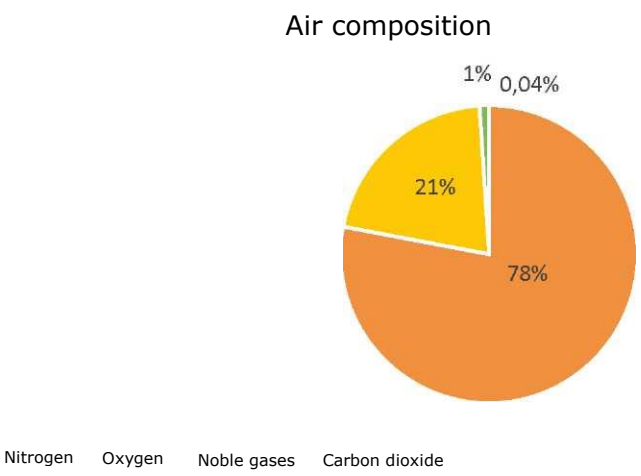
## THIS THIN LAYER, THE ATMOSPHERE, WARMS UP. ENTER CLIMATE CHANGE.

Researchers around the world have been measuring the Earth's exact temperatures for more than a hundred years and can prove that it is getting warmer. The reason for this is the greenhouse effect. You can imagine the atmosphere of a greenhouse: Cold on the outside, but warm on the inside. Without the atmosphere, the average temperature on the planet would be minus 18 degrees. Fortunately, we have this thermal blanket, which means that on our planet we enjoy an average temperature of plus 15 degrees.

Carbon dioxide, also called CO2, is the product of burning fossil fuels. This is a gas that is essential for the greenhouse effect and therefore for global warming.

The so-called carbon footprint was designed to measure CO2 emissions per person. This represents about half of the environmental footprint.

Burning petrol, gas and coal releases CO2. This proportion is very small compared to the rest of the air, but this amount is sufficient because this CO2 stores heat. Six thousand years ago it was as hot as today, but that happened for different reasons, and the process did not happen over such a short period of time.

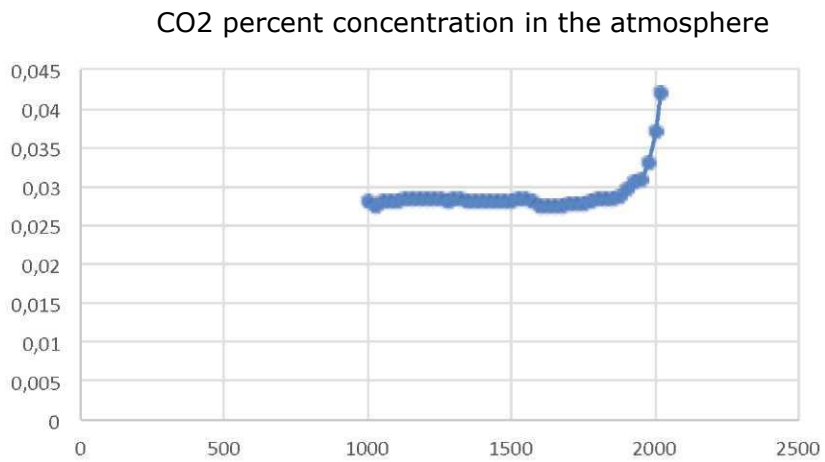



As you can see from the graph, most of the air is made up of nitrogen, a non-reactive gas that is of no interest to us. 21% of the atmosphere is made up of oxygen, which we need to breathe. Noble gases, like nitrogen, are non-reactive and of no interest to us. Now we come to CO2, which is only 0.04% of the air.

**What we learn from this:**

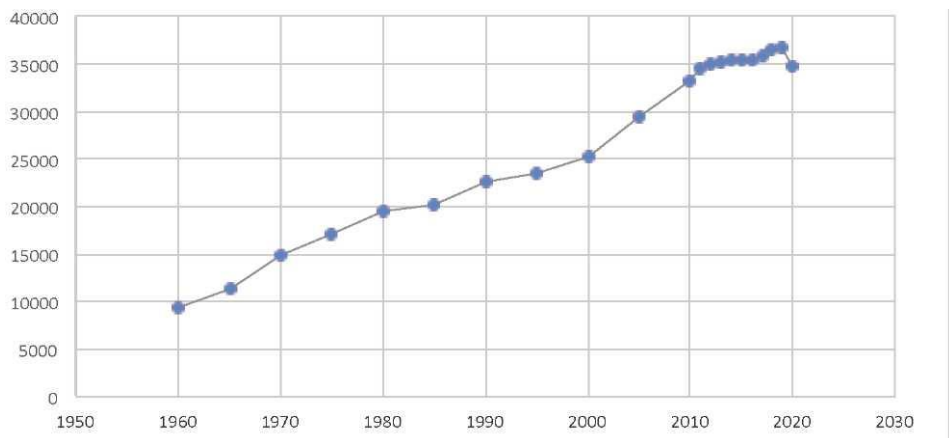
**The Earth's atmosphere is very thin and undergoing constant change due to human activity. By burning oil, natural gas and coal, we soak the atmosphere with CO2. As a result, it is getting warmer and warmer, which is called climate change. If we fail to change something in our behaviour soon, we will have to call it a climate catastrophe.**

The current international community has agreed to limit the temperature rise to 1.5 degrees. But this challenge would require a very rapid switch away from fossil fuels. However, there are still interest groups preventing this. It would be a success if we could limit global warming to 2 degrees.



In addition to global warming, storms are also intensifying, while ice-covered areas around the world are shrinking. Poles as well as glaciers around the world are losing ice volume.

CO2 worldwide emissions worldwide in the 1960s to 2020
(in million tonnes)




**Notes:**

# 5. ABOUT PLANTS AND ANIMALS

**"MAN IS A PART OF NATURE, AND HIS WAR AGAINST NATURE IS INEVITABLY A WAR AGAINST HIMSELF" RACHEL CARSON**

We don't know exactly how many species of animals and plants are there in the world. So far, 2 million species have been described, but it is thought that there are up to 10 million. Many of those undiscovered are in inaccessible regions of the world, such as rainforests, mountains or the deep sea. As these organisms measure only a few centimetres, many of them may not be discovered before extinction.

The red list of all undiscovered species currently includes over 100,000 species, of which 37,400 are threatened with extinction. 100.000 species out of an estimated 10 million may not seem like a lot at the moment, but observing and inventorying species is a huge effort. So it's a great achievement when we know how things stand for 100,000 species.

## 5.1. WHY DO SPECIES BECOM EXTINCT?

The biggest threat to many species is the change in land use. These situations arise when a meadow is turned into a grain field or a virgin forest becomes a commercial forest. 75% of the world's surface has been heavily shaped and changed by man. So we use 75% of the land and oceans for our food production, for extracting raw materials and for our living space as a whole. The remaining 25%, which is still largely natural, has to be shared by the other species. But even this share of habitat is also steadily declining.

Another threat to biodiversity is pollution. Waste can poison animals and animals may mistake it for food and starve to death for lack of adequate feed.

In some cases, there is even intentional pollution, such as the use of pesticides, for example. These are chemicals and micro-organisms that are used to control pests in agriculture. In the process, however, many other animals and plants in the environment are attacked or poisoned at the same time.

When it rains, the pesticides are washed into rivers, which can then spread into nature. Fertilizers are also washed away in this way and the waters become hypertrophic, which means very rich in nutrients. In this context, algae and other aquatic plants thrive in these nutrient-rich waters. They absorb large amounts of oxygen that other aquatic organisms are deprived of. As a result, these creatures die from lack of oxygen.

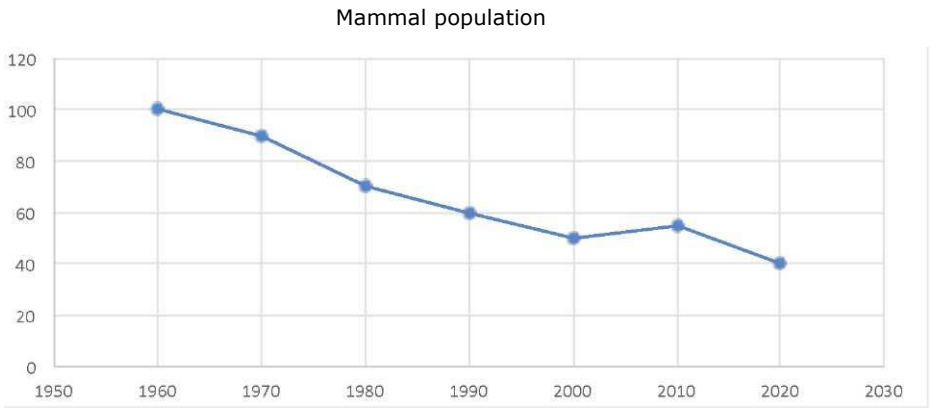
Climate change is another threat. In the Arctic, polar bears and all other Arctic animals are severely affected by climate change. But global warming and increasing extreme weather events are also causing problems for many species in other parts of the world.

Over-exploitation of nature, poaching and over-fishing are the most direct threats to some species. Fish are caught in large numbers, threatening many species. Even rhinos are still hunted for their horns supposed to have healing powers that are not even real.

Through the global trade network, it's not just products that reach every corner of the world, but animals too. In their habitat, each animal species has its own role: It eats certain species and is itself eaten by others. Species in a habitat are thus kept in balance. If a species enters a foreign habitat, it is called a neophyte. Often, this new species has no chance of establishing itself in the new environment and is largely eliminated by native species. Sometimes, however, things are the other way around and this new species eliminates native species and feeds on them. In Australia and New Zealand, for example, cats and rats brought to the continent have devoured countless species of birds and their eggs.

## 5.2. CONSEQUENCES OF SPECIES EXTINCTION

Today, the protection of nature and biodiversity often has to give way to economic interests. An ecosystem, however, it behaves like any other system: if one component changes, many other factors change with it.




Mammalian extinction as percentage

Many species of animals and plants need a diverse landscape as a habitat, which they cannot find in our monocultures. In these monocultures, only very few species spread over large areas. The species we call pests really only lack their natural predators, because they need natural features such as trees and hedges to spread. Thus, the use of pesticides not only destroys pests but also their predators.

While pest populations are rapidly recovering, their predators are increasingly disappearing. As pests continue to spread, species that are useful to us are becoming increasingly threatened.

Wild bees, for example, which are essential for pollinating our crops, are seriously threatened by pesticide use. About two-thirds of pollination activity is carried out by bees and other wild insects. In China's Sichuan region, so many pesticides have been used that there are almost no bees or other insects left. To pollinate fruit trees, people now have to go from tree to tree and pollinate the plants themselves.

*Bees are important for pollination.*

**What we learn from this:**

**We use most of the Earth's surface and therefore leave almost no room for nature to thrive. Many species of animals and plants are already extinct. If we don't start using them in moderation, we will only know about bees and polar bears from history books.**

**Notes:**

# 6. IMPROVING THE ENVIRONMENT

"YOU CANNOT GET THROUGH A SINGLE DAY WITHOUT HAVING AN IMPACT ON THE WORLD AROUND YOU. WHAT YOU DO MAKES A DIFFERENCE, AND YOU HAVE TO DECIDE WHAT KIND OF DIFFERENCE YOU WANT TO MAKE." - JANE GOODALL

For a green lifestyle, a switch to products that are often more expensive or to alternatives is not justified in all cases. We should rather pay attention to a more environmentally friendly way of life in general, and not just stick to using sustainable products.

Let's look at the impact our behaviour can have on the environment. Perhaps the most important part of a sustainable existence is being aware of your actions and their consequences.

In this context we look at four areas: food, housing, mobility and consumption. Food is the largest part of the environmental footprint.

## 6.1. FOOD

**Nearly 30% of our footprint is food.**

Animal products account for about 80% of land consumption in agriculture. There are important reasons why we should eat fewer animal products:

**What do we learn from this?**

**Food can also help protect the environment. It is the largest part of the environmental footprint.**

**Eat less meat!**

### LAND CONSUMPTION

Livestock feed crops occupy a lot of land. The same area of land could be used more efficiently for agricultural crops to get a higher yield and thus more energy for people. About 70% of cereal crops is used for animal feed. These grains could also be used for plant-based foods, which would be much more efficient.

### WATER NEEDS

Farm animals need plenty of water. One kilogram of beef requires about 15,000 litres; in comparison, one kilogram of potatoes requires about 250 litres of water.

### EMISSIONS

Methane emissions from ruminants (cattle, goats, etc.) are very high. Nitrous oxide is produced by manure and fertilisers. Large areas of rainforest are also being cleared for grazing land. This process generates CO2.

### ANIMAL WELFARE

Because the demand for meat is very high and consumers demand a low price, sometimes animals are not reared per the requirements of the species. This sounds very abstract, but pigs sometimes live on an area of only 0.75 $m^2$ and chickens on an area the size of an A4 sheet.

Animals suffer in such conditions because they have almost no space and cannot move around. Some don't even see the sunlight during their lives. When we eat meat, we should buy it from a farmer or trader who ensures that the animals are reared in a way that is appropriate to their species. The origin of the meat and the related transport routes play an important role.

In terms of ecological footprint, fish can also be considered meat to some extent, although the species is decisive in this context. Predatory fish have a particularly poor ecological footprint. Their food comes from the bycatch of large fishing vessels. These fish grow slowly and need a lot of food until they grow. Given the overfishing of the oceans, this is very worrying.

Trout from domestic fish ponds are also fed on by-catch food. They are very susceptible to disease and require regular antibiotic treatments. They accumulate and enter our bodies through the food chain.

The MSC (Marine Stewardship Council) eco-label indicates whether the fish has been sustainably sourced. Non-predatory fish species, such as carp, feed on underwater plants and algae that grow in the area where the fish live. Thus, they no longer need extra food. Carp therefore has a much smaller environmental footprint and is very healthy.

### BETTER REGIONAL AND SEASONAL MANAGEMENT

**It is important to pay attention to the origin of the food. The long transport distances required for fruit and vegetables cause considerable emissions in some cases.**

## WHAT CAN WE DO?

**> We should consume around 300 grams of meat per week from animals reared according to the standards applicable to the species concerned.**

**> We should preferably eat non-predatory fish species, e.g. carp, herring, barbel, tench, rudd and roach.**

**> Fruit and vegetables should form the basis of our diet. They are healthy and good for the environment.**

**> If possible, we should do away with packaging.**

**> We should also eat less refined foods such as chocolate bars, which are packaged and involve more production effort.**

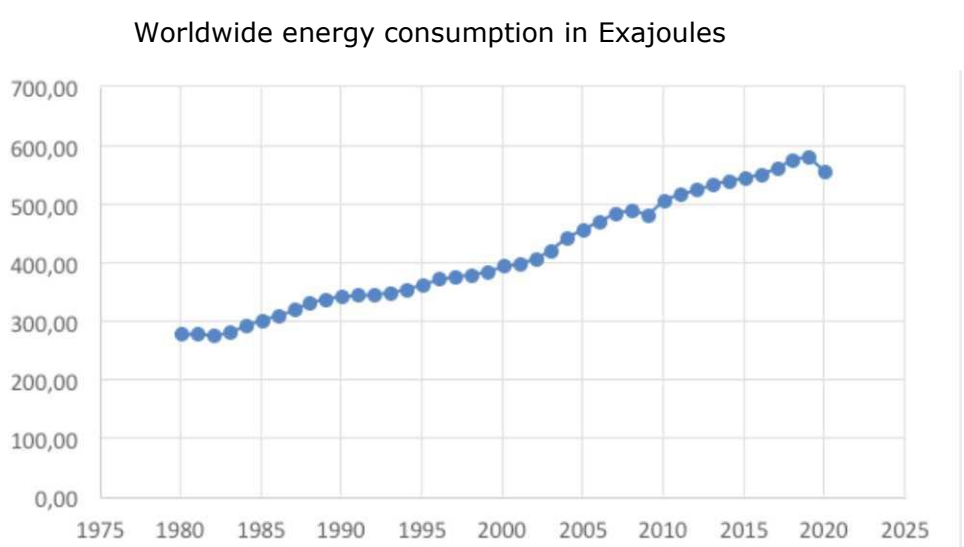
**Notes:**

# 6.2. HOUSING AND ENERGY

**Housing and energy generate the second largest impact on our environmental footprint.**

## ENERGY AND HEATING

Energy can never be lost. It can only be transformed.




*Energy consumption, Source: BP*

**Fossil energy:** this would be energy from oil, natural gas or coal.
**Nuclear energy:** it is produced in nuclear power plants and converted into electricity.
**Renewable energy:** this is hydropower and wind power and the energy produced by solar panels.
**Geothermal energy:** this is generated by our planet's temperature differences and is used for heating in Iceland, for example.

The first form of energy is responsible for global warming because burning these fuels produces greenhouse gases.

Oil is a brilliant fuel, it is light, can be refined into diesel and gasoline, has a high energy density and is very easy to store. It can also be used to manufacture plastics. All these advantages make it difficult to replace this fuel. Crude oil was formed about 300 million years ago. A significant share of this fuel is extracted in Romania.

Natural gas is the "cleanest" fossil fuel because it releases "the least amount" of residues during combustion. Gas is used for cooking, heating and electricity generation. Vehicles can also be fuelled by natural gas. However, we should become as independent as possible from this energy source, because CO2 is released during combustion and natural gas has to be imported from countries outside Europe. Coal is the dirtiest form of energy. It is needed to generate electricity and for district heating. During coal burning, large amounts of CO2 and sulphur are released.

However, coal-fired power plants are still being built, for example in China. As part of its climate targets, the EU has agreed to reduce CO2 emissions, which is why coal-fired power plants are being phased out of the grid.

**Only the phasing out of fossil fuels can mitigate climate change. This is already taking shape in the field of electricity generation.**

Renewable energy is generated by the forces of nature. As already mentioned, these are wind turbines, solar panels and hydropower plants. They generate no CO2 emissions during operation.

The energy is only needed to build these facilities. Geothermal energy is the harnessing of the Earth's inner heat. Geothermal energy is very good for heating.

The kilowatt-hour (Kwh) unit is used to determine the energy consumed. One kilowatt-hour is the amount of energy a cyclist produces in 8 hours. In Romania, an average person consumes 46 Kwh per day, so there would be 46 cyclists, each of them cycling 8 hours a day. In Germany there are 120 cyclists and in Finland almost 200 cyclists.

### HOW IS ELECTRICITY GENERATED?

Electricity is generated by fossil fuel power plants and natural energy power plants. Power plants that require fossil fuels are gas-fired power plants and coal-fired power plants. Coal-fired power plants generate a high volume of emissions, which is why efforts are being made to replace them with power plants that emit fewer emissions.

*A nuclear power plant*

There are also nuclear power plants that use nuclear fission to generate large amounts of energy. What sounds so good can have serious consequences if it comes to the worst. Because in the event of accidents or a fusion during operation, the situation becomes uncontrollable. Another problem is the unresolved concern about the final disposal of nuclear waste. As a result, more and more countries are shutting down their nuclear power plants.

Romania has a nuclear power plant at Cernavodă, which is cooled by water from the Danube.

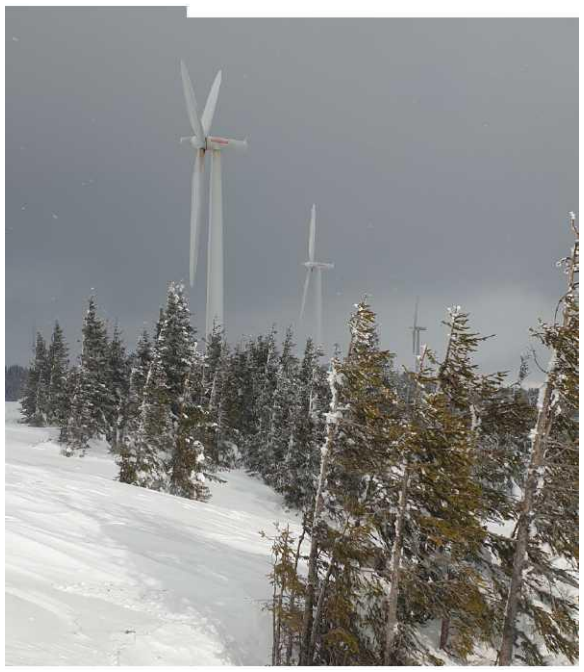
In addition, there are also renewable energies. These are produced by photovoltaic, wind and hydro power plants.

**What we learn from this?**

**All forms of renewable energy have drawbacks. Some bigger, some smaller. That's why we should use energy more carefully. Because the less energy we need, the less energy we have to produce.**

**However, each of these forms of renewable energy also has drawbacks.**

Wind power provides about 10% of Europe's electricity. However, the foundations for wind turbines are largely made of concrete, with all the environmental issues that come with the production and use of concrete - and need to be replaced every 20 years. So wind turbines generate renewable energy, but they are made of non-renewable and non-recyclable materials. Wind turbines also kill large numbers of birds and bats every year.



*Wind turbines also provide plenty of electricity in winter*

Because of the noise they produce during operation, they should not be built near residential areas. This noise can be so loud that it causes headaches.

However, in combination with solar power plants, wind turbines are ideal because they produce electricity even in autumn and winter.

Hydropower is currently the most important renewable energy on the market. It uses falling or flowing water to generate electricity and power. Because it is mainly water-based, it does not generate any impact on air, but it does cause an impact on water. The dams needed to generate hydropower affect the course of rivers, altering their ecosystem and thus having a negative impact on animal life. These dams can sometimes also cause flooding and therefore destruction of land and wildlife.

One example is the Aswan Dam in Egypt. It was built in the 1960s and still serves today as protection against floods and drought. However, during its construction, the dam flooded a large area, destroyed wildlife and displaced over 100,000 people. Since it has been in operation, the dam has caused desert areas in Egypt to expand, increasing soil salinity. This high salinity affected 28% of Egypt's soils and favoured certain water-borne diseases (e.g. beaver fever). The advantage, which outweighs the disadvantages, is the sustainability of the dams. When measured in terms of costs and benefits, hydropower is very cheap.

Photovoltaics is currently experiencing a boom. Photovoltaic panels are increasingly cheaper to produce, making more and more projects profitable. However, the sun only shines during the day and only when there are no clouds. It is therefore difficult to plan for and therefore it strains electricity grids. The situation could be improved if there were a cheap way of storing electricity, which is currently being researched. However, photovoltaics are certainly part of the solution to reducing CO2 emissions. But many toxic metals (lead and cadmium) are used in the production of solar modules. And these are hard to eliminate.

*A photovoltaic system with a wind turbine in the*

**What we learn from this:**

**Most of the energy consumed in the household is heat. This means that heating and hot water consume the most energy. It is therefore important to save here too.**

So, in conclusion, we can say that although people are trying to reduce environmental pollution, no solution is perfect.

## WHAT CAN WE ACHIEVE?

**> You can use rechargeable batteries for remote controls and the like and you don't always have to buy new batteries.**

**> Dishwashers and washing machines need a lot of energy. Therefore, these appliances should always be completely filled before use.**

**> If you don't set the fridge temperature too low, you also save energy.**

**> If possible, faulty appliances should be repaired. In this case, no new equipment needs to be manufactured.**

**> With a push-button power socket, several appliances can be unplugged when not in use.**

**> Switching off the lights when leaving a room also reduces energy consumption.**

## 6.2.1 HOT WATER AND HEAT

### WHERE DO HOT WATER AND HEAT COME FROM?

As with electricity generation, both fossil and renewable fuels are used. That's why low consumption is also important for heating and hot water consumption. So it is best to choose a short shower in all situations!

### HOW DO WE WARM UP?

In the past, most people used only wood for heating. Later, people switched to coal and natural gas. Even today, much of the heating is still done with natural gas. Emissions can be reduced by better insulation and other heating systems. Solar energy, for example. It uses the heat of the sun's rays. The systems are similar to photovoltaic systems, except that the water is heated and no electricity is generated.

*Solar thermal system*

These systems are a cost-effective way to produce hot water in the warmer months. Heat pumps are also an option. They would have to run only on 'green' electricity to really reduce emissions. Otherwise, they are very effective and certainly a possible partial solution.

Another possibility to switch away from fossil fuels is the use of biomass plants. Here, biogenic materials such as wood are gasified or burned. The heat generated is then supplied to homes in the surrounding area. But there is not enough arable land to grow enough biomass for all uses.

## WHAT CAN WE ACHIEVE?

**> The use of household appliances and heating should be more efficient.**

**> Taking short showers or choosing economical settings, as well as reducing the temperature in the home, significantly lowers energy consumption.**

**> Radiators should not be covered and should be switched off when the room is not in use.**

## 6.2.2. ABOUT CONSTRUCTIONS

The United Nations Agenda 21 for Sustainable Growth (1992) states: "Man is at the centre of everything and should lead a healthy life in harmony with nature" This raises the question of how we should use and at the same time conserve the resources we have.

### BUILDING MATERIALS OVER TIME

| Period | Prevalent construction materials |
|---|---|
| 0-1900 | Natural stone, bricks, iron, wood, glass, straw, clay |
| 1900-1950 | **Other materials added** |
| | Concrete, reinforced concrete, asphalt and insulating materials |
| 1950-2020 | **Other materials and additives added** |
| | Aluminium, chipboard, laminated wood, asbestos, heavy metals, polyvinyl chloride (PVC), polychlorinated biphenyls (PCB), nanomaterials and electronic materials, etc. |

Vitruvius (about 80-70 BC) - about 15 AD) was a Roman architect who laid the foundations of architecture. He established the three golden rules of architecture: utility or leisure, sustainability and beauty.

### WOOD

Construction wood was cut in autumn and throughout the winter, because at this time the trunks have that strength and firmness from the roots that is spread to foliage and fruit in spring and summer. To increase the strength of the wood, a ring was cut to the heart of the wood. Then the tree was left until it dried out so that the moisture was removed. Wood is CO2 neutral and even binds CO2. It only releases CO2 when it burns or decomposes. Instead, a new tree can grow in its place.

### STONES

For churches, palaces and villas, mainly sandstone and marble were used. These stones were processed immediately after extraction.

The other undamaged stones were used for building and decorating houses. Stones are also CO2 neutral.

This method of construction produces no CO2 emissions and no toxic substances entering the air, soil and water!

*< Stone wall from the Inca period, about 600 years old*

### BRICK

In many places, the earth was dug up in autumn, crushed in winter, and bricks were formed in spring. They were then left for about 2 years to dry evenly, not only on the outside but also on the inside.

The Romans used larger or smaller bricks, depending on the type of building.

### WALL PAINTS

Simple houses and farmhouses were usually painted white with lime paint. To prepare the paint, the stones were crushed into powder, or oxidised iron, soot or brick dust was used (0 or very low emissions).

## THE INDUSTRIAL AGE

At the beginning of the 20th century, the invention of reinforced concrete ushered in a new era: industrial construction. It has given architects new and never-before-seen possibilities. The tallest building today is the Burj Khalifa in Dubai. It is 828 metres high.

In many places, buildings have been adapted to political systems. Bacău, in the north-east of Romania, is a good example: the city centre was cleared and multi-storey blocks were built there, all with the same housing units, parks and a concert hall.

"Construction is a $10 trillion industry worldwide. This equates to about $1,400 per person per year. About 25% of the world's economic output and about 25% of the world's labour force exists thanks to the construction industry."

The dream of futuristic paradises was shattered in the 1970s by the asbestos scandal.

Asbestos is a material that has been used by architects to ensure the heat resistance of materials. "Due to inhaling asbestos fibres, thousands of people fell ill with asbestosis and lung cancer. Worldwide, there are over 100,000 deaths from asbestos-related diseases every year."

Large-scale destruction and alteration of natural landscapes, waterways and ecosystems, the associated extinction of species, CO2 and toxic emissions on a gigantic scale and so on. This makes the construction industry one of the main drivers of climate change.

### ALUMINIUM

However, as the use of aluminium becomes increasingly popular in many industries, its production is also increasing significantly. The problem is that aluminium production requires a lot of energy and releases various hazardous gases. Specifically, the production of one tonne of aluminium equals 3.115 tonnes of carbon dioxide emissions and 21.46 kilograms of sulphur dioxide emissions

These emissions are harmful to human and animal health and are a major driver of climate change. The energy required for aluminium production is so intense that in North America, for example, about 25% of energy production from water is used for aluminium production.

### CEMENT

Waste materials are increasingly being (re)used in cement factories. This approach is useful for preserving raw materials.

However, it is not uncommon for these so-called substitute raw materials to be contaminated with environmental toxins; HCB (hexachlorobenzene) is one of many cases. Long-term comparison shows that this practice also leads to the release of an increasing amount of mercury and lead per tonne of cement produced into the atmosphere through heating."

### CONCRETE

The biggest problem with concrete is soil sealing caused by concrete foundations. A poison for every ecosystem! All natural cycles are destroyed by sealing.

It is also estimated that a total of more than 64 million kilometres of roads have been built worldwide. To understand these figures, think about how many times the earth would be covered?

Asphalt and concrete create artificial heat islands in big cities through radiated heat and warming, in addition to general climate change. As a result, in more and more cities, the temperature hardly drops at all on summer nights.

**If, for example, an air temperature of 26 degrees Celsius is measured in Bucharest, a concrete ceiling heats up by about 10.5 degrees Celsius and an asphalt ceiling by about 18 degrees more than the air!**

### GLASS

In glass production, the material is melted at 1600 °C for two days. Melting glass at a high temperature for two days consumes a lot of energy. A glass furnace runs for 24 hours a day and cannot be turned off or cooled during its 15-year life.

This means that large amounts of CO2, SO2, nitrogen oxides (NOx) and other specific particles are constantly released during glass production. Switching to a different process would reduce CO2 emissions but increase NOx emissions. Glass production will therefore always have a strong environmental impact.

### PLASTICS

However, both the production and use of plastic have significant drawbacks. During the production process, high quantities of toxic chemicals are released into the air, including acetone and methylene, as well as sulphur and nitrogen oxides. Plastics can also have negative health effects - for factory workers, but also for people who use plastics, as they sometimes even end up in food.

The biggest problem, however, is the waste generated by the use of plastics. In 2010, global plastic waste reached 275 million tonnes and almost 100 million tonnes of this amount is disposed of in oceans, causing major problems for the animal world. This is because only about 20% of all plastics used are recycled, the rest being disposed of.

In addition, plastics take a very long time to decompose. Plastics are therefore now one of, if not the most environmentally damaging building material.

### REINFORCED CONCRETE

However, in practice, reinforced concrete has a number of problems. Firstly, cement production causes environmental problems (toxic emissions). In addition, reinforced concrete tends to corrode at the joints, which is one of the reasons why the life expectancy of many buildings is low. Experts speak of a maximum life expectancy of 100 years. In practice, therefore, many modern buildings are rebuilt or demolished after only 25-50 years, and interiors are refurbished at much shorter intervals (usually 5-10 years).

*Empire State Building, New York, USA*

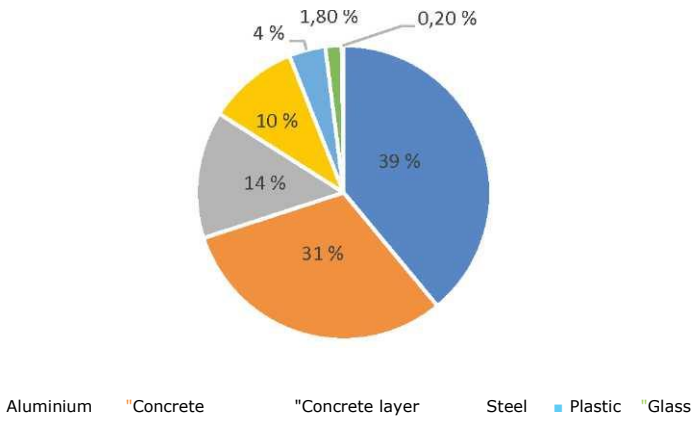
### DISPERSION PAINTS

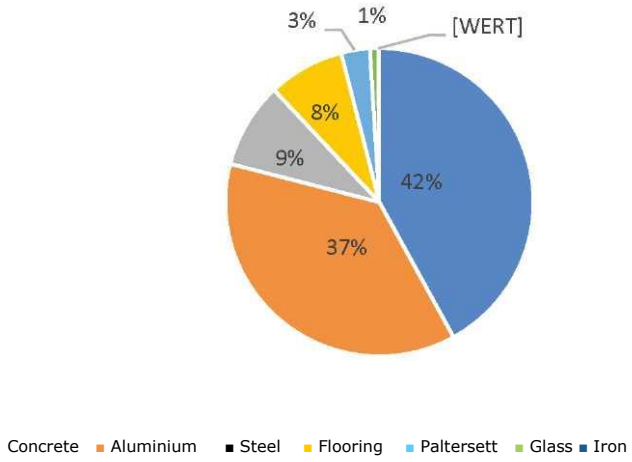
For a good indoor climate, it is important that the walls are not sterile, but able to 'breathe', which means that condensation in the air is absorbed by the walls and re-released. However, dispersion paints have the property of effectively sealing walls. Figuratively speaking, it's like living in a nylon bag. Dispersion paints are also enriched with various chemical compounds, the vapours of which we breathe, especially when the paints are fresh.

## ENVIRONMENTAL DAMAGE CAUSED BY THE CONSTRUCTION INDUSTRY

Before humans, the entire planet was an intact ecosystem. This has changed, largely because of the construction industry: fresh water (rivers, lakes, groundwater) has been diverted, polluted, drained and encased in concrete; pollution, greenhouse gases, etc. changed the nature of the air; highways and urbanisation replaced many forests and grasslands. The oceans are getting more acidic.

**In 2016, for every one of us, for every person on the planet, about 11 tons of material were dug out of the ground!**




**What do we learn from this?**

**Construction also has an impact on our environmental footprint.**

**Building a house involves an incredibly high consumption of energy and resources. Natural building materials such as wood even absorb CO2, unlike concrete and brick.**

## WHAT CAN WE DO?

**> stop extending land use regulations**
**> erection of passive houses**
**> new green areas in the city: green roofs, green walls**
**> conscious building:**
**> protection of water and wetlands**
**> straightening and concreting of waterways**
**> stop water pollution**
**> protect forests, woodlands and ecological corridors.**
**> construction mainly with natural, biologically degradable materials**
**> avoidance of waste, hazardous materials and litter**

## > POSITIVE EXAMPLES IN BREB

*Wooden house in Breb, Romania, Photo: Teodor Nicula-Golovei*

**You can find the full text on construction at refeproject.eu**

*Book recommendation: Teresa Coady "Rebuilding Earth"*

**Notes:**

# 6.3. MOBILITY AND TRANSPORT

Transport also accounts for a significant share of emissions, particularly car, truck and plane traffic. There are 7 million cars in Romania. By 2030, the EU wants to reduce the number of cars with internal combustion engines to 55%. This is a very ambitious goal, but every step counts.

In our daily lives we travel to many different places. At school, at work, at the supermarket, with friends, on the sports field and, of course, at home. What connects these points are the routes we take. We have different options for this. The way we travel in our daily lives can have a major impact on the environment and climate. In the EU, transport alone is responsible for 30% of total emissions, making it the biggest polluter in the EU.

So it makes a big difference whether we walk, cycle, take public transport or drive.

It also matters how many people share a vehicle, for example, if 30 people drive their own car or 30 people travel on a single bus.

If you cycle 1000 km, you consume 45 kg of CO2 emissions, as the production of the bike and tyres also requires energy.

The train consumes almost 100 kg CO2, the electric car 225 kg CO2 and the plane 552 kg CO2. So if you fly, you produce 5 times more emissions than if you travel by train.

However, a large SUV generates the most emissions, namely 1.5 tonnes of CO2.

## WHAT CAN WE ACHIEVE?

**> Avoid domestic/short-haul flights**

**> If you fly a lot, you should save even more in other areas.**

**> Always fly direct routes and as infrequently as possible.**

**> Sustainable travel means seeing the beautiful places on the road that others simply overlook.**

**> Cycling or walking is recommended whenever possible.**

**Notes:**

## 6.4. TECHNOLOGY AND COMPUTERS

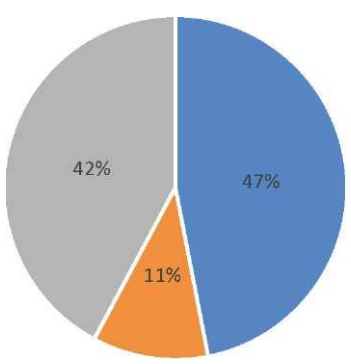
We all use electronic devices, especially smartphones, laptops and TVs. But we are less aware of how many resources are needed to produce and operate these devices. Children and young people in particular consume a lot of energy, as using social media requires a lot of energy. For comparison, the average energy consumption of digital life requires one tonne of CO2. An environmentally friendly level would be two tonnes of CO2 per person per year. However, these two tonnes also include heating and food as well as transport. So if we spend a ton on our digital lives, there's not much left, therefore we should save in this area too.

**What do we learn from this?**

**Cars and planes emit huge amounts of greenhouse gases that cause global temperatures to rise. We therefore need to rethink our mobility behaviour.**

As shown in the chart below, a significant share of emissions is caused by the production and extraction of raw materials. So if you don't always buy a new mobile phone or laptop, you can save quite a lot because usage is spread over a longer period of time. For example, producing a laptop requires 422 kg of CO2. It can be used for about four years.

Materials used in the manufacturing of a mobile phone




But the use itself also generates considerable emissions. A wide-screen TV consumes about 150 kg of CO2 per year, and a laptop consumes about 40 kg of CO2 per year.

As if that wasn't enough, we shouldn't neglect the computing power needed to store photos and data on the internet and make them available. Daily video streaming alone requires about 60 kg of CO2. And if you post 5 photos a day on social media, that's also 0.5 kg CO2.

1 gigabyte of backup consumes 11 kg of CO2 per year. These are the emissions that can most easily be reduced. Overall, it is important to know that the IT sector accounts for 2% of global emissions. As children and young people use IT systems a lot, it is important to raise awareness among them.

## WHAT CAN WE ACHIEVE?

> **Always switch off the device!**
> **Listening to a video consumes 33 times more energy than listening to it on a music streaming service**
> **Cloud storage consumes more energy than we think.**
> **External hard drives may be a better alternative, especially if you consider data security.**
> **Web browsing also consumes energy. Each Internet search consumes electricity.**
> **Buy an older model that is still functional and fully maintained and save up to 70%.**

**Notes:**

# 6.5. HYGIENE

HYGIENE - fragrance, well-being, cleanliness and freedom from pathogens with their dirty parts.

Clean, soft linen that comes out of the washing machine, scented shower gels, shampoos and deodorants in bathrooms, sparkling clean and scented toilets, perfectly clean dishes from the dishwasher. Make no mistake: our modern world is fragrant, impeccably hygienic and very clean, because, after all, who likes smell, dirt and smelly bodies?

However, behind this cleanliness and sterility lie many chemical and natural (raw) materials for the use and production of which the environment has to pay a high price. But who thinks about chemicals and environmental pollution when spraying citrus perfume on the toilet or using fabric softener...?

## WHAT CLEANING, WASHING AND COSMETIC PRODUCTS CONTAIN...

Our hygienic comfort comes at a price, which both the environment and, to some extent, our health have to pay. These substances are hidden in common detergents and cleaning products:

### A. Petroleum surfactants: polluting detergents

Surfactants are the most important active ingredients in detergents, shower gels and shampoos. They ensure that fat and impurities combine with and remain in the water. Surfactants are among the most common chemical compounds. They can be found in every household and in all kinds of everyday products.

Detergents and cleaners are the leading consumers of surfactants: they account for more than half of the 2.5 million tonnes of surfactants consumed annually in Western Europe. Cosmetics and pharmaceuticals come second, accounting for around 15% of total consumption.

**Surfactants are not biodegradable.**

Conventional cleaners and detergents mostly use synthetic surfactants that are produced from petroleum. According to an EU regulation, surfactants must be biodegradable. However, according to this definition, a surfactant is already considered "fully biodegradable" if it is 60% degraded after 4 weeks.

This means that gasoline-based surfactants or their breakdown products continue to enter the environment via our waste networks and remain there for a long time. These substances are hazardous to aquatic organisms.

In terms of health, surfactants are a problem because they can dry or irritate the skin and mucous membranes, increasing their sensitivity to allergies and rashes.

Reduced use of detergents also means that fewer surfactants end up in waste water.

## PALM OIL - AN "ENVIRONMENTALLY FRIENDLY" RAW MATERIAL?

To replace chemical surfactants, palm oil surfactants are increasingly used in hygiene, washing and cleaning products. However, the cultivation of this natural raw material, which plays an increasingly important role in the energy and food industry, has serious consequences for the climate and the environment.

At 66 million tonnes per year, palm oil is the largest vegetable oil produced worldwide. Meanwhile, palm oil plantations are expanding globally on more than 27 million hectares of land. Over an area the size of New Zealand, rainforests, people and animals have already had to give way to "green deserts". When plantations are cultivated, the original rainforests are destroyed and with them, entire biotic communities. Soil erosion, heavy pesticide use and inhumane working conditions for farm workers make palm oil a problem ingredient.

A large share of palm oil is used in energy and food production, but consumption is also quite high in cleaning and cosmetic products. However, there are some manufacturers of cleaning products and cosmetics who are working to reduce the amount of palm oil.

## PERFUMES - ALLERGIES AND SEWAGE PROBLEMS

Vanilla, honey and almond, citrus, lavender, coconut or violet scents: almost all hygiene, washing and cleaning products contain fragrances. Some of these are natural, but most are artificially produced in the laboratory.

Around 3000 different substances are used to flavour products. In most cases, a combination of up to 100 individual substances in a wide range of concentrations is used. In addition to the health risks, often in the form of allergies, some fragrances also cause problems in waste water: they are toxic to aquatic organisms and very difficult to degrade in the environment.

Therefore, allergy sufferers and people with sensitive skin would be better off using fragrance-free 'sensitive' products and wearing gloves when cleaning or washing dishes. Some organic companies offer particularly gentle, fragrance-free products.

## ANTIBACTERIAL AGENTS - UNHEALTHY HYGIENE

During the coronavirus pandemic, all stocks of disinfectant were depleted in drugstores and pharmacies for several months. Hand disinfection has been seen as a means to contain the coronavirus pandemic. This sometimes came with serious health consequences: Excessive use leads to rashes, sometimes spreading to the whole body, or to dry, cracked hands. In addition, disinfectants often contain chlorine compounds that can irritate the respiratory tract.

Cleaning products with antibacterial agents are also sometimes used in the household. So-called hygienic cleaning products or disinfectants are, as a rule, not only completely useless in the household, but also potentially dangerous for both health and the environment.

Although much of the substance is removed by wastewater treatment, some of the disinfectants can end up in the environment, where they are slow to degrade.

## MICROPLASTICS AND PLASTIC COMPOUNDS

Individual cleaning agents still contain microparticles of microplastic which they release into waste water.

"Very few cleaning agents for scratch-sensitive surfaces contain microplastic particles because of their slightly abrasive effect," wrote the Industrial Association of Personal Care and Detergents (IKW) in a statement in summer 2017. This seems to relate in particular to ceramic hob cleaning products.

Polymers (plastic compounds) in liquid or gel form, which are soluble in water, are more commonly used. Such polymers are found in many cleaning agents and liquid detergents. Their environmental effects have not yet been clarified.

## SINCE WHEN IS CHEMISTRY WIDELY USED IN HYGIENE?

At that time, the substances used were already to some extent harmful to the environment, especially as there were no sewage treatment plants, but serious environmental pollution became a reality only after the economic development of the late 1950s and into the 1960s. This has brought a real wave of innovation in terms of household management and hygiene, but also a growing demand for hygiene standards. Washing machines and dishwashers, which had to be filled with laundry detergent and dishwashing detergent, respectively, as well as household cleaning agents in different variants, ensured cleanliness in households, but at the same time caused unrestricted water pollution.

It was therefore important to increase the number of wastewater treatment plants. Despite these significant advances in the protection of waters and the fish population etc. living in them, the release of detergents into the environment has continued in recent decades. Although surfactants are largely removed in sewage treatment plants, they continue to enter the environment to a limited extent. Some of these surfactants pass directly through wastewater treatment plants into surface waters. In addition, some surfactants cannot be further biodegraded and linger in the sewage sludge. When used as a fertilizer, surfactants are also spread on agricultural soils.

## WHAT CAN WE ACHIEVE?

**> First of all, we should use small amounts of dishwashing detergent and laundry detergent. We should also use less soap in our daily shower.**

**> Hygiene articles can also be produced in line with sustainability standards. These should be purchased if available.**

**>Avoid fragrances.**

## 6.6. CLOTHING

### WHAT ARE YOU WEARING NOW?

What is it made of? How long have you had it? Where did you buy it? Where was it produced? How was it produced? Who designed it? Who sewed it?

Now let's turn to clothing and see what impact clothing has on nature and the people who produce it.

### COTTON

is the world's most popular textile. 43% of all clothing in the EU is made of cotton. However, cotton is also the most problematic material from which clothes can be made. Firstly, cotton requires very large amounts of water - depending on the estimate, between 7,000 and 29,000 litres of water per kilogram of cotton, making it by far the most water-dependent agricultural crop. Secondly, cotton is mainly grown in areas with little rainfall, snce rain is harmful to the crop as the fibres stick together. Thus, cotton often worsens the natural status in areas already facing water shortages. Cotton production, like many components of the textile industry, takes place in developing countries where environmental regulations are weak. A lot of fertilisers and pesticides are used, and people work in poor conditions and are underpaid.

**What do we learn from this?**

**Our everyday hygiene products are not always good for us and certainly not good for the environment.**

We have already mentioned the Aral Sea. Once the fourth largest lake in the world, it has shrunk by more than half in two decades as cotton has been grown massively around it. The local population has benefited from this crop for the time being, but now has to face the consequences.

### ORGANIC COTTON

is better for the growing area, but yields less in organic crops. Therefore, larger areas are needed for the same amount of cotton.

Other natural fabrics include linen, hemp and soy silk. As with cotton, these are vegetable fibres. In terms of environmental impact and cultivation, they are all better than cotton. They require less water than cotton and are not sensitive to rain during harvesting, so should not necessarily be grown in dry regions. During cultivation, however, these plants require several thousand litres of water for every kilogram of fabric. In addition, many pesticides are also used in conventional crops. These fabrics are better than cotton, but not yet perfect.

## WOOL

is probably the most widespread textile. As with other types of animal hair, wool is basically a good and durable material. However, attention must be paid to how the animals are raised. Animals need species-appropriate raising, sufficient space and quality feed. Especially in industrialised livestock farming, animals suffer often because it is not the welfare of the sheep that matters, but only the exploitation of wool and working time. Sheep feed requires large areas of cultivated land. For grazing, forests are sometimes cleared or other natural ecosystems are destroyed just to get pasture.

In addition to the natural fibres discussed so far, there are also synthetic fibres such as polyacrylic, polyester, polyamide and spandex. Each of these textiles is petroleum-based, which is why they cannot decompose. When they burn during disposal, greenhouse gases are also produced. In addition, all textiles wear out through rubbing during normal use. In the case of synthetic fibres, these abrasion residues end up in the environment as microplastics and, via ingested animals, re-enter the human body. Therefore, from a sustainable point of view, synthetic fibres should be avoided in clothing.

**However, different textiles serve different purposes, which is why not only durable materials can be used.**

## FAST FASHION

A fashion collection appears on the market, stays trendy for a while, and then disappears. Usually, it remains fashionable for several months or at best it changes with the season. However, in the case of "fast fashion", this period is drastically shortened. Instead of every few months, a new collection appears every 2-3 weeks. As a result, wardrobes fill up and old clothes are thrown away or donated because they are no longer in fashion.

In order to produce this amount of clothing, an adequate amount of textiles is needed, with all the negative side effects. Fast fashion produces more than is needed, which means that many times more resources are consumed and go to waste. The environmental consequences are getting worse. An area can do well with small cotton production, but large cotton production can destroy complete natural landscapes.

For fast fashion to work, it has to be cheap. Low prices mean we can buy more, but also that clothes are produced cheaply. "Cheap product" means that huge amounts of pesticides and fertilisers are used on the plantations, and workers are paid little and condemned to live in poverty, even if they work full-time. "Cheap product" also means that no attention is paid to human health and nature protection, but that people get sick and nature is mercilessly destroyed. Not only in plant cultivation, but also in fabric production and garment sewing, savings are made wherever possible. Seamstresses often work long hours without a break for meagre wages. Safety standards in developing countries are often so low that disasters such as fires happen all the time, where people die because they can't escape or because they are let out of the factory too late by supervisors.

A particularly serious disaster occurred in Bangladesh in 2013 when a factory building in Sabhar collapsed, killing more than 1,000 people. Working conditions around the world are steadily improving, but unfortunately at a very slow pace.

For every item of clothing that is discarded, even if still in good condition, a new one has to be produced, thus contributing to the destructive cycle. Donating clothes seems to be the most useful alternative, but even in this context appearances can be deceiving. In principle, it is good to help people in need, but sometimes such an attitude can do more harm than good. Bringing donated clothes to a developing country often prevents the country from developing its own fashion industry. The country's own products don't sell enough because people get clothes donated for free. But this does not create new jobs and prosperity in the country. However, donations can be a beneficial alternative, for example, in the case of a natural disaster or homelessness, which means when it comes to providing quick and useful help.

**Slow fashion has developed as a counterbalance to fast fashion.**

Slow fashion is opposed to the fast and short life cycle of a garment, with all its consequences. This means that a garment is worn for as long as possible and that newly produced clothing is not always bought. Even though slow fashion is the new sustainable answer to fast fashion, it has been around much longer than fast fashion. In slow fashion, garments are repaired and passed on, which was considered normal until recently. Slow Fashion is therefore a new, newfound consciousness rather than a new idea.

However, slow fashion doesn't mean you have to wear the same thing for many years. Thanks to thrift stores, clothing circles or swap parties, you can get new things and let go of old ones with a clear conscience.

The better the quality of the fabrics, the longer the clothes will last. Examples of durable materials are loden wool, linen and wool.

**Notes:**

## 6.7. WHAT IS WASTE?

**The simple answer to this question: Waste is everything we no longer need and want to get rid of.**

Waste wasn't always waste. Before something became waste, it was something we used. A newspaper we read, a food wrapper, a shopping bag, a Coke can or a plastic bottle. All these items have two things in common: we use them for a very short period of time and they consume valuable resources and energy to be manufactured. From this point of view, waste is not economically viable, so we should avoid it to conserve resources and save energy. Some of these raw materials are regrown, some can be reused, but others do not fall into any of these categories. They must be burned or stored in a landfill. Not all waste is the same. The EU waste list sets out 232 different types of waste.

### HOUSEHOLD WASTE

**Residual waste**
**Organic waste**
**Glass waste**
**Paper waste**
**Packaging (plastic)**
**Electrical waste**
**Textiles**
**Hazardous waste**

Waste does not always remain waste. Organic waste can be composted and used to fertilise new plants. New glass can be made from waste glass. The same goes for paper, textiles and plastics. Certain electrical appliances can be broken down into their component parts and can also be recycled. However, the waste must first be sorted properly. Incorrectly sorted waste can only be incinerated, dumped in landfill or directly into nature as it is disposed of carelessly.

### WASTE IN NATURE

**We don't want garbage, and nature wants it even less.**

If waste is carelessly or even deliberately dumped in nature, it has consequences for plants, animals and ultimately humans. Chemicals can leak from ice chests and old electrical appliances. They poison and subsequently kill animals and plants. Old plastic bags are often eaten by animals, which then have no more room in their stomachs for food because they are full of garbage and therefore starve. The plastic gets smaller and smaller over time, releasing toxins that can lead to disease, deformity and even death. Microplastic particles are absorbed by plants and fish and accumulate in the body. If a person eats such a fish, small plastic particles enter the human body. On average, a person ingests 5g of plastic per week, which is about the size of a credit card. Every year, 10% of the plastic produced worldwide ends up in the sea. It accumulates in ocean currents and forms huge films, preventing sunlight from penetrating the sea.

**More and more volunteers are taking it upon themselves to clean up nature from plastic. In 2013, Ocean Clean Up was founded by Boyan Slat, then 18 years old. The aim of this initiative is to clean the world's oceans of plastic.** There are many things you can do on your own, with a small group or with an organisation, both locally and globally, against environmental pollution. However, the best way to rid nature of plastic waste is to prevent it from getting there.

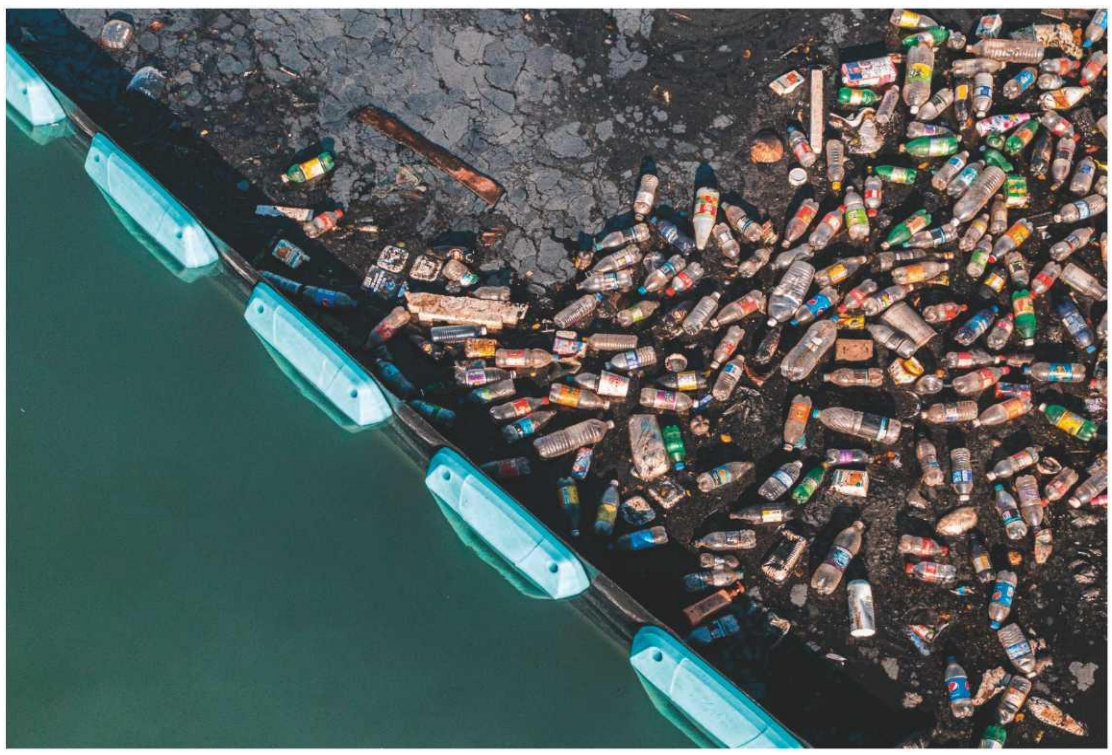
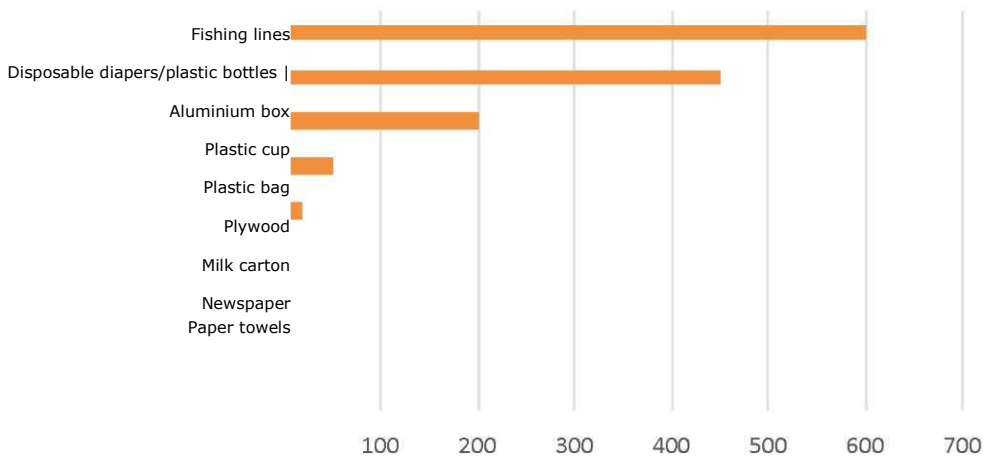


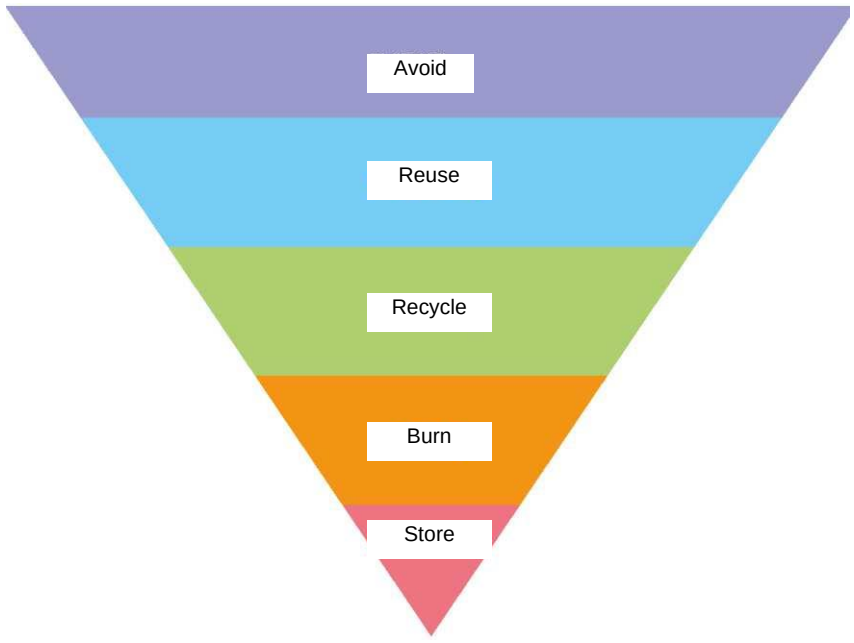
*Photo: Ocean CleanUp*



## Reduce, Reuse, Recycle

The waste hierarchy pyramid highlights how waste should be treated from an environmental point of view. At the first and highest level of this pyramid is waste avoidance. For example, if you use a bag that you bring with you when shopping, instead of buying one from the supermarket, which is usually thrown away after shopping, less waste will be generated. Second in this hierarchy is the re-use of resources. A good example is reusable or returnable bottles, whose plastic always ends up in the bin but can often be refilled by then. Another form of re-use is so-called 'up-cycling'. Old objects are given a new use.

Third in the waste hierarchy is recycling, where, for example, PET bottles that are no longer usable are melted down and the recovered plastic is used to make new plastic bottles. Ideally, the recycling stage would be the end of the pyramid. However, despite recycling, a lot of waste remains, which has to be incinerated or landfilled in the last two stages. In both cases, however, climate-damaging greenhouse gases are produced and valuable raw materials are destroyed in the process. For this reason, these strategies should be avoided whenever possible.




## CRADLE TO CRADLE

Recycling is the process of turning waste into raw material. In principle, any material can be recycled, but this process is not carried out in all situations. The reason is often that it is too costly and therefore not a cost-effective process. Either it is found in too small quantities, or it is difficult to sort from other materials, or it is simply cheaper to use new raw materials. Each recycling process also requires large amounts of energy. Whether or not an object can be recycled often depends on how many different materials it is made of. A newspaper is made only of paper and can therefore easily be transformed into something new. PET bottles can also be melted down and turned into new PET bottles.

But most products are made of several materials and cannot be completely broken down into their individual parts. For example, paper packaging is often covered with plastic, making it difficult to separate. Many plastic products contain so many chemical additives that they can no longer be made into new products. Mobile phones are also made from dozens of different materials. Many of them are rare earths, which are present in such small quantities that it would not be cost-effective to sort them individually.

To improve recycling, a growing number of product developers are relying on the idea of "Design to Recycle". This design philosophy already takes into account during the development of a product how it can be recycled after use. This means, for example, that packaging can be easily separated into its component parts or simply made from fewer materials. When shopping, you can pay attention to how elaborate a package was produced, whether it consists of more than one material and what kind of materials it contains. The simpler the packaging, the easier to recycle.

Recycling itself takes place mostly in industrial plants. The most important step, however, is in private households. Before it can be recycled, waste must first be separated according to type. Sorting waste that is separated or not separated correctly requires a great deal of technical effort or can only be done by humans. Therefore, this step is often not taken.

## Waste generation per country (million tonnes)


**What do we learn from this?**

**The best waste is waste that is not generated. That's why we should avoid disposable products and packaging whenever possible.**

**If waste cannot be avoided, attention will be paid to materials and waste sorting.**

### WASTE DISPOSAL AND INCINERATION

Until two decades ago, it was natural to simply dispose of waste in landfill. This is problematic, on the one hand, because toxins from the waste can leak into the ground and, on the other, because organic materials such as biodegradable waste or paper start to decompose and methane is generated in the process. Methane is a greenhouse gas that is 20 times more damaging to the climate than CO2. It is very dangerous for the climate, animals, plants and humans to be exposed to methane.

It is therefore forbidden throughout the EU to landfill household waste.

Today, waste incineration has become an accepted alternative. Although no methane is produced and no energy is generated, it does release CO2, which is a greenhouse gas that contributes significantly to climate change. Raw materials cannot be used further in waste incineration either. While this alternative is better than simply disposing of waste in landfill, it is not a sustainable solution.

## WHAT CAN WE ACHIEVE?

**> Reduction and reuse**

**> For meals on the go, we recommend the classic sandwich for a snack or a visit to a restaurant. Takeaway meals generate much more unnecessary waste for the same food because of the large amount of packaging waste.**

**> Before discarding items, the possibility of a second use by other people should be considered.**

**> Use rechargeable batteries instead of batteries where possible.**

**> Buy fruit and vegetables in bulk, without packaging. Buy food according to actual needs and shelf life.**

**> When purchasing new appliances, attention should be paid to quality, as they usually have a longer life span.**

**Notes:**

# A JOURNEY INTO THE TREE

For the research journey into the tree trunks, we shrink like the smallest organisms in this world. As small as little viruses, maybe. In any case, we consider ourselves so small that we can comfortably walk together through the tree's system of ribs, the so-called capillary tubes. We want to get into ach cell of the tree, we will be able to look at the finest structures of the wood.

I promise: everyone, really everyone who attends will be amazed. A piece of wood is a solid, impenetrable piece - or so you think. In fact, wood is one of the most finely woven materials. It has ingenious conduction systems that allow water and nutrients to circulate from root to crown. For example, in times of drought, when water is in short supply and the tree is in danger of drying out, the stained cells keep the last precious moisture in the leading section for as long as possible. In this way, they wisely divide up their drinking water supplies so as to survive until the next rain.

Wood cells are beautifully geometrically shaped bodies, one with thick walls to withstand the enormous loads of an entire tree, and the other with thinner walls to provide more inner space for storing various substances. All the walls, thickness, circumference, mutual support of fibre bundles for the entire trunk, are accurately optimised. Nothing is too thick or too thin. There is no waste here, nor is there much economy.

It's a maze that successfully meets so many requirements. The sap flow is precisely directed and controlled through the hollow capillary tubes. All the forces from the storm, the snow, the tree leaning on the edge, all the push and pull forces are carried over. And standing next to it is a large laboratory. Nutrients, preservatives, wound remedies, defensive substances and more are stored in precisely divided areas, and brought in as needed and often temporarily chemically transformed. For all these purposes, in addition to longitudinal capillary tubes and supporting wood fibres, there are also transverse cells. For our expedition, they are priceless. These are the best way to get comfortably inside the tree. But beware, medullary rays are pretty popular storage places of the indoor tree factory! Apart from resins and terpenes, there are acids, oils, extractive substances and fragrances. So we will be very careful they not get stuck in resin or preserved in an acid.

Let's move on. The first cell layers of the trunk need to be explored.

Solid retaining walls alternate with arches and halls with light columns. These sections of the building are replicated hundreds of times, so we little people can get lost. A magical world opens up before us. And the strangest thing is that something is happening everywhere. It flows, rushes and bubbles, bubbles and steams. Cells divide and multiply. Substances are constantly transformed and incorporated into the elaborate structure. Everywhere there is bustling activity and you still don't see anyone working.

The finest molecules, often just a few connected to form an enzyme, work over here, opening airlocks, bringing substances together or carefully separating others into the appropriate storage cells. We could watch this magical workshop endlessly in awe. Never before have I been able to experience such a quiet and perfect interaction. And the rooms, the floors of this factory itself: No architect could have designed them to be more beautiful and artistic, yet fully functional. It is a perfect construction.

Imagine that in every wall, in every corner, in the smallest and most insignificant component of the magic castle, all the forces that push, pull or strain here are precisely measured at every moment. As soon as a single piece seems too weak, pressure has increased or other changes occur, new cells are formed, added, built around, or another solution sought. Everything we see originates from a function and yet works in perfect beauty. The tree is a factory which, in addition to its normal activity of cell formation, photosynthesis and oxygen production, is constantly measuring and reinventing itself. It constantly tests its structure and improves it in all its components. Only now do we understand how it is possible for trees as heavy as clay to grow to the height of a steeple and be anchored in soil that is often soft with only a single rootstock. No civil engineer or structural engineer in the world could solve this task so efficiently and with so little effort. The growth of trees and all plants is one of the greatest miracles on earth. Consider that the largest living thing in the world is created seemingly from nothing. A seed, a few cubic metres of humus, the power of the sun and water flowing through it are all nature needs to raise thousands of crowns to great heights.

The tree's laboratory of life, the upward flow of water, the immediate supply of all major nutrients and defences, all happen in the outermost layers, just a few centimetres below the surface of the tree trunk. The actual cell division, the annual thickening, is limited to the fine transition zone between bark and bare wood, the so-called cambium. This skin of a tree ring's annual growth is provided from the inside. The feeding area, the first few inches of wood inward, is called the sapwood. They all have their own recipe for supplying the tree.

As soon as we penetrate a few centimetres deep from the bark inside the tree trunk, we reach the so-called heartwood. The most striking difference is the water. Suddenly, it's hardly flowing at all. The former locks seem abandoned. They degenerated into almost unrecognisable thickening of the hairline. There is hardly any water flowing up here.

We move on, always through the heart of the tree, towards its centre. There, just inside, is the core or core tube. This is the centre that was once formed by the thin branch of the top shoot. It is a few millimetres thick cloth filled with soft brown wood pulp.

Things are much slower here. At the core lies the secret of centuries of tree life. Contemplative constancy in all processes, precious stored materials. The fungicidal bacteria and resins, acids and tree extracts, oils and contents that have been tried and tested over millions of years preserve the woody material made up of lignin and cellulose.

They soak and preserve the world of cellular cascades inside. All this happens as growth around the trunk directs the lush life forces of cell division into sophisticated forms.

Though we wander here, deeply enclosed, far from all worlds, all the work, all the change is subject to a ceaseless throbbing. Nothing, absolutely nothing, is consistently the same. There is rather a continuous slowing down, acceleration - up and down. The flow of water, the density of transported nutrients, the speed of cell division, even the size and number of control molecules, all pulse at rates we will soon understand. A law says: "Any life process runs stronger and healthier when it pulsates in oscillation rather than in a continuous manner." This is why water never flows straight when it has the freedom to choose to find a riverbed on flat ground. It will always choose a winding path. In the meanders it renews its tension, purifies itself, and receives the force of life.

We, who now spend a lot of time here in the tree, are amazed at how day and night become the first rhythm. Without sunlight, oxygen production in leaves and needles comes to a halt. Work is followed by rest. Summer and winter fill the indoor shops. As soon as the sap flow stops more and more in late August, the cells that hold the leaves to the branches and direct all the food back and forth begin to condense. The close all the flow valves and soon they dissolve. The leaves are now falling from the tree.

In wood itself there are a multitude of biochemical processes besides the conversion of sugar to starch. It's a preparation for winter, reminiscent of the hard work farmers put in when they harvest their fields. The harvested fruit is delivered to the factory one load at a time. What is not set aside for storage and not turned into storable food spoils within weeks.

We humans see only a small part of the last great rhythm of the trees. We simply live too little, too fast in this world. Even the strongest body development has only one purpose: wanting to preserve the continuity of life. With the root, trunk and branches in the crown, they become earth again - mother earth. They come from the topsoil and return to it.

If we could see an entire forest slope in a time-lapse movie showing the events of a few thousand years in a few minutes, we would be amazed. Generations of the tall forest rise up and back to earth like the green wave crests of an ocean

*Quote from: Ewin Thoma, Die geheime Sprache der Băume: die Wunder des Waldes fur uns entschlusselt. (Servus, 2016)*

# CHARTS

Page 4: Population growth chart; Source:

www.science-at-home.de/wiki/index.php/Bevölkerungs- entwicklung_seit_10.000_v._Chr.

Page 5: Two illustrations of sustainability; Source: Alexander Rotter

Page 6: UN Sustainable Development Goals; Source: sdgs.un.org/goals

Page 9: Footprint structure; Source:

www.fussabdruck.de/oekologischer-fussabdruck/ueber-den-oekologischen-fussabdruck/

Page 10: Beech tree and leaves; Source: www.pexels.com

Page 11: Forest in Maramures; Source: Alexander Rotter

Page 12: Agricultural crop areas; Source: https://de.statista.com/statistik

Page 13: Image of mudflow; Source: Alexander Rotter

Page 15: Inputs/Outputs; Source: Kraussmann 2005

Page 16: Land use; Source: https://ourworldindata.org/land-use

Page 17: Water deficit; Source: AdobeStock

Page 18: Aral See; Source: www.istockphoto.com

Page 20: Sea level; Source: AdobeStock

Page 20: Image of fish; Source: AdobeStock

Page 21: Image of river; Source: Alexander Rotter

Page 22: Image of Earth atmosphere; Source: AdobeStock

Page 23: The composition of air; Source: https://www.lubw.baden-wuerttemberg.de/luft/ zusammensetzung-der-luft

Page 23: $CO_2$ concentration in the atmosphere; Source: https://de.statista.com/statistik

Page 24: $CO_2$ atmosphere emissions worldwide; Source: https://de.statista.com/statistik

Page 26: Mammal population; Source: William J. Ripple, Christopher Wolf, Thomas M. Newsome, Mauro Galetti, Mohammed Alamgir, Eileen Crist, Mahmoud I. Mahmoud, William F. Laurance und 15.364 Biowissenschaftler aus 184 Ländern: World Scientists' Warning to Humanity: A Second Notice. In: BioScience. Vol. 67, Nr. 12, 2017

Page 27: Image of a bee; Source: www.pexels.com

Page 30: Primary energy consumption; Source:

Page 31: Image of a nuclear power plant; Source: www.pexels.com

Page 32: Image of wind turbines; Source: Alexander Rotter

Page 33: Image of wind turbine and solar panels; Source: www.pexels.com

Page 34: Image of solar panels; Source: www.pexels.com

Page 35: Image of stone walls; Source: viator.com

Page 38: Image of Empire State Building; Source: www.pexels.com

Page 39: Energy consumption and emissions; Source: Biswas W.K., 2014

Page 40: Wooden houses; Source: Teodor Nicula-Golovei

Page 42: Materials used for manufacturing a mobile phone; Source: Wuppertal Institute, from UNEP 2006

Page 51: Image of sea and trash; Source: OCEAN CLEANUP

Page 51: Degradation rate over years; Source: World Ocean Review

Page 52: Image of a pyramid; Source: AKEXA

Page 53: Waste generation per country; Source: www.statista.com

**The teaching materials are based on the following books. These are recommended as further reading:**

Abdollahi, J., Emrani, N., Chahkandi, B., Montazeri, A., Aghlmand, R., Gheibi, M., Abdollahi, J., Emrani, N., Chahkandi, B., Montazeri, A., Aghlmand, R., Gheibi, M., 2021. Environmental impact assessment of aluminium production using the life cycle assessment tool and multi-criteria analysis. Annals of Environmental Science and Toxicology 5, 059-066. https://doi.org/10.17352/aest.000038

Berners-Lee, M., 2020. How Bad Are Bananas?: The carbon footprint of everything - 2020 new edition, Main Edition. ed. Profile Books.

Braungart, M., McDonough, W., 2014. Cradle to Cradle: Einfach intelligent produzieren, 7. ed. Piper Taschenbuch, Munchen.

Coady, T., Figueres, C., May, E., 2020. Rebuilding Earth: Designing Ecoconscious Habitats for Humans. North Atlantic Books, Berkeley, California.

Emmott, S., 2020. Zehn Milliarden: Das AusmaB der Klimakrise. Erweiterte Neuausgabe, 1. ed. Suhrkamp Verlag, Berlin.

Flannery, T., 2007. The Weather Makers: Our Changing Climate and what it means for Life on Earth. Penguin, London.

Heinberg, R., 2011. End of Growth: Adapting to Our New Economic Reality, Original Edition. ed. New Society Publishers, Gabriola, B.C.

Holler, C., Gaukel, J., Lesch, H., Lesch, F., 2021. Erneuerbare Energien zum Verstehen und Mitreden. C.Bertelsmann Verlag, Munchen.

Holzbaur, U., 2020. Nachhaltige Entwicklung: Der Weg in eine lebenswerte Zukunft, 1. Aufl. 2020 Edition. ed. Springer, Wiesbaden.

Klein, N., 2014. This Changes Everything: Capitalism vs. the Climate by NAOMI KLEIN(1905-07-07). Vintage Canada.

Konietzko, N., Teschler, H., 1992. Asbest und Lunge, Softcover reprint of the original 1st ed. 1992 Edition. ed. Steinkopff Verlag.

Lehmann, R.M., 2021. Mission Erde - Die Welt ist es wert, um sie zu kämpfen, Originalausgabe Edition. ed. Ludwig Buchverlag, Munchen.

Pabon, J., 2020. Sustainability for the Rest of Us: Your No-Bullshit, Five-Point Plan for Saving the Planet. Thorpe-Bowker.

Ritchie, H., Roser, M., 2018. Plastic Pollution. Our World in Data.

Rosa, W. (Hrsg.), 2017. Transforming Our World: The 2030 Agenda for Sustainable Development, in: A New Era in Global Health. Springer Publishing Company, New York, NY. https://doi.org/10.1891/9780826190123.ap02

Sijacic-Nikolic, Sijacic-Nikolic, M., Milovanovic, J., Nonic, M., 2018. Forests of Southeast Europe Under a Changing Climate: Conservation of Genetic Resources, 1st ed. 2019 Edition. ed. Springer.

Thoma, E., 2016. Die geheime Sprache der Bäume: die Wunder des Waldes fur uns entschlusselt, 8. Auflage. ed. Servus, Wals bei Salzburg.

Wackernagel, M., Beyers, B., 2016. Footprint: Die Welt neu vermessen. Neuausgabe 2016 mit aktuellen zahlen und Kommentaren, Grafiken und Tabellen, Neuausgabe 2016 mit aktuellen zahlen und Edition. ed. Europische Verlagsanst.

Wallace-Wells, D., 2019. The Uninhabitable Earth: Life After Warming, INT Edition. ed. Crown, New York.

What is Reinforced Concrete? Uses, Benefits, and advantages [WWW Document], 2019. . The Constructor. URL https://theconstructor.org/concrete/reinforced-concrete-uses-benefits-advantages/35976/ (zugegriffen 7.Juni 2022).

Idea: Sylvia Rotter
Concept and graphic design: Barbara Theis
Authors: Alexander Rotter, Sylvia Rotter, Magdalena BruckmuNer Schindler Editing: Valerie Gfohler Cover photo: Lukas Beck
The teaching materials have been developed to the best of our knowledge and are largely based on the scientific works and texts listed in the bibliography.
They can be downloaded at refeproject.eu.
Follow us on social media: facebook.com/refeprojecteu, instagram.com/refeprojecteu
The project is part of the European Climate Initiative (EUKI) ideas competition. EUKI is a funding instrument of the Federal Ministry for Economic Affairs and Climate Protection. The EUKI Ideas Competition is implemented by the German Association for International Cooperation (GIz) GmbH.
The overall objective of the EUKI is to promote cooperation within the European Union (EU) to reduce greenhouse gas emissions.
www.euki.de