



IMPRINTING SUSTAINABILITY: From Theory to Practice

FULL RESEARCH REPORT FOR IMPRINT+ PROJECT



Title	<i>Imprinting sustainability: from theory to practice</i>
Authors	University of Aveiro, Portugal Armando Alves (<i>leading author</i>) armandoalves@ua.pt Milene Matos Eduardo Ferreira Carlos Fonseca Rosa Pinho Lísia Lopes Maria João Antunes Pedro Amado Pedro Beça
Layout	E.N.T.E.R.
Proofreading	Leave no Trace Ireland (Maura Lyons, Kate Egan)
Partners	University of Aveiro (Portugal) Municipality of Lousada (Portugal) Leave No Trace (Ireland) E.N.T.E.R. (Austria) IISS Cipolla - Pantaleo – Gentile (Italy) IES Pedro Jiménez Montoya (Spain)
Publisher	UA Editora, University of Aveiro 1 st Edition – November 2016
ISBN	978-972-789-494-9

copywrite: pictures © fotolia.com



Co-funded by the
Erasmus+ Programme
of the European Union

2015-1- PT01-KA201- 012976
This project has been funded with support from the European Commission.
This publication [communication] and all its contents reflect the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

FOREWORD

This report is the materialization of IMPRINT+ Output 1. It consists of a multidisciplinary evidence based state-of-the-art summary research report regarding environmental sustainability, best practices and environmental action and is divided in three separated but complementary parts available to download at <http://imprintplus.org/>

Part I ENVIRONMENTAL SUSTAINABILITY FRAMEWORK: an overview

In Part I you get all the basic introductory theory and data to contextualize IMPRINT+.

Part II IMPRINT+ CASE STUDIES

Read Part II for inspiration and a quick introduction to green entrepreneurship!

Part III IMPRINT+ PRACTICAL GUIDELINES FOR OFFSETTING ACTIONS

Part III is all about action and getting your hands dirty!

The authors would like to thank all project partners for their contributions and express gratitude to the projects, organizations and researchers that kindly provided images to illustrate the report.

ABOUT IMPRINT+

IMPRINT+ aims at the promotion, at a transnational level, of an ecological reasoning based on the changing power of local community and on the participation, empowerment and entrepreneurship of young European citizens. IMPRINT+ is a transectorial project that brings together 6 partners from 5 countries, each with different experiences and perceptions. The project's methodology is based on establishing the state-of-the-art approaches regarding education for sustainability, IT technologies and ecological footprint offsetting. The project starts with an integrative research that will enable the project team to consolidate already existing know-how in the above-mentioned areas and better define the project's innovative edge within its context of use. It will also help the team establish a roadmap that will reinforce the project's up-to-date nature in the long run.

IMPRINT+ is coordinated by the [University of Aveiro](#), in Portugal, in partnership with the [Municipality of Lousada](#), where the project's field actions are taking place; [LeaveNoTrace Ireland](#), a leading Irish NGO in the field of environmental good practices; [IISS Cipolla-Pantaleo-Gentile](#), a science school of Sicily, Italy; [IES Pedro Jiménez Montoya](#), a secondary school of Baza, Spain; and [E.N.T.E.R.](#), the European Network for Dissemination and Exploitation of EU Project Results, located in Graz, Austria.

For more information visit <http://imprintplus.org/> and follow us at <https://www.facebook.com/erasmusimprint>

If you must print this report, make sure you use recycled paper and print on both sides!

Legal notice

The contents of this publication do not necessarily reflect the official opinions of the European Commission or other institutions of the European Union. Neither the European Environment Agency nor any person or company acting on behalf of the Agency is responsible for the use that may be made of the information contained in this report.

CONTENTS

PART I – ENVIRONMENTAL SUSTAINABILITY FRAMEWORK: AN OVERVIEW

1.1 FOREWORD	8
1.2 OBJECTIVES.....	9
1.3 BASELINE CONCEPTS.....	10
1.3.1 Footprints	11
Ecological footprint.....	12
Carbon footprint.....	18
Water footprint.....	20
1.3.2 Other concepts	22
1.4 GLOBAL PRESSURE: WE ONLY HAVE ONE PLANET.....	25
1.4.1 One exciting journey.....	26
1.4.2 By the billions!	28
1.4.3 An urbanized planet.....	30
1.4.4 Modern intensive agriculture	32
1.4.5 Biodiversity loss.....	34
1.4.6 The Great Acceleration	37
1.4.7 A new epoch.....	40
1.4.8 The need for change	41
1.5 LOCAL PRESSURES: FROM MINUS TO PLUS	44
1.5.1 Energy and greenhouse gases	46
1.5.2 Transport.....	50
1.5.3 Food	52
1.5.4 Consumption and waste.....	58
1.5.5 Water	62
1.5.6 Buildings	64
1.6 AND DID YOU KNOW THAT... ..	66

PART II – IMPRINT+ CASE STUDIES

2.1 WEB-BASED TOOLS FOR SOCIAL ENGAGEMENT AND ENVIRONMENTAL EDUCATION & COMMUNICATION	70
2.2 GREEN ENTREPRENEURSHIP AND ALTERNATIVES TOWARDS A GREEN AND SOCIAL ECONOMY	86
2.2.1 Green economy	88
2.2.2 Examples	92

PART III – IMPRINT+ PRACTICAL GUIDELINES FOR OFFSETTING ACTIONS

3.1 TREES	104
3.1.2 Choosing Trees	106
3.2 ORGANIC VEGETABLE GARDEN	110
3.3 WILDLIFE SHELTERS.....	114
3.3.1 Birds	115
3.3.2 Bats	116
3.3.3 Herpetofauna.....	117
3.3.4 Bug hotel	118
3.4 POND	120
3.5 INVASIVE PLANT SPECIES	122
3.6 WASTE.....	124
 GLOSSARY	 126
BIBLIOGRAPHY	128



IMPRINTING SUSTAINABILITY: From Theory to Practice

PART I – ENVIRONMENTAL SUSTAINABILITY FRAMEWORK: AN OVERVIEW

In Part I you get all the basic introductory theory and data to contextualize IMPRINT+.

1.1 FOREWORD

The main goal of Part I of the Initial Research Report is to be a positive point of contact where **knowledge** and **motivation** meet. We present a short introduction to environmental sustainability by compacting several different but connected environ-

mental issues that are direct or indirectly related to **IMPRINT+**. We hope that you will gain a new insight that enables you to understand complex global issues and learn how to take action to relieve the environmental pressure on the planet.

1.2 OBJECTIVES

Provide an overview
about environmental
sustainability

Introduce the
ecological, carbon
and water footprints
and other related
concepts

Present the global
main environmental
pressures and drivers

Understand the
urgent need for
change and sustain-
able solutions

Acknowledge and
understand how
individual behaviour
affects local and glo-
bal sustainability

Highlight behaviours
and alternatives that
reduce the individual
ecological footprint

Motivate for positive
change and inspire
others

Prepare the mindset
for the participation
and implementation
of **IMPRINT+**.

1.3 BASELINE CONCEPTS

One of the objectives of this report is to establish a common ground of concepts and ideas. It is crucial to clearly understand some basic concepts used throughout the report and to be able to find relationships between them and connect the dots regarding pressing environmental issues. Therefore, no matter the level

of understanding about environmental issues, all readers are encouraged to carefully read this chapter and think about the concepts and their meanings. Additionally, at the end of the report there is a **Glossary**¹ for further exploration about other terms not explicitly mentioned in this chapter.

¹Underlined words: see glossary at the end of this report

1.3.1 Footprints

Given the nature of the report we can “warm up” by first considering what are “footprints”. What do they account for and how to interpret them? We will soon realize that they don’t have anything to do with body parts. Instead, they are nothing more than indicators that use a specific unit to represent our impact on the environment. Nevertheless, despite the apparently simple result, keep in mind that footprints are complex from a methodological point of view, obtained from complicated mathematical calculations with data acquired from multiple sources. Also, footprints are recalculated on a regular basis to guarantee that the most recent data and methodological advancements are used. The scale of footprint calculation can also reflect their complexity, given that they can be calculated for individual, population, activity, product, region, nation or global scale.



Ecological footprint

The **ecological footprint (EF)** measures the amount of biologically productive land and water that an individual, population or activity requires to produce all the resources it consumes and to absorb the waste generated, using prevailing technology and resource management practices. The ecological footprint is measured in **global hectares (gha)** and increased 80% over the last 40 years (Galli 2010). Each global hectare represents an equal amount of *biological productivity* area or, in other words, a hectare with the Earth's average biological productivity for a given year. This value varies yearly because the planet's productivity also varies. Also, each land type (e.g. arable land, pasture, forest, productive sea) has different biological productivity: to obtain equal amounts, each land type requires more or less area accordingly. Think for example that because of pasture land's inferior biological productivity per area, to attain the same amount of gha than a forest, the area of pasture land would have to be larger.

Finally, take in consideration that we live in a global society and economy and therefore an individual or country's EF includes land types from all over the world. In 2010, the global ecological footprint per capita was 2.6 gha.

Biocapacity (BC) is another important concept that uses global hectare as units. It refers to the capacity of ecosystems to produce useful biological materials and to absorb waste materials (specifically, carbon dioxide) generated by humans using current management schemes and technologies. In 2010, the world average per capita was 1.70 gha (WWF 2014). In the same year the ecological footprint per capita surpassed global per capita biocapacity in 91 of 152 countries (WWF 2014).



Sometimes the ecological footprint is associated with another unit: planet equivalents. We already know that we live in a finite planet, with limited resources so it shouldn't be a surprise to say that there is a "magic number" representing a real physical limit to Earth's biological productivity. In 2012, this number was roughly 12 billion ha (Global Footprint Network 2015). This physical limit is calculated from the sum of all the biologically productive areas of land and water in the planet. By multiplying an individual's EF by the rest of the world's population and then divide the result by the Earth's biologically productive area for a given year – we obtain planet equivalents, in other words, the theoretical number of Earth's needed if all citizens lived accordingly to that specific lifestyle. For example: if all the world's population had the same lifestyle of an average USA citizen, we would need 3.9 planets! (WWF 2014). Planet equivalents can be a very intuitive unit to measure our (un)sustainability.

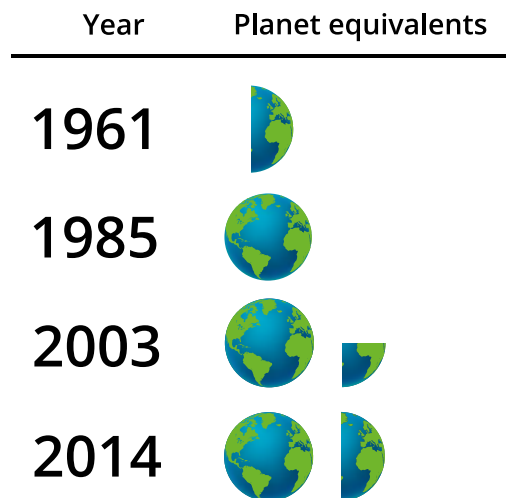
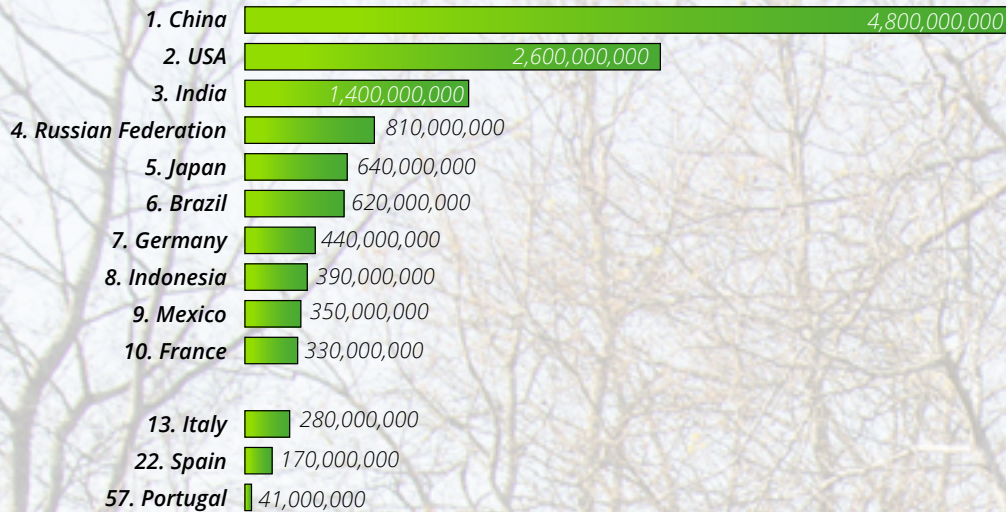


Figure 1: Historical planet equivalents (Collen et al. 2010).

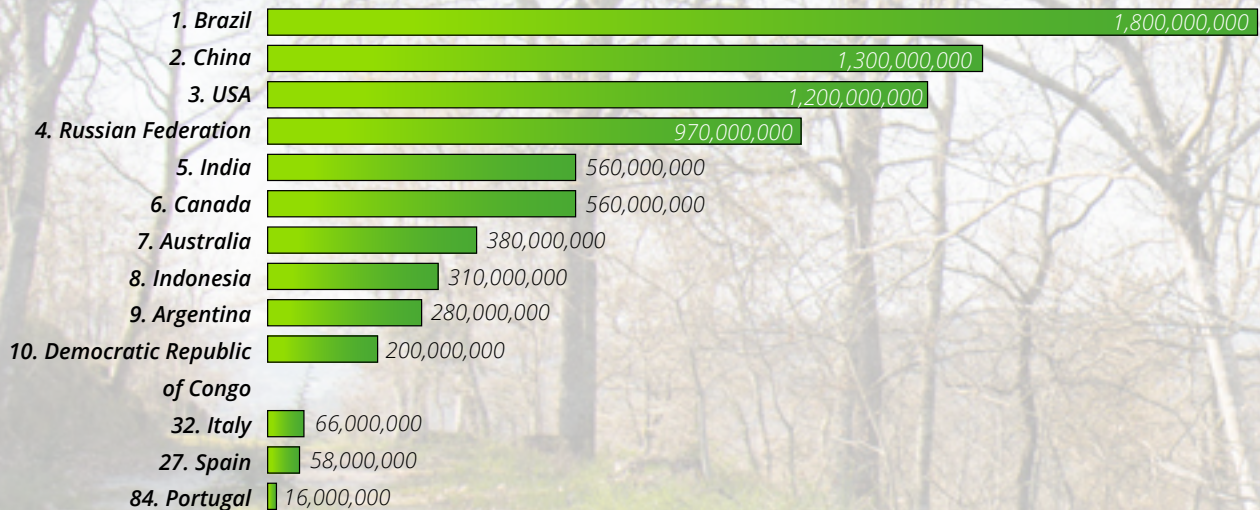
If the ecological footprint per capita and population continues to increase at current rates, humanity will need the resources of 2 planets within the next 25 years! (Galli 2010) Using planet equivalents can prove to be useful: it is intuitive and easy to understand, specially if you think "visually" using the "number of planet Earth's".

In order to help contextualise the ecological footprint and biocapacity in terms of nations, we provide in Figure 2, a world ranking and in Figure 3, the ecological footprint of several countries.

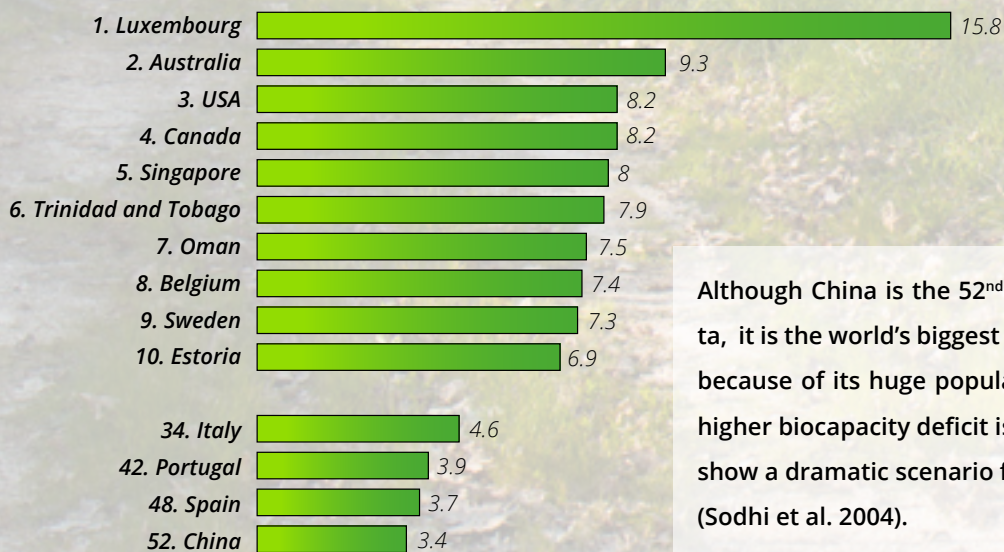
TOTAL ECOLOGICAL FOOTPRINT (GHA)



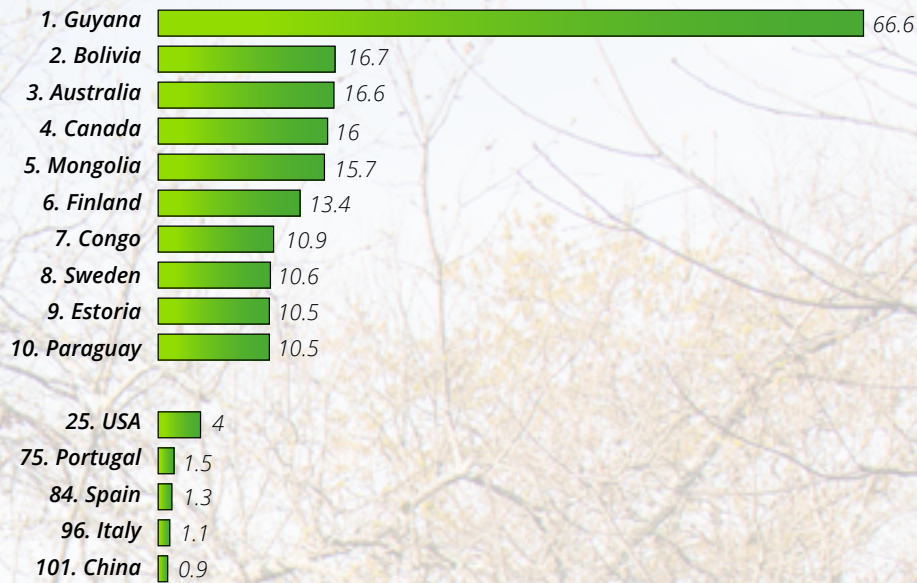
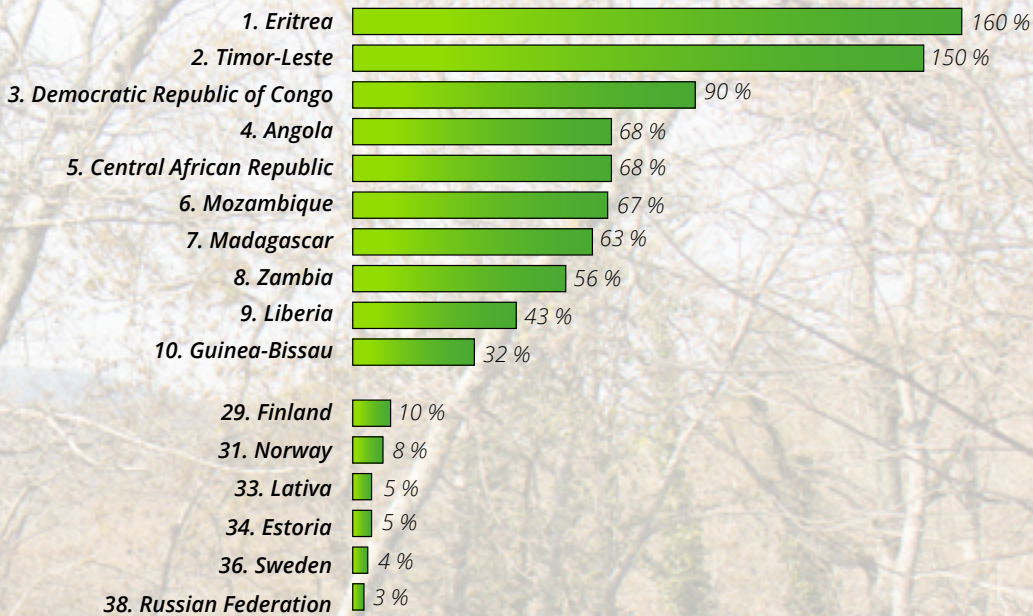
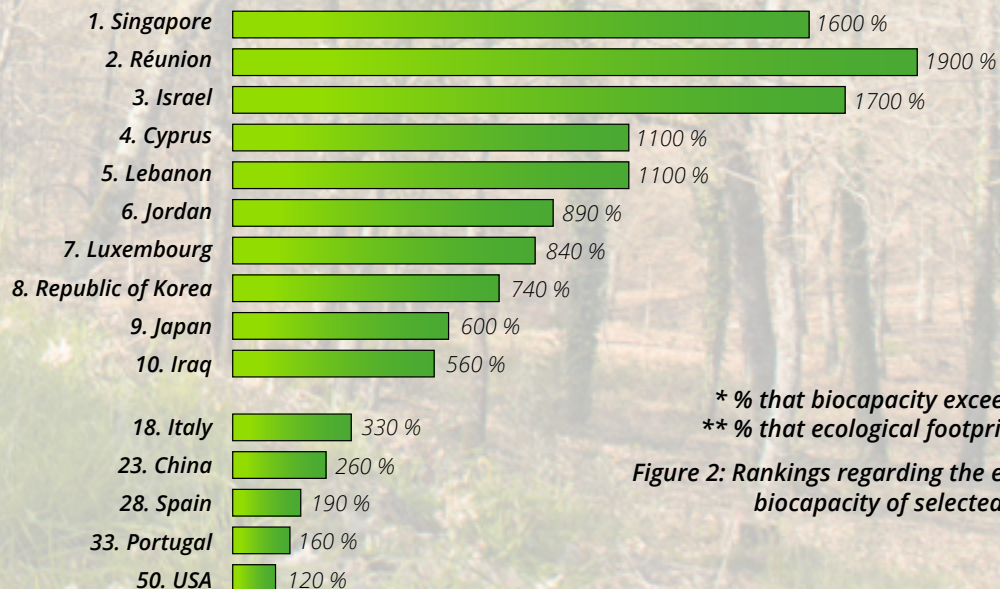
TOTAL BIOCAPACITY (GHA)



ECOLOGICAL FOOTPRINT PER CAPITA (GHA)



Although China is the 52nd country in EF per capita, it is the world's biggest contributor to global EF because of its huge population. The country with higher biocapacity deficit is Singapore and studies show a dramatic scenario for biodiversity (Sodhi et al. 2004).

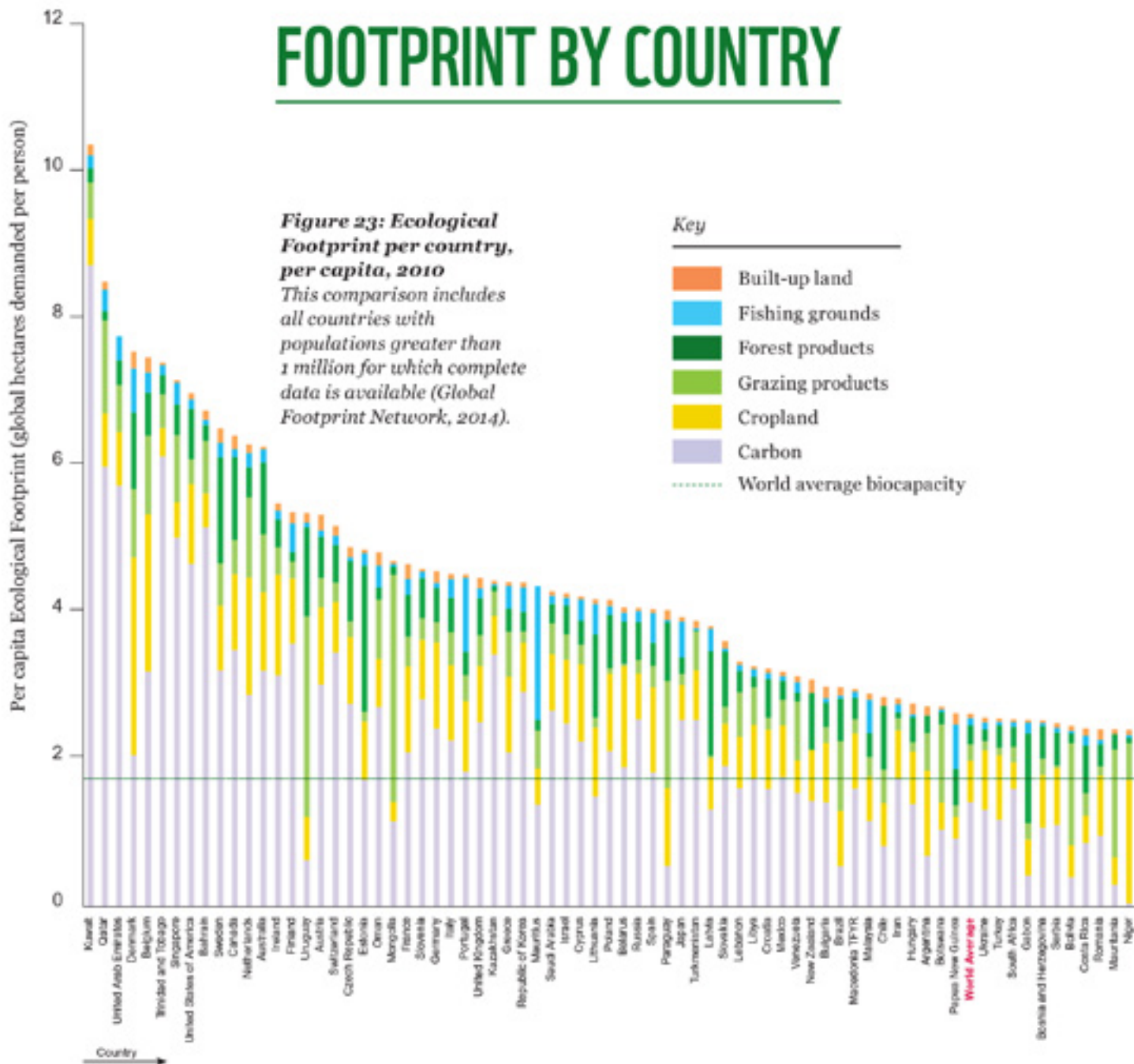
BIOCAPACITY PER CAPITA (GHA)**BIOCAPACITY RESERVE*****BIOCAPACITY DEFICIT****

* % that biocapacity exceeds ecological footprint

** % that ecological footprint exceeds biocapacity

Figure 2: Rankings regarding the ecological footprint and biocapacity of selected countries. (WWF 2014)

FOOTPRINT BY COUNTRY



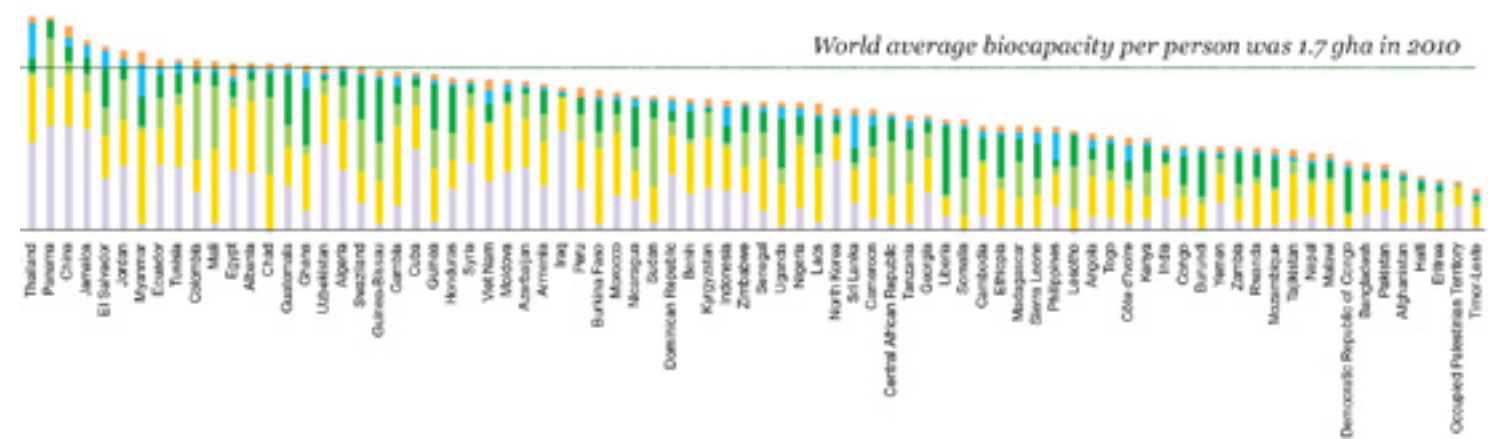


Figure 3: Ecological footprint by country (WWF 2014)

Carbon footprint

Most certainly, at some point, you came across one way or the other with the most famous footprint of all: the carbon footprint (CF). It is a specific type of footprint that quantifies the amount of dioxide carbon (CO_2) emissions produced directly or indirectly, by an individual, activity, process, product, service or country. It is usually expressed in kg or tonnes of

CO_2 , however, if other *greenhouse gases (GHG)* besides CO_2 are taken into consideration, then the carbon footprint is expressed in CO_2e (CO_2 equivalent). The carbon footprint is responsible for more than 50% of the global ecological footprint (WWF 2014).






Water footprint

The **water footprint (WF)** is another specific indicator that quantifies the amount of water used directly or indirectly in three components: green water (refers to the consumption of rainwater), blue water (water withdrawn from groundwater or surface water) and grey water (pollution of water). For example: 94% of the 15,000 liters of water needed to produce 1 kg of beef are green water, meaning it comes from precipitation, causing less environmental impacts in comparison with “blue” water for instance. Pig and chicken meat, although it requires less water to produce, it causes more water pollution because the grey component is higher.

Vegetables require much less water than meat, an average of 322 litres for every kg of vegetables (Mekonnen & Hoekstra 2012). The water footprint can be calculated for any product or activity as well as for any well-defined group of consumers (individual, household family, city, region or nation), or producers (e.g. a public organization, private enterprise or a whole economic sector) (Hoekstra 2008).



GLOBAL AVERAGE LITRES				COMPONENT			
	Portion	Per Portion	Per kg	Green	Blue	Grey	
Meat							
	Beef cattle	-	-	15 400	94 %	4 %	3 %
	Sheep	-	-	10 400	94 %	5 %	1 %
	Pig	-	-	6 000	82 %	8 %	10 %
	Goat	-	-	5 500	94 %	6 %	0 %
	Chicken	-	-	4 325	82 %	7 %	11 %
Drinks							
	Tea	1 cup 250 ml	27	8860	82 %	10 %	8 %
	Beer	1 glass 250 ml	74	298	85 %	6 %	9 %
	Wine	1 glass 125 ml	109	870	70 %	16 %	14 %
	Coffee	1 cup 125 ml	132	18 900	96 %	1 %	3 %
	Orange juice	1 glass 250 ml	200	1020			
Dairy							
	Milk	1 glass 250 ml	255	1020	85 %	8 %	7 %
	Eggs	1 egg 60 g	196	3300	79 %	7 %	13 %
	Butter	-	-	5553	85 %	8 %	7 %
	Cheese	-	-	3178	85 %	8 %	7 %
Vegetables & Fruits							
	Cucumber	-	-	353	58 %	12 %	30 %
	Cabbage	-	-	237	56 %	12 %	32 %
	Orange	1 orange 150 g	80	560	72 %	20 %	9 %
	Apple	1 apple 150 g	125	822	56 %	12 %	32 %
Other							
	Rice	-	-	2500	68 %	20 %	11 %
	Pasta (dry)	-	-	1849	70 %	19 %	11 %
	Chocolate	-	-	17 196	98 %	1 %	1 %
	Pizza Margherita (725 g)	-	1260	-	76 %	14 %	10 %





Table 1: Water footprint of food products (Water Footprint Network 2014).

Table 1: Water footprint of food products (Water Footprint Network 2014).

1.3.2 Other concepts

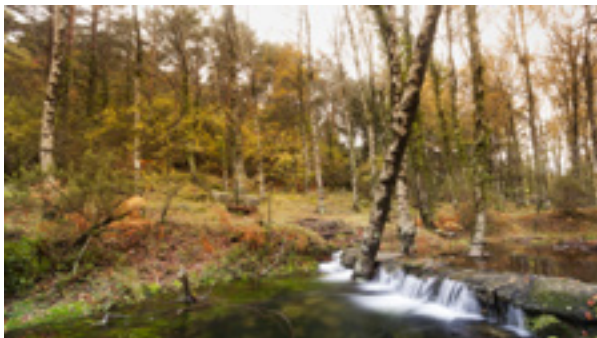
In recent decades **climate change** has been intensely researched and refers to long-term changes in Earth's climate variables caused by either natural variability or human influence. **Global warming** is a gradual long-term increase in global average surface temperatures observed in the last decades. Pre-industrial revolution estimates of global average CO₂ concentration in the atmosphere is 280 ppm (parts per million). In April 2016 it reached 407.43 ppm (NOAA 2015; NOAA 2016).

“Human actions have released 555 petagrams of carbon (where 1Pg = 10¹⁵g = 1billion metric tons) to the atmosphere since 1750, increasing atmospheric CO₂ to a level not seen for at least 800,000 years”

“The released carbon has increased ocean water acidity at a rate probably not exceeded in the last 300 million years”

(Lewis & Maslin 2015)

Today's scientific community claim it's extremely likely that humans are the main cause of global warming due to GHG emissions (CLIMATE-ADAPT 2016). 2015 was the warmest year since temperature record keeping, which began in 1880, and the average global land and ocean surface temperatures was 0.90°C higher than the 20th century average (NOAA 2014). In 2003, a heat wave in Europe caused up to 70,000 deaths over four months. The 'ClimateCost' project concluded that there would be an additional 127,000 heat-related deaths per year in Europe in 2080 without climate adaptation activities or 40,000 deaths per year with adaptation activities (Brink et al. 2015).



Biological diversity or **biodiversity** is the diversity of all life on Earth (micro-organisms, plants, animals, etc.) on three levels: genetic, species and ecosystems. Presently, there are about 1.75 million species known to science, and although the total number is unknown, some estimates indicate that it could be close to 13 million (CBD 2010). **Ecosystems** such as a deciduous forest, a river or coral reefs, are a dynamic complex of plant, animal, and micro-organism communities and the non-living environment that interact as a functional unit (Alcamo et al. 2003). An ecosystem may have different **habitats** or, in other words, the physical place where a species naturally occurs and lives (United Nations 1992). For example, a small pond, a rocky beach or even urban areas can be im-

portant habitats for several species of birds, bats and even amphibians!



The species that, naturally and without human action, have been established for thousands of years in a given region are called **native species**. Currently, not all species occur in their natural distribution range and in many cases, not even in their native continents. **Alien species** or **non-native**, are species that were introduced by humans outside their natural range and over centuries of human interference there have been many intentional and accidental species introductions. Today some of the non-native species have become invasive, growing aggressively, negatively affecting the local, native species, and are one of the main threats to the conservation of biodiversity worldwide (European Union 2014).

Ecosystem services are the direct and indirect contributions of ecosystems to human well-being (European Union 2014) usually in the form of goods and services. Generally four categories of ecosystem services are considered: provisioning, regulating, support and cultural. Provisioning services are directly generated by ecosystems such as food, freshwater, wood, fiber, medicine, etc.; regulating services are generated from controlling natural processes such as climate, carbon storage, water purification, pollination, natural hazard and disease control, etc.; support services help main-

tain life on Earth, for example: nutrient cycle, soil formation, primary productivity, etc.; finally, cultural services consider all non-material aesthetic, recreational and spiritual benefits (European Environment Agency 2010; Alcamo et al. 2003).



Almost any human activity from personal daily choices to economical activities use resources, materials and energy and create waste, pollution and GHG emissions. **Environmental impacts** can occur as a result of any activity at any scale, with positive or negative consequences to the environment. When habitats or ecosystems are damaged or even destroyed, ecological restoration techniques such as reforestation, re-vegetation or control of alien invasive species can be carried out to restore the area to the previous natural conditions, biodiversity and ecosystem services as far as possible. When damages to species or habitats are permanent, irreversible or it is no longer feasible to restore to the original natural conditions, but it is possible to restore another degraded area of similar size and ecological values, then, biodiversity loss can be partially offset and this process is known as **ecological offsetting**.

According to the United Nations Environment Program, the **green economy** “results in ‘improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities’ (UNEP 2010). In its simplest expression, a green economy is low-carbon, resource efficient, and socially inclusive. In a green economy, growth, income and employment are driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services” (UNEP 2011).



The **circular economy** intends to keep the value of materials, products and resources for as long as possible inside the economy by recycling and transforming waste into new products or raw materials. Improved industrial processes and product design will favour more interaction between economic agents to create conditions where one business’s waste is another’s raw material or energy source, therefore contributing to waste reduction, resource efficiency and a low carbon, sustainable and competitive economy. Finally, the circular economy attempts to internalize the negative externalities. (European Commission 2015a)

1.4 GLOBAL PRESSURE: WE ONLY HAVE ONE PLANET

In this important chapter we bring to discussion societal key drivers for global negative impacts on climate, natural resources, ecosystems services and biodiversity. Examples and data will be used to demonstrate the consequences from: human population increase, consumption patterns, use of raw materials, waste, the plastic age, globalization and global inequality, population living in urban areas and other topics.

1.4.1 One exciting journey

Never before, in all human history, has planet Earth witnessed the amount of human expansion at a global scale like in the last few centuries. Technological innovation has been increasing at a rapid pace and has never been so intense since the Industrial Revolution in the mid XVIII century. In fact, it is truly astonishing if we consider all

technical achievements and scientific discoveries over the last two centuries. It can even be overwhelming! Try for a moment to take a step back and consider all human history and surely you will feel at least amazed by humanity's "very recent" but unprecedented development! Have a glimpse of some achievements and the timeframe:

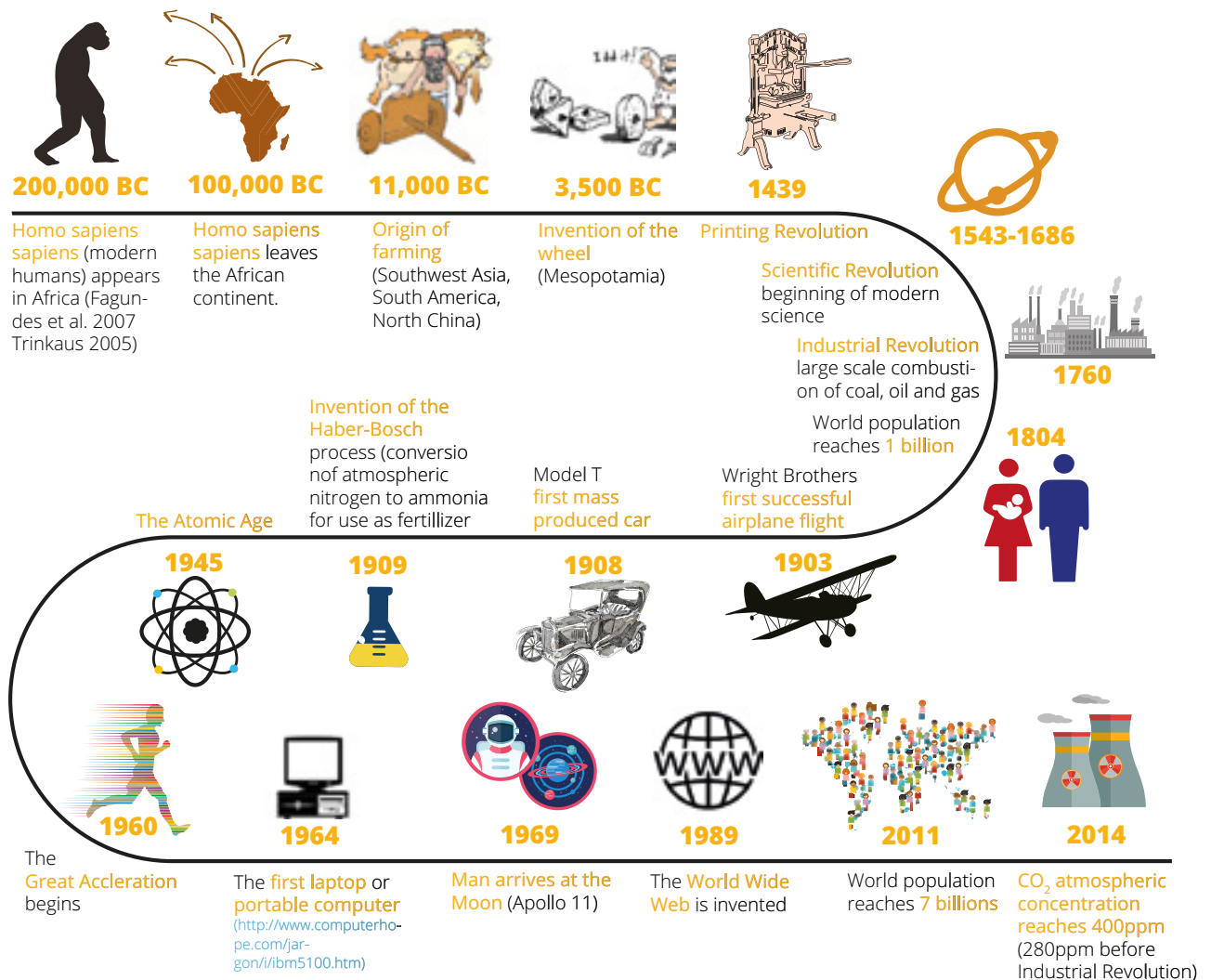


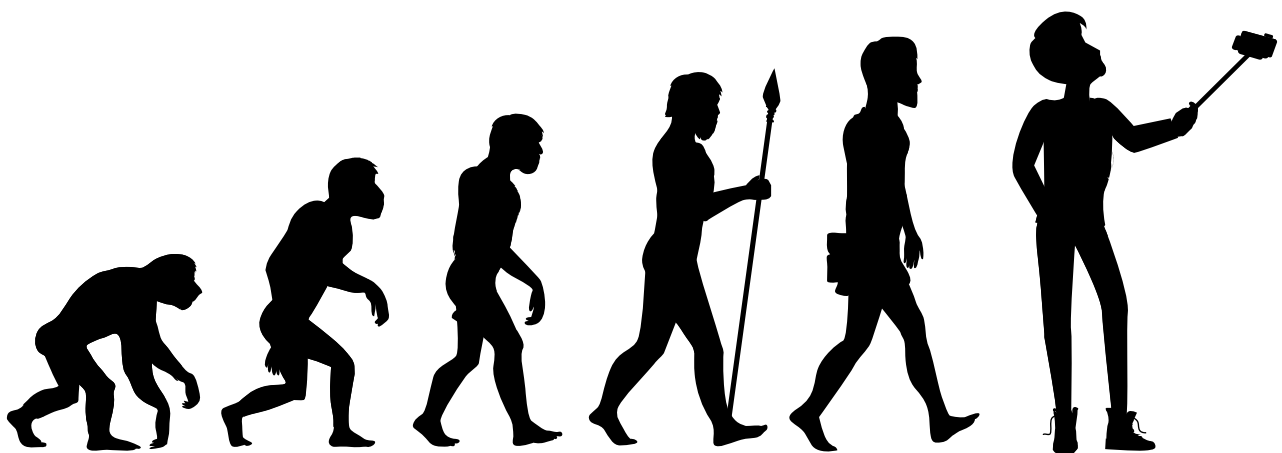
Figure 4: Human development. Adapted from <http://anthropocene.info/>

At this point we have no doubt that our species has been very successful in the last 250 years. In recent decades, driven by technical-scientific discoveries, humans have rapidly created new technologies and ma-

terials but also evolved in almost all fields of science and medicine. These discoveries have had a profound influence and shaped our way of life in almost all possible ways you can think of.

TO THINK ABOUT....

Can you imagine a world without cars, the Internet, modern telecommunications, plastic or other innovations?



1.4.2 By the billions!

Surely you noticed that planet Earth is not getting any bigger, but human population is, and fast! Earth's resources are abundant, yes, but not unlimited. Is it a good idea to act as if the Earth had infinite capability to provide resources and endless capacity to absorb pollutants without causing long term and irreversible damage? The planet's resources should be shared among humanity, fair and equitably. Aside an anthropocentric view, ultimately, we share the planet with other species, probably more than 10 million, and these species also need habitat, resources and have the intrinsic right to exist and live in a healthy unpolluted planet with a stable climate.

Human population has been increasing immensely. In the XX century population grew from 1.6 to 6 billion (United Nations 1999). In just 37 years, from 1950 to 1987, the population doubled (United Nations 2015a). In July 2015, there were more than 7,349,472,000 peo-

ple alive in the world and today's projections estimate that by 2050 there may be as much as 9.7 billion and even 11.2 billion in 2100! In just one year, by the end 2016, 83 million people will be added to the world's population (United Nations 2015b). Most of the population growth will occur in development countries, especially in the Asian and African continent. Naturally, as world population increases, so does the pressure on the planet because more of everything is necessary: energy, water, food, products, infrastructures, all kinds services, etc. Likewise, more pollution and waste will result from these activities. Therefore, it is crucial to find sustainable alternatives to assure global access to basic rights such as safe drinking water and food, medicine, education, fair and safe work conditions, just to name a few, without over exploiting natural resources, damaging biodiversity, polluting or creating social inequalities.

TO THINK ABOUT....

Population (Billion)	Year	Years to increase 1 billion
1	1804	200,000*
2	1927	123
3	1960	33
4	1974	14
5	1987	13
6	1999	12
7	2011	12

Table 2: Population growth: years to increase population by 1 billion (adapted) (Worldometers.info 2016)

* Based on estimations of the appearance of *Homo sapiens sapiens*. Human lineage is much older.



1.4.3 An urbanized planet

Not only are humans increasing demographically but are also changing where they live. Since 2007, for the first time in the history of civilization, there are more people living in urban than in rural areas (UNFPA 2007). 70% of Europe's population lives in towns or cities (UNFPA 2007). In 1950, 30% lived in cities, in 2015 54%, and by the year 2050, estimates indicate that 66% of the population will be living in cities. Furthermore, the number of megacities – cities with more than 10 million people – is increasing: in 1990 there were only 10 megacities, 28 in 2014, and it's estimated that in 2030 there will be 41 megacities. Experts predict that in the next decades, worldwide, rural population will continue to decrease as urban population continues to increase, particularly in Africa and Asia (United Nations 2014).



TO THINK ABOUT....

Have you thought before that humans are becoming more urban than rural? What is your view about this? Do you think that being in contact with nature is important for the development of values and environmental awareness?

1.4.4 Modern intensive agriculture

What triggered the fast increase in human population in the last two centuries? Most certainly, modern medicine and higher standards of living had a key role. In fact, nowadays, more humans reach reproductive age, due to decreases in child, infant and maternity mortality and furthermore, humans now tend to live longer than before. Humanity is also capable of producing more food than before. The Green Revolution in the 1950's gave birth to new ways of producing food with intensive agriculture, new crops and farming methods and, for the first time, synthetic agrochemicals like fertilizers, pesticides and herbicides were extensively used in food production. The use of fertilizers alone accounts for 50% of yield increase in crops (Nellemann et al. 2009). Millions of tons of synthetic chemicals reached the soil, freshwater and air. With some substances we learned by the hard way just how harmful these chemicals can be.



DDT was used worldwide as an effective pesticide to control diseases such as malaria or typhus, spread by insects. Later, scientific studies proved DDT to be very persistent in the environment, capable of accumulating in food webs and impacting negatively on bird populations, causing many countries to ban its use. DDT can be detected everywhere in the world from remote Arctic ecosystems, to food and even in human breast milk. Long term health effects in humans are associated with chronic diseases. With this example, science and society became more aware about the potential danger for both humans and the environment of widespread use of pesticides (Stockholm Convention 2008).

This is also a brilliant example of human collective action: where DDT was removed from the open market, the negative effects of it were drastically reduced, for instance, the return of the Peregrine Falcon which became an endangered species as a result of egg shell thinning because of DDT. This dramatic example demonstrates that when we work together as a global community we can drive real change.

New farming methods and most importantly, food production, are now directly dependent on petroleum; as an energy source for all productive agricultural processes (fuel for machinery, transportation, etc.) but also as a source of petrochemicals to synthesize agrochemicals. As the agroindustry rapidly expanded motivated by higher yields and profits, modern agriculture became synonymous with large monoculture areas with extensive use of agrochemicals, mechanization and industrialization, all heavily dependent on fossil fuels. Consequently, significant land use changes occurred around the world. Natural and semi-natural areas with important ecosystems and habitats were sacrificed to satisfy the increasing demand for more land for crops and animal production. According to Walls (2006) "almost one third of the world's land area is used for food production, making agriculture the largest single cause of habitat conversion"

Therefore, ecosystems and biodiversity are largely affected by food production methods. As food production expanded and intensified, forest were cut, wetlands were drained, rivers diverted, aquifers over-exploited and biodiversity, bit by bit, was weakened, fragmented and lost. Soil, water and air became contaminated with effluents, gases and the final destination for much of the chemical products used in modern intensive agriculture. According to Lead et al. (2005) "between 20% and 50% of 9 of the 14 biomes have been transformed to croplands". Studies suggest that the EU's objective to halt biodiversity loss caused by agricultural intensification could be achieved with more environmental friendly production scenarios by using techniques such as organic farming (Reidsma et al. 2006).



TO THINK ABOUT....

What kind of agricultural practices are more common in the region you live? When you buy food, do you consider that you're supporting with your purchase a certain production method?

1.4.5 Biodiversity loss

Planet Earth has incredible biodiversity: millions of species and a great variety of ecosystems and habitats that have intrinsic value and should be protected. Also, biodiversity is fundamental to provide vital services and products to both human life and economic development. The air we breathe, the food we eat, the medicine we use or a stable climate, are all dependent on biodiversity and the well-being of ecosystems and natural processes. Unfortunately, biodiversity is facing many threats, most of which are related to human activities. Species are being lost at such high rates that scientists now claim there is evidence to support that biodiversity is currently facing its 6th

mass extinction in Earth's 4.5 billion years history. The average rate of vertebrate species loss over the last century is up to 1,000 times higher than the background rate (Ceballos et al. 2015). The Living Planet Index (LPI) assesses the trend in vertebrate species, providing an important insight about global biodiversity status. It uses more than 10,000 representative populations of mammals, birds, reptiles, amphibians and fish around the world. The latest data show that LPI declined by 52% between 1970 and 2014 (WWF 2014). Currently, biodiversity loss is one of the main environmental problems.



The main causes for the loss of species are:

Climate Change.

Modifications in surface temperature, ocean temperature, rainfall distribution or weather patterns, affect ecosystems, habitats and species distribution, threatening the survival of species that can't adapt or migrate fast enough.

Habitat change, loss, and degradation affects 86% of all threatened birds and mammals assessed and 88% of the threatened amphibians (IUCN 2010).

Invasive alien species impacts negatively on ecosystems and the survival of native species.

Overexploitation of natural resources: overhunting, overfishing and over-harvesting. Many populations cannot regenerate at the present rate of extraction causing population decline, extinction, dangerous negative impacts on food-webs, food security and ecosystems services.

Pollution. Human action causes all kind of air, water and soil pollution and interference with nutrient cycles and natural processes. Persistent organic pollutants, pharmaceuticals, acid deposition, heavy metals, herbicides, pesticides or plastic are just a few examples of pollutant substances that contribute to biodiversity loss.

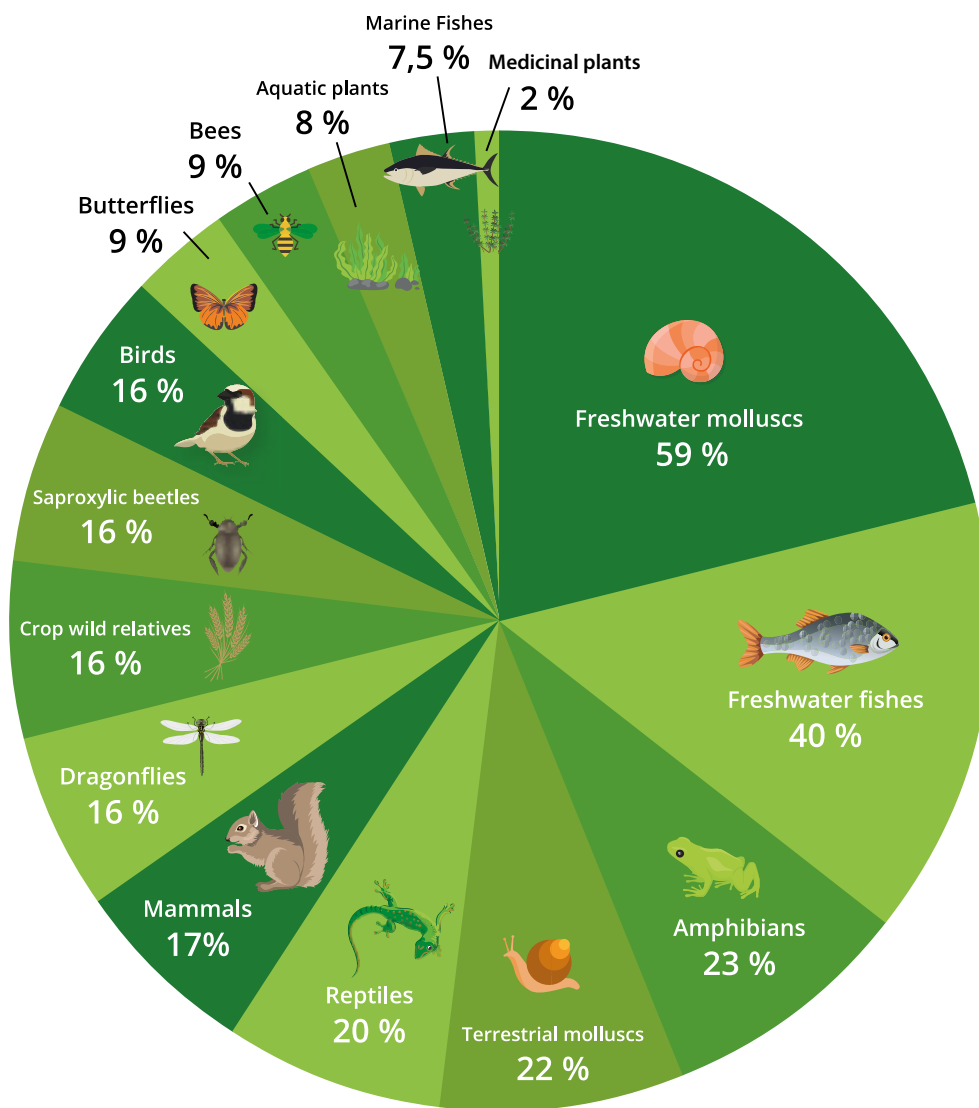


Figure 5: Overview of European species threatened (IUCN 2011)

According to the International Union for Conservation of Nature (IUCN), at least 1,677 of European species assessed to date are threatened with extinction, 4 species are no longer found in the wild, and 36 have gone extinct in Europe (IUCN 2011). Future and ongoing research is crucial to determine the extinction risk for more than 2,250 species still not evaluated.

TO THINK ABOUT....

"Agriculture is thought to cause around 70% of the projected loss of terrestrial biodiversity. In particular, the expansion of cropland into grasslands, savannah's and forests contributes to this loss" (TEEB 2015).

1.4.6 The Great Acceleration

After the 1950's the world witnessed abrupt increases in a vast number of social, economic and environmental indicators. This period became known as the Great Acceleration. The rhythm of changes observed in the second half of the XX century have been so rapid and

unprecedented that humanity has not been capable of being aware on how profound and dramatic these change are for life on Earth, the planet's equilibrium and, ultimately, the fate of humans. Now lets see how the Great Acceleration looks like.

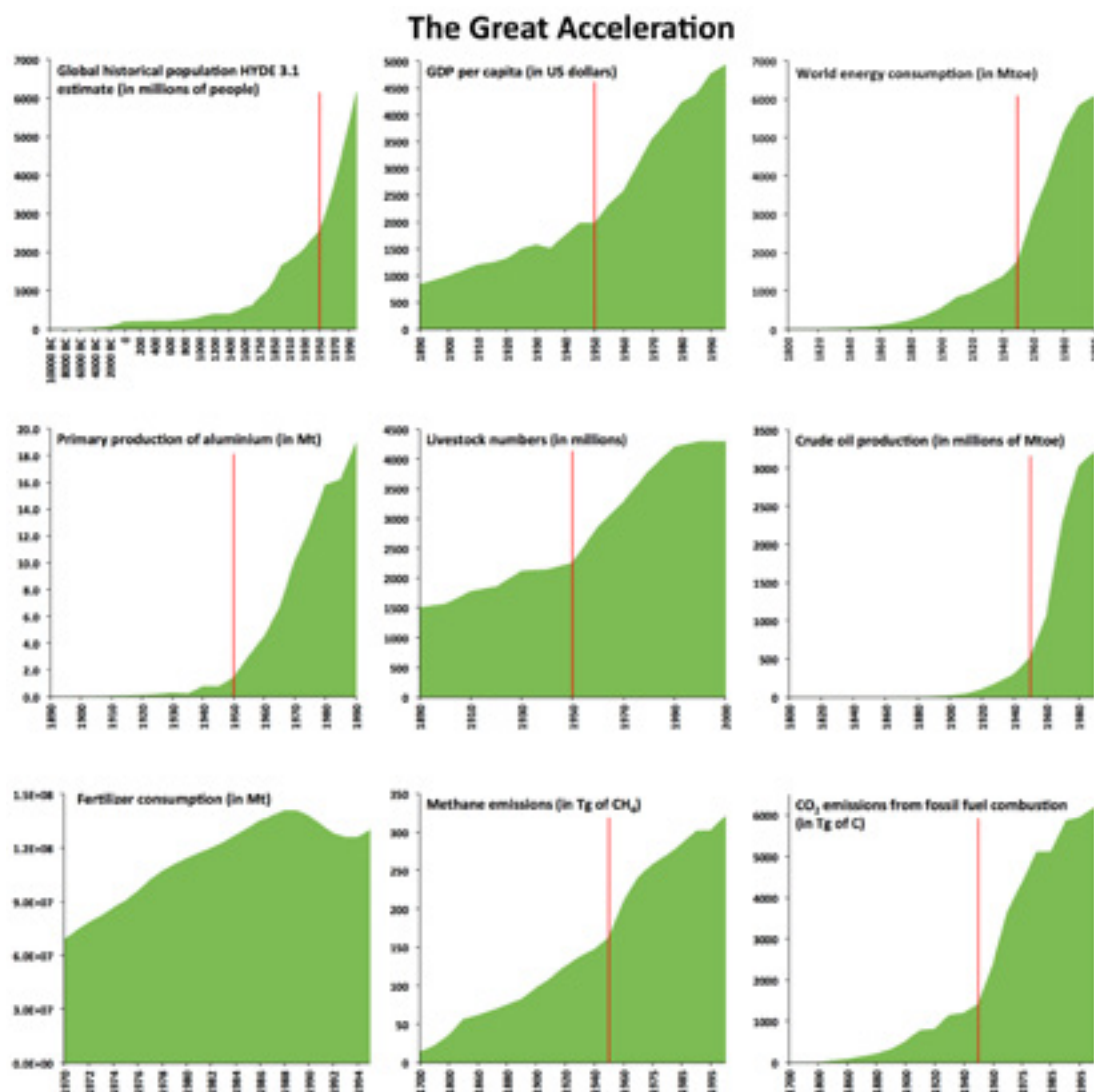


Figure 6: The numbers of the great acceleration of the 1950s. The increase in global numbers of: population and GDP per capita; total energy and fertilizers consumption; aluminium, oil and livestock production and methane and carbon dioxide emissions to the atmosphere. Graphs generated using data compiled by the History Database of the Global Environment (HYDE, Netherlands Environmental Assessment Agency, <http://themasites.pbl.nl/tridion/en/themasites/hyde/index.html>) from references cited there.

Since 1750, both Earth systems and socio-economic indicators have increased to unprecedented levels in human history. Consider the following:

Current human interference is so intense in some biogeochemical cycles that more nitrogen is converted from the atmosphere by fertilizer production and fossil fuel combustion than by all of the natural processes in terrestrial ecosystems put together.

Global terrestrial “domesticated” surface increased from 10% around 1800’s to 25–30% by 1950.

In 200 years, population increased more than six-fold, global economy 50-fold and energy use about 40-fold.

Motor vehicles increased from 40 million to 700 million between the end of Second World War to 1996.

Amphibians are the most threatened group of species known to date: around 1,895 of the planet’s 6,285 amphibians are in danger of extinction (IUCN 2010).

Nowadays, more than 60% of ecosystem services are degraded and the trend will continue unless significant changes in societal values and management practices.

(Steffen et al. 2007)

There is abundant and clear evidence suggesting that humanity now lives in a very different planet than 200 or even 50 years ago and that it is not possible, advisable or logical to continue business as usual without having a tremendous negative environmental impacts at a planetary scale with dangerous long term consequences. However, it seems that despite all warning signs, recent scientific evidence and good sense, humanity is following a development model that causes the depletion of natural resources, deterioration of the biosphere, widespread pollution, climate change and social and economic inequalities. In today's market-based approach it seems that incessant economic growth, mass consumption, global markets, international finance and banking, dominate the world's agenda above all else.

TO THINK ABOUT....

In your opinion, what are the challenges of continuing the current trajectory?
What would it take for a paradigm shift in social, political and economic terms?

These are certainly complex but key questions on which we should reflect.



© André Couto

1.4.7 A new epoch

The human species has become such a global dominant driving force that is now capable of changing profoundly planet Earth's natural geophysical and biological processes. Scientists believe we are no longer in the Holocene, an 11.000 year interglacial epoch characterized by climate stability that allowed the development of agriculture and unprecedented human development, but entered a new epoch in Earth's long history called the Anthropocene dominated by mankind's influence (Steffen et al. 2015). Multiple evidences are building up to suggest that humanity has reached a position where it has become a major influence on Earth's surface processes.

One view, argues that the Anthropocene might have begun thousands of years ago, when humans started to modify more dramatically the ecosystems by clearing forests for agriculture and pasture, releasing more CO_2 and CH_4 to the atmosphere. (Ruddiman 2013). Another view, suggests that the Anthropocene is more recent and there are two important dates that meet the criteria for the beginning of the Anthropocene in the Geological Time Scale: 1610 and 1964. The first, when the New and Old World merged resulting in rapid exchanges between species across continents and oceans, changing the distribution of life on Earth, leaving fossil records and most importantly, causing long term changes to Earth biosphere. In addition, the

death of an estimated 50 million indigenous people (only 6 million survived) caused by smallpox brought by Europeans, along with war, enslavement and famine, allowed massive forest regrowth of 50 million ha and consequently, a noticeable decrease in CO_2 atmospheric concentration capable of being detected in ice cores (Lewis & Maslin 2015). Regarding 1964, high quantities of radioactive isotopes were found in rock layers all over the globe around that year as a result of the fallout from nuclear detonations.

Despite this, there is still no formal decision if or when the Earth entered a new epoch, the Anthropocene Working Group geologists from the International Union of Geological Sciences are expected to make a formal decision about the Anthropocene in 2016 (Lewis & Maslin 2015).



TO THINK ABOUT....

In your opinion what could be humanity's main objectives for the Anthropocene?

1.4.8 The need for change

All over the world, especially since the 1960's (Steffen et al. 2007), the environmental movement (environmentalism) and environmental awareness have increased across society as a response to pressing environmental issues such as nuclear testing, the ozone layer, acid rain, wildlife conservation, etc. Environmental legislation has been created, green political parties have been born, national and international environmental organizations have been formed and scientific knowledge is in progress. Today, the Internet allows us access to vast amounts of information, new ways of communication and ideas spread at the speed of the click of a button! Also, today, there are a vast number of people, projects and different kinds of organizations dedicated to some aspect of sustainable development, nature conservation or any other environmental or human rights cause that call out for urgent change within society, development models and business practices, aiming for a more sustainable and fair planet. Nevertheless, the world has changed so abruptly that humanity is still struggling to understand the full extension of the consequences of this rapid unsustainable growth. Ultimately, the majority of the population still lives business as usual lifestyles, but this must change quickly and can only be achieved by an engaged, educated and empowered society.

The market-based economy is still primarily focused on achieving maximum profits in the short term, maximizing the advantages of today's global market, free trade, global finance, legislation gaps, and most importantly, not having to internalize the environmental externalities created by their activity. Furthermore, the economic differences around the globe are huge and profound: did you know that 1% of the richest population has more wealth than the rest of the world combined? Or that in 2015, just 62 individuals had the same wealth as half of the world's poorest population (3,600 million people) (Oxfam 2016)? All humankind has the right and legitimacy to improve their quality of life and well-being and it should be humanity's main priority to eradicate poverty and reduce global social and economic inequalities. The current dominant lifestyle of the western developed world is only (temporarily) possible due to profound and unfair global inequalities. What would happen to the Earth's resources, ecosystems and climate if everyone in the world had the same consumption patterns of an average European or North American? The answer: the Earth would not be enough.



Lastly, governments and international institutions, despite some improvements in areas such as environmental legislation and policy (e.g. EU environmental directives, Natura 2000 Network, etc.), still lack the strength to make decisions that affect the root causes of unsustainability, including some of the most fundamental premisses of today's modern society. In short, the challenge ahead is enormous, complex and implies profound changes in personal behaviour and in society. However, the changes required to shift society onto a sustainable path are neither a utopia nor impossible to accomplish. As showed before, humanity has excelled itself multiple times in history by accomplishing outstanding technical and scientific achievements in very short periods of time. Huma-

nity's capacity of solving problems should not be underestimated. Perhaps what is needed, foremost, is a new global consciousness to guide and inspire humanity through the current unsustainable path into a less *anthropocentric* and more respectful of Earth's safe operating boundaries.

The choice is everyone's to make: perpetuate a system and lifestyle that supports business as usual with never ending pollution, environmental damage, mass extinction of species, human exploitation and inequality or, choose to bring society together and concentrate all efforts, knowledge and human will to change paradigms that, if continued, sooner or later will bring humanity and the planet to a dangerous outcome.

THERE'S A LOT TO THINK ABOUT....RIGHT?

Organize a round-table discussion and use the issues presented so far to debate. In the next chapter we focus our attention on more specific environmental aspects that affect our individual ecological footprint.



1.5 LOCAL PRESSURES: FROM MINUS TO PLUS

In this section we will discuss more carefully our role as individuals and how everyday choices have an effect on planet Earth and the ecological footprint. We will also debate our individual role and responsibility across different scales from individual, organizational, municipal, regional, national to global.

To be successful in raising environmental awareness, educating and imprinting positive (+) changes in the lifestyles of individuals, families, communities, countries and ultimately the world, it is vital to have a global vision and understanding about key environmental issues. We started our journey by having a glimpse about global trends and at this point it should be clear that humanity is capable of causing profound long-term changes to Earth and if we continue to intensify consumption patterns, extract and use natural resources in an unsustainable way, then, biodiversity, ecosystem services and global climate will continue to be further damaged with disastrous consequence for human life and the planet.

**“Human activity has clearly altered the land surface,
oceans and atmosphere, and re-ordered life on Earth”**

(Lewis & Maslin 2015)

TAKE A STEP FORWARD

Now that we have raised our environmental awareness and have had the opportunity to reflect on some pressing environmental issues and facts, perhaps you came to the conclusion, or reinforced your view, that humanity's current trajectory is irresponsible and desperately needs to change. But how to contribute to the change? You are just one person! Feeling like a drop in the ocean? Changing the world how? What can you do? Possibly you are feeling overwhelmed by the overall complexity, perhaps even paralysed.

So now it is time to prevent inaction and to take a crucial and very important step forward: change your point of view from the global and overwhelming to the personal and practical, and realize that, actually, there is a lot you can do! You can choose better by keeping in mind during your daily life that every decision you make influences, directly or indirectly, positively or negatively the ecological, carbon and water footprints and consequently, biodiversity, climate change and ultimately the entire planet! The world's (un)sustainable trajectory is shaped by billions of small individual everyday choices. During the following sections we will focus on how the environment is affected by individual actions and explore ways to reduce negative impacts and even go further to positively impact our planet!

Take that step forward now! Make sustainable choices, start your **IMPRINT+** attitude today and inspire others!



1.5.1 Energy and greenhouse gases



Energy consumption has been rising in the European Union (European Commission 2015) and we use it everywhere: in houses and offices to power household appliances, lighting, computers, tablets, mobile phones or any other electronic device; and in industry and services to provide the products and services we use. Energy plays a central role in the ecological and carbon footprints, mainly because of its origin that can be from renewable sources such as solar, wind, hydroelectric, geothermal, biomass or wave energy, or from non-renewable sources such as oil, natural gas,

coal or nuclear. Each production method causes different environmental impacts. Although nuclear energy does not emit significant GHG during operation, nuclear waste disposal and safety are still important issues. In the following table some potential negative environmental impacts on biodiversity associated to different energy production methods are listed. Worldwide, fossil fuels still dominate energy production although renewable energy is increasing (European Commission 2015).

ENERGY SOURCE

POTENTIAL NEGATIVE ENVIRONMENTAL IMPACTS ON BIODIVERSITY



Low impact: habitat loss, fragmentation and land use change in large solar central over big extensions of land



Habitat fragmentation and destruction – road access construction/operation
Bird and bat collisions – operation
Moderate impacts on fauna and flora



Important land use change
Habitat loss and fragmentation over large areas
Changes in hydrology and micro-climate
Serious impacts on flora and fauna.



Air, water and soil pollution – extraction/mining/production
Impacts on flora and fauna – extraction/mining
Greenhouse gases emissions – production
Land use changes – extraction/mining
Fragmentation and habitat destruction – extraction/mining
Risk of environmental contamination – spills and leaks during transport and operation

Although renewable energy is not free from environmental impacts, generally they are responsible for less negative impacts on the environment and biodiversity than non-renewable sources, with the exception of large hydroelectric dams. GHG emissions in renewable energy is also much lower. Regarding energy, it is important to consider not only how much energy is being consumed by an individual, household, school, region or country but also how the energy is generated. Consider turning on a light at home: the electricity being consumed, is it from renewable or non-renewable sources? Probably a bit of both. This is called the energy mix and it varies yearly and it is different from country to country. Natural resources availability and choices made in energy, environmental and economic policy determine investments in energy production infrastructures, consequently influencing the energy mix. Climate change and weather conditions can

also influence the energy mix. For example, without wind there is no wind power or during droughts less electricity is produced from hydroelectric dams. Consequently, more electricity has to be generated from alternative sources including non-renewable.

Which sectors use more energy and how can energy consumption be reduced? Table 3 provides an overview about where energy is consumed in Italy, Spain, Portugal and in the EU 28. In Italy, for example, households are responsible for 26.1% of final energy consumption, while in Spain corresponds to 18.6% and in Portugal to 16.3%. This is the energy used by every family at home, so your everyday choices can make a difference! European societies also use large amounts of energy in transportation (25.9%) and industry (33.2%).





				
Sector	Italy	Spain	Portugal	EU 28
Industry	23,1 %	25,3 %	27,9 %	33,2 %
Transport	35,4 %	40,4 %	40,9 %	25,9 %
Households	26,1 %	18,6 %	18,3 %	48,8 %
Services	12,9 %	11,2 %	12,1 %	13,3 %
Agriculture & Fishing	2,4 %	3,5 %	2,7 %	2,3 %
Other	0,1 %	1,1 %	0,2 %	0,5 %

Table 3: Final energy consumption by sector in 2014 (European Commission 2015b)

It is possible to improve the ecological and carbon footprint performance and minimize impacts on the environment by reducing the global amount of ener-

gy consumption and by preferentially using renewable energy that has much lower GHG emissions and fewer environmental negative impacts.

Energy and GHG: What can you do to improve your footprint?

1. Use less energy globally everywhere: home, work, school, travelling, etc.



2. Use energy preferentially from renewable sources! Is there an exclusive renewable energy supplier in your country?



3. Produce your own energy!
Learn which renewable is more appropriate in your case.



4. Reduce as much as possible the use of car!



5. Make energy efficiency a key requirement when considering an electronic device or even a house!



6. Make conscious choices – keep in mind which option has lower carbon footprint.

7. Use online carbon calculators to estimate the amount of CO₂ emissions and compensate!

8. Reuse and buy second-hand! Avoid emissions from the production and distribution of new products.



9. Don't miss a chance to plant native trees, plant as much as possible!



10. Use the [IMPRINT+ App](#) to take offsetting action and leave a positive impact on the environment!



1.5.2 Transport



In 2014, the transport sector was responsible for 35.4%, 40.4% and 40.9% of the final energy consumed in Italy, Spain and Portugal, respectively (Table 3) (European Commission 2015). The majority of today's transports (motorcycle, car, bus, train, ship, airplane) emit CO₂ and other GHG's either because they burn fossil fuels or use electricity generated by non-renewable energy sources. Besides, during the combustion of fossil fuels, pollutants are released to atmosphere, soil and water with negative consequences to human health, biodiversity and climate. The Europe-

an Environmental Agency estimates that poor air quality was responsible for more than 400,000 deaths in the EU-28 in 2012, making air pollution the largest environmental health risk in Europe (Brink et al. 2015). If electricity is generated from renewable sources, then GHG, pollution and environmental impacts will be much lower. Generally, terrestrial public transport such as buses, trams, subway, trains and others, have lower CO₂ emissions per passenger than individual transport.

	Spain		Italy		Portugal		EU 28	
	Mt	%	Mt	%	Mt	%	Mt	%
Domestic aviation	2,7	3,3 %	2,0	1,9 %	0,3	2,2 %	15,7	1,8 %
Road transportation	74,7	94,0 %	96,6	93,4 %	14,8	96,0%	838,9	94,5 %
Railways	0,2	0,3 %	0,1	0,1 %	0,0	0,2 %	6,9	0,8 %
Domestic navigation	1,6	2,0 %	4,2	4,0 %	0,2	1,6 %	16,2	1,8 %
Other transportation	0,3	0,4 %	0,7	0,6 %	0,0	0,0 %	9,7	1,1 %
TOTAL	79,4	100,0 %	103,4	100,0 %	15,5	100,0 %	887,5	100,0%

Table 4: 2013 Transport GHG's Emissions (without LULUCF, with indirect CO₂) (European Commission 2015b)

Road transportation is responsible by the vast majority of GHG emissions within the domestic transport sector reaching 96% in Portugal's case in 2013! International maritime transport and international and national aviation are also major sources of GHG's

(Table 4). From this data, it becomes very clear that simple everyday actions such as leaving the car at home and starting to use the bicycle is an excellent way to reduce the ecological and carbon footprints as well the air pollution in cities! And it's all up to you!

Transport: what can you do to improve your footprint?

1. Don't use transport systems in the first place: walk! It's healthy, free and zero pollution guaranteed!



2. Use the bicycle for short distances. Usually inside cities the distances travelled are small enough to bike. You'll exercise and discover that for many itineraries it is much faster. Zero carbon and zero air pollution!



3. Use public transportation systems; bus, metro, tram, train or any other. Make the most of your travelling time: read a book or work while you travel from home to school or work. And there is no need to park, of course!



4. If you don't have access to good collective transport systems, use carpooling with your friends or colleges from work. You'll save time and money.

5. If you really must use a car, use it as a last alternative and avoid travelling alone and use carpooling. There are many websites where you post your travel itinerary and find travellers with the same route and share the economical and environmental cost of the trip.



6. If you're buying a car, make fuel efficiency and environmental performance a decisive feature to consider in the decision. According to EU regulation by 2015, new cars should not emit more than 130 grams of CO₂ per kilometre (g CO₂/km) and fuel consumption should be around 5.6 l/100 km of petrol or 4.9 l/100 km of diesel. The target set for 2021 is 95 g CO₂/km and fuel consumption of around 4.1 l/100 km of petrol or 3.6 l/100 km of diesel (European Commission 2015c).



7. Electric cars have the advantage of not emitting air pollution during operation and if the electricity is generated from renewable sources then the advantages are maximized.

8. For medium travel distances, prefer ground transportation like fast trains for example instead of flying.



9. Consider using video-conferencing as a viable alternative for work meetings.

10. Regarding holiday destinations, avoid taking short domestic flights but also long intercontinental flights.

11. For every trip you take, use online carbon calculators to estimate the amount of CO₂ emissions.



12. Plant as much native trees as possible!

13. Use the **IMPRINT+ App** to take offsetting actions and leave a positive impact on the environment!



1.5.3 Food



As seen previously on this report there is a growing population and demand for resources. Since 1970, food availability has increased from 2,370 to 2,770 kcal/person/day. However, despite existing enough food in the world for everyone to be properly feed, there is great inequality that causes overconsumption and obesity in some parts of the world, while in others, hunger and malnutrition. Keep in mind that 500 million people consume less than 2,000 kcal/day, around 2.3 billion in developing countries consume under 2,500 kcal/day, while in developed countries, 1.9 billion people are consuming more than 3,000 kcal each day. Due to serious flaws in the system, food waste reaches unimaginable proportions: one-third of the world food production for human consumpti-

on (1.3 billion tonnes) is lost or wasted every year. If food waste was a country, it would be the third largest emitter in terms of GHG (3.3 billion tonnes) (TEEB 2015).

Much of today's food security issues and environmental challenges are a result of changes that occurred in food production methods. Food needs to be produced, processed, stored and transported, devouring large amounts of resources such as land, energy, water and packaging materials that create waste. During each of these steps, different kinds of pollutants are released to the atmosphere, water and land. Food production is intrinsically linked with energy, GHG, water, land use, pollution and biodiversity.

- Global food demand is predicted to increase by 50% by 2030 and 70% by 2050 (FAO 2000)
- Biological diversity is fundamental for agriculture. According to Walls (2006) "about 7,000 plant species have been cultivated and collected for food by humans since agriculture began about 12,000 years ago. However, today, only about 15 plant species and 8 animal species supply 90% of the global demand for food".
- 52% of land used for agriculture worldwide is moderately or severely affected by land degradation and desertification (TEEB 2015)

How can you reduce your ecological footprint? By introducing small changes in your daily habits there is a lot to do when it comes to reducing negative environmental impacts on the planet because of food! Food demand, eating habits and diet type are some of the most powerful drivers of land use change, capable of literally altering the surface of the Earth! What we eat and how much have tremendous impacts on the planet and simple individual everyday consumer choices are at everybody's reach. For instance: by choosing what kind of food is bought (e.g. heavily packaged processed food or in bulk and more natural); its origin (e.g. locally produced or imported); or which production methods is being supported (e.g. intensive or extensive), will determine very different environmental impacts. Did you know that half of the world's cereal production is used in animal feed? FAO estimates that meat consumption will increase from 37.4 kg/person/year in 2000 to over 52 kg/person/year by 2050, thus

affecting cereal production and use. Several scientific studies suggest that diets with less meat and dairy intake such as low meat, vegetarian or vegan, have considerable less environmental impacts; or, that extensive and organic production methods are more sustainable and fundamental for the reduction of global environmental footprint (Westhoek et al. 2014; Scarborough et al. 2014; Ercin et al. 2012). The ecological, water and carbon footprints are very different across distinct diets (Vanham et al. 2013). Usually, the production of animal-based foods has higher GHG emissions than plant-based foods. Although it is not expected that the entire world becomes vegetarian or vegan for environmental reasons, there is little doubt that a decrease in animal and dairy intake in significant percentage of the population, would certainly contribute to reduce GHG emissions and relieve pressure on many species and habitats.

Regarding GHG:

- In 2012, agriculture was responsible for more than 10% of total GHG emissions in the EU (Euractiv 2016).
- Each European consumes an average of 86kg of meat each year (Euractiv 2016).
- A vegetarian diet would save 1,230kg CO₂e per person per year in comparison with high meat diet (Cassidy et al. 2013).
- A high meat diet (2,000kcal) produces 2.5 times as many GHG emissions as a vegan diet, and twice as many as a vegetarian diet (Cassidy et al. 2013).
- A high meat to a low meat diet would save 920kg CO₂e/ per person annually (equivalent to a return flight from London to New York) (Cassidy et al. 2013).

Regarding water, according to Mekonnen & Hoekstra (2012): “animal production and consumption play an important role in depleting and polluting the world’s scarce freshwater resources, information on the water footprint of animal products will help us understand how we can sustainably use the scarce freshwater resources”. Food production (crops and animals) is the single biggest water consuming activity, responsible for the use of large amounts of water. It is estimated that globally, 70% of all freshwater is used for irrigation, 22% for industry and 8% for domestic use

(IFAD 2016). Therefore, when considering ways to reduce water consumption, the food water footprint has to be taken into consideration. Actions such as showering quickly or turning the tap off when brushing the teeth, although they are significant, it is important to engage directly on the 70% regarding food production. Studies show that animal products have larger water footprints than crop products with equivalent nutritional value (Mekonnen & Hoekstra 2012).



For example:

- In average, a calorie of beef has 20 times larger water footprint than for cereals and starchy roots (Mekonnen & Hoekstra 2012).
- The water footprint per gram of protein from milk, eggs and chicken meat is 1.5 times larger than from pulses (Mekonnen & Hoekstra 2012).
- “More than half the world’s crop calories (55%) are consumed by people, 36% is used in animal feed and 9% in biofuels and industry” (Cassidy et al. 2013).



It is not only terrestrial biodiversity and ecosystems that are affected by food production. Marine pollution combined with global warming, overfishing, illegal, and harmful fishing techniques are disrupting marine, coastal and coral reefs habitats, food webs and global fish stocks, threatening food supply and the

source of income of millions of people. However, it is recognized that the exploitation by fishing activities is the greatest threat to marine species globally (Nieto et al. 2015).

Here are some facts:

- Each person eats on average 19.2kg of fish per year, around twice as much as 50 years ago (FAO 2014).
- Worldwide 52% of fish stocks are fully exploited, 20% are moderately exploited, 17% are overexploited, 7% are depleted, 1% is recovering from depletion (FAO 2014)
- Eutrophication has contributed to the creation of over 400 oceanic dead zones worldwide, in total around 245,000 km², mostly in Europe, eastern and southern US, and Southeast Asia (TEEB 2015)
- Bycatch each year causes the death of more than 1,000,000 sharks, 300,000 small whales and dolphins and many other species.
- According to the European Red List of Threatened Species, 7.5% of all European marine fish species are threatened with extinction in European waters and 40.4% of European sharks, rays and chimaeras face an elevated risk of extinction (Nieto et al. 2015).

Food: what can you do to improve your footprint?

1. Eat less meat, fish and dairy products. Never eat an endangered species of animals or plants.



2. Incorporate several vegetarian meals each week. Considered vegetarianism? What about meat free Mondays to start?



3. Eat locally produced food and avoid buying food that travelled great distances to arrive to your kitchen.



4. Eat seasonal fruit and vegetables.



5. Look for ecolabels and choose organic, sustainably produced food and fair trade certified.



6. Buy at farmers markets or community supported agriculture (CSA). Always choose products from extensive agriculture.



7. Avoid wasting food.



9. Avoid products containing palm oil. Palm oil cultivations are responsible for deforestation, habitat and biodiversity loss (orangutan and the Sumatran tiger for example) as well for negative impacts in local communities.

8. Avoid processed food and don't eat fast food! Not a healthy choice for you or the planet!



10. Make an organic vegetable garden! Learn how at [IMPRINT+ website!](https://www.imprintplus.org/)



1.5.4 Consumption and waste



The invention of mass production, globalization and plastic, changed our lives completely and the way we produce, consume and deal with waste. In today's modern societies, consumers are constantly buying new products that have their own intrinsic ecological, carbon and water footprints. In turn, this behaviour affects our very own personal ecological footprint. Being conscious, in everyday choices, that the amount

and type of products we consume affects directly our impact on the environment is crucial for the reduction of our ecological footprint. The full extension of the environmental dimension of products becomes more evident when the entire life cycle is considered, from the sourcing of raw materials to manufacturing, transport, use and waste.

It is no surprise that the use of natural resources to satisfy the human demand has been increasing in the last decades:

- Humans extract and use for the production of goods and services about 50% more (60 billion tonnes annually the amount of natural resources (biomass, minerals, metals, fossil fuels) than only 30 years ago.
- Each person on the planet uses on average over 8 tonnes of natural resources per year or 22 kg per day.
- In Europe, in 2000, the average extraction of resources per capita was around 13 tonnes per year or 36 kg per day.

(Giljum et al. 2009)

The current economic system is greatly responsible for many of the environmental problems and social inequalities and poses a real challenge for the implementation of many solutions. Specifically the solutions that require a real change in the way the system works. The economic model has embedded many

incentives and mechanisms to keep consumption patterns high: i) the majority of products are intentionally made to have a short lifespans and durability; ii) new consumer "needs" are always being reinvented through marketing and advertising to keep the consumer demand high; iii) environmental costs are

intentionally not accounted in manufacturing costs and consequently, companies, despite high environmental or social impacts, are able to keep products profitable and affordable by deflecting *environmental externalities* to society. Worldwide there are huge gaps and inequality regarding consumption patterns and use of resources between regions: while in some there is abundance and overconsumption, in others, there is scarcity. According to the European Environmental Agency (EEA) “an average European citizen uses approximately four times more resources than one in Africa and three times more than one in Asia, but half of that of a citizen of the USA, Canada or Australia” (European Environment Agency 2012). Too often, due to disparities between countries in income, human rights, legislation or government policy, profits of companies are maximized based on unfair exploitation of human labour and unsustainable extraction of natural resources that causes environmental degradation. When it comes to the choice of buying a product it is very important to have an idea about the life cycle, where it is produced, which natural resources have to be extracted to manufacture it, etc. The problem is that most companies are not transparent enough about their products and do not disclose this information making it very difficult for consumers to make informed sustainable choices. However, nowadays there are environmental certifications such as ISO 14001 or EMAS for companies and ecolabels², such as the Forest Stewardship Council (FSC), Marine Stewardship Council (MSC) or Rainforest Alliance Certified for products, that can guide consumers in distinguishing companies that, in theory, are more committed to environmental protection and products with lower environmental impacts. Always keep in mind that companies profit from selling to consu-

mers. Every time you buy something you are also sending a signal of support to the company's policies (e.g. environmental, human rights, corporate social responsibility) or lack of them. For instance, if many consumers reject a product by not buying it for environmental reasons (e.g. causes massive rainforest deforestation and biodiversity loss), then, a strong signal is sent through sales performance to the company and hopefully influences for the better the company's policy and production methods.

Waste management is a big environmental issue and is closely related with consumption. One obvious consequence of consumption is the production of waste, thus, the most sustainable option possible when it comes to waste is to avoid its production in the first place! Notice that, overconsumption, even of environmentally certified products, is not a solution! If waste is not disposed correctly it becomes an environmental problem. By 2020, all EU countries should recycle 50% of municipal waste. In 2008, an average European citizen produced 444 kg of household waste and indirectly generated 5.2 tonnes (European Environment Agency 2012).



² You can see an extensive list at: <http://www.ecolabelindex.com>

Consumption: what can you do to improve your footprint?



1. Reduce, reduce and reduce!
Always avoid buying stuff that you don't really need! That extra pair of jeans? Or the latest smartphone?



2. Explore second-hand shops and flea markets: you'll find everything from clothes, furnitures to kitchen utensils, etc. Avoid new raw materials and GHG emissions from manufacturing and transporting.

3. Don't throw away useful things: give them to friends, charity, [freecycle](#) or sell them! Keep it within the circular economy.



4. Always avoid any over packaged product and buy in bulk when possible.

5. Choose products totally or partially made with recycled materials and reduce the consumption of new raw materials. Heard about ecodesign? More sustainable solutions exist, see some product examples [here](#).

6. Choose environmentally certified products like paper, wood, coffee, chocolate or tea. Look for environmental certification labels. Always choose local, organic and ethically produced.



7. Save paper: eliminate paper, use e-documents, reduce prints, print both sides, reuse paper, etc. Trees will appreciate it!



8. Use (buy or make your own) biodegradable and environmental cleaning products. Aquatic biodiversity will benefit and so will your wallet.

9. Avoid at all cost products that use palm oil (food and cosmetics).



10. Use your consumer choice power! Make sustainable choices!

Waste: what can you do to improve your footprint?

1. Reuse and recycle as much as possible at home, work and school. Help creating a circular economy!



2. Remember that plastic enters your home through your shopping decisions, so keep that in mind and always try to minimize the use of plastic at its source. Reduce, reduce, reduce!



3. Choose products in bulk as much as possible and avoid excessive packaging.

4. Always use your own reusable bag when shopping.



5. Avoid buying bottle water. Drink tap water and use a reusable water bottle!



6. Never use disposable products like cups, plastic cutlery,

7. Compost your organic waste and create good fertile soil from waste for your plants, for free!



8. Upcycle! What materials do you have? Search the Internet for ideas and inspiration, be creative or even an entrepreneur by creating an eco-business!

9. Dispose properly of Electrical and Electronic Equipment (EEE). These often contain hazardous substances for the environment



10. Get involve or organize local environmental actions to clean up waste from beaches, rivers or forests! Learn how at [IMPRINT+ website!](#)

1.5.5 Water

By 2025, two-thirds of the world population could be under stress conditions caused by water scarcity (IFAD 2016). Although sometimes the Earth is referred to as the “blue planet” because 70% of the the Earth’s surface is water, in fact, liquid freshwater available for human use is scarce: 97% of the world’s water is seawater (in the oceans), 2.5% is frozen, and only 0.5% is available as freshwater. Water is a finite natural resource and good clean drinking freshwater is becoming increasingly rare in many regions of the globe. It is also unevenly distributed: 60% of the world’s available freshwater supply is concentrated in 9 countries (World Business Council for Sustainable Development 2009). Climate change scenarios estimate that global rainfall is likely to change distribution patterns leaving some areas of the world more vulnerable to desertification, while others to flooding. Human activities are responsible for polluting freshwater sources, such as rivers, lakes and aquifers, that are absolutely essential to water supply systems, human health and biodiversity conservation. Nitrates, phosphorus and pesticides are common freshwater pollutants with agricultural origin, that cause many environmental problems and biodiversity loss. Clean and abundant freshwater is vital to humanity. For survival, humans need approximately a minimum of 2 litres of drinking water each day, less than 1m^3 per year. For drinking, cooking and cleaning we need 20-50 litres of safe freshwater a day, or $7.3\text{--}18.3\text{m}^3$ per year. The yearly average domestic consumption of a citizen of Mali is 4m^3 , 32m^3 in China, 77m^3 in Egypt, 106m^3 in France, and 215m^3 in the USA. Worldwide, 884 million people use an unimproved drinking water source (mostly in Africa and Asia), 1.8 million people die every year from diarrhoeal diseases (equivalent to

12 Boeing 747 crashes every day!) and more than 5,000 children die each day due to dirty water or poor hygiene (World Business Council for Sustainable Development 2009).

As seen in the previous chapter, our personal impact on the water resources is much more than just the water we consume at home and see on our water bill. Advances in water footprint science have clearly highlighted the differences regarding the water footprint of different products. In order to facilitate environmental conscious choices, consumers should have access to information about the product’s environmental performance, including the water footprint and its composition in terms of green, blue and grey components. Currently, consumers cannot easily make informed choices, mostly because companies do not disclose their products environmental information. The proportion between blue and green components would provide a hint about the origin of irrigation water. Products with high blue water components and sourced in areas of water scarcity and stress should be avoided. Likewise, products with high grey water component, which cause higher degrees of water pollution, should be avoided. As previously seen, eating habits and diet have a strong impact on the personal water footprint, hence, water can be saved by simply choosing less water intensive food and diets. Finally, take direct actions to reduce water consumption, either by changing behavioural patterns in the way water is used (e.g. quick showers) or by installing water saving devices or choosing water efficient appliances. How will you start to reduce your water footprint?

Water: what can you do to improve your footprint?



1. Calculate your water footprint [here](#) and take action to reduce it!

2. Consider the water footprint of all products and services, especially food products and choose products with lower water footprint. See a list of some examples [here](#)!



3. Reduce meat and dairy consumption. Animal food products have much higher water footprint than vegetables.



4. Save water when brushing teeth, dishes or showering! Turn off the tap when not using it!

5. Take short showers instead of a bath!



6. Reuse water. For example, save the initial cold water from the shower and reuse it to water house plants or to flush the toilet!



7. Collect rain water, it's free!



8. Inform your family and friend about the water footprint of products! Surprise them with an example or two!



9. Build a pond for wildlife and improve local biodiversity and learn more about this important habitat! Learn how at [IMPRINT+ website](#)!

1.5.6 Buildings



Nowadays most of us spend a large portion of our daily lives inside buildings, either at home, in school, or in office buildings. In this section, we think of buildings not only as the physical infrastructure and the technologies they have, for example, thermal insulation, solar panels or water saving technology, but also as the places where we live our lives, have daily routines and perhaps implement, regular sustainable practices. In fact, lifestyles and daily routines at home regarding energy, consumption, food, waste, nature conservation, or almost any other environmental topic, are a reflection of our very own environmental awareness and willingness to lower the personal and household ecological footprint. Our interaction with buildings, is key in the development of environmental

awareness and to imprint behaviours that favour sustainable practices throughout our lives.

It is best to start small. Remember the step forward we took from global and overwhelming to personal and practical? The same applies here: first change yourself and your household rather than changing your neighbourhood, city, country or the world! Even if you do not control every aspect of the household, either because you are renting, living with our parents, or for any other reason, and you cannot install that solar energy system that you want so badly, there are always things that you can do in buildings at an individual level. The important thing is to take action now!

Buildings: what can you do to improve your footprint?

1. Insulate your home: windows, doors, walls, roof, water tank, everything! Reduce your energy bill and avoid GHG emissions.



2. Install solar hot water, photovoltaic or wind energy. Produce your own energy!



3. When buying a new house consider energy performance and the best eco-friendly construction materials available. Heard about bioclimatic architecture, [passive house](#) or natural building concepts?



4. Use energy efficient lighting and electronic equipments. Check for energy efficiency label.



5. Turn off lights when not in use and avoid all types of stand-by modes in electronic devices.



6. Always use a full load of washing machine and dishwasher. Save energy, water and soap!



7. Lower the temperature of heating in winter and cooling in summer.



8. Take the most advantage possible of solar passive techniques to save energy!

9. If you have a refrigerator/freezer with more than 20 years old, consider switching to a newer energy efficient model.



10. Convert your backyard into a productive organic vegetable garden. Or use your balcony or make a vertical garden!



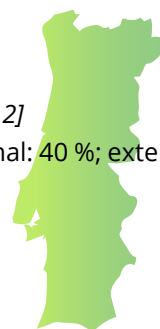
11. Help local biodiversity by building shelters for fauna or flowers for pollinators in your garden, rooftop or balcony! Learn how at [IMPRINT+ website!](#)

1.6 AND DID YOU KNOW THAT...

Some facts and figures about the differences between distinct areas of the world and project partners countries concerning some sustainability/environmental indicators.

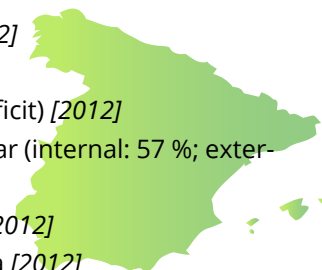
Portugal

Population: 10,604,000 [2012]
Ecological footprint per capita: 3.9 gha [2012]
Biocapacity per capita: 1.5 gha [2012]
Biocapacity – Ecological footprint = -2.4 (deficit) [2012]
Global water footprint: 26,000 million m³/year (internal: 40 %; external: 60 %) [2012]
Water footprint per capita: 6,900 litre/day [2012]
GHG per capita: 6.84 metric ton CO₂eq/capita [2012]
Recycling rate: 19%



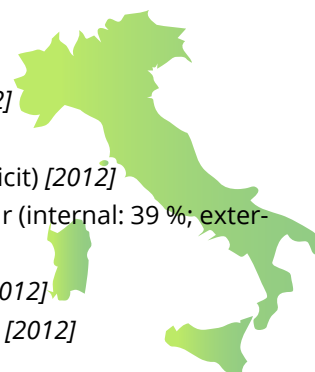
Spain

Population: 46,755,000 [2012]
Ecological footprint per capita: 3.7 gha [2012]
Biocapacity per capita: 1.3 gha [2012]
Biocapacity – Ecological footprint = -2.4 (deficit) [2012]
Total water footprint: 100,000 million m³/year (internal: 57 %; external: 43 %) [2012]
Water footprint per capita: 6,700 litre/day [2012]
GHG per capita: 7.45 metric ton CO₂eq/capita [2012]
Recycling rate: 33%



Italy

Population: 60,917,000 [2012]
Ecological footprint per capita: 4.6 gha [2012]
Biocapacity per capita: 1.1 gha [2012]
Biocapacity – Ecological footprint = -3.5 (deficit) [2012]
Total water footprint: 130,000 million m³/year (internal: 39 %; external: 61 %) [2012]
Water footprint per capita: 6,300 litre/day [2012]
GHG per capita: 7.93 metric ton CO₂eq/capita [2012]
Recycling rate: 36%



Source: JRC Joint Research Centre 2016; Mekonnen & Hoekstra 2011; Global Footprint Network 2016





IMPRINTING SUSTAINABILITY: From Theory to Practice

PART II – IMPRINT+ CASE STUDIES

Part II presents an overview of selected project case studies.

2.1 WEB-BASED TOOLS FOR SOCIAL ENGAGEMENT AND ENVIRONMENTAL EDUCATION & COMMUNICATION

First, in section 2.1, are presented projects that share similarities with IMPRINT+ concerning:

- 1) conceptual framework;
- 2) use of information technologies;
- 3) training techniques. The methodologies and overall results collected from the case studies will help to further improve **IMPRINT+** methodology and to maximize innovation opportunities.

Second, in section 2.2, demonstrative examples of green economy are presented.



PROJECT

School's Global Footprint (Scotland)

PARTNERS: 2nd edition: WWF, Sustainable Scotland Network, Eco-Schools Scotland, Improvement Service, Scottish Government and ScottishPower.

TARGET AUDIENCE: Schools: first, second and third levels.

GEOGRAPHICAL SCOPE: Scotland.

OBJECTIVES:

- Study the ecological footprint concept by engaging in cross-curricular and interdisciplinary work.
- Understand how individual actions affects the ecological footprint.
- Calculate the school's ecological footprint.
- Explore ways to reduce the school's ecological footprint.

TEACHING RESOURCES:

IT AND WEB-BASED TOOLS:

- Online footprint calculator for educators.
- Website.

COMMUNICATION AND TRAINING TECHNIQUES:

- Series of training videos for teachers.

OTHER:

- [Teacher's handbook](#) and [workbook](#).

OUTCOMES/RESULTS: Not available, although two video case studies are available at the project's website.

HIGHLIGHTS:

- Directed for teaching and integration in the schools curriculum and Eco-schools.
- Well structured teacher's manual and workbook.
- Series of training videos for teachers and videos of school case studies.
- Online ecological footprint calculator.

LINK: [School's Global Footprint](#)

PROJECT DESCRIPTION

"Schools Global Footprint is a resource designed to help your learners examine, measure and reduce their school's Ecological Footprint. It is made up of two main teaching and learning tools which work hand in hand: the handbook for teachers and an online footprint calculator for learners (...). The online footprint calculator introduces and enables the calculation of their school's Ecological Footprint and Carbon Footprint. The calculator is divided into the six components of an Ecological Footprint; Buildings, Energy, Food, Transport, Waste and Water. (...) The handbook of practical teaching and learning ideas and materials; set in a broad global context, introducing and investigating each of the six components that make up an Ecological Footprint, and exploring their interconnections. The understanding of this global interconnectedness lies at the root of sustainable development education (...) It is intended that by using this handbook, and the online footprint calculator, your school will be able to draw up an Action Programme which contains actions designed to reduce the size of your school's Ecological Footprint."

PROJECT

CO₂nnect – CO₂ on the way to school | 2009 – present |



ORGANIZATION/FUNDING: EU Comenius Lifelong Learning project “SUPPORT: Partnership and participation for a sustainable tomorrow”.

TARGET AUDIENCE: Schools

GEOGRAPHICAL SCOPE: International.

OBJECTIVES:

- Engage a large number of schools, pupils, parents and communities internationally to work with sustainable development in the field of climate and transport.
- Increase schools' competency to deliver high quality Education for Sustainable Development.
- Provide information and communication technology based tools including guidelines, links, a CO₂ transport emissions calculator and opportunities for partnership.
- Generate information useful to research and management about transport and climate issues (including an international database on CO₂ emissions from school transport).
- Generate innovative ideas for sustainable transport.

TEACHING RESOURCES:

IT AND WEB-BASED TOOLS:

- CO₂ transport emissions calculator
- Website

COMMUNICATION AND TRAINING TECHNIQUES:

- Facebook

OUTCOMES/RESULTS: Not available.

HIGHLIGHTS:

- Teacher handbook.
- 10 steps of the campaign.
- National and international comparison of results.
- Multi-language website (17 languages)

LINK: [CO₂nnect](#)

PROJECT DESCRIPTION

“The idea with CO₂nnect is to support learning activities that help provide pupils with abilities, skills, attitudes and awareness as well as knowledge and understanding of issues related to sustainable development. Teachers can use the website as a support for organizing teaching activities or school projects, adjusted to the age of the pupils and local setting. The aim is that schools, researchers, local decision makers and other actors in the local community will collaborate on the theme of CO₂ emissions from local transportation. The website contains a CO₂-from-transport calculator, a shared database for the results, possibilities to compare results in order to analyse and discuss different outcomes, pupil questionnaires, about 50 pages of help sheets for teachers and an evaluation module.”

PROJECT

AQUAPATH | 2014 - 2016

Project code: 2014-1-IT02 KA200-003610.



FUNDING: Erasmus+

PARTNERS: France, Germany, Italy, Netherlands, Spain and Portugal.

GEOGRAPHICAL SCOPE: European

TARGET AUDIENCE: Children and adults but not specifically directed to schools.

OBJECTIVES:

- Reduce individual direct water consumption.
- Change consumption habits from water intensive products to those with a sustainable water footprint.
- Apply pressure on brands and manufacturers to increase the supply of products with sustainable water footprints.

RESOURCES:

IT AND WEB-BASED TOOLS:

- Website.
- [Water Footprint Calculator](#) including practical suggestions for water consumption through a drop-down menu and guidelines for household management.
- [Report local water issues](#): online tool that uses [SeeClixFix](#) to identify locations on a map that need fixing regarding water issues. It is possible to describe the problem and upload a picture.

COMMUNICATION AND TRAINING TECHNIQUES:

- Six online training modules: Awareness, Sustainability, Consumption and Production, Lifestyle, Household, Public Sector. Each module consists of one online document and one quiz.
- Video ["What do you know about your water footprint?"](#)
- Newsletter, Facebook.

OTHER:

- [Teacher textbook](#)
- [Textbook for children](#)


OUTCOMES/RESULTS: Website (8000 visitors); 17 multiplier events in 6 countries (1009 participants).

HIGHLIGHTS:

- Water Footprint Calculator.
- Training modules and quiz.
- Good design of the Water Footprint Calculator and project website, in contrast with the less advanced design of the textbook for children.

LINK: [Aquapath](#)

PROJECT DESCRIPTION



"Aquapath project aims at fostering citizens awareness (children – tomorrow's citizens – and adults) regarding water consumption in Europe. Taking into account populations' various backgrounds, the objective is to educate Europeans at making responsible choices and eventually assist the implementation of law directives, which will only become effective when followed by a real mind shift."



Children event. Aquapath



Children event. Aquapath



Game. Aquapath



Children event. Aquapath



Children event. Aquapath



Children event. Aquapath



*Municipality of Monza
event. Aquapath*

PROJECT

LEAF – LEARNING ABOUT FORESTS | 2000 to present.



ORGANIZATION: Foundation for Environmental Education (FEE) and Forest in Schools programmes in Norway, Sweden and Finland.

GEOGRAPHICAL SCOPE: International.

TARGET AUDIENCE: Students, teachers and the wider community.

OBJECTIVES:

- Increase the level of awareness and knowledge about the key role that forests play for sustainable life on our planet.
- Promote activities to help students increase the level of environmental knowledge regardless of age or previous knowledge.
- Ensure students learn to enjoy the outdoors, experience and observe nature.
- Ensure students understand the ecological web and the interplay of man and nature.
- Ensure students are capable of making decisions on environmental issues and take responsibility for their future.

RESOURCES:

IT AND WEB-BASED TOOLS:

- Website

COMMUNICATION AND TRAINING TECHNIQUES:

- [Tree Planting Video](#) series.
- The Forest Cycle methodology: a series of carefully engineered measures to help schools maximise the success of their LEAF ambitions.
- LEAF newsletter, Facebook, Twitter, Flickr.

OTHER:

- [Environmental Education Principles](#)

OUTCOMES/RESULTS:

- 23 participating countries.
- In 2015, over 1,000 tree-planting activities took place and over half a million trees were planted, 9,836 participating schools (from pre-school to universities), 17,600 teachers and 556,754 students.

HIGHLIGHTS:

- Teacher handbook.
- 10 steps of the campaign.
- National and international comparison of results.
- Multi-language website (17 languages)

LINK: [LEAF](#)

PROJECT DESCRIPTION

“Learning about Forests aims to increase knowledge about the key role forests play in sustaining life on our planet. The programme encourages students to reconnect with our woodland heritage and imbue students with a sense of ownership of their environment which, in many places, has become lost over time. This reconnect with the environment is intended to reassert the idea that our forests are a natural asset to be treasured and kept safe for future generations, an idea which has for decades been neglected as our trees fuelled economic expansion and lifestyle improvements. The myriad of ways in which forests show a beneficial impact on our lives is stressed to students, often during field trips out into the woods to see first hand where they can be educated on the importance of the ‘lungs of the planet’. (...) The LEAF programme aligns itself with Education for Sustainable Development (ESD), the Global Action Programme (GAP) and the new Sustainable Development Goals (SDGs). The LEAF programme is operated in a thematic manner. Participating countries encourage schools to work on the current LEAF theme. The programme looks at all the functions of forests: forests and biodiversity, forests and water, forest and products, forests and climate, forests and community, forest laws and codes, forests myths, creativity and innovation.”



FEE Learning about forests. Leaf Belgium 2014



FEE Learning about forests. Leaf Belgium 2014



FEE Learning about forests. Leaf Belgium 2015



FEE Learning about forests. Leaf Netherlands 2016



FEE Learning about forests. Leaf Bulgaria



FEE Learning about forests. Leaf Czech Republic - Celebrating 15 years of Leaf



FEE Learning about forests. Leaf Belgium 2015



*FEE Learning about forests.
Leaf Belgium 2015*



*FEE Learning about forests.
Leaf Belgium 2015*



*FEE Learning about forests.
Leaf Uganda*

PROJECT

Future Happiness Challenge!

ORGANIZATION: Developed in collaboration between Mistra Urban Futures, Region Västra Götaland, the City of Gothenburg, the Pedagogical Centre and IUS Innovation. The development of the game was funded by Region Västra Götaland and the City of Gothenburg.

GEOGRAPHICAL SCOPE: International.

TARGET AUDIENCE: Upper secondary school students (15-19), but the game can be played by both younger and older students.

OBJECTIVES:

- Encourage a political dialogue about sustainable living, based on science.
- Increase students' level of understanding for the changes needed on both individual level and as a society to halt global warming.
- Increase young people's interest in political debate, participation in public elections as well as other democratic work.
- Encourage healthy lifestyles.

RESOURCES:

IT AND WEB-BASED TOOLS:

- Electronic pedagogical game (multi-platform)

COMMUNICATION AND TRAINING TECHNIQUES:

- Videos

OTHER:

- Teacher's guide

OUTCOMES/RESULTS: Not available.

HIGHLIGHTS:

- Theme of the electronic game, objectives, functionality and design.

LINK: [Future Happiness Challenge](#)

A photograph of three young people riding bicycles on a paved path in a park during autumn. The person in the foreground is a woman with dark hair and sunglasses, wearing a blue jacket and black leggings. Behind her is a young man with curly hair wearing a red and black plaid shirt over a white t-shirt. Further back is another person wearing a pink jacket and sunglasses. The ground is covered with fallen brown leaves, and the background shows trees with yellow and orange foliage.

PROJECT DESCRIPTION

“The game Future Happiness Challenge aims at communicating the results of the report Low Carbon Gothenburg. The game is easily accessible and can be used in schools, at workplaces, for workshops and other places where you need a platform to discuss changes for a sustainable future.” <http://pedagogisktcentrum.se/fhc/>

2.2 GREEN ENTREPRENEURSHIP AND ALTERNATIVES TOWARDS A GREEN AND SOCIAL ECONOMY

Have you heard about green economy? What business opportunities can be presented by green economy? Is it possible to combine social and economic well being with nature protection? Can companies profit and contribute to sustainable development goals? How can natural protected areas and biodiversity be a driver for local social and economic development?

In this section we present a brief overview about green economy followed by a few examples of green entrepreneurship.



2.2.1 Green economy

The green economy is a broad term that refers to a type of economy where profit, the environment and social responsibility are not in contradiction. As well as supporting economic development, the green economy aims to reduce pollution, biodiversity loss, improve nature conservation, resource efficiency and social fairness. An important feature is the attempt to internalize the environmental and social costs of the products and services, for instance, by making polluters pay for the pollution. This approach can be an important incentive to implement sustainable business practices. For example, from the green economy standpoint, it makes much more sense to sustainably manage a forest in the long term, considering not only the timber that a forest produces, but also other forest products, environmental protection aspects, the provisioning of ecosystem services and the well-being of local communities, rather than exploiting intensively to maximize economic profit at the short term, despite causing environmental, societal and economic damages (negative externalities). In general, the green economy approach minimizes environmental and social damage and it is more sustainable at the long run, even from an economic perspective.

Presently, many companies already have their business models aligned with green economic princi-

ples. Some sectors, due to the nature of their activity, are closer to transitioning to a greener economy, such as (eco)tourism, renewable energy technology, waste, forestry or agriculture, just to name a few. The green economy extends beyond the scale of business: cities are starting to adapt to the green economy by making strategic choices and investments in key areas such as transport systems, waste management, green spaces or energy efficiency. At a larger scale, regions and countries around the world are already developing green growth strategies and planning the transition to low carbon economies. Some are even setting ambitious goals such as achieving fossil fuel independence within the next years.

Old economic models and business premises were partially responsible for the path that lead humanity to some of the current environmental and social challenges. Nowadays, if the objective is to achieve sustainable development, environmental equilibrium and social equity, than it no longer makes any sense to continue with the same models and premises. As seen in Part I, to solve current and future challenges, it is imperative to change at the individual, collective and system level.

How can we accelerate the transitioning to a greener economy?







2.2.2 Examples

Sustainable natural resource management in Portugal

The *montado* is probably Portugal's best example of sustainable management of natural resources and an inspirational model. The *montado* is an old agro-sylvo-pastoral system where economy, biodiversity and sustainability coexist in harmony through careful human management of the natural resources. The forest is usually dominated by cork oak-trees (*Quercus suber*) or holm-oak trees (*Q. rotundifolia*) and the under cover is used to feed cattle, grow rain-fed or dry farming arable crops.



This extensive production system promotes soil conservation, local biodiversity and multiples sources of income, providing cork but also other products with economic interest, such as meat, honey, medicinal and aromatic plants, mushrooms, wild berries and nuts. Tourism is another potential source of income. Considered a biodiversity hotspot, the *montado* is an important ecosystem for many species of animals such as the emblematic and endangered Iberian lynx (*Lynx pardinus*) or the Iberian imperial eagle (*Aquila adalberti*) and is home to many other species of invertebrates, amphibians, reptiles, birds, mammals and more than 700 plants can be found in the Portuguese *montado*. Think of the business possibilities that exist associated to the *montado* ecosystem. Feeling inspired to be an eco-entrepreneur?





Cycling in Ireland

What happens to the local economy when an old railway is converted into a cycling path? By looking to the Great Western Greenway example you might have a clue.

Not so long ago, the villages along the Great Western Railway were a place to pass through, with scarce development, limited tourist activity, under-developed tourism infrastructures and the community lacked a cohesive vision of the territory. Today, after the construction of the Great Western Greenway (Westport-Newport-Mulranny-Achill), a 42km traffic-free cycling and walking route that follows the line of the old Great Western Railway which closed in 1937, things are quite different for local residents. The Great Western Greenway is the longest off-road walking and cycling trail in Ireland and now a popular and successful destination. It has won several awards including European Destination of Excellence, European Greenways Award or the LAMA award and now there are even plans to expand the project.



Quick facts:

- Growing number of users 145,000 in 2011 and 265,000 in 2014.
- 54% hired a bike.
- Average daily spend €62/person/day.
- New business opportunities: bicycle hire, guided tours, hospitality services, local shops, accommodation, taxi services, etc.
- 38 new jobs created and supports 56 existing jobs.
- Estimated economic benefit: 7.2 € million to the local economy (2.8 € million - overseas visitors)

Nature tourism in Spain

Natural areas around the world attract enthusiastic nature lovers presenting many business opportunities for green entrepreneurship.

The Delta de l'Ebre Natural Park is Catalonia's largest wetland, a place of ornithological and ecological importance where more than 95 species of birds breed and about 300 come to stopover. This biodiversity attracts thousands of visitors annually. Tourists can also find beaches, sand dunes, rivers, estuaries, salt pans, lagoons and marshes. Specialized companies provide visitors many ways to explore the Delta de l'Ebre Natural Park, from guided walking tours, to horseback riding, bird watching, biking, etc.

Another successful example of the green economy in a natural protected area can be found in the Natural Parks of Arribes del Duero (Spain), Douro International (Portugal) and in the Natural Park of Sanabria (Spain), where a private company operates environmental cruises, taking every year more than 60,000 tourists to visit the protected areas. As part of the strategy of the company, some of the economic resources are allocated to projects of research, conservation and enhancement of natural resources of the protected areas in which it operates. Which areas of natural, cultural or historical importance can you identify near you? Would you dare to be an entrepreneur?



Eco-innovation in Italy

An important part of the green and circular economy is about operating in closed production cycles. Many companies and industries are investing in research and innovation not only to reduce the production of waste, but also to give waste a second life by using it as a raw material. Some of the advantages for companies consist of lower production costs with materials and transportation, reduction of the carbon and ecological footprints, reputable environmental certification, access to new markets and jobs creation.



For example, tonnes of hazelnut and cocoa beans are used everyday in the production lines of a famous confectionery Italian company. Now, through research and innovation, the company has developed an industrial process that enables the incorporation of shell and peel left over into a new type of packaging cardboard that is used in the packaging of their products. With this innovation the company has reduced production costs and improved environmental performance by reducing waste and environmental pollution.

Another Italian company, specialized in recycling, is giving glass from old television screens a new life by transforming into a new environmental certified product. The company processes the glass and transforms into a new raw material that is used in the production of high quality designer ceramic tiles. The floor of a 70m² apartment requires 30 television sets. Until now, more than 500,000m² of ceramic tiles have been produced from 2,500 tons of glass from old televisions. By using this process it is estimated that the carbon dioxide emissions reduction is about 0.7 kg per square meter of manufactured tiles.





IMPRINTING SUSTAINABILITY: From Theory to Practice

PART III IMPRINT+ PRACTICAL GUIDELINES FOR OFFSETTING ACTIONS

Part III is all about action and getting your hands dirty!

IMPRINT+ aims to provide the tools and the knowledge to empower all citizens to take positive actions towards the environment. In Part III we present practical guidelines to implement different offsetting actions suggested in the [IMPRINT+ App](#).

Can we reduce all our individual environmental impact to zero? Probably not, however, as previously seen, it is possible to reduce it to sustainable levels and make use of our “fair share” of the planet’s capacity and resources. As for the things that you cannot reduce any more or avoid doing, such as showering, use motorized transport to get to school or work, well, you can offset!

IMPRINT+ will help you to take positive actions for the planet. Use the **CONVERTER** to simulate which measures you would have to take in order to compensate for the environmental impacts of air travel, private or public transport, daily shower, clothing, paper use, fast food consumption, waste production or even for the hours that you spend with electronic entertainment!

Have fun, offset and earn points by submitting the offsetting activities that you have done: planting trees, removal of invasive plants, collecting waste, building wildlife shelters, wildlife ponds, organic vegetable gardens or even environmental volunteering!

Remember to register all offsetting actions with the IMPRINT+ App!



“ IMPORTANT

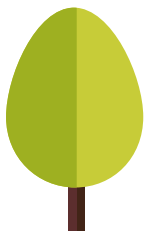
An adult should be present and responsible for supervising and coordinating all offsetting actions. All safety measures regarding procedures and equipments must be previously explained to all participants and followed. All participants must use appropriate protective equipment (e.g. gloves, closed shoes, etc.) according to the activity.

3.1 TREES

Have you ever planted a tree? As you will learn with IMPRINT+ CONVERTER, everyone should plant a few trees each year!

When a native tree is planted and it successfully develops throughout the years into an adult tree, have you ever considered the amount of benefits generated by that tree over time? Just think: trees produce clean oxygen (O²), capture carbon dioxide (CO²), neutralize greenhouse gases emissions; they are the building blocks of many habitats and ecosystems where other plants, mosses, lichens and fungi grow, providing habitat, shelter and food for mammals, birds, reptiles, amphibians, insects and other invertebrates; finally, trees provide and support many vital ecosystem services.

Besides, tree planting can be fun! Just remember, always plant native tree species from your region and at the right time of year!



1. The best time for planting trees is during the dormant season: in autumn after leaf drop or in early spring before bud break.

2.

Choose an appropriate location according to the tree species characteristics: consider climate, surrounding habitat, soil type, lighting conditions, moisture, etc.

3.

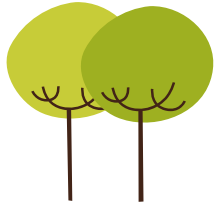
Dig a hole 3 times wider than the root ball, but no deeper than the root ball.



4.

Make sure that the root flare is above the soil and not covered (use a piece of wood or the shovel handle placed horizontally to check the height).

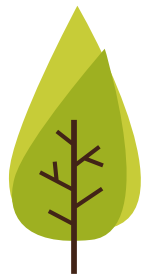
- 5.** Confirm if the soil on the sides of the planting hole is not compacted and the base of the planting hole where the root ball sits is firm and stable.



- 6.** Set the tree in place and remove the container or wrappings.



- 7.** Make sure the tree is vertical and start to fill the planting hole with backfill soil, but leave the top of the root ball uncovered.



- 8.** Make sure the tree is stable and stake if necessary, be careful and do not damage the roots.



- 9.** Water to settle the soil, but without over packing it.



- 10.** Finally, mulch over the backfill area (never against the trunk) to reduce competition with weeds and to conserve soil moisture.

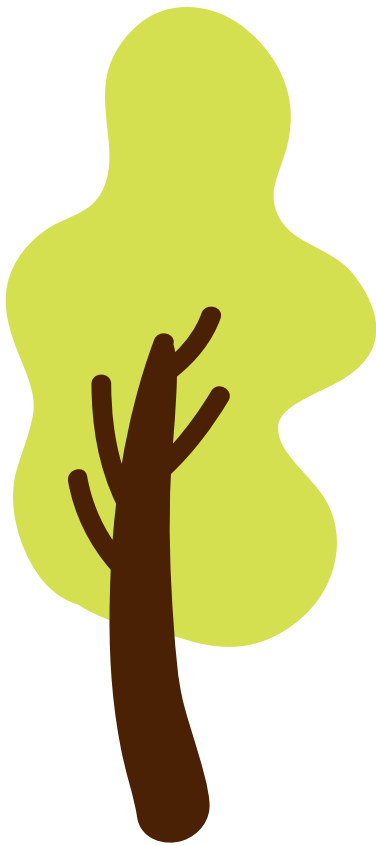
[Click here](#) to see a tree planting video #1

[Click here](#) to see a tree planting video #2

3.1.2 Choosing Trees

Always plant native trees! Use the following list as guidance and know more at the [European Atlas of Forest Tree Species](#).

PORTUGAL



Alnus glutinosa (L.) Gaertn., common or black alder.

Betula pendula Roth, silver birch and downy birch
(*Betula pubescens* Ehrh.).

Castanea sativa Mill., sweet chestnut.

Corylus avellana L., European hazel or common hazel.

Fraxinus angustifolia Vahl.

Ilex aquifolium L., European holly.

Juglans regia L., common, English or Persian walnut.

Juniperus oxycedrus L., prickly juniper.

Olea europaea L., olive.

Pinus pinaster Ait., maritime pine.

Pinus pinea L., stone pine.

Populus alba L., white poplar.

Populus nigra L., black poplar.

Prunus lusitanica L., Portugal laurel.

Quercus ilex L., holm oak or evergreen oak.

Quercus pyrenaica Willd., pyrenean oak.

Quercus robur L., pedunculate oak.

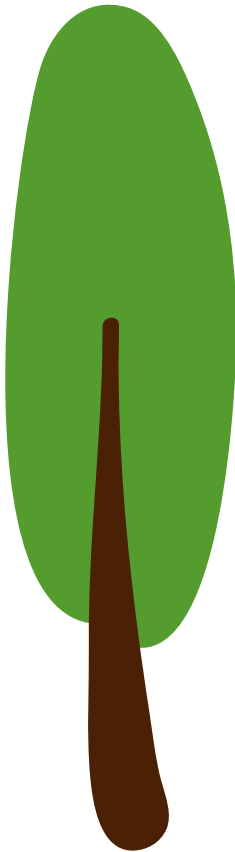
Quercus suber L., cork oak.

Salix alba L., white willow.

Sambucus nigra L., elder.

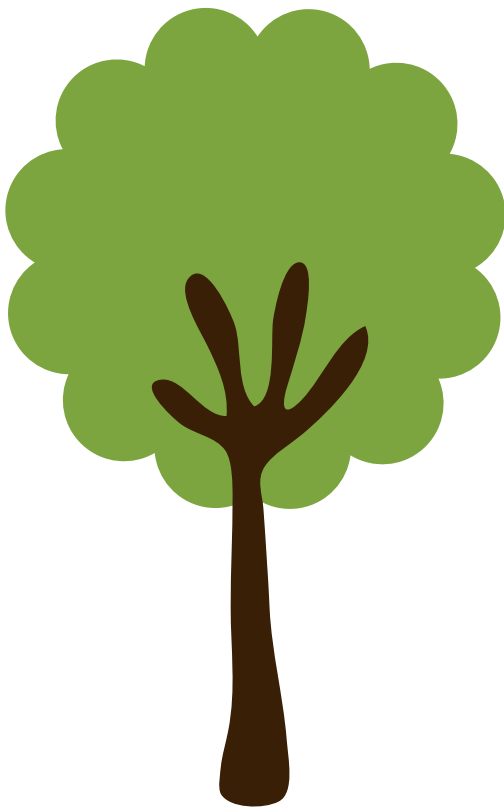
Ulmus minor Mill., field elm.

ITALY



- Acer pseudoplatanus* L., sycamore maple.
Alnus cordata (Loisel.) Duby, Italian alder.
Alnus glutinosa (L.) Gaertn., common or black alder.
Carpinus orientalis Mill., oriental hornbeam.
Castanea sativa Mill., sweet chestnut.
Celtis australis L., southern nettle tree or European hackberry.
Corylus avellana L., European hazel or common hazel.
Cupressus sempervirens L., Mediterranean or common cypress.
Fagus sylvatica L., European beech.
Fraxinus ornus L., manna ash.
Ilex aquifolium L., European holly.
Juglans regia L., common, English or Persian walnut.
Juniperus oxycedrus L., prickly juniper.
Olea europaea L., olive.
Pinus halepensis Miller, aleppo pine.
Pinus nigra J.F. Arnold, European black pine or black pine.
Pinus pinea L., stone pine.
Populus alba L., white poplar.
Quercus cerris L., Turkey oak.
Quercus ilex L., holm oak or evergreen oak.
Quercus pubescens Willd., pubescent oak.
Quercus suber L., cork oak.
Salix alba L., white willow.
Sambucus nigra L., elder.
Ulmus minor Mill., field elm.

SPAIN



- Alnus glutinosa* (L.) Gaertn., common or black alder.
Castanea sativa Mill., sweet chestnut.
Celtis australis L., southern nettle tree or European hackberry.
Corylus avellana L. European hazel or common hazel.
Cupressus sempervirens L., Mediterranean or common cypress.
Fraxinus angustifolia Vahl, narrowed-leaved ash.
Ilex aquifolium L., European holly.
Juglans regia L., common, English or Persian walnut.
Juniperus oxycedrus L., prickly juniper.
Olea europaea L., olive.
Pinus halepensis Miller, Aleppo pine.
Pinus nigra J.F. Arnold, European black pine or black pine.
Pinus pinaster Ait, maritime pine.
Pinus pinea L., stone pine.
Populus alba L., white poplar.
Populus nigra L., black poplar.
Prunus spinosa L., blackthorn.
Quercus ilex L., holm oak or evergreen oak.
Quercus pyrenaica Willd., Pyrenean oak.
Quercus suber L., cork oak.
Salix alba L., white willow.
Sambucus nigra L., elder.
Ulmus minor Mill., field elm.

3.2 ORGANIC VEGETABLE GARDEN

“

Reduce your **food miles** by locally growing organic herbs and vegetables!



CREATE A VEGETABLE GARDEN IN 10 STEPS

1. First of all, consider the following factors: vegetable garden size, type of plants, amount of time that is available for gardening and maintenance, individual plant requirements and sowing, planting and growing seasons.
2. Analyse all possible locations for your vegetable garden and consider:
 - sun exposure: most plants need 6-8h of sunlight. Prefer south-facing locations and protected from strong winds;
 - access to irrigation water;
 - soil quality: look for well drained soils and rich in organic matter;
 - terrain slope: prefer level terrains;
 - possible sources of pollution and contamination;
 - accessibilities and storage of equipment (shovel, buckets, gloves, etc.)
3. Plan your vegetable garden layout: make a drawing including the pathways, growing beds, water points, irrigation system, compost area, etc.
4. Mark the perimeter of the vegetable garden. Identify wild edible, medicinal or ornamental small plants and shrubs that you want to keep and remove unwanted grass, shrubs or any other vegetation.



5. Mark out the paths and the growing beds: make sure that you can easily reach the center of the growing beds from both sides of the pathway. This way you avoid stepping and compacting the soil. [\[About raised beds construction\]](#).
6. Prepare the soil by digging the first 20-30cm and, if needed, add compost or animal manure to the bottom.
7. Plant and sow according to individual species requirements (depth, spacing, season, etc.). When possible, use regional plant varieties because they are best adapted to local conditions. Favour non-transgenic and organic seeds.
8. Make a border around the vegetable garden with aromatic herbs, flowers and small edible shrubs such as blueberries, raspberries, etc.
9. Build a compost bin. Remember that all waste from the vegetable garden can be composted as well all raw vegetable waste from the kitchen.
10. Do not neglect the maintenance of your vegetable garden: water when needed, remove weeds, add compost, be aware for signs of pests and diseases, keep pathways clear of weeds, etc.



DO NOT USE SYNTHETIC CHEMICAL FERTILIZERS, PESTICIDES OR HERBICIDES!

[School gardening resources \(RHS\)](#)

[A crop-by-crop guide to growing organic vegetables \(Mother Earth News\)](#)





3.3 WILDLIFE SHELTERS

Every animal needs a home and in the following section you will learn how to build houses for birds, bats, amphibians, reptiles and bugs!

Habitat lost and fragmentation, overexploitation, alien invasive species, climate change,.... Biodiversity is facing many threats and it needs your help! By building wildlife shelters and placing them in appropriate areas you are contributing to the protection of local biodiversity.



VERY IMPORTANT

Always [Leave No Trace](#) in any habitat and do not disturb plants or animals.

Never remove any wild animal or plant from nature and keep in mind that all wildlife species are protected under national and EU law. Wildlife colonization must come naturally to your garden, pond or wildlife shelter.

Always have adult supervision and adequate use of protective equipment and clothing when using tools.

3.3.1 Birds



There are more than 10.000 species of birds in the world and Europe is home to more than 530 regularly occurring wild bird species! Like every other animal, birds need a home, so why not help local biodiversity and build nest boxes?

Birds exist in every continent and are capable of remarkable achievements, for example they can travel great distances: the bar-tailed godwit (*Limosa lapponica*) holds the record for the longest non-stop flight, having travelled [11.500 km from Alaska to New Zealand](#) in 9 days and the Arctic tern (*Sterna paradisaea*) is capable of travelling 90.000 km every year! Birds are also a very important group of animals because they are crucial for seed dispersion, pollination, food webs and nutrient recycling. At last, who does not appreciate a bird song or their majestic flight?



Explore these websites for information and instructions about bird nest boxes building and make your own research to find which species are more common in your area.

[BTO Nestbox Guide \(BTO\)](#)

[Frequently asked questions \(RSPB\)](#)

[How to make a house martin nest \(RSPB\)](#)

[Nest Watch \(Cornell Lab of Ornithology\)](#)

[Nestboxes \(RSPB\)](#)

[Nestboxes for owls and kestrels \(RSPB\)](#)

[Nestboxes for small birds \(RSPB\)](#)

[Make a nest box \(Looking out for birds\)](#)

[Making a nestbox \(RSPB\)](#)

[Nest box activity \(RSPB\)](#)

3.3.2 Bats

There are more than 1,200 bat species in the world and in Europe there are about 45 species of bats, accounting for 20% of all European mammals. Bats play a key role in maintaining ecosystem services across different habitats by controlling pests, acting as pollinators or seed dispersers. Nevertheless, bats, like many other groups of animals, are facing many threats such as habitat loss, fragmentation and also persecution, leading to the decline of many populations.



You can do something to help these animals! Want to learn how to build a house for bats? Explore the following websites and make your research to find out which species are more common in your region and learn more about their biology, habitat and diet.

[Bat Box Information Pack \(Bat Conservation Trust\)](#)

[Bat boxes \(Bat Conservation Trust\)](#)

[Build a bat box \(RSPB\)](#)

[Common Questions about Bat Houses \(Organization for bat conservation\)](#)

[EUROBATS](#)

[Living with bats \(Bat Conservation Trust\)](#)

[Put up a bat box \(BBC Breathing Places\)](#)

[Tenho morcegos em casa, o que devo fazer? \(in Portuguese\) \(ICNF\)](#)



3.3.3 Herpetofauna



Did you know that you can make shelters for amphibians and reptiles with simple natural materials? And that there are 151 species of reptiles and 85 species of amphibians in Europe? Contribute to their conservation and build shelters for their hibernation during winter or to take refuge in during the summer heat.

Amphibians and reptiles are very important in ecosystems but also to the health of your vegetable garden! For example, adult amphibians are very effective predators of slugs, worms, insects and many other invertebrates and therefore, are an excellent natural pest control. Reptiles will also naturally help to keep away undesired inhabitants from your vegetable garden: they are natural predators of invertebrates and small mammals such as rodents!



Explore the following websites for instructions on how to build wildlife shelters for these animals and make your own research and investigate about your local herpetofauna diversity!

[Amphibians in your garden: your questions answered \(Natural England\)](#)

[Create an amphibian home \(BBC Breathing Places\)](#)

[Hibernacula activity \(Froglife\)](#)

[Make a frog and toad abode \(RSPB\)](#)

[Make a wood pile \(BBC Breathing Places\)](#)

[Making a toad home \(Froglife\)](#)

[Reptiles in your garden: your questions answered \(Natural England\)](#)

[Toad abode activity \(Froglife\)](#)

3.3.4 Bug hotel



Bugs also need a place to live so why not build them a magnificent “hotel”? You will be amazed with the diversity of insects and other invertebrates that will take shelter and live in community! Think about how important they are in food webs and nutrient cycling.

Want to know more? Make your own research and observations and check out these websites for ideas!



[Build a bee home \(BBC breathing places\)](#)

[Build a bug hotel \(RSPB\)](#)

[Building an insect hotel habitat \(The wildlife trusts\)](#)

[How to build an insect hotel from found materials \(Inhabitat\)](#)

[Insect hotel activity \(Froglife\)](#)

[Make a bug Hotel \(RHS school gardening\)](#)





3.4 POND

Wildlife ponds are important but threatened habitats! Did you know that besides being a high biodiversity habitat, ponds are essential for the reproduction of many plants and animals? When you build a good wildlife pond you are directly encouraging local biodiversity, contributing to flood control, CO₂ sequestration and other ecosystem services. Besides, they look beautiful in any garden or park and can be even used as a living lab for educational purposes!

HOW TO BUILD A POND IN 10 STEPS:

1.

When choosing the site, consider:

- slope: look for a flat terrain or with minimal slope;
- sun exposure: good exposure with partial shading;
- nearby ponds, streams or other water bodies;

2.

Size and depth: at least 5m² in area and 30cm in depth at the deepest part for small ponds and up to 70 cm for larger.

IMPORTANT: always consider safety issues, accessibility, local regulations and permissions.

3.

Retain water in the pond: the most common option is to use a pond liner – never use plastic.

In alternative, if the ground has a high content in clay, you can compact the bottom to make it more impermeable.

4.

Plan your pond construction:

- make a layout of the site;
- design the pond shape, plan the shallow and the deep parts. Avoid steep slopes and aim for minimal slope along margins;
- list materials and equipments to be used in the construction and ensure that you have enough participants;
- consider building a fence around the pond to restrict access to young children and animals.

5.

Mark the perimeter of the pond and clear the vegetation.

6.

First, remove the topsoil (organic layer) and then, excavate the inorganic layer to the desired depth and store separately both layers. Remove any stones or roots than can damage the liner and compact the bottom of the pond.

7.

Apply the protective layer: use old carpet, straw or any other material that will prevent the liner from being damage.

8.

Apply the impermeable liner, fill the bottom with water and secure the liner in the outer margin with soil and stones.

9.

Place some bigger stones inside the pond. In alternative, you can cover all the surface with smaller rocks.

10.

Colonization will happen naturally! Optionally, you can add a few native aquatic plants.



MORE INFORMATION [Pond creation \(Froglife\)](#)

“

IMPORTANT

- Never introduce fish! They will feed on dragonfly larvae, tadpoles and frog spawn, reducing biodiversity!
- Never introduce invasive aquatic plants (e.g. *Elodea canadensis*, water hyacinth *Eichhornia crassipes*, etc.) or animals (e.g. pond slider *Trachemys scripta*, *Gambusia spp.*, etc.).
- Even in small shallow ponds, take all measures necessary to ensure the safety of young children.

3.5 INVASIVE PLANT SPECIES

The spread of alien invasive species is amongst the top threats to biodiversity and it is time you do something about it! Get to know some of the most common species and learn how to control them.

Investigate which are more problematic in your region, where they are and which type of control methods are more successful. Contact your local environmental NGO's, municipality, environmental and forestry services or invasive species control projects that you know of.

NB: Remember it is very important to seek expert advice on the removal of invasive species, as attempting to remove it using the wrong method, can actually increase the spread rather than prevent it.

Acacia dealbata | **silver wattle (en), mimosa (pt, es, it)** | [fact sheet I](#), [fact sheet II](#)

Acacia longifolia | **Sydney golden wattle (en), acácia-de-espigas (pt), Acacia a foglie lunghe (it)** | [fact sheet](#)

Acacia melanoxylon | **Australian blackwood (en), austrália (pt), acácia negra (es), acacia dal legno nero (it)** | [fact sheet I](#), [fact sheet II](#)

Arundo donax | **giant reed (en), cana (pt), canna domestica (it), caña común (es)** | [fact sheet I](#), [fact sheet II](#)

Carpobrotus edulis | **ice plant (en), chorão-da-praia (pt), uña de gato (es), fico degli Ottentotti (it)** | [fact sheet I](#), [fact sheet II](#)

Cortaderia selloana | **pampas grass (en), erva-das-pampas (pt), hierba de las Pampas (es), erba delle Pampas (it)** | [fact sheet I](#), [fact sheet II](#)

Robinia pseudoacacia | **black locust (en), robínia (pt), robinia (it), falsa acacia (es)** | [fact sheet I](#), [fact sheet II](#)

Tradescantia fluminensis | **Wandering Jew (en), erva-da-fortuna (pt), tradescanzia sudamericana (it), amor de hombre (es)** | [fact sheet I](#), [fact sheet II](#)

Pittosporum undulatum | **Pittosporum (en), árvore-do-incenso (pt), pittosporo ondulado (it)** | [fact sheet I](#), [fact sheet II](#)

Phytolacca americana | **American pokeweed, fitolaca (es), tintureira (pt), fitolacca americana (it)** | [fact sheet I](#), [fact sheet II](#)

EXPLORE THESE WEBSITES FOR MORE INFORMATION



[Atlas das plantas aloctonas invasoras de Espanha](#) (in Spanish)

[A thematic contribution to the National Biodiversity Strategy Plant invasion in Italy - an overview](#)

[Delivering Alien Invasive Species Inventories for Europe \(DAISIE\)](#)

[EASIN \(European Alien Species Information Network\)](#)

[Fichas del Atlas de las plantas alóctonas invasoras de España](#) (in Spanish)

[Invasoras](#) (in English and Portuguese)

[The European Network on Invasive Alien Species \(NOBANIS\)](#)

FIGHTING THE INVADERS

It is not an easy fight! Biologists prefer to use the term “control” instead of “eradication” because some invasive species, once the invasion reaches a certain level, are very difficult to eradicate completely, making almost impossible to reverse the invasion. Therefore, early detection is very important to amplify the chances of success.

Your help is fundamental to win this battle! Learn more about biological, chemical and physical control methods in this [series of videos](#).

3.6 WASTE

In 2008, an average European citizen produced 444 kg of household waste and indirectly generated 5.2 tonnes! It can be very challenging to avoid making any waste at all because almost inevitably we produce it in our daily routines. Despite the fact that we need to make all possible efforts to reduce the production of waste, starting with our buying choices, it is time to take practical action and make our local communities cleaner!

However waste can cause greater problems when it is found in natural environments. It is important that while we are trying hard to reduce the amount of waste we create, the waste materials that are created are sent to the appropriate places to be managed effectively. Litter and waste present significant threats to our native wildlife. Collecting litter on an organised litter pick, is a great way to clean up our natural areas and protect the wildlife that live there.

IMPRINT+ challenges you to contribute to the improvement of the environmental quality your local community and to make planet Earth more clean! For sure you can identify litter near you: at the beach, in the urban park, at the corner of your street or even in your school playground. Organize a group of friends or get in touch with local environmental NGO's and ask for their help. Identify areas that need intervention, plan a cleaning action and act! Collect safely as much waste as possible and dispose of it properly!



FOR INSPIRATION!

“Limpar Portugal”

Did you know that in Portugal on the 20th of March of 2010 an unprecedented event took place, when a group of citizens was able to organize a nation wide event with more than 100.000 volunteers that collected 50.000 tons of waste from the forests, resulting in the cleaning of more than 10.000 sites? The event had massive participation at several levels gathering both private and public, individual and collective and profitable and non-profitable entities: at least 155 schools participated, 147 groups of scouts, 484 private companies and public institutions, 18 fire-fighters departments, 290 city councils and around 3.000 parish councils.

Versova beach cleaning

[Watch this video](#) to see an extreme example of a beach cleaning in Mumbai, India. Started by a civic movement, more than 500 volunteers collected trash during the weekend, resulting in the removal of around 610.000 kg of waste!



GLOSSARY

Anthropocentric – interpreting through human values and experiences.

Biological productivity – Refers to the amount of biomass or energy production and accumulation over a period of time by an individual, population, community, habitat or ecosystem.

Biome – Large areas where plants and animals are adapted to a certain climate. A biome can have many ecosystems and high diversity of habitats. Examples of biomes: coniferous forest, temperate deciduous forest, desert, grassland, rainforest, shrubland and tundra.

Bycatch – The indiscriminate capture of non-target organisms. While some bycatch may be sold, others cannot, and are often thrown back to sea, dead or dying in the case of fisheries. This unused sub-set of bycatch is known as discards.

Environmental externalities – Externalities are market failures. This is an economic term that refers to when a producer of products or services imposes a cost or benefit to external parties. Negative environmental externalities happen, for example, when an industry produces pollution or damage to the environment for which it does not pay but someone else does. Think of an industry that pollutes a river but is not accountable for the cost of clean-up/restoration. Further downstream, if a city or another economic activity needs to use the water from the river, they will have to cover the cost of cleaning the water through restoration or installing a water treatment plant.

Eutrophication – This is the over-enrichment of nutrients in water, usually nitrogen and phosphorus, that causes excessive algae and aquatic plant growth which can eventually completely cover the surface of the water. When sunlight can no longer penetrate into the water column photosynthetic organisms die. The decomposition process consumes all the available oxygen leaving an asphyxiating zone for organisms. This phenomenon has negative implications both in freshwater and coastal marine ecosystems and reduces water quality. Although eutrophication can happen due to natural causes, human activities such as agriculture, industry and sewage disposal are greatly responsible for this phenomenon.

Greenhouse gases (GHG) – Gases that have a strong effect in the greenhouse effect by trapping heat in the atmosphere making the Earth warmer. The most important GHG are: water vapour (H₂O), carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), ozone (O₃) and chlorofluorocarbons (CFCs)

Imprinting – Refers to a process that occurs in specific life stages in many animals, including humans, where rapid learning takes place. For example, in young animals, fundamental behaviours and connections can be those imprinted from the parents.

In **IMPRINT+** we want to lead by example and imprint positive environmental behaviours across society.

BIBLIOGRAPHY

Alcamo J., Ash N.J., Bennett E.M., Biggs R.O., Butler C.D., Callicott J.B., Capristano D., Carpenter S.R., Castilla J.C., Chambers R., Choo P.S. et al. (2003) Ecosystems and their services (Chapter 2). In: *Ecosystems and Human Well-being: A Framework for Assessment*, 49-70.

Cassidy E.S., West P.C., Gerber J.S. and Foley J.A. (2013) Redefining agricultural yields: from tonnes to people nourished per hectare. *Environmental Research Letters*, 8(2013):034015.

CBD - Secretariat of the Convention on Biological Diversity (2010) *Sustaining life on Earth - How the Convention on Biological Diversity promotes nature and human well-being*, 20pp.

Ceballos G., Ehrlich P.R., Barnosky A.D., García A., Pringle R.M. and Palmer T.M. (2015) Accelerated modern human – induced species losses: entering the sixth mass extinction. *Sciences Advances*, 2015(1):e1400253.

CLIMATE-ADAPT - European Climate Adaptation Platform (2016) <http://climate-adapt.eea.europa.eu/about> [Accessed June 20, 2015].

Collen B., McRae L., Kothari G., Mellor R., Daniel O., Greenwood A., Amin R., Holbrook S., Baillie J.E.M., Goldfinger S., Kitzes J., Wackernagel M., Peller A., Williams R., Kalter R., Hogan R., and Shepherd G. (2010) *2010 and Beyond: rising to the biodiversity challenge*, 16pp.

Ercin A.E., Aldaya M.M. and Hoekstra A.Y. (2012) The water footprint of soy milk and soy burger and equivalent animal products. *Ecological Indicators*, 18:392–402.

Euractiv (2016) INFOGRAPHIC: EU agricultural emissions: On the table. <http://www.euractiv.com/section/agriculture-food/infographic/eu-agricultural-emissions-on-the-table/> [Accessed May 1, 2016].

European Commission (2015) *EU energy in figures – Statistical Pocketbook*. European Commission, 257pp.

European Commission (2015a) *Closing the loop - An EU action plan for the Circular Economy*. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions.

European Commission (2015b) *Country Datasheets 2015*. <https://ec.europa.eu/energy/en/data-analysis/country> [Accessed May 1, 2016].

European Commission (2015c) *Reducing CO2 emissions from passenger cars*. http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm [Accessed May 5, 2016].

European Environment Agency - Biodiversity Information System for Europe (BISE) (2010) <http://biodiversity.europa.eu/topics/ecosystem-services> [Accessed June 20, 2016].

European Environment Agency (2012) *Unsustainable consumption – the mother of all environmental issues?* <http://www.eea.europa.eu/highlights/unsustainable-consumption-2013-the-mother> [Accessed May 1, 2016].

European Union (2014) Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species. Official Journal of the European Union.

Fagundes N.J.R., Ray N, Beaumont M., Neuenschwander N., Salzano F.M., Bonatto S.L. and Excoffier L. (2007) Statistical evaluation of alternative models of human evolution. PNAS, 104(45):17614-17619.

FAO - Food and Agriculture Organization of the United Nations (2014) The state of world fisheries and aquaculture, 243pp.

FAO - Food and Agriculture Organization of the United Nations (2000) Water and food security. http://www.un.org/waterforlifedecade/food_security.shtml [Accessed May 20, 2016].

Galli A. (2010) Stomping on biodiversity: humanity's growing Ecological Footprint. Commonwealth Ministers Reference Book 2010, 156-159.

Giljum S., Hinterberger F., Bruckner M., Burger E., Frühmann J., Lutter S., Pirgmaier E., Polzin C., Waxwender H., Kernegger L., Warhurst M. (2009) Overconsumption? Our use of the world's natural resources. SERI, GLOBAL 2000, Friends of the Earth Europe, 36pp.

Global Footprint Network (2015) Glossary. <http://www.footprintnetwork.org/en/index.php/GFN/page/glossary/> [Accessed April 1, 2016].

Global Footprint Network (2016) Ecological Wealth of Nations. http://www.footprintnetwork.org/ecological_footprint_nations/ [Accessed May 15, 2016].

Hoekstra A.Y. (2008) Water neutral: reducing and offsetting the impacts of water footprints. Value of Water – Research Report Series 28. UNESCO-IHE Institute for Water Education, Delft, the Netherlands, 42pp.

IFAD - International Fund for Agricultural Development, United Nations (2016) Water Facts and Figures. https://www.ifad.org/topic/facts_figures/overview [Accessed May 30, 2016].

IUCN (2010) Why is biodiversity in crisis? <http://www.iucnredlist.org/news/biodiversity-crisis> [Accessed May 1, 2016].

IUCN (2011) European species under threat: overview of European Red Lists results - November 2011. Available at https://cmsdata.iucn.org/downloads/red_list_overview_2.pdf

JRC - Joint Research Centre (2016) GHG (CO₂, CH₄, N₂O, F-gases) emission time series 1990-2012 per capita for world countries. http://edgar.jrc.ec.europa.eu/overview.php?v=GHGts_pc1990-2012 [Accessed June 6, 2016].

Lewis S.L. and Maslin M.A. (2015) Defining the Anthropocene. Nature, 519(7542):171–180.

Mace G., Masundire H., Baillie J. et al. (2005) Chapter 4 Biodiversity. In: Hassan R., Scholes R., Ash N. Ecosystems and Human Well-being: Current State and Trends. Millennium Ecosystem Assessment. Island Press, Washington, US, 46pp.

Mekonnen M.M., and Hoekstra A.Y. (2011) National Water Footprint Accounts - The green, blue and grey water footprint of production and consumption. Value of Water – Research Report Series 50. UNESCO-IHE Institute for Water Education, Delft, the Netherlands.

Mekonnen M.M., and Hoekstra A.Y. (2012) A Global Assessment of the Water Footprint of Farm Animal Products. *Ecosystems* 15(3):401–415.

Nellemann C., MacDevette M., Manders T., Eickhout B., Svihus B., Prins A.G., and Kaltenborn B.P. (2009) The environmental food crisis – The environment's role in averting future food crises. A UNEP rapid response assessment. United Nations Environment Programme, GRID-Arendal, www.grida.no.

Nieto A., Ralph G.M., Comeros-Raynal M.T., Kemp J.; García Criado M., Allen D.J., Dulvy N.K., Walls R.H.L., Russell B., Pollard D. et al. (2015) European Red List of marine fishes, IUCN Global Species Programme, IUCN European Regional Office.

NOAA – National Centers for Environmental Information (2015) Earth System Research Laboratory: Recent Monthly Average Mauna Loa CO₂, from <http://www.esrl.noaa.gov/gmd/ccgg/trends/index.html> [Accessed May 30, 2016].

NOAA – National Centers for Environmental Information (2016) State of the Climate: Global Analysis for March 2016, published online April 2016, <http://www.ncdc.noaa.gov/sotc/global/201603>. [Accessed May 30, 2016].

NOAA – National Centres for Environmental Information (2014) State of the Climate: Global Analysis for December 2014, published online January 2015, <http://www.ncdc.noaa.gov/sotc/global/201412> [Accessed May 30, 2016].

Oxfam (2016). An Economy for the 1% - How privilege and power in the economy drive extreme inequality and how this can be stopped. Oxfam International Briefing Paper, 44pp.

Reidsma P., Tekelenburg T., van den Berg M., and Alkemade R. (2006) Impacts of land-use change on biodiversity: An assessment of agricultural biodiversity in the European Union. *Agriculture, Ecosystems and Environment*, 114(1):86–102.

Ruddiman W.F. (2013) The Anthropocene. *Annual Review of Earth and Planetary Sciences*, 41(1):45–68.

Scarborough P., Appleby P.N., Mizdrak A., Briggs A.D.M., Travis R.C., Bradbury, K.C., Key T.J. (2014) Dietary greenhouse gas emissions of meat-eaters, fish-eaters, vegetarians and vegans in the UK. *Climatic Change*, 125(2):179–192.

Sodhi N.S., Koh L.P., Brook B.W., and Ng P.K. (2004) Southeast Asian biodiversity: An impending disaster. *Trends in Ecology and Evolution*, 19(12):654–660.

Steffen W., Crutzen J., and McNeill J.R. (2007) The Anthropocene: are humans now overwhelming the great forces of Nature? *Ambio*, 36(8):614–621.

Stockholm Convention (2008) Stockholm Convention on Persistent Organic Pollutants – DDT Overview <http://chm.pops.int/Implementation/DDT/Overview/tabid/378/Default.aspx> [Accessed June 20, 2016].

TEEB - The Economics of Ecosystems and Biodiversity (2015) TEEB for Agriculture & Food: an interim report, United Nations Environment Programme, Geneva, Switzerland.

ten Brink P., Mutafoğlu K., Schweitzer J.-P., Kettunen M., Twigger-Ross C., Baker J., Kuipers Y., Emonts M., Tyrväinen L., Hujala T., and Ojala A. (2016) The Health and Social Benefits of Nature and Biodiversity Protection. A report for the European Commission (ENV.B.3/ETU/2014/0039), Institute for European Environmental Policy, London/Brussels.

Trinkaus E. (2005) Early Modern Humans. *Annual Review Of Anthropology*, 34(1):207–230.
UNEP – United Nations Environment Program (2011) Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication, www.unep.org/greeneconomy.

UNFPA – United Nations Population Fund (2007) State of World Population 2007: Unleashing the Potential of Urban Growth, 100pp.

United Nations – Department of Economic and Social Affairs, Population Division (2015a) Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2015 Revision. Key Findings and Advance Tables. Working Paper No. ESA/P/WP.241.

United Nations – Department of Economic and Social Affairs, Population Division (1999) The world at six billion: Part 1 - Introduction and Table 1-4, 11pp.

United Nations – Department of Economic and Social Affairs, Population Division (2015b) World Population 2015 Wallchart. Available at: http://esa.un.org/unpd/wpp/Publications/Files/World_Population_2015_Wallchart.pdf [Accessed May 1, 2016].

United Nations – Department of Economic and Social Affairs, Population Division (2014) World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352).

United Nations, 1992. Convention on Biological Diversity. 28pp.

Vanham D., Hoekstra A.Y., and Bidoglio G. (2013) Potential water saving through changes in European diets. *Environment International*, 61:45–56.

Walls M. (2006) Agriculture and Environment. Standing Committee on Agricultural Research (SCAR) Foresight Group, 22pp.

Water Footprint Network (2016) Product Gallery. <http://waterfootprint.org/en/resources/interactive-tools/product-gallery/> [Accessed May 30, 2016].

Westhoek H., Lesschen J.P., Rood T., Wagner S., De Marco A., Murphy-Bokern D., Leip A., van Grinsven H., Sutton M.A., Oenema O. (2014) Food choices, health and environment: Effects of cutting Europe's meat and dairy intake. *Global Environmental Change*, 26(1):196–205.
World Business Council for Sustainable Development (2009) Water Facts and Trends – Version 2, 14pp.

Worldometers.info (2016) World Population Milestones. <http://www.worldometers.info/world-population/#table-historical> [Accessed May 1, 2016].

WWF (2014) Living Planet Report 2014 - Species and spaces, people and places, 180pp.

