Natural Resource Economics & Management

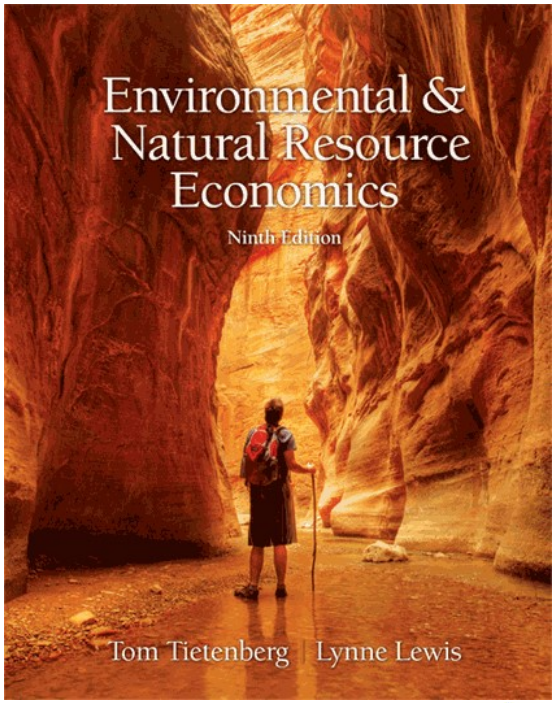
Οικονομικά και διαχείριση φυσικών Πόρων

Lecture 1

Introduction to Resource and Environmental problems

Course Information

- Objectives: The course provides a general introduction to the field of Environmental Economics with emphasis on the relationship between Sustainable Development and Economics and examines various instruments for environmental policy and the role of the firm in the protection of environment.
- Textbook: T. Tietenberg and T. Lewis Environmental and Natural Resource Economics (7th edition and up)
- Prerequisitives: None
- Teaching methods: Lectures
- Assessment: Midterm 40%, Final exam 60%
- Language of instruction: English



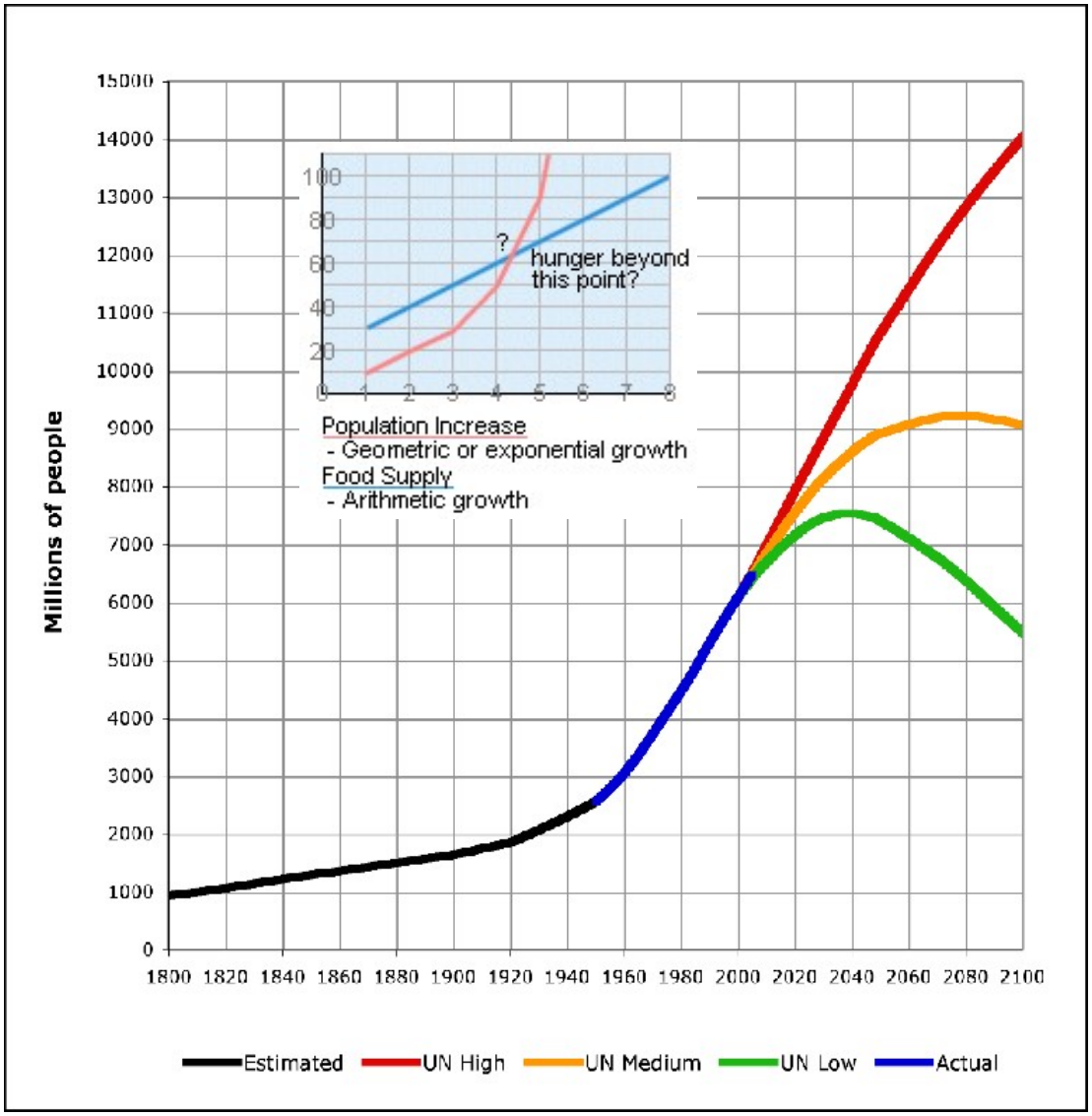
Lecture 1 Visions of the Future

- Introduction
- Future Environmental Challenges
- Meeting the Challenges
- How will Societies Respond?
- The Road Ahead

Introduction

- The Self-Extinction Premise

"The power of population is so superior to the power of the earth to produce subsistence for man, that premature death must in some shape or other visit the human race. The vices of mankind are active and able ministers of depopulation. They are the precursors in the great army of destruction, and often finish the dreadful work themselves. But should they fail in this war of extermination, sickly seasons, epidemics, pestilence, and plague advance in terrific array, and sweep off their thousands and tens of thousands. Should success be still incomplete, gigantic inevitable famine stalks in the rear, and with one mighty blow levels the population with the food of the world."



Malthus T.R. 1798: An essay on the principle of population http://www.esp.org/books/malthus/population/malthus.pdf

Introduction

- The Self-Extinction Premise
  - Some Historic Examples
    - The Easter Islands
    - The Mayan civilization

The collapse of the Mayan civilization was due to environmental damage caused by deforestation and damage to the agricultural system. "It was a collapse and not an abandonment, because the second is temporary; while the first represents an abandonment over the long term and the destruction of the social and economic system that maintains a state, as occurred in the said region," Dr. Richard D. Hansen

Picture a lush, green little island, settled in the 5th century AD. It was Eden itself with tropical trees, fertile soil, pure spring water and surrounded by abundant seafood. As centuries passed, the human population swelled to about 10,000 people - a lot for only 103 km^2. Rival clans evolved, competing to erect large (up to 20m) stone statues of their ancestors. They cut down the island's trees for timber to move the statues. They took essential natural resources for granted. By 1400, they had cut down the last tree. Without vegetation, the rich soil just blew away. Crops failed, there was no timber to build fishing boats or house roofs -- and there was no way out. Famine led to wars over the remaining scraps, and only a few survivors remained by the time Europeans arrived in 1722.

M. Scott Taylor and James A. Brander. "The Simple Economics of Easter Island: A Ricardo-Malthus Model of Renewable Resource Use" *The American Economic Review* 88.1 (1998): 119-138.

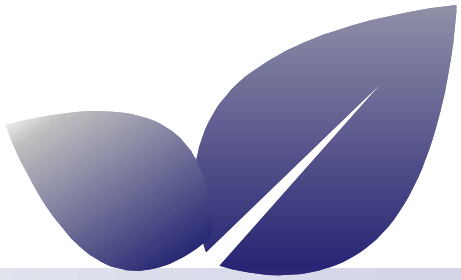
Introduction

- The Self-Extinction Premise
  - Some Historic Examples
    - The Minoan civilization

Collapse of the Minoan civilization
Archaeological evidence from the Minoan civilization of Crete has shown proof of deforestation during the late stages of development, leading many scholars to suggest that environmental mismanagement may have been a chief culprit in its collapse. Since the Minoans were a mighty sea power, they likely needed large quantities of wood to construct their ships.

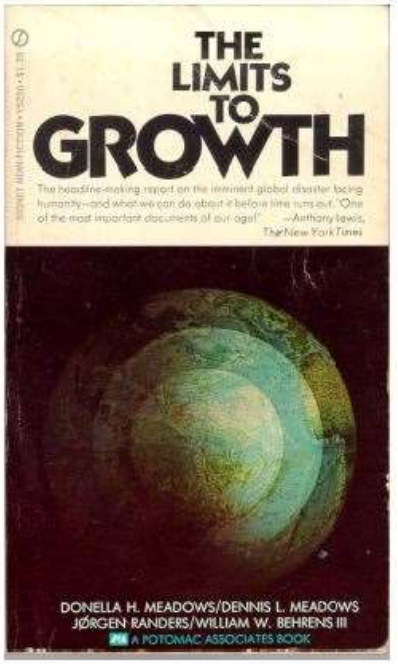
From local to global effects

- Although there is evidence that the relationship between human civilization and the environment has always been fraught, prior to industrialization, the effects of human intervention on the environment remained local.
- Over the past two hundred years, human demand on the environment has increased enormously, threatening the stability of the climate and global ecosystems.
- International concern gathered steam in the 1960s with the extremely influential publication ***Our Common Future***, also known as the Brundtland report, named after the World Commission on Environment and Development's chair, Ms. Gro Harlem Brundtland.
- The report established, for the first time, the connection between economic development and environmental degradation, while highlighting the emerging challenges of climate change. The report, in describing the problem of covering the needs of the ever-growing population without degrading environmental quality, offered the most well cited definition of **sustainability** as the



"development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987, p. 35).

Natural resources & environmental limits



- At the beginning of the 1970s, the **Club of Rome** drew again attention to the depletion of natural resources, focusing not on food but on fossil and mineral resources. It was estimated that various important natural resources such as oil and various metal ores would be exhausted within a few decades. As in the case of Malthus, this turned out not to be true. Technological advances led to the discoveries of new deposits, extending considerably the estimated remaining lifetimes of some resources.

- But this is no reason for complacency because, as we shown in the introduction, global resource use has more than tripled since 1970 reaching over 92 billion tons in 2017 and material productivity has not increased in the last 20 years. Furthermore, apart from natural resource limits, extremely serious environmental problems have emergent such as climate change, biodiversity loss and pollution. The main cause of these environmental problems is resource use, i.e., extraction and processing. The Global Resources Outlook 2019: Natural Resources for the Future We Want, UNEP, attributes more than 90% of global biodiversity loss and water stress, and more than half of global climate change impacts on resource use.

- Therefore, it is important for policy makers and businesses, to move towards decoupling resource use and impacts from economic growth. Business success will be determined by the development of new production methods and new products focusing on resource efficiency, circularity and sustainable resource management.

The problem defined

Resource use, measured as material extraction, has fuelled economic progress since the industrial revolution, at the same time causing human-made GHG emissions.

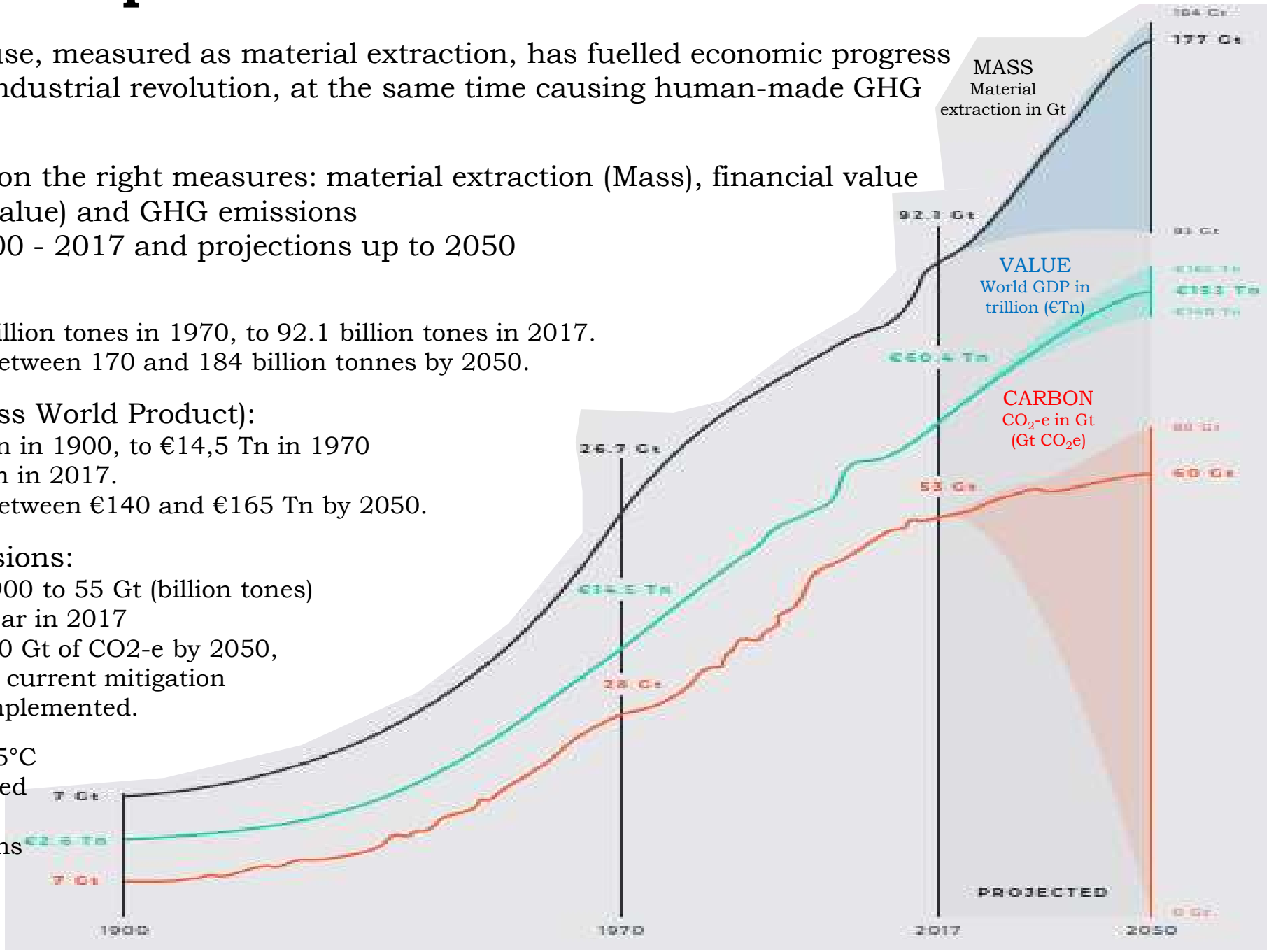
The figure on the right measures: material extraction (Mass), financial value creation (Value) and GHG emissions
Period: 1900 - 2017 and projections up to 2050

Mass:
From 26.7 billion tones in 1970, to 92.1 billion tones in 2017.
Projection: between 170 and 184 billion tonnes by 2050.

Value (Gross World Product):
From €2,6 Tn in 1900, to €14,5 Tn in 1970 and €60,4 Tn in 2017.
Projection: between €140 and €165 Tn by 2050.

GHG emissions:
From 7 in 1900 to 55 Gt (billion tones) of CO2-e /year in 2017
Projection: 60 Gt of CO2-e by 2050, even with all current mitigation ambitions implemented.

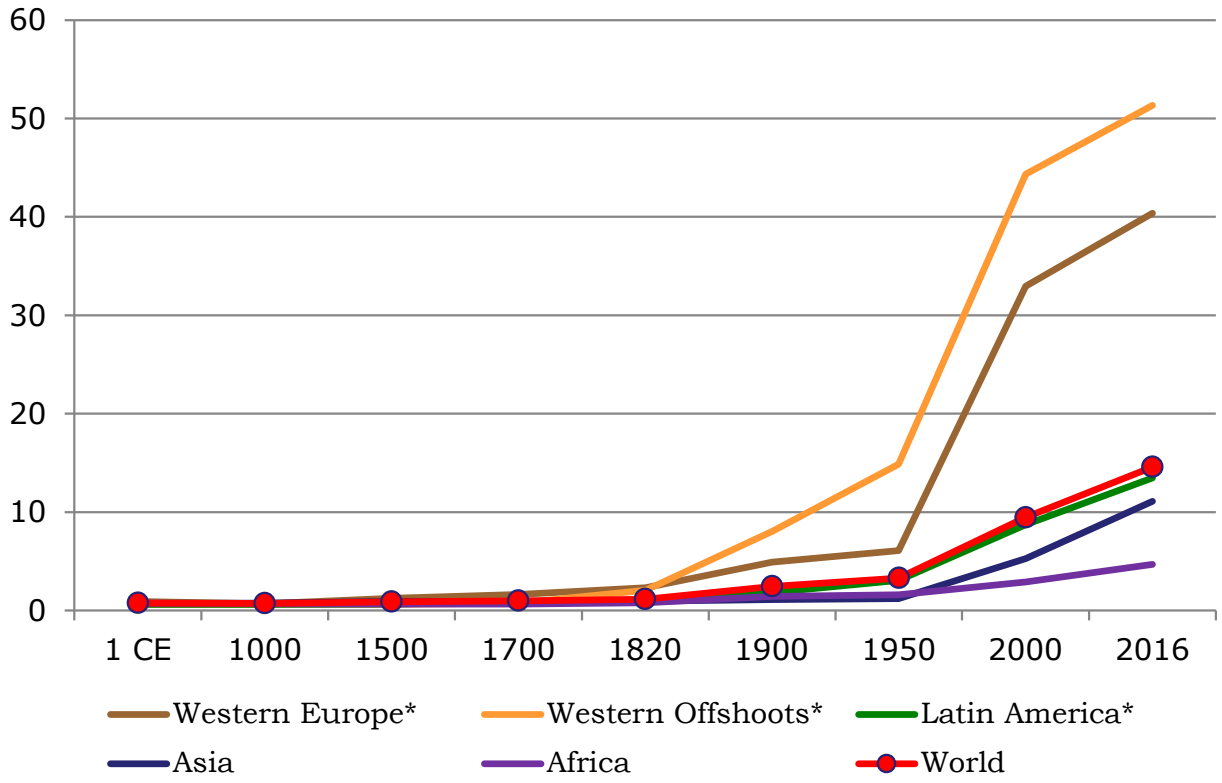
To keep a 1.5°C world, we need to achieve zero emissions by 2050.



Source: **The circularity gap Report**, https://www.circularity-gap.world/copy-of-report-1

The problem defined

- The average person in the world was very poor up to the beginning of the modern period (approximately 1700 CE.
- Regional variations start in the beginning of the Early Modern period (≈ 1500).
- Average world income in 1820, the time of the Industrial Revolution, was only about 50% higher than in 1 CE.
- The world income/capita growth rate over the 1,820-year period, on averaged, was almost zero.
- Significant increases in the standard of living took place only in the 20th century, mostly in the West.
- In less than 70 years (1950 to 2016), GDP/capita increased 27 times in Western Europe.

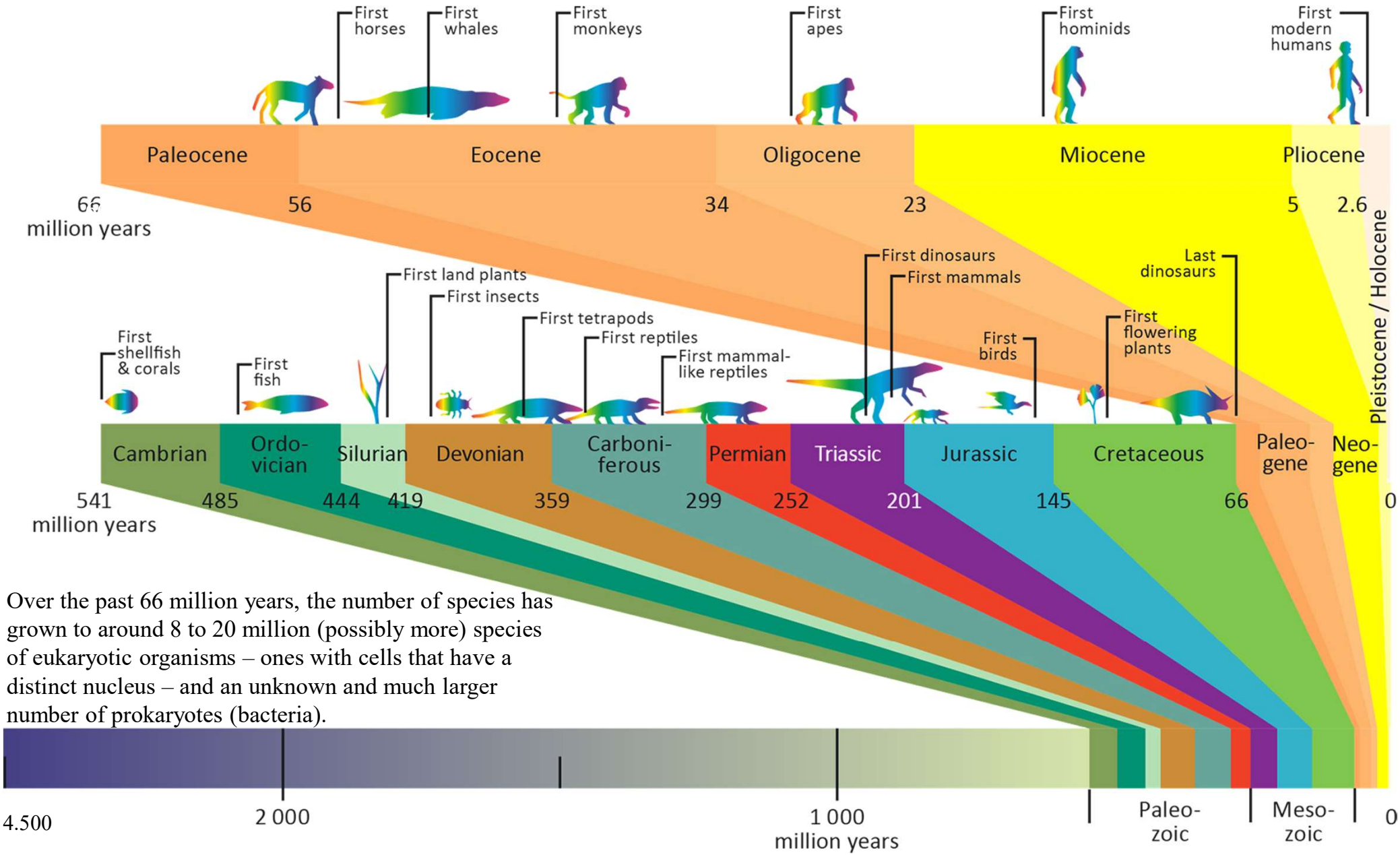


Deep History, 1 – GDP Per Capita (2011 International Dollars)

	1 CE	1000	1500	1700	1820	1900	1950	2000	2016
Western Europe*	0,914	0,676	1,232	1,63	2,313	4,904	6,078	32,956	40,364
Western Offshoots*	0,636	0,636	0,636	0,755	2,07	8,027	14,867	44,331	51,342
Latin America*	0,636	0,636	0,66	0,843	0,999	1,822	3,048	8,728	13,47
Asia	0,725	0,747	0,904	0,909	0,939	1,099	1,201	5,286	11,102
Africa	0,747	0,676	0,66	0,668	0,774	1,444	1,596	2,889	4,68
World	0,747	0,723	0,898	0,978	1,132	2,446	3,277	9,456	14,574

Source: **Dasgupta Report** (2021). Note: 'Western Offshoots' include what are today US, Canada, New Zealand and Australia.

The problem defined

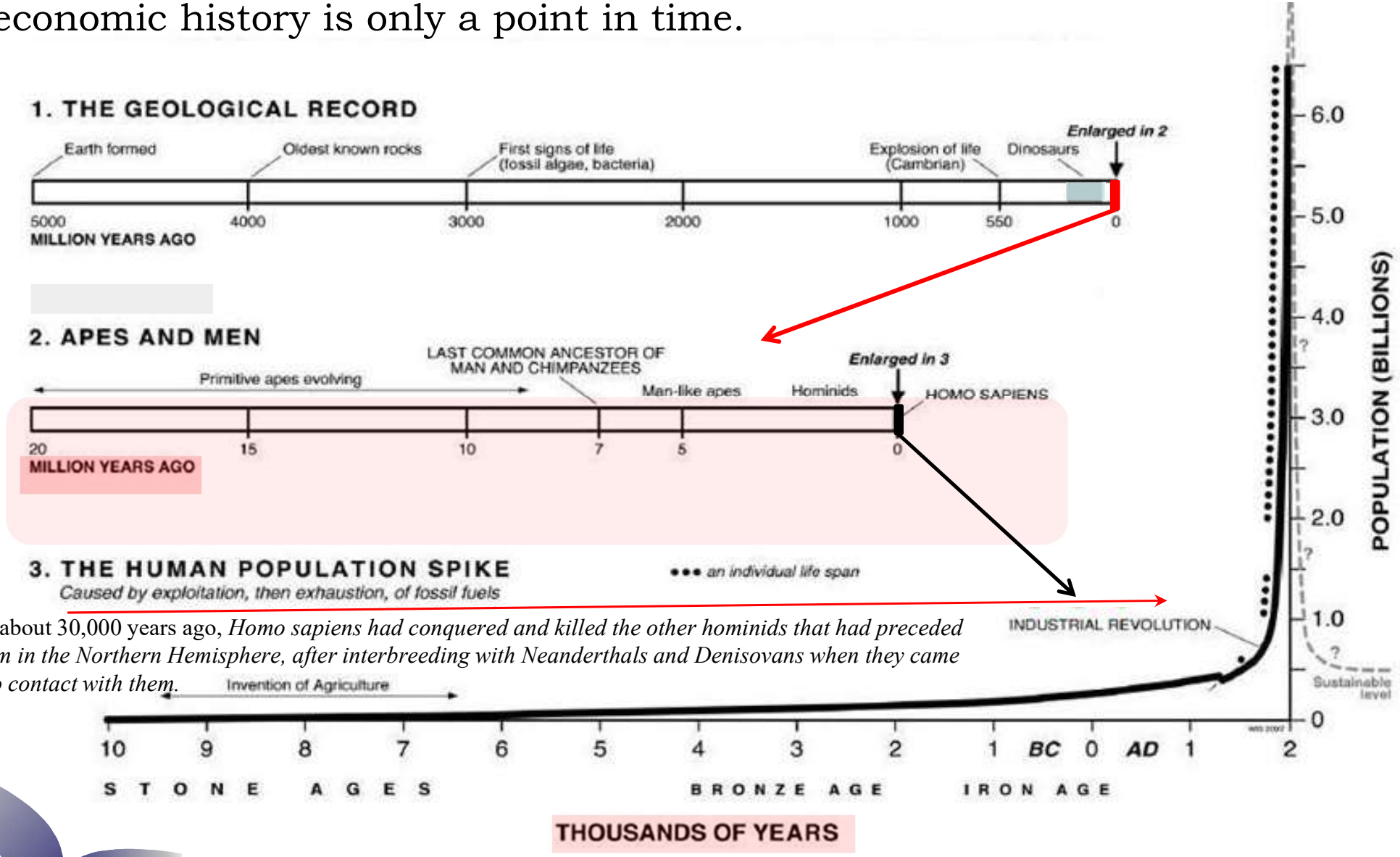


Over the past 66 million years, the number of species has grown to around 8 to 20 million (possibly more) species of eukaryotic organisms – ones with cells that have a distinct nucleus – and an unknown and much larger number of prokaryotes (bacteria).

Source: The Norwegian Petroleum Directorate

The problem defined

Human history is a mere blink in the history of the biosphere, and economic history is only a point in time.



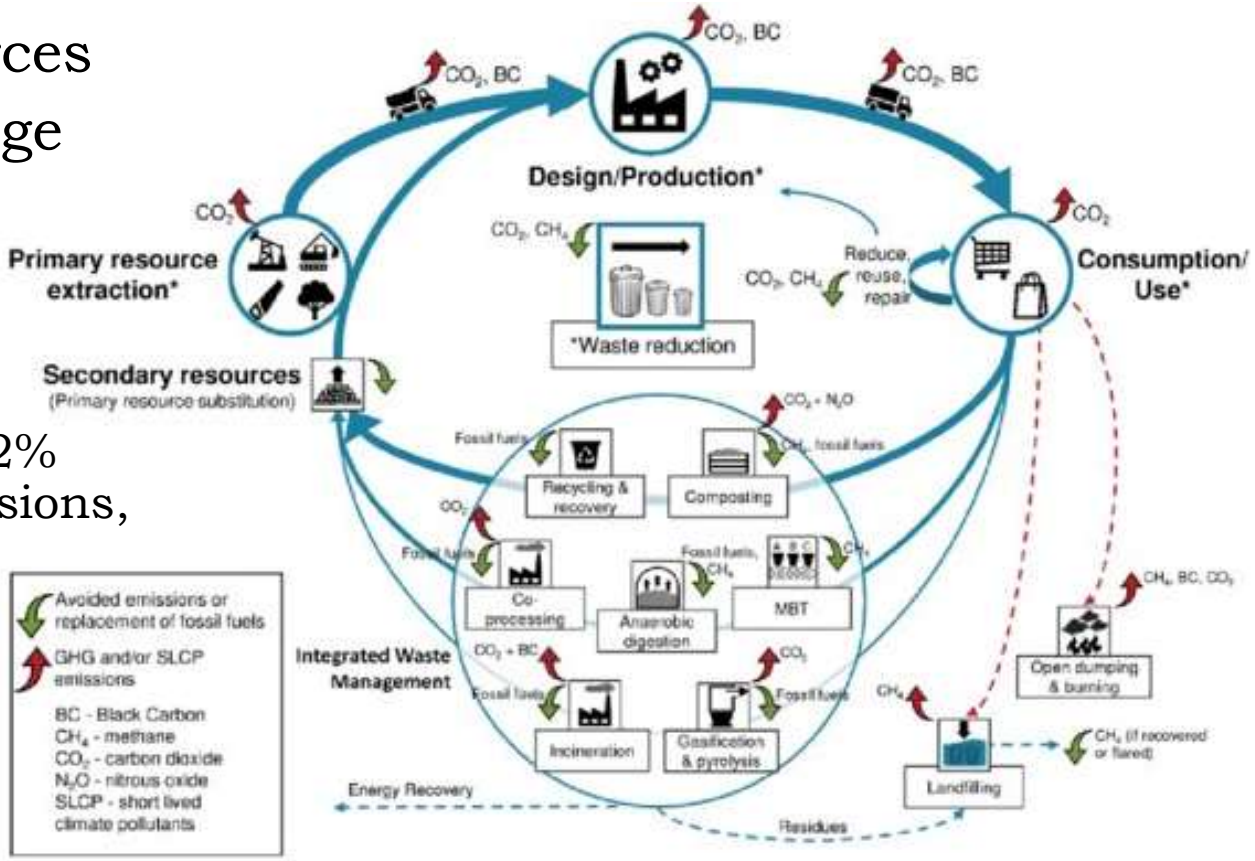
By about 30,000 years ago, *Homo sapiens had conquered and killed the other hominids that had preceded them in the Northern Hemisphere, after interbreeding with Neanderthals and Denisovans when they came into contact with them.*

Agriculture (the first appearance being some 12,000 years ago in the Middle East). At that time, the entire global population of humans is estimated to about 1 million people, with only about 100,000 in Europe.

The environmental problems defined

- Two are the most important problems regarding the interaction between economic activity and the physical environment:
  - ➢ Use of resources
  - ➢ Climate change

- Climate change and resource (over)use are closely linked: 62% of global greenhouse gas emissions, excluding those from land use and forestry, are released during the extraction, processing and manufacturing of goods.



Source: Sectoral implementation of nationally determined contributions - Circular economy & solid waste management

- These two problems create huge pressure for the transformation of economic activity and thus, on business behavior. Fundamental changes are already happening and will continue both on the level of products and processes. The first part of Teaching Module 1 establishes the problems and the general direction in which changes are occurring and will keep moving.

Resource use: global

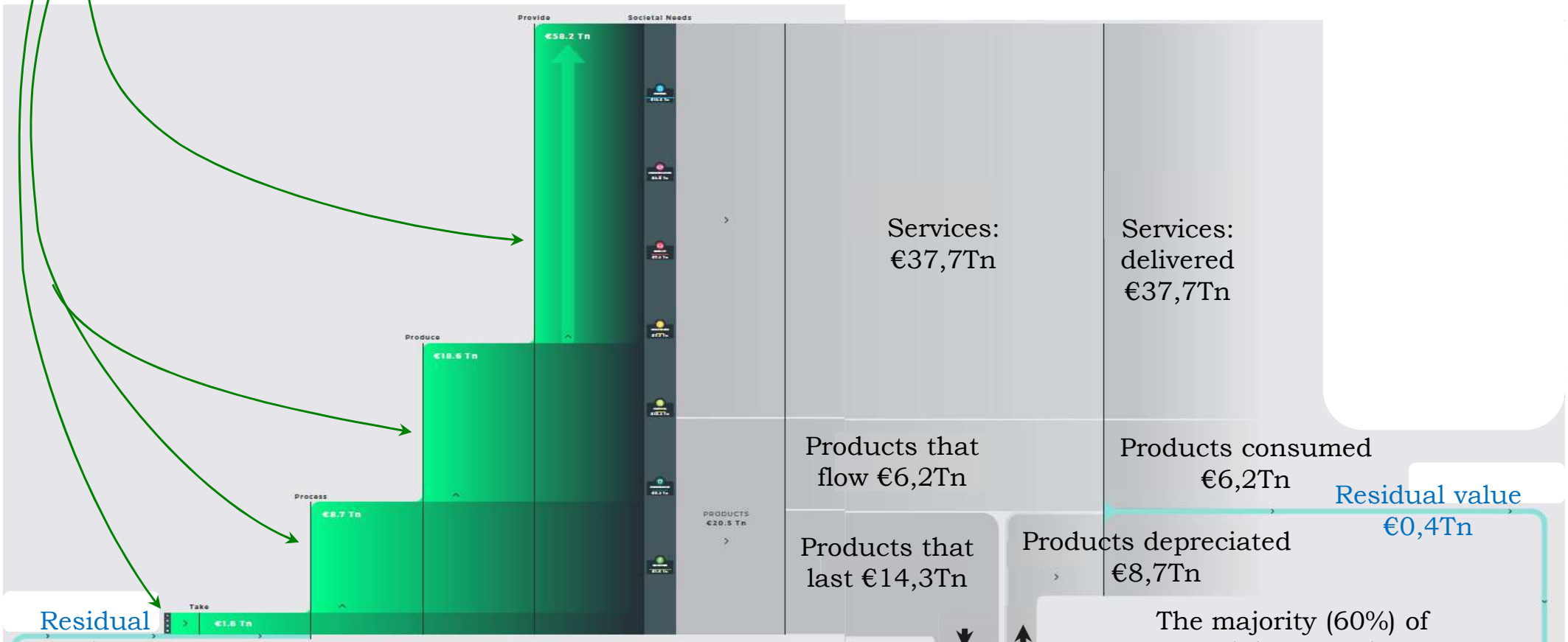
Measure: Gross Value Added (GVA) Time: 2016

Total GVA = €58.2 tril.

- Extraction (Take): €1.6Tn (2,8%)
- Processing (Process): €7.1Tn (12,2%) + Production (Produce): €9.9Tn (17%)
- Delivery (Provide): €39.6Tn (68%)

Contribution/sector:

- Manufactured products: €20.5Tn (35.3%)
- Services: €37.7Tn (64.7%)

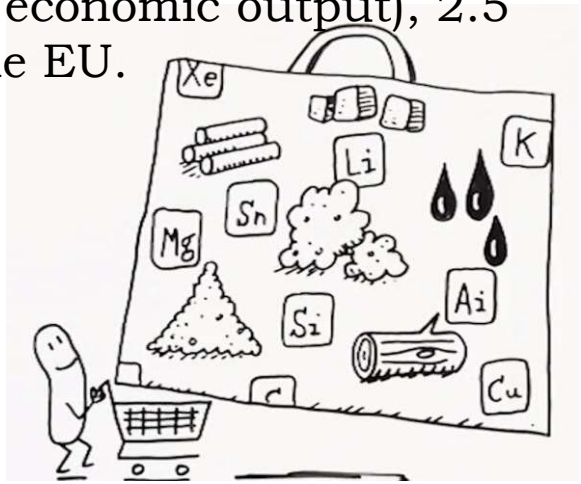


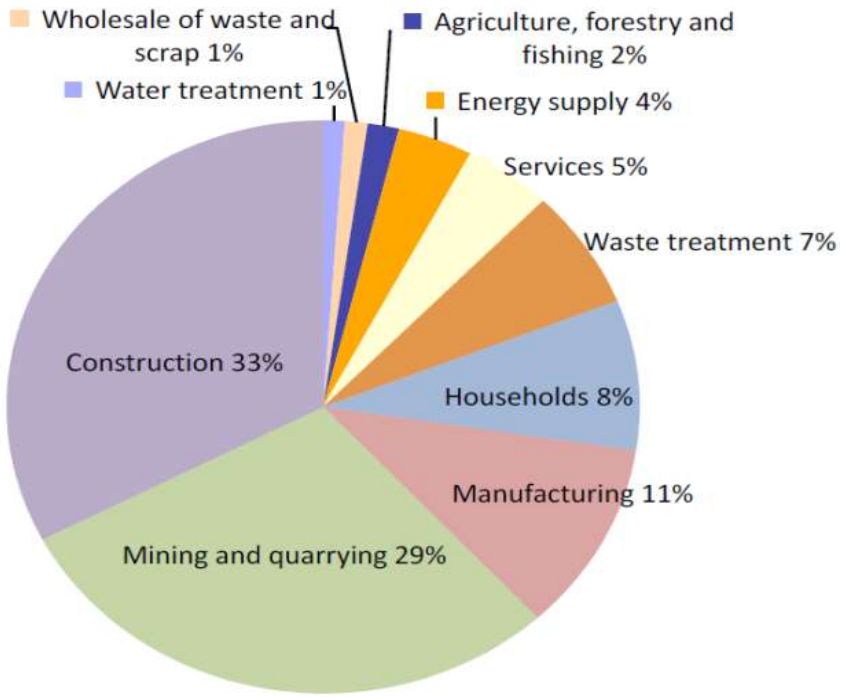
The majority (60%) of materials enter the economy in the form of Products that Flow and a smaller fraction as Products that Last.

Source: The circularity gap Report, https://www.circularity-gap.world/copy-of-report-1

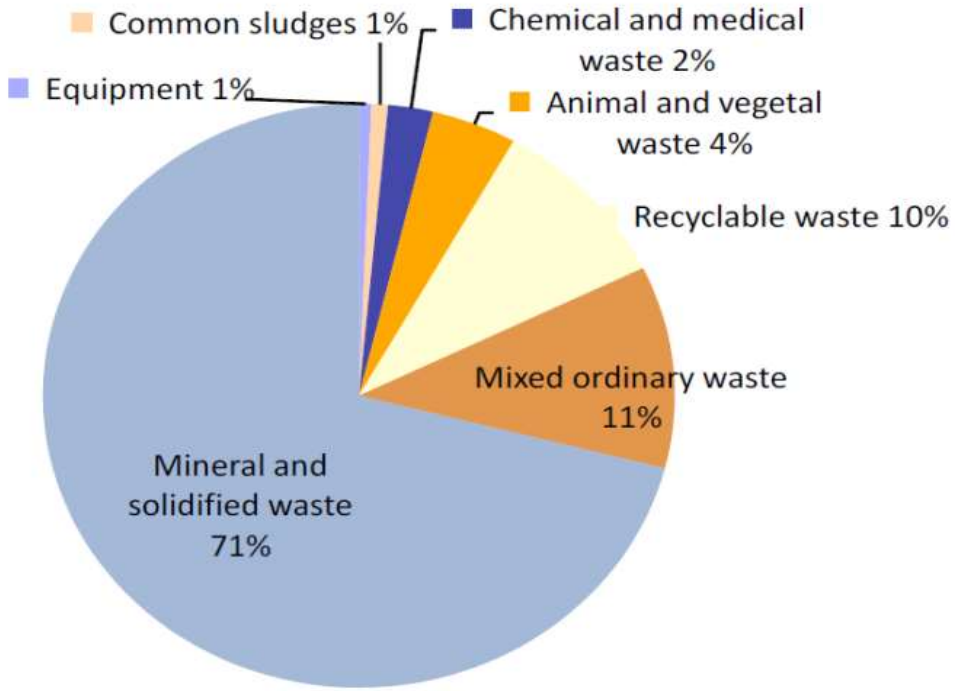
Resource use: Europe

- Although waste generation from manufacturing and services sectors in the EU-28 and Norway declined, between 2004 and 2012, by 25% and 23% respectively (and this despite respective increases of 7% and 13% in sectoral economic output), 2.5 Gt (billion tones) of waste are still generated each year in the EU.
- Every European citizen uses on average 14 tones of raw material and generates 5 tones of waste.
- More than half are generated by the construction and mining sectors an more than 70% are in the form of mineral and solidified waste.





- Waste generation in EU-28 by sector in 2012
  Source: Eurostat, 2016



Waste generation in EU-28 by type in 2012

Natural resource & environmental limits

- Overexploitation of natural resources

Food	Water	Forest
Food production has to increase in order to cover the increase in the population by 3 billions in the next 30 years.	**1/3 of global population has problems accessing drinking water. This is expected to double in the next 30 years**	**Tiber is the sole source of energy for 1/3 of global population. Tiber demand will double in the next 50 years**

MILLENNIUM ECOSYSTEM ASSESSMENT

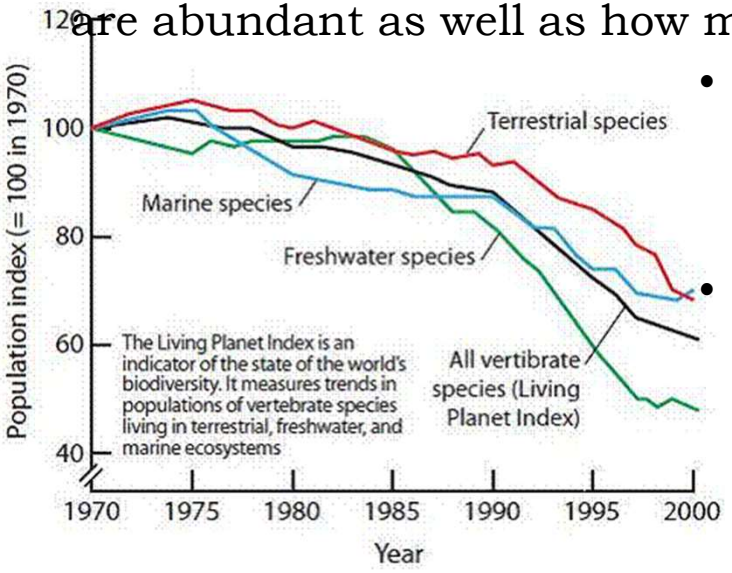
http://www.millenniumassessment.org/en/index.aspx

- Human well-being is highly dependent on ecosystems and the benefits they provide such as food and drinkable water. Over the past 50 years, however, humans have had a tremendous impact on their environment. To better understand the consequences of current changes to ecosystems and to evaluate scenarios for the future, UN Secretary General Kofi Annan has launched a comprehensive scientific study, the Millennium Ecosystem Assessment, which from 2001 to 2005, involved the work of more than 1,360 experts worldwide.

Natural resource & environmental limits

• Loss of Biodiversity

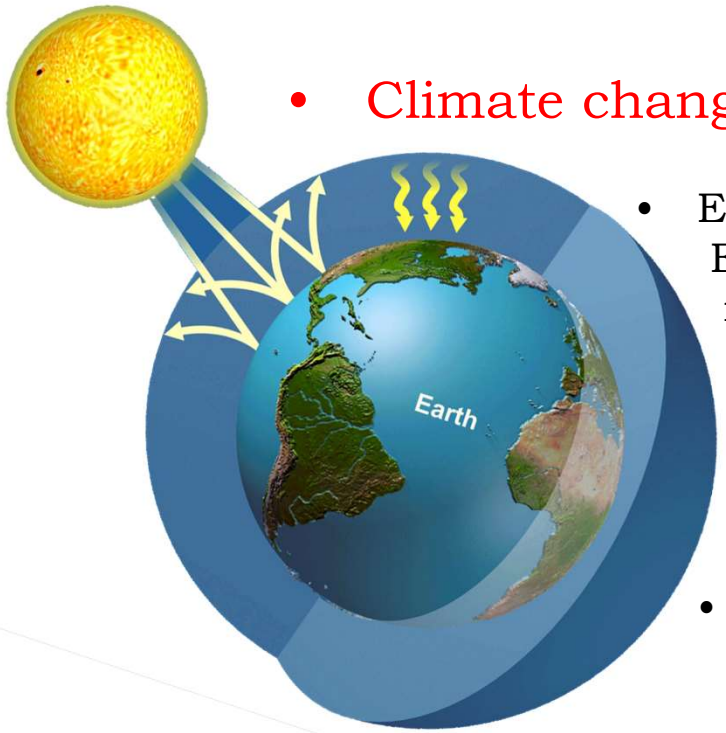
- Ecosystem services are the benefits people obtain from ecosystems. Biodiversity plays an important role in the way ecosystems function and in the many services they provide. Services include nutrients and water cycling soil formation and retention, resistance against invasive species, pollination of plants, regulation of climate, as well as pest and pollution control by ecosystems. For ecosystem services it matters which species are abundant as well as how many species are present.



- Biodiversity loss has negative effects on several aspects of human well-being, such as food security, vulnerability to natural disasters, energy security, and access to clean water and raw materials.
- The 'health' of the world ecosystem, based on measurements of the loss of forest area and freshwater and marine animal species, has declined by 30% in 25 years (WWF 1998).

- Half the natural forest cover world-wide has already disappeared, 13% in the last 30 years. Europe only has 1% of its original forest cover left. And there is no sign of this attack on biodiversity diminishing.

Natural resource & environmental limits



- Climate change crisis

- Energy from the Sun drives the Earth's weather and climate. The Earth absorbs energy from the Sun, and also radiates energy back into space. However, much of this energy going back to space is absorbed by “greenhouse” gases in the atmosphere (see the Figure). Because the atmosphere then radiates most of this energy back to the Earth’s surface, our planet is warmer than it would be if the atmosphere did not contain these gases.

- Without this natural "greenhouse effect," temperatures would be about 60°F lower than they are now, and life as we know it today would not be possible.

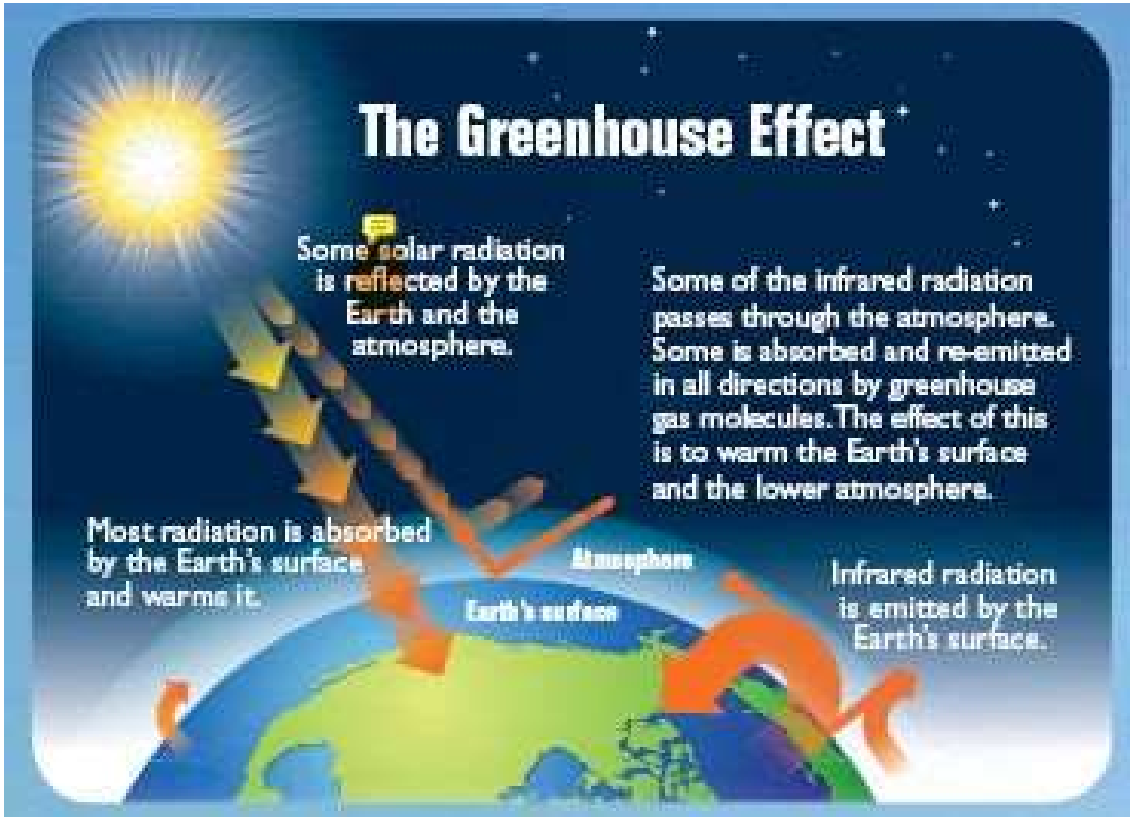
- During the past century humans have substantially added to the amount of greenhouse gases in the atmosphere by burning fossil fuels such as coal, natural gas, oil and gasoline to power our cars, factories, utilities and appliances. The added gases — primarily carbon dioxide and methane — are enhancing the natural greenhouse effect, and contribute to an increase in global average temperature and related climate changes.

- The climate change problem is closely linked to fossil fuels and we will consider it again when we discuss energy issues. Despite the fact that some steps in reducing fossil fuels use has been taken, average global temperature has already increased by 1°C relative to pre-industrial levels and is expected to reach 1.5°C around 2030, and 2 - 4.5°C by the end of the century and increases above 4.5°C cannot be excluded. (IPCC Report, October 2018).

Climate Change

– Greenhouse effect

Energy from the Sun drives the Earth's weather and climate. The Earth absorbs energy from the Sun, and also radiates energy back into space. However, much of this energy going back to space is absorbed by “greenhouse” gases in the atmosphere (see Figure 1 of Greenhouse Effect). Because the atmosphere then radiates most of this energy back to the Earth’s surface, our planet is warmer than it would be if the atmosphere did not contain these gases.



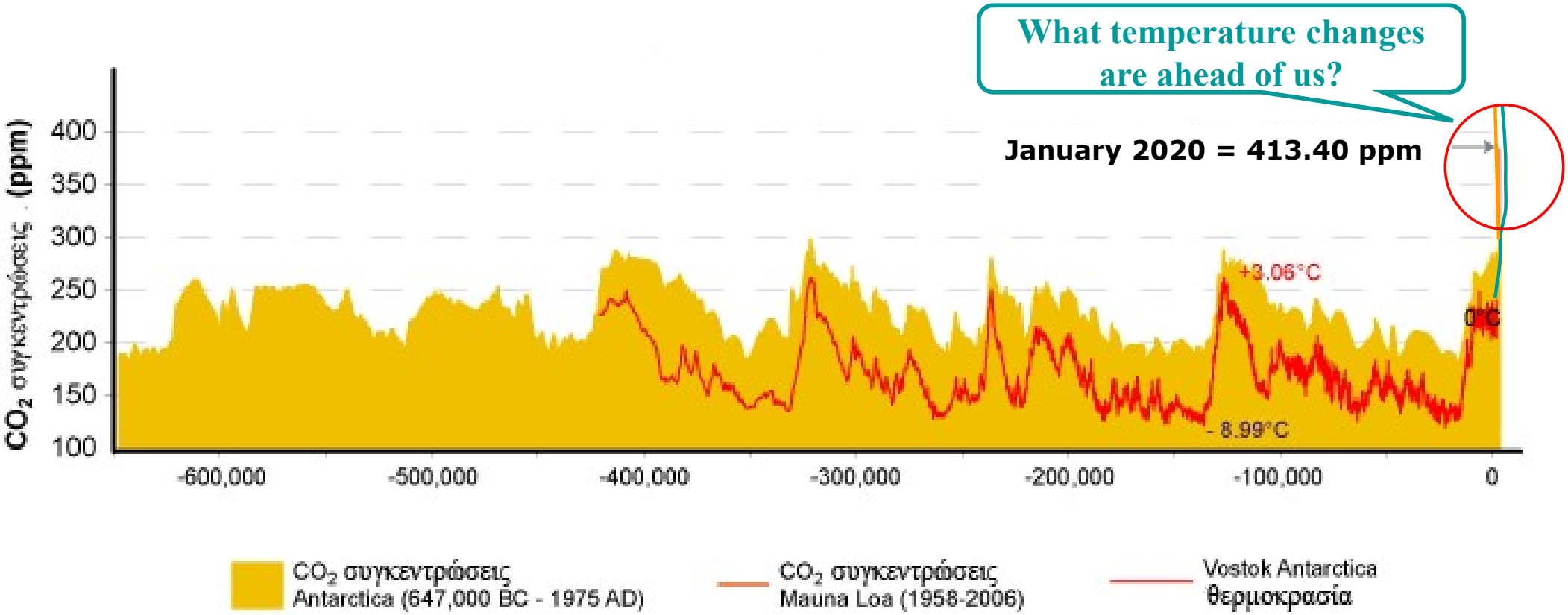
Without this natural "greenhouse effect," temperatures would be about 60°F lower than they are now, and life as we know it today would not be possible.

During the past century humans have substantially added to the amount of greenhouse gases in the atmosphere by burning fossil fuels such as coal, natural gas, oil and gasoline to power our cars, factories, utilities and appliances. The added gases — primarily carbon dioxide and methane — are enhancing the natural greenhouse effect, and likely contributing to an increase in global average temperature and related climate changes.

Climate Change crisis

- COP25 (Μαδρίτη): WWF and Prado Museum use art to show climate change

Carbon and climate change



The red line shows changes in temperature and the orange solid shape shows CO2 concentrations for the past 649,000 years. The red line in the circle shows CO2 concentrations in the last two centuries and up to 2006.

Fossil fuels

- Fossil fuel consumption
- The solar energy originally stored in the plant or animal is eventually converted into energy stored in carbon and hydrogen bonds of the fossil fuel. The fuels that took millions of years to make are being used at an enormously rapid rate. The Figure below presents the use of fossil fuels over time, including an estimation of how long they might last.

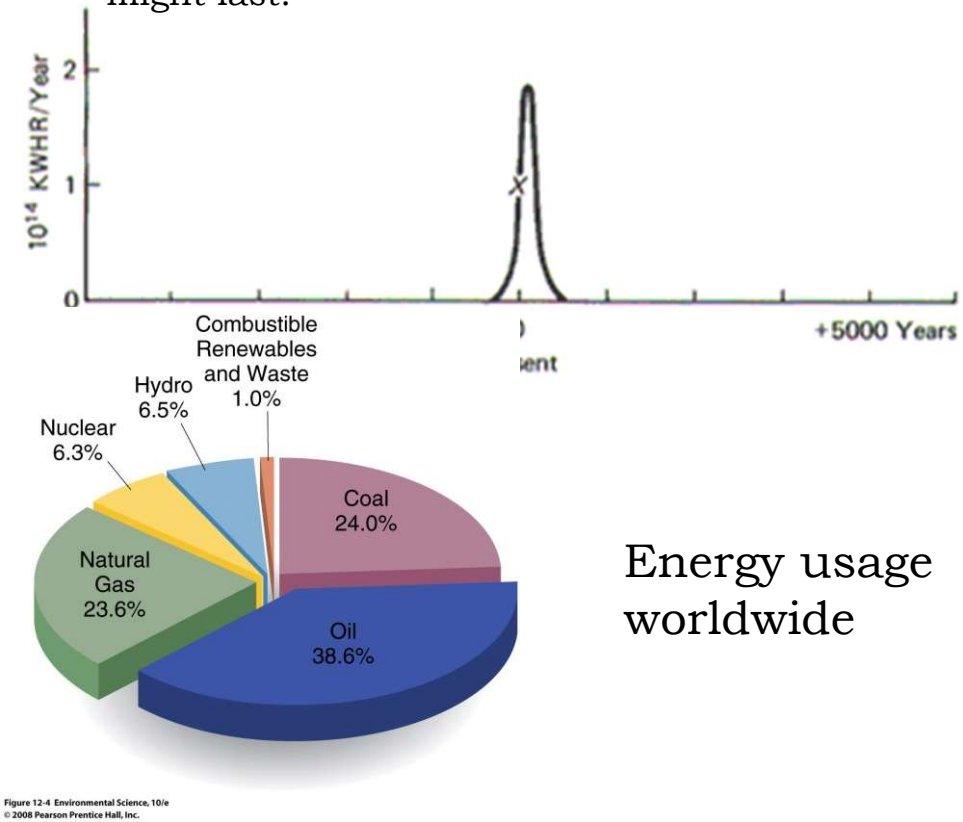
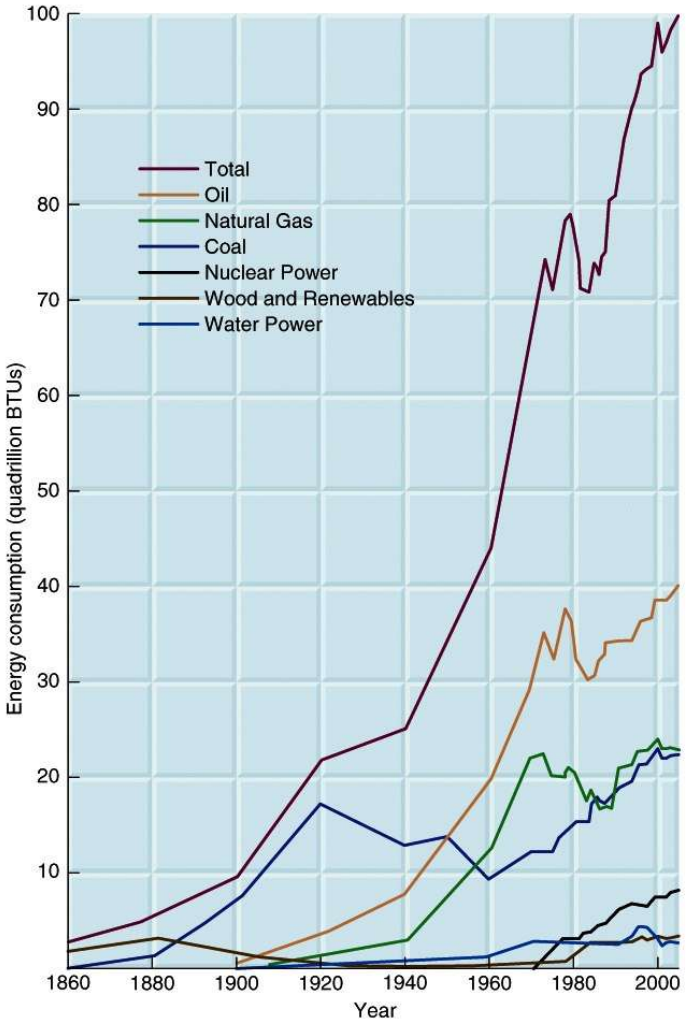


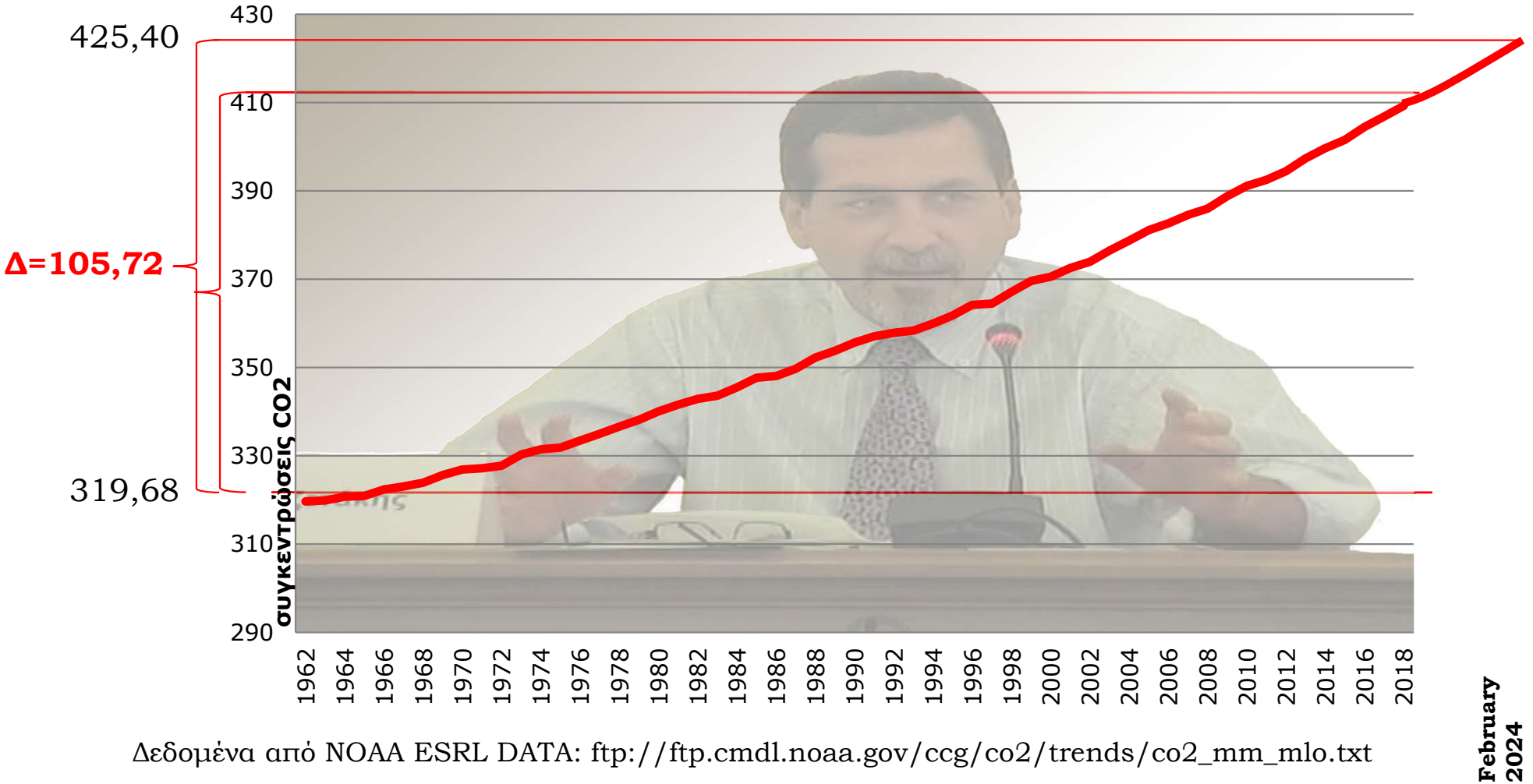
Figure 12-4 Environmental Science, 10/e
© 2008 Pearson Prentice Hall, Inc.

Energy usage worldwide



Energy consumption in the US
The top three sources = oil, coal and natural gas. Coal was the dominant energy source throughout most of the early 1900's (88% of energy in 1920).

Carbon and climate change



Δεδομένα από NOAA ESRL DATA: ftp://ftp.cmdl.noaa.gov/ccg/co2/trends/co2_mm_mlo.txt

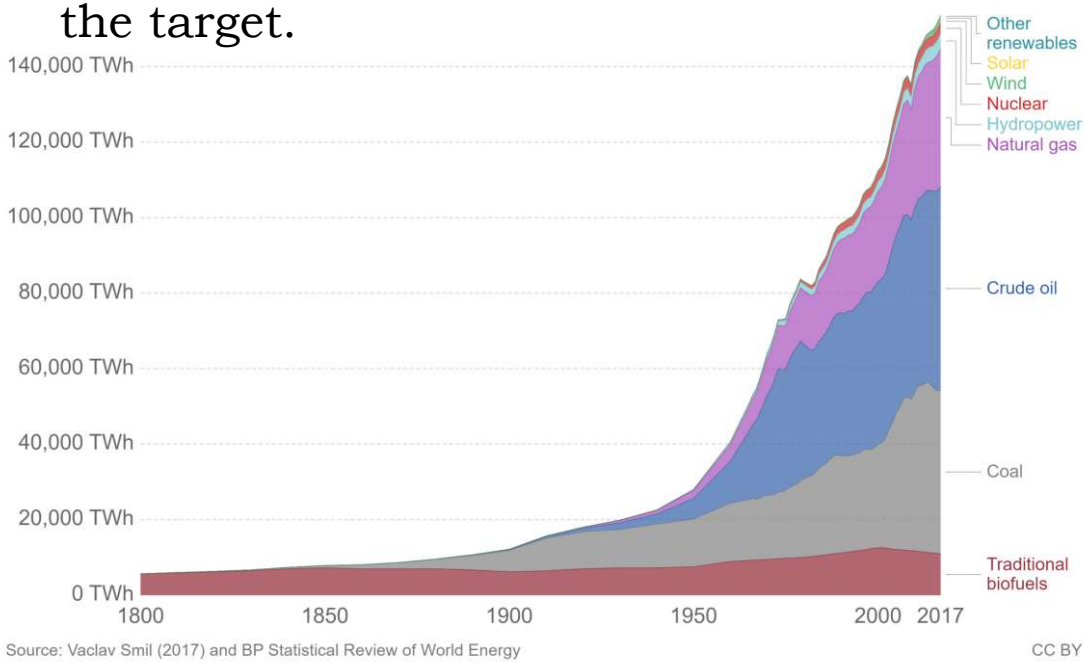
Given the difficulty to grasp changes over such long period, allow me to make the argument a bit more personal in an attempt to improve understanding.

Since I have already witnessed an increase of 88,38ppm, it's very likely that during my lifetime I will have contributed to an increase in CO_2 concentration by 100ppm, an amount greater than the max variance during the last 800.000 years, while the mean change/1.000y (for the 800.000y) never exceeded 25ppm!!!!!!!!!!!!!!!!!!!!

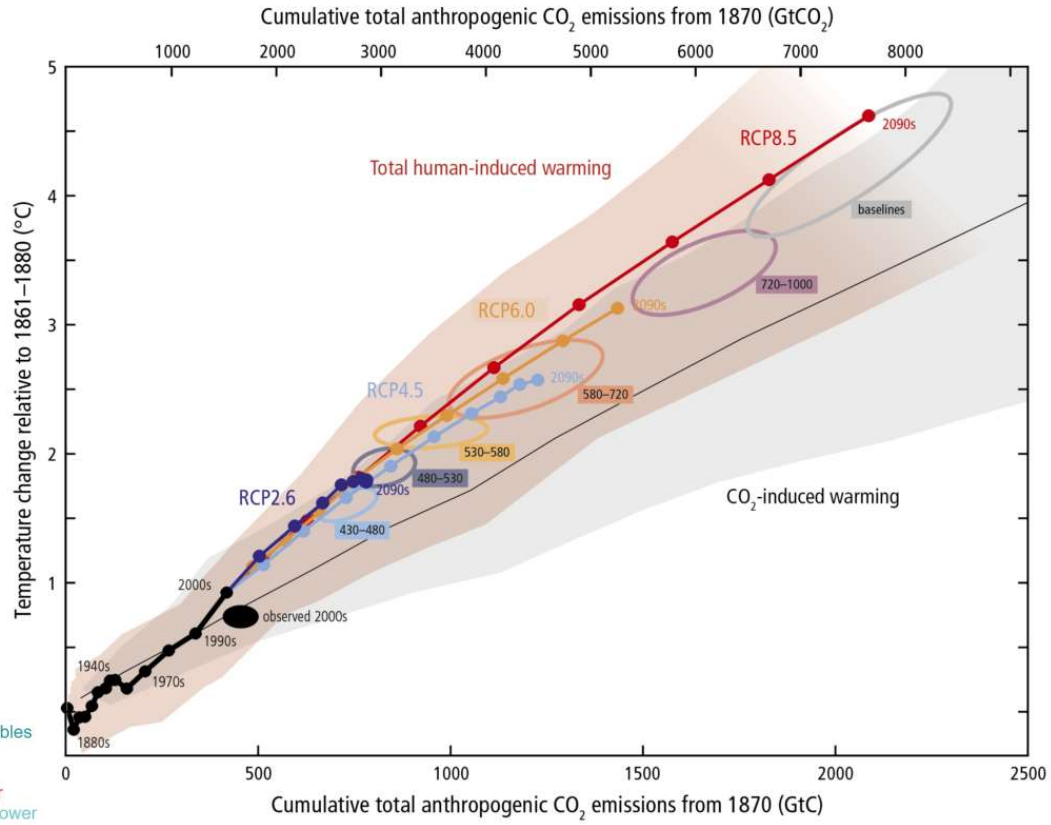
Climate crisis

"..To limit total warming <2°C relative to the period 1861--1880 with a probability >66% requires cumulative anthropogenic CO_2 emissions since 1870 <2900 $GtCO_2$" (IPCC, 2014).

Given the accumulation of CO_2 emissions, the remaining (for the 2°C target) cumulative carbon budget, is estimated at 1.000 $GtCO_2$. Therefore, we have to drastically reduce CO_2 emissions, is we are to stay close to the target.



Global primary energy consumption in TWh/year



Warming versus cumulative CO_2 emissions (Source: IPCC 2014, Figure SPM.5 (b))

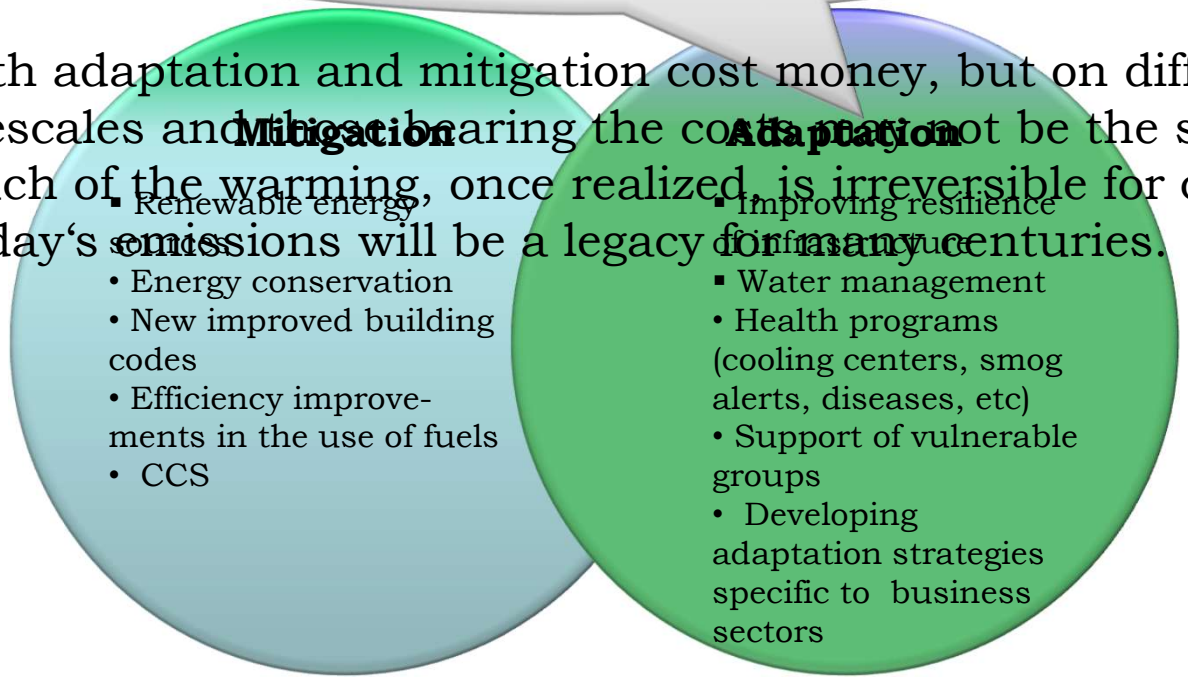
The solar energy originally stored in plants and/or animals is eventually converted into energy stored in carbon and hydrogen bonds of the fossil fuel. The fuels that took millions of years to make, are being used at an enormously rapid rate, creating the climate crisis.

Climate change Mitigation & Adaptation

Realizing the importance of the problem, there are two types of actions that should be undertaken: (1) Mitigation actions targeting the long-term reduction of greenhouse gas emissions (GHG) and (2) Adaptation actions targeting at ameliorating the non-reversible impacts of climate change in the short and medium run.

Adaptation: design of actions, but also behavioral changes for ameliorating climate change impacts

In November 2011, Canada announced a $148.8 million investment over five years (2011-2016) for the continued support of federal adaptation programs.



✓Both adaptation and mitigation cost money, but on different timescales and those bearing the costs may not be the same.
✓Much of the warming, once realized, is irreversible for centuries.
✓Today's emissions will be a legacy for many centuries.

«White paper - Adapting to climate change: towards a European framework for action.» Commission of the European Communities COM(2009) 147.

Education - awareness: It is extremely important that people understand the problem so that they change behavior

Mitigation is a collective goal and can only be achieved through some type of an international environmental agreement among all countries, such as the one signed (but not yet ratified) at Paris. Unilateral action, by one or a small number of countries will only have a small effect. Adaptation, to the unavoidable affects of climate change, depends on local effects and should be undertaken by governments, which should develop Adaptation Strategies at the national and local levels.

Adaptation

- An estimated 600 million people live directly on the world's coastlines, among the most hazardous places to be in the era of climate change. According to scientific projections, the oceans stand to rise by one to four feet by the end of the century, with projections of more ferocious storms and higher tides that could upend the lives of entire communities.

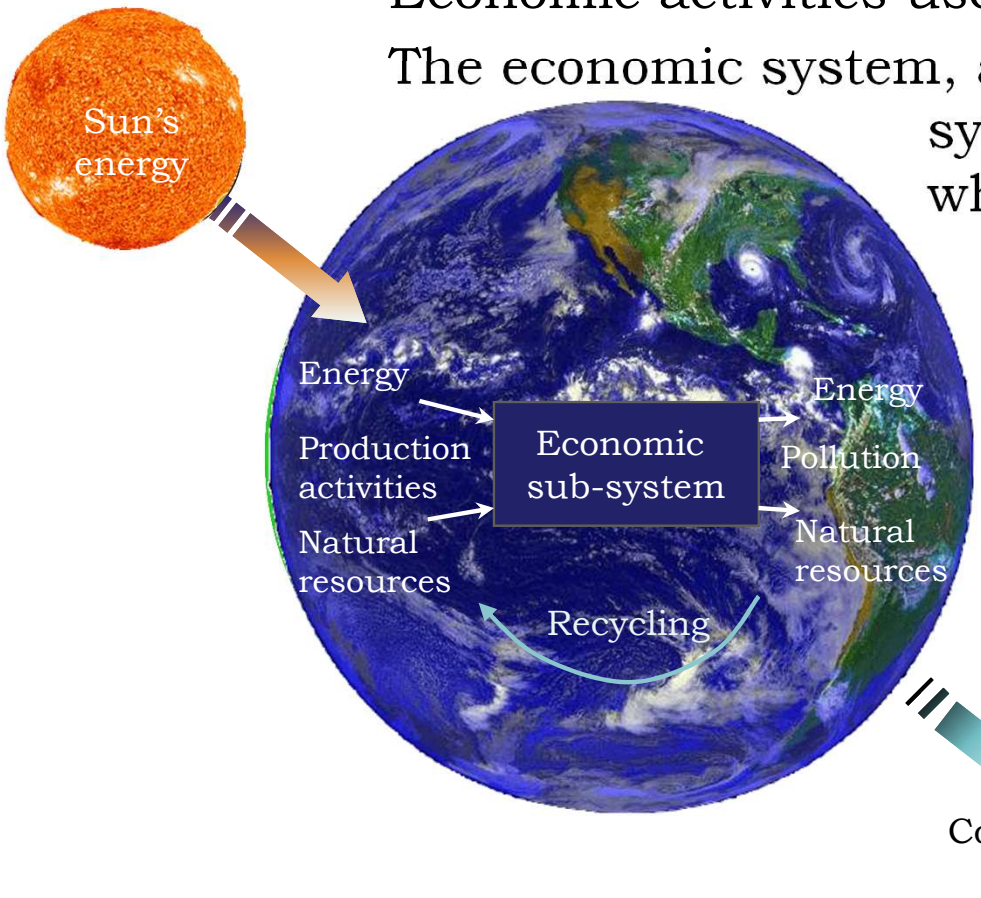
- Voters in San Francisco have approved a $425 million bond measure to start fortifying a sea wall along the bayfront road, the Embarcadero. Along the road sits some of the city's most expensive real estate; below it sits a subway line, a light rail tunnel, and part of the city's sewage infrastructure. The San Francisco airport is getting a $587 million makeover to raise its sea wall.

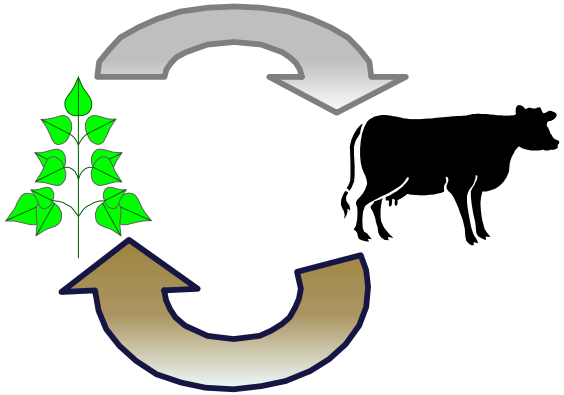
- In both places, it turns out, how you face the rising sea depends mostly on the accident of your birth: Whether you were born rich or poor, in a wealthy country or a struggling one, whether you have insurance or not, whether your property is worth millions or is little more than a tin roof. And, in both places, climate change has magnified years of short-sighted decisions. Manila allowed groundwater to be pumped out so fast that the land sagged and turned into a bowl just as the sea was rising. The Bay Area allowed people to build right at the water's edge, putting homes, highways, even airports at risk of catastrophic flooding.

Problem's cause: linear economy

Economic activities use resources and generate waste.

The economic system, as currently designed, is a linear system unlike the natural processes which are cyclical.





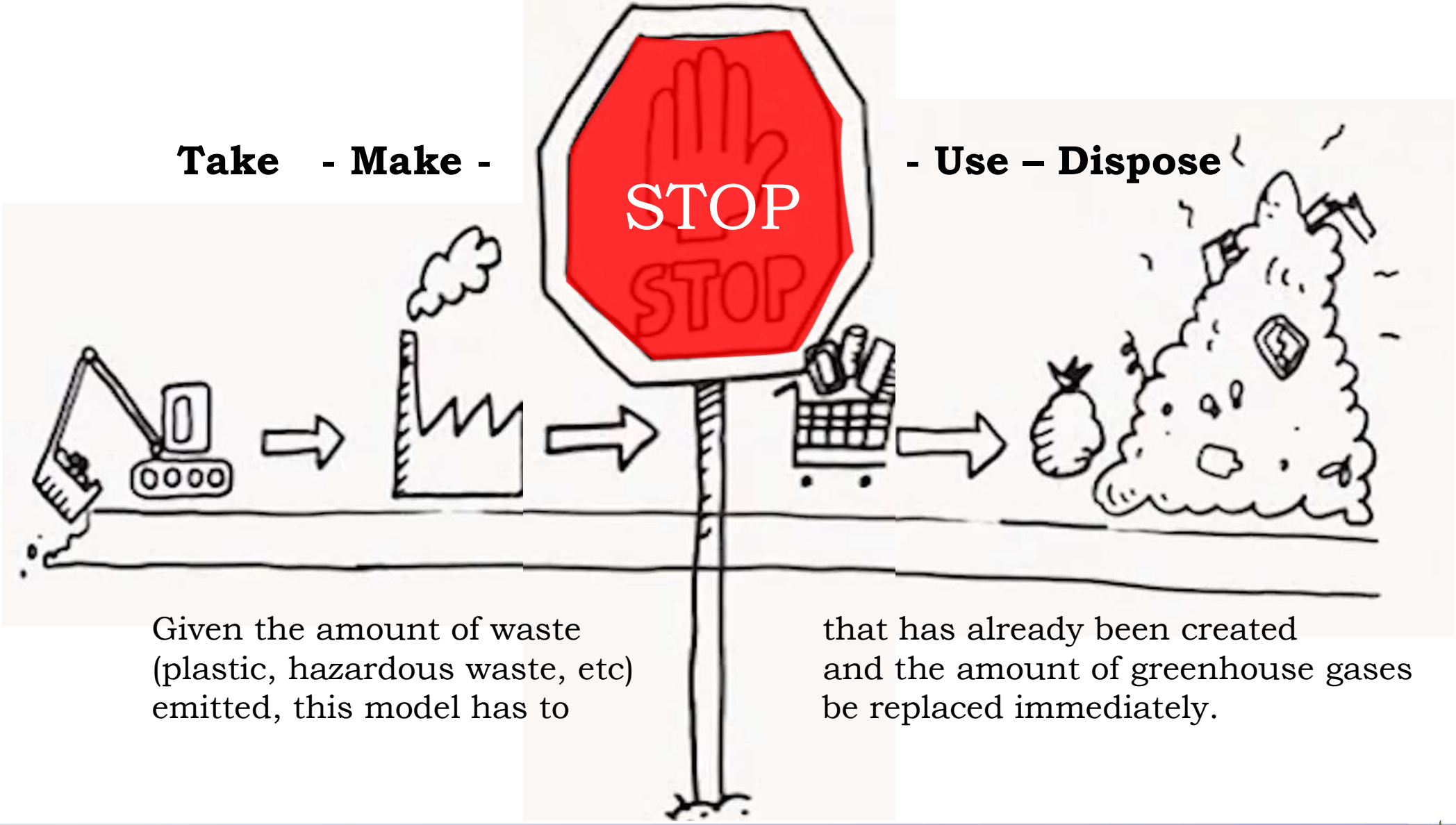
*Note: It is not that the system destroys the waste (this would contradict the first law of thermodynamic). Rather, the system transforms it into a substance not considered to be harmful to the ecological system, or dilutes it so that the resulting concentration is not harmful.

- This linearity of the system, puts under question its sustainability, given that natural resources are finite and the absorptive (assimilative) capacity* of the ecosystem is also limited. That is, we are in danger of running out of resources and degrading the quality of the environment to a level that cannot any longer support us.

Problem's cause: linear economy

- The problem of excessive use of resources (in a steeply increasing rate) and the generation of waste and harmful pollutants, it's a result of the currently used model of economic growth, which is almost completely linear:

Take - Make -



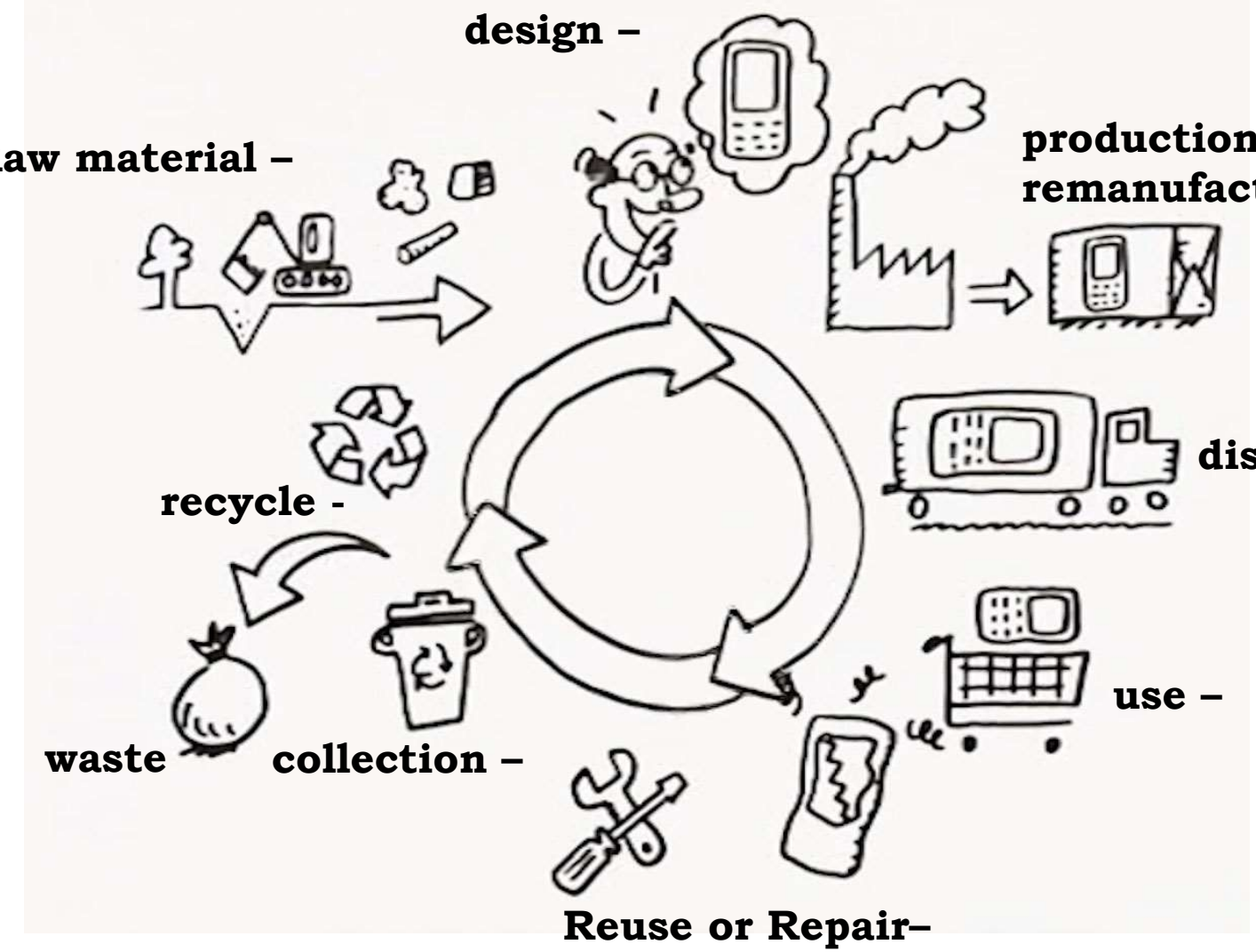
- Use – Dispose

Given the amount of waste (plastic, hazardous waste, etc) emitted, this model has to

that has already been created and the amount of greenhouse gases be replaced immediately.

Problem's solution: circular economy

- The solution is to move to a **circular economic growth model** where the lifecycle of products is much extended in order to reduce the use of raw materials and the production of waste**.** In this model the cyclical sequence is:



Circular economy: Definition & benefits

- The new, circular, model of production and consumption, should work towards extending the life cycle of products as long as possible, and will involve: sharing, leasing, reusing, repairing, refurbishing and recycling existing materials keeping them within the economy, creating additional value, wherever and for as long as possible. Products should be designed so as to have extended rather than limited lifespan (as was the case in the linear model which, through planned obsolescence, encouraged repeated purchases.
- **Benefits:**
  - **Reduced pressures on the environment**: reduced greenhouse gas (GHG) emissions and resource use.
  - **Enhanced security of supply of raw materials:** reduced risks associated with the supply of raw materials, such as price volatility, availability and import dependency.
  - **Increased competitiveness:** reduced costs by improving resource efficiency.
  - **Innovation:** improved incentives for innovation because of the need to redesign materials and products for circular use.
  - **Growth and jobs:** strengthened growth and creation of new jobs.

Circular economy: challenges

- Finance: need for financing public investment in waste management and digital infrastructure and business and particular SMEs, for which the cost of 'green' innovation and business models is a major barrier to the adoption of more sustainable practices. The lack of appropriate finance tools for mass market development of radical innovations is also seen as an issue.
- Key economic enablers: absence of, pricing systems encouraging efficient resource reuse and reflecting full environmental costs; incentives for producers and recyclers to work together in order to improve performance within and across specific value chains; and markets for secondary raw materials.
- Skills: a CE would require technical skills which are currently not present in the workforce. Skills would for instance enable businesses to design products with circularity in mind, and to engage in reuse, refurbishment and recycling.
- Consumer behavior and business models: a CE would require systemic shifts in consumer behavior and business models, with implications for everyday behavior, in terms of waste sorting and food waste for instance. Many industries are currently based on a fast turn-around driven by fashion.
- Multi-level governance: a transition to a CE would require action at many levels (e.g. international, European, national, local, business, and individual) and in many policy areas (e.g. waste management, professional training, packaging and product design, R&D, and finance). External trade aspects and existing EU policies such as the internal market would have to be taken into account.

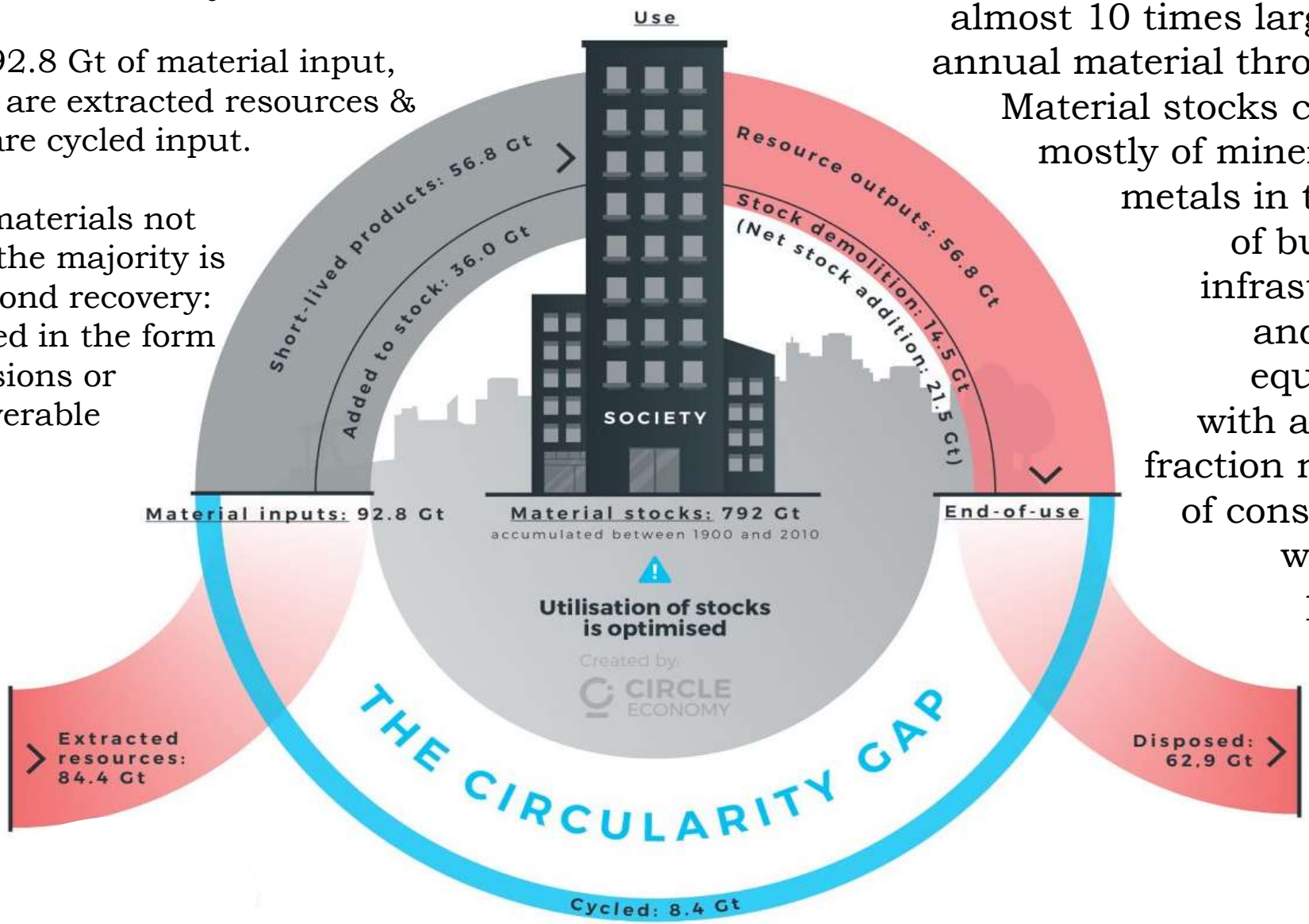
Circular economy: current state

Global circularity: 9%

Out of 92.8 Gt of material input, 84.4 Gt are extracted resources & 8.4 Gt are cycled input.

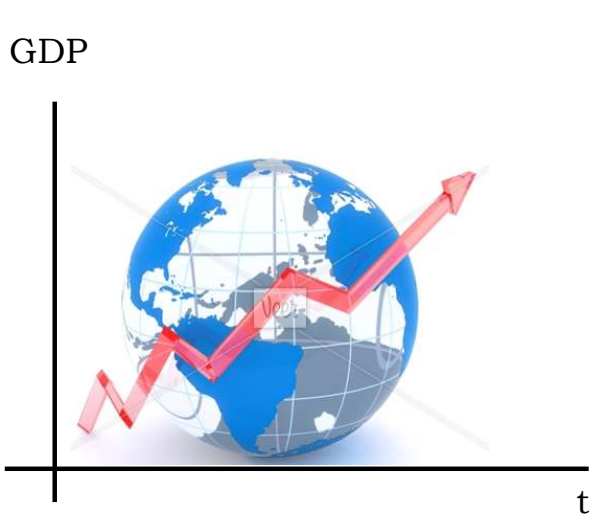
Of the materials not cycled, the majority is lost beyond recovery: dispersed in the form of emissions or unrecoverable waste.

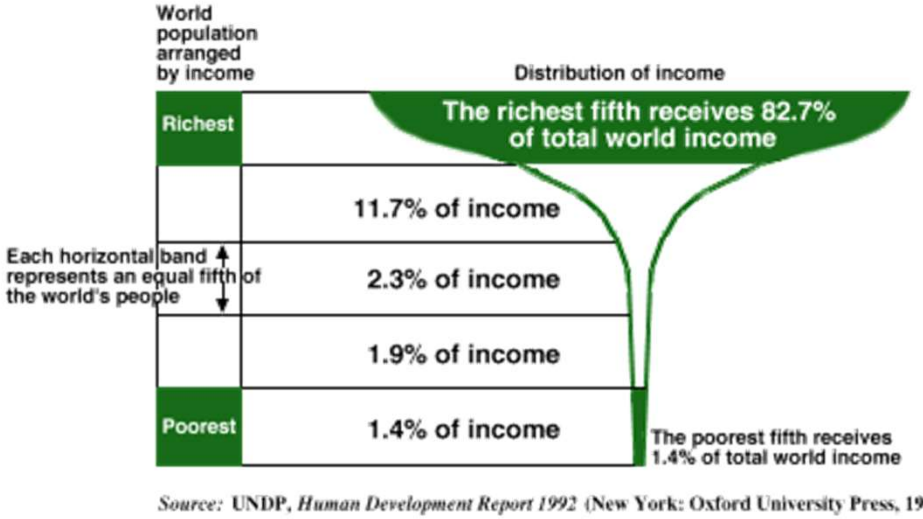
Accumulated material stocks are almost 10 times larger than annual material throughput. Material stocks comprise mostly of minerals and metals in the form of buildings, infrastructure and capital equipment. with a smaller fraction made up of construction wood and plastics.



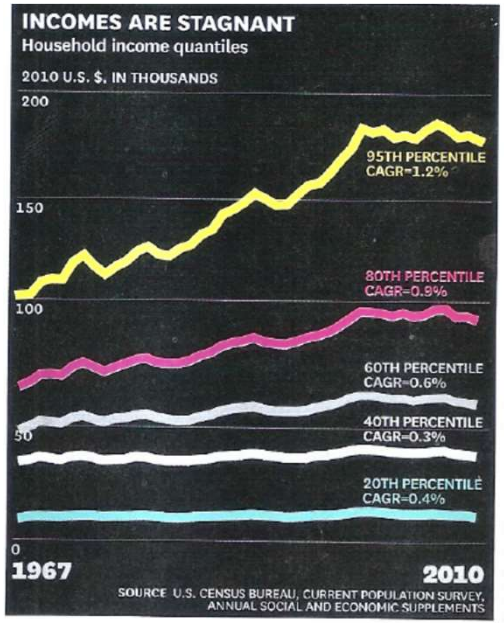
Source: The circularity gap Report, https://www.circularity-gap.world/copy-of-report-1

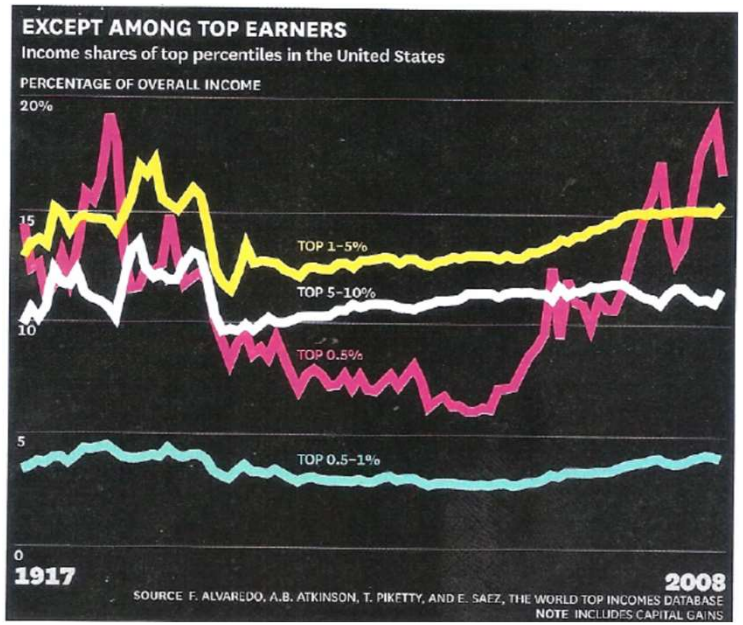
A layman's view of sustainability





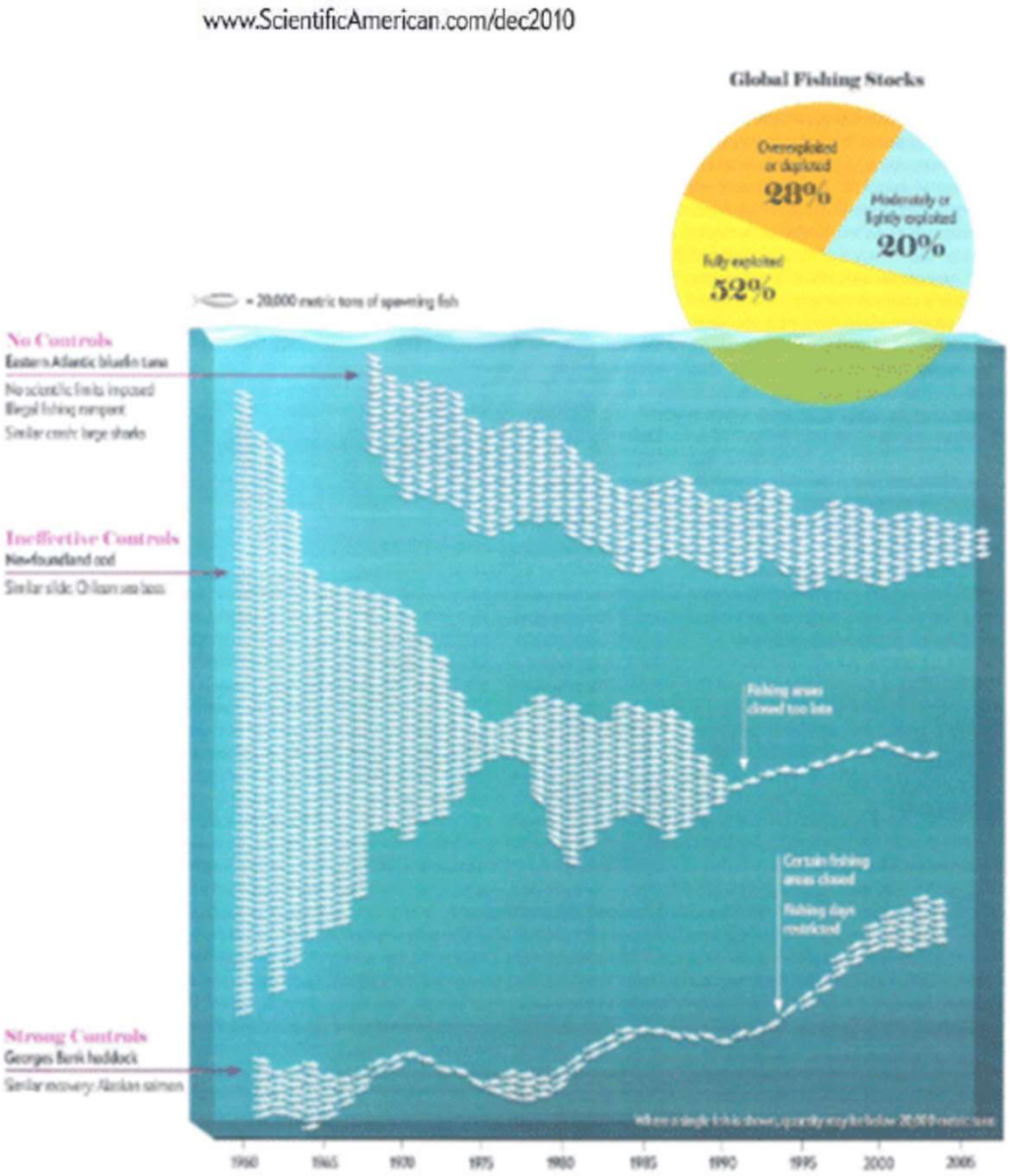
Source: UNDP, *Human Development Report 1992* (New York: Oxford University Press, 1992).



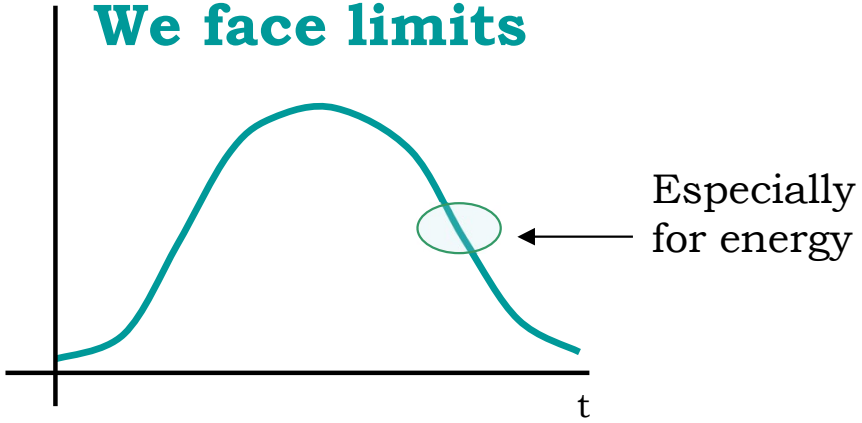


Harvard Business Review **March 2012**

A layman's view of sustainability



Natural resource use

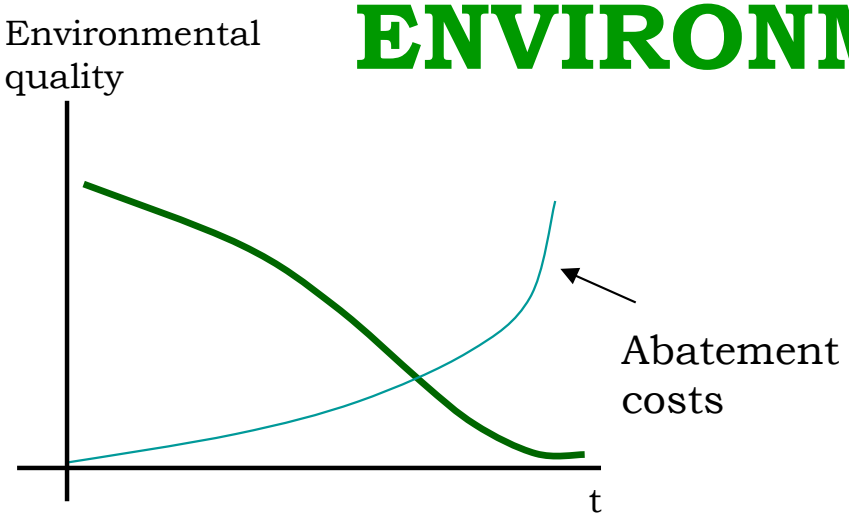


NATURAL RESOURCES

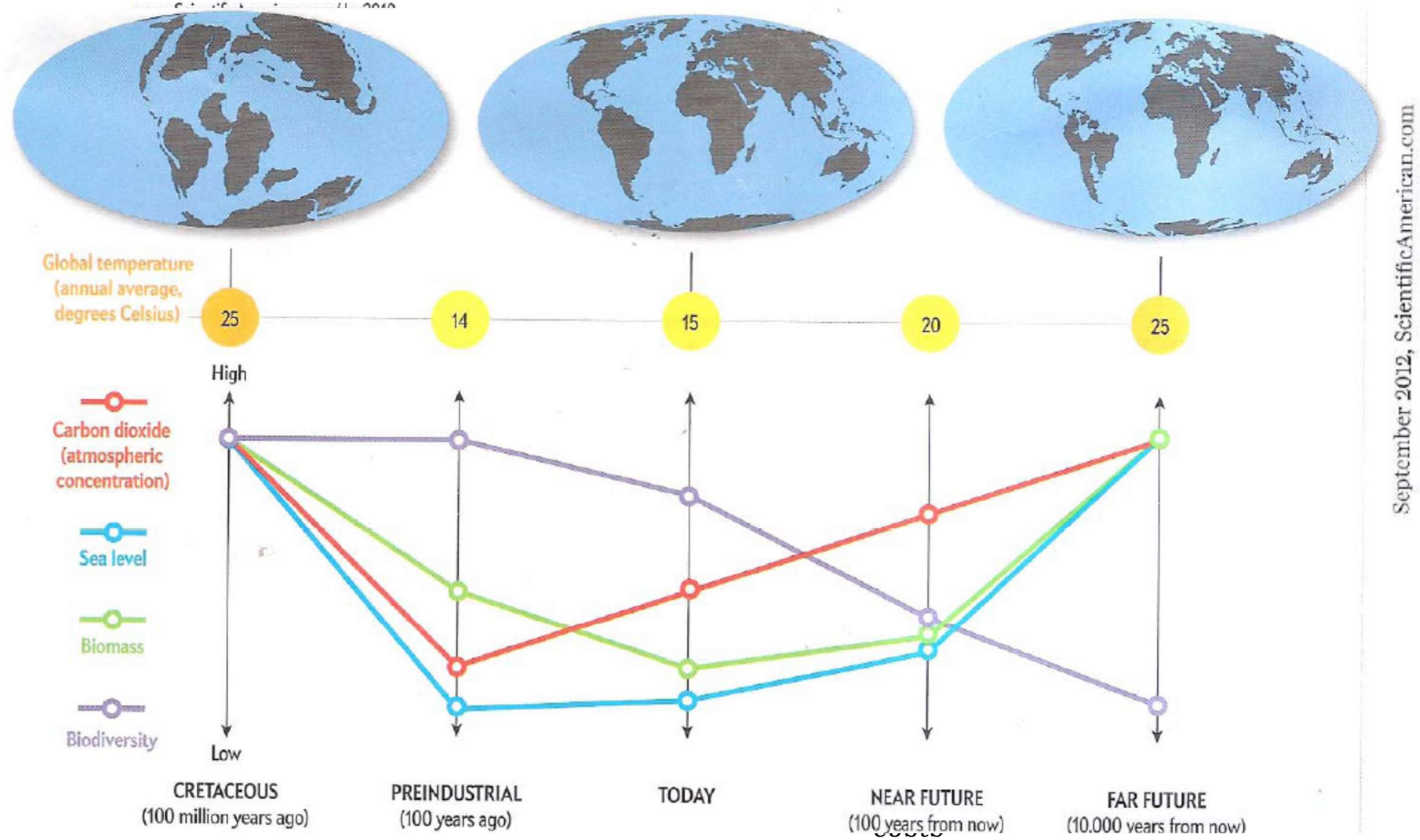
A layman's view of sustainability

Continuous degradation of the

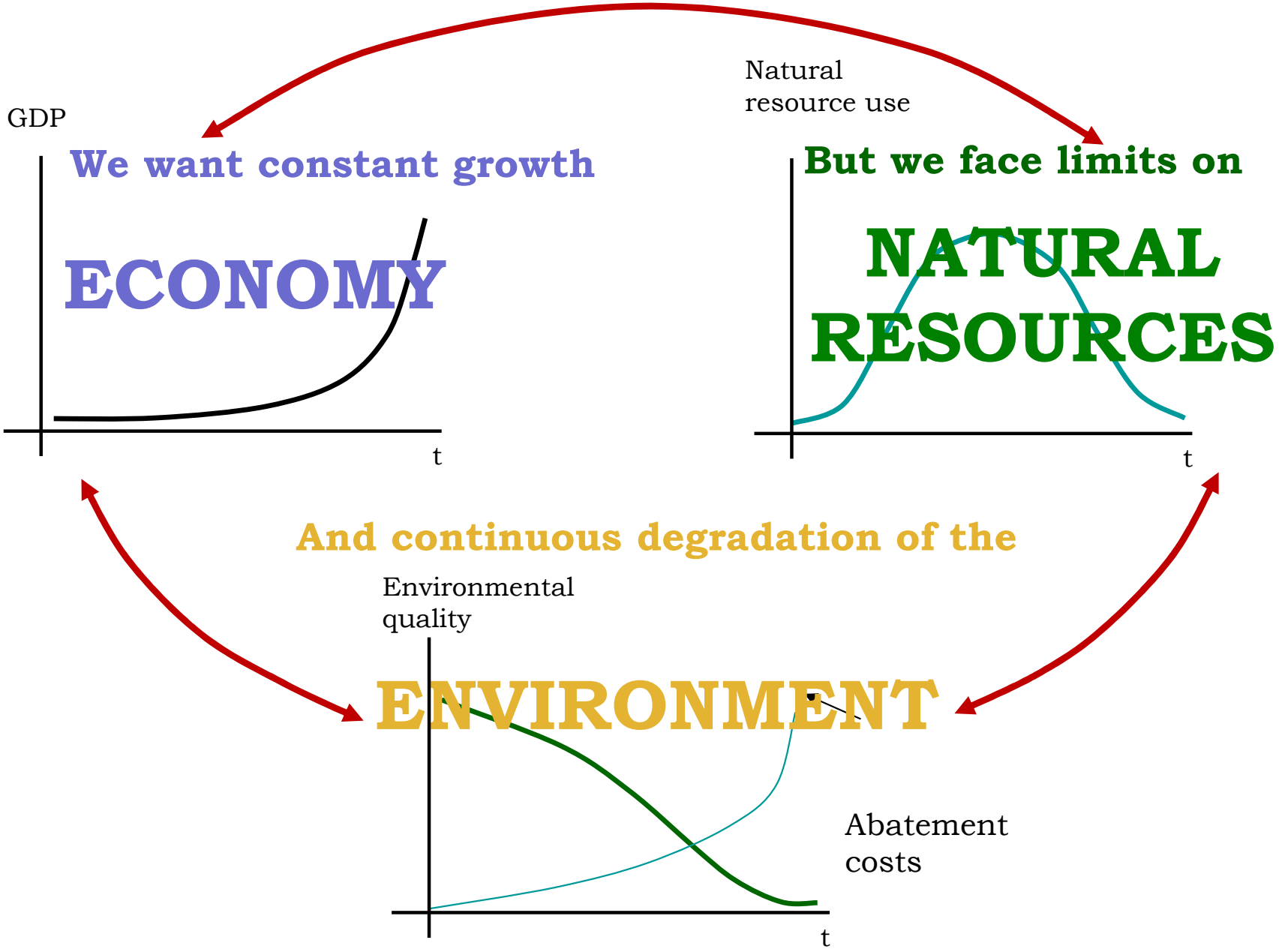
ENVIRONMENT



A layman's view of sustainability



A layman's view of sustainability



Sustainability

- A crucial factor in defining sustainability is the assumed degree of substitutability between human-made and natural capital.

- ***Weak sustainability*** requires the maintenance of a specified value of aggregate capital (which is the sum of **produced, human and natural capital** as we will discuss later), assuming that produced and human capital are substitutes for natural capital and, most importantly, natural resources.
- ***Strong sustainability*** does not allow such substitutability, requiring that certain environmental constraints are imposed on the working of the economic system.

- Restricting attention to natural resources used as an input to the production function, historical evidence favors the weak sustainability view. However, noone can assure us that this trend will continue. Quite the opposite happens with numerous environmental assets, such as air and water quality.
- Other dimensions that complicate the problem: (1) it involves **many generations** with potentially different preferences and thus divergent definitions of sustainability and (2) in light of great **uncertainty and irreversibility**, it has been broadly accepted that the basic principle in guiding public policies should be to err on the side of precaution.

- Social sustainability that considers issues such as equity within and between generations is even more difficult to define.

> For instance, in a quite famous wager, the biologist Paul Ehrlich betted, in September 1980, that prices of natural resources would increase, reflecting increased scarcity. He lost the bet to the economist Julian Simon, since prices had fallen a decade later.

Green growth or De-growth?

- Degrowth broadly means shrinking rather than growing economies, so we use less of the world's energy and resources and put wellbeing ahead of profit.
- The idea is that by pursuing degrowth policies, economies can help themselves, their citizens and the planet by becoming more sustainable.
- Practical degrowth actions might include buying less stuff, growing your own food and using empty houses instead of building new ones.
- Degrowth as a term was coined in 1972 by Austrian-French social philosopher André Gorz. As a movement, degrowth started to take off in the early 2000s, according to media platform openDemocracy. Modern degrowth protagonists include French economist Serge Latouche, who argues that society's current model of economic growth is unsustainable.

Green growth or De-growth?

- **Green growth** (infinite growth on a finite planet): the key to maintaining a habitable planet is ***decoupling*** — reducing the environmental impact associated with each pound or dollar of GDP. By deploying new technologies, and shifting the nature of our consumption, green growthers argue that we can do our bit for the environment while continuing to grow GDP, even in wealthy countries.

- **De-growth:** to be sure of offering a good life for all within planetary boundaries, we need to kick our addiction to consumption growth (in wealthy countries at least). These 'green growth sceptics' include those advocating for 'degrowth', 'prosperity without growth', 'steady state economics', 'doughnut economics' and 'wellbeing economics'.

- https://compassionatespirit.com/wpblog/2022/09/19/debate-degrowth-or-green-growth/