EV20001: ENVIRONMENTAL SCIENCE

Lecture #1

Causes of Modern Environmental Concerns

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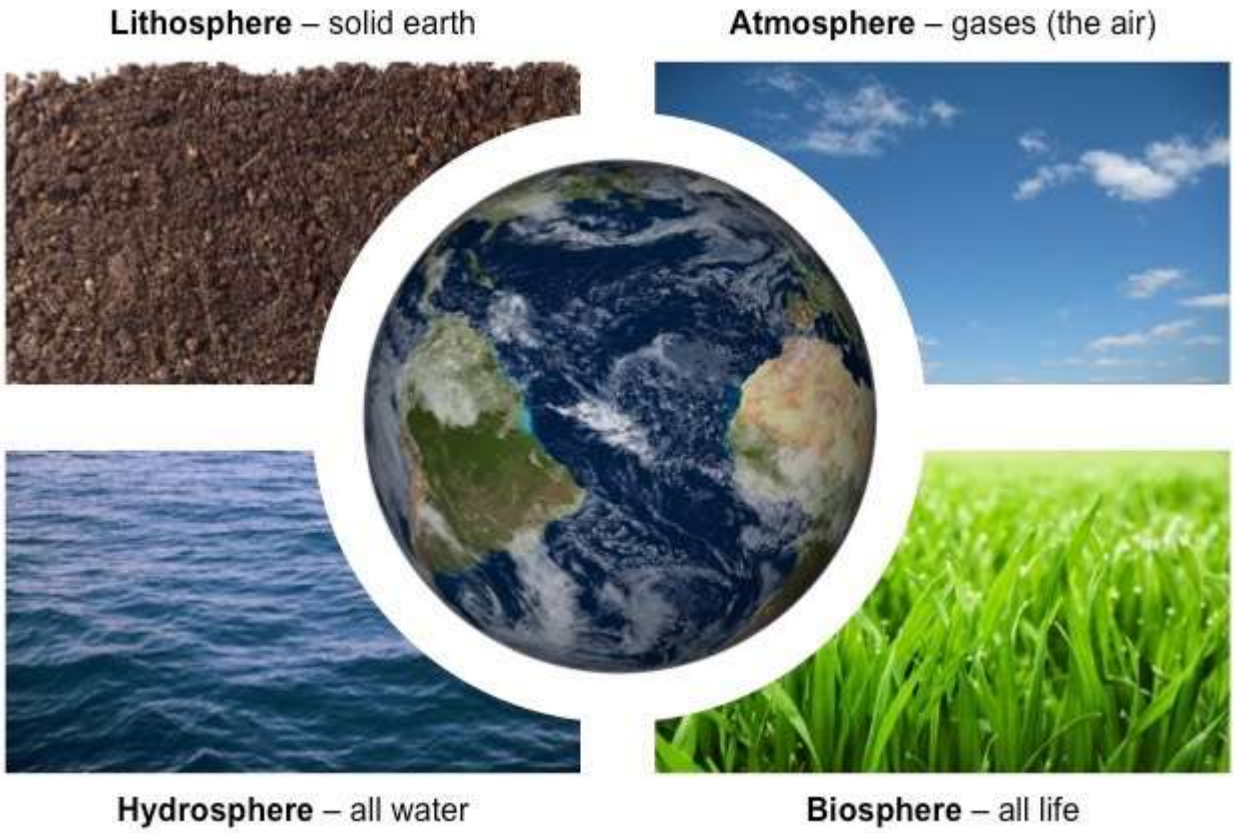
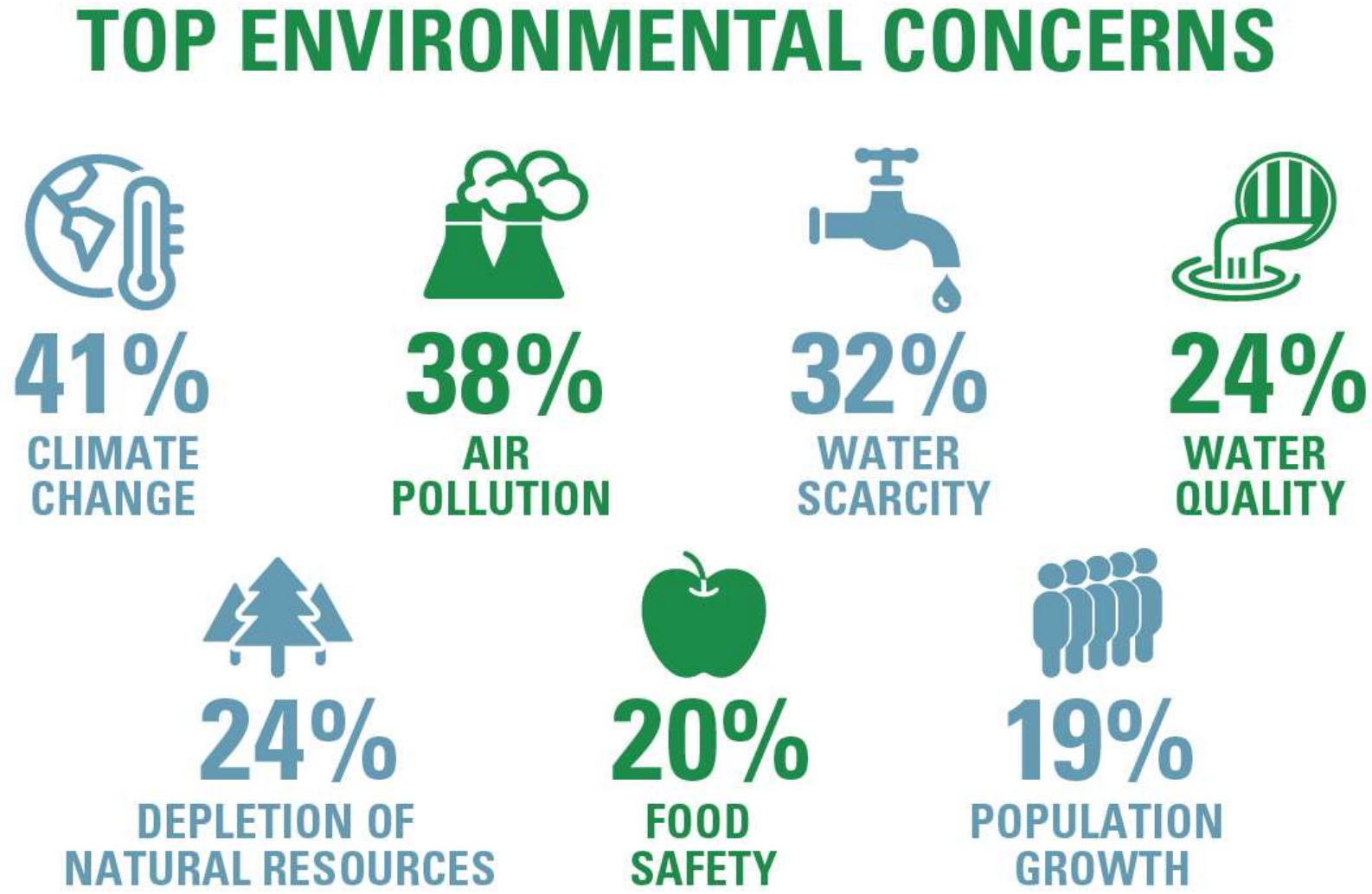
Global Environmental Issues



Global Environmental Issues

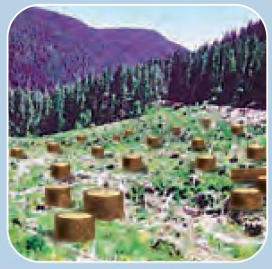


Sources: Cotton Council International & Cotton Incorporated 2017 Global Environment Survey --- survey of 7,365 women and men in the U.S., U.K., India, China, Mexico, Germany and Italy.

Causes of Modern Environmental Concerns

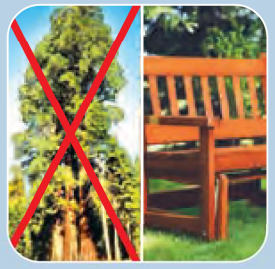
Causes of Environmental Problems

Population growth



Unsustainable resource use

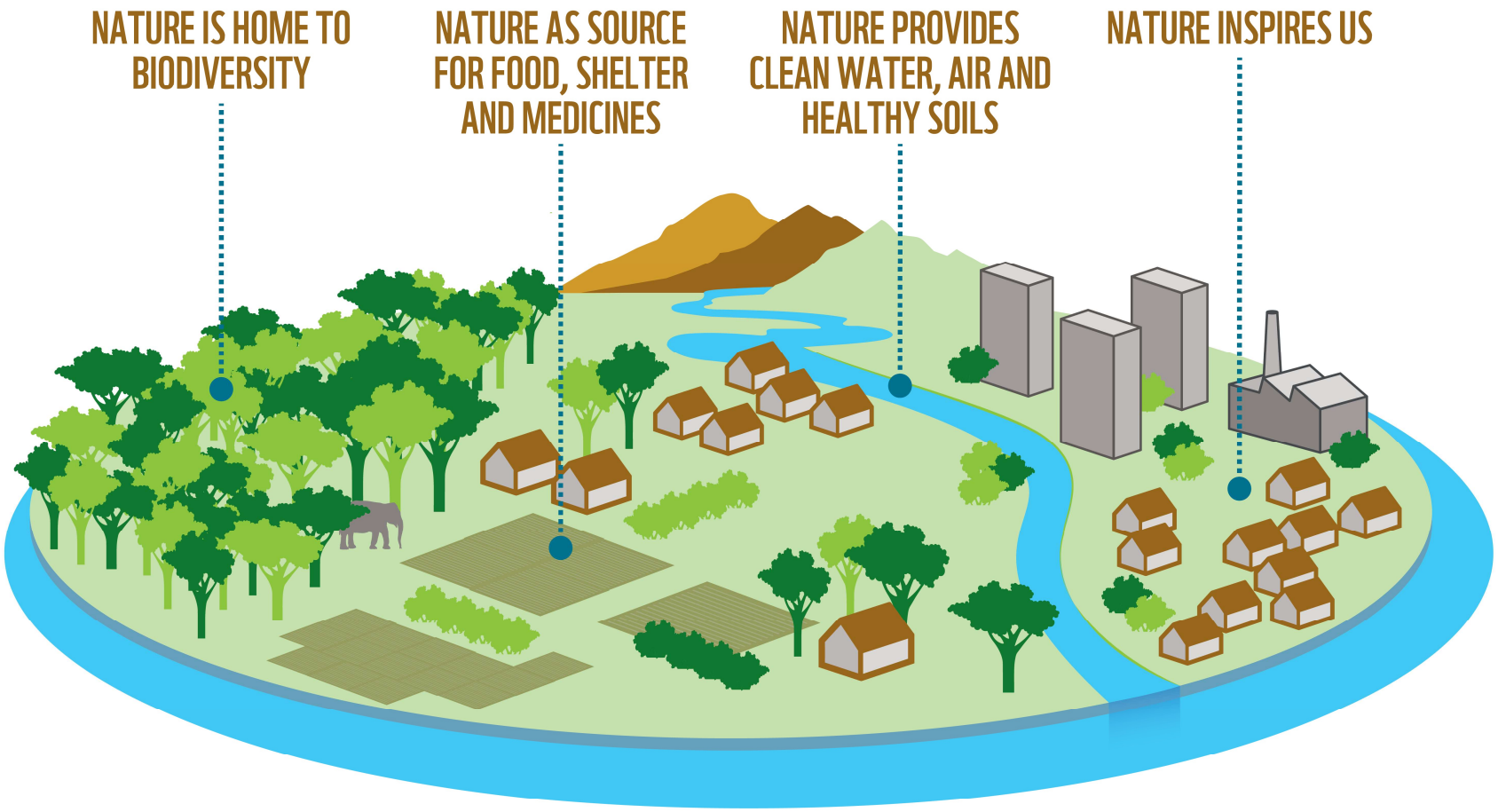
Poverty



Excluding environmental costs from market prices

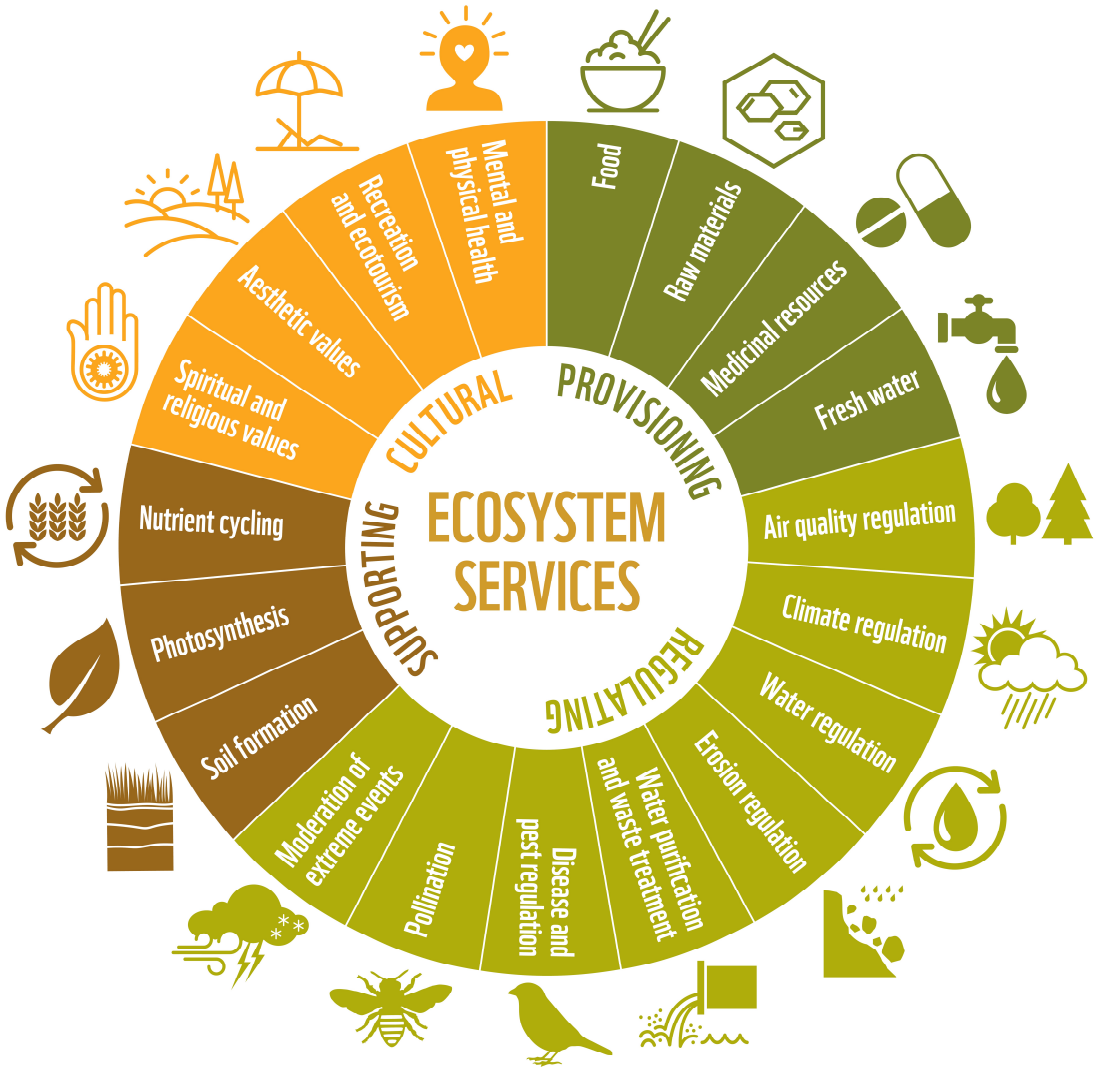
Importance of Natural Capital

- Nature provides us with vital goods and services. To sustain modern human society we will continue to need the resources of nature that, throughout history, have allowed us to thrive.

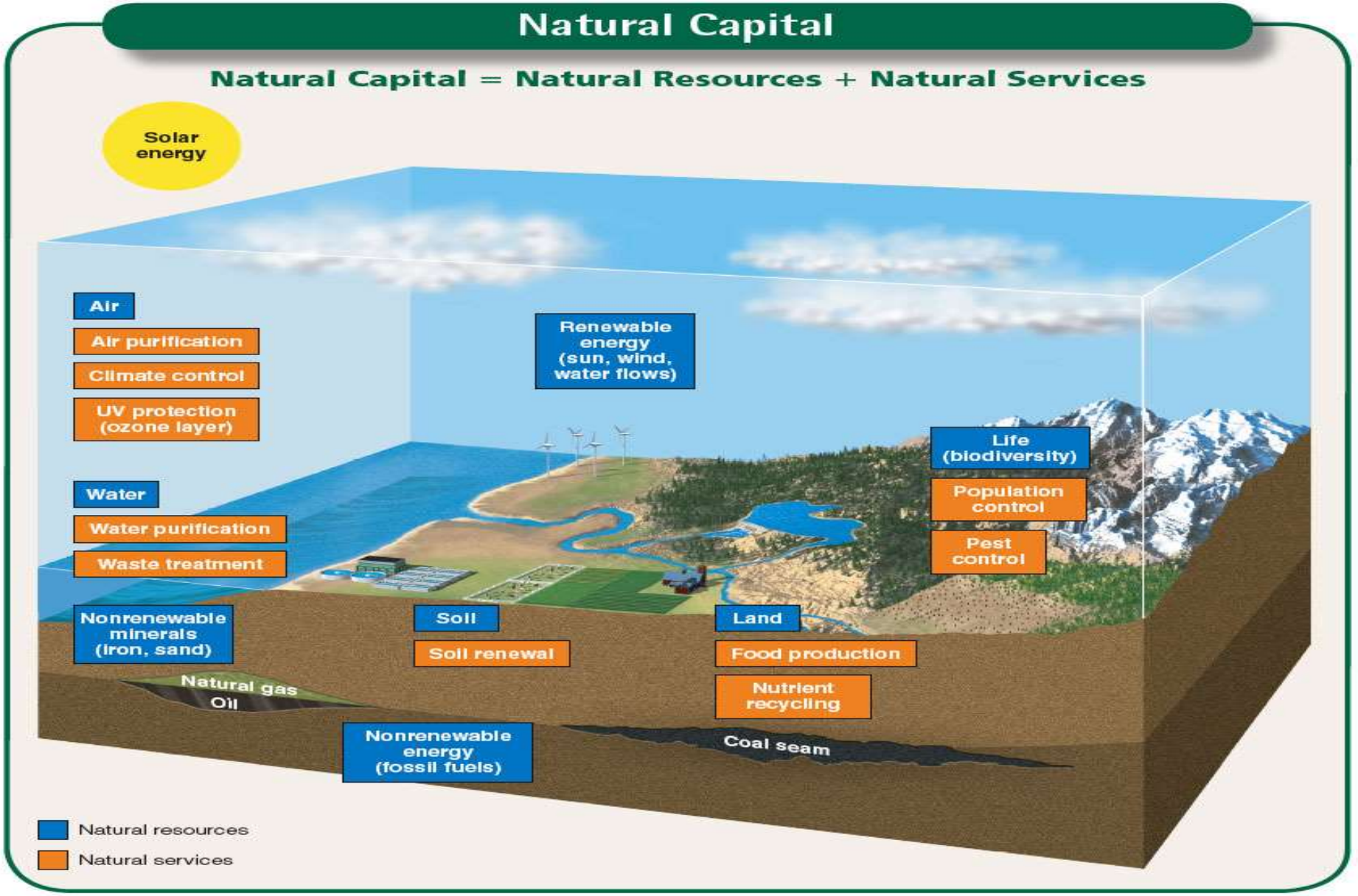


Importance of Natural Capital

- Ecosystem provides us a number of services for free, some of which are more easily visible than others.



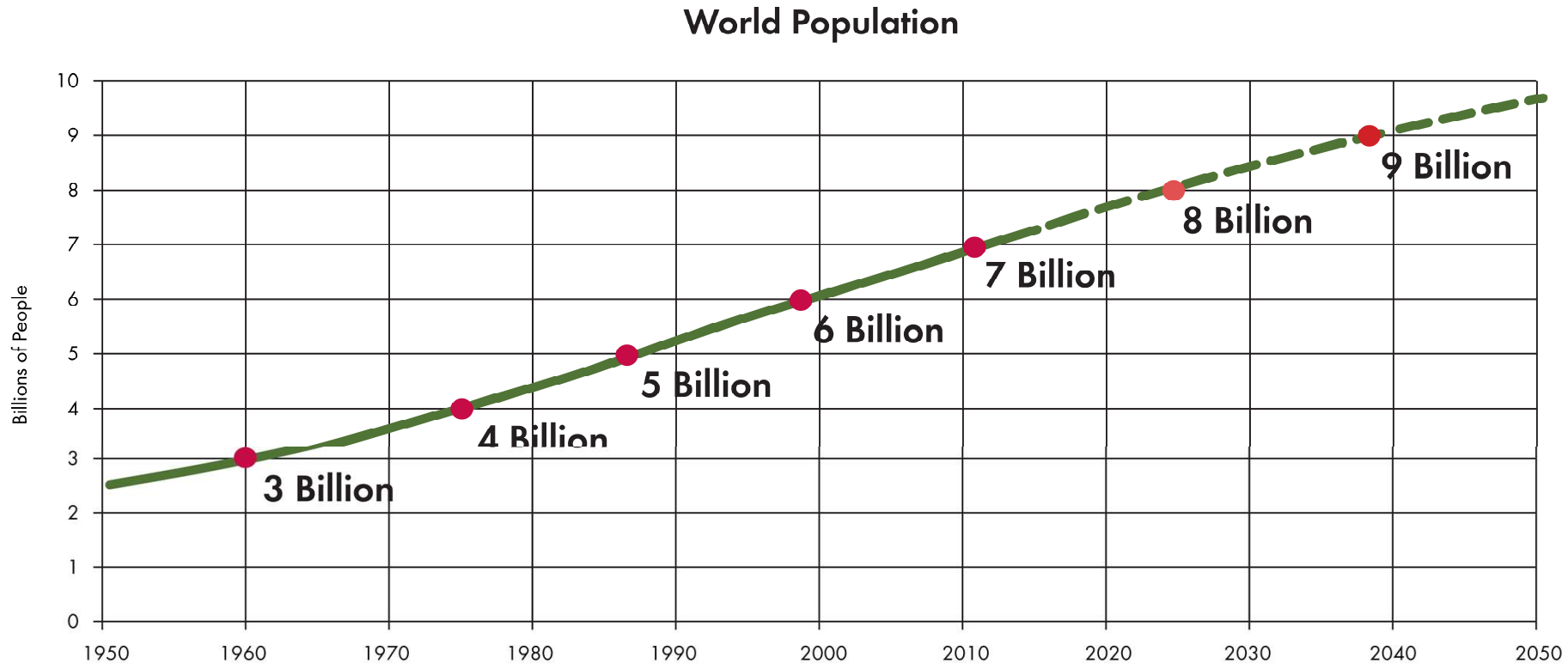
Importance of Natural Capital

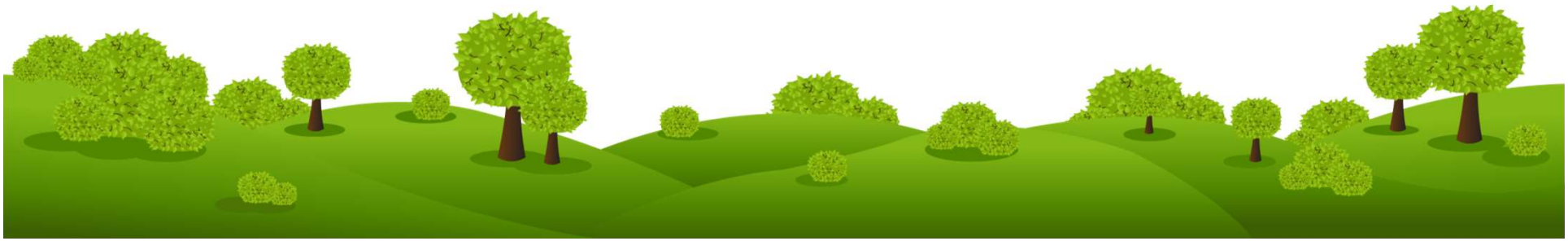



Overpopulation

Exponential Population Growth

- As the future of the fossil fuel economy is increasingly uncertain, the world's population is still on the rise, and so are people's material expectations.





Overpopulation: Why Does it Matter?

- **Environment**
  - Overuse of non-renewable natural resources
  - Habitat destruction and loss of biodiversity
  - Pressure on land and soil degradation
- **Economy**
  - Strain on infrastructure
  - Widespread poverty and unemployment
  - Inequitable distribution
- **Social**
  - Lack of education to large population
  - Social unrest due to limited resources
  - Poor coverage of healthcare

Our Finite World

Earth offers many natural resources that help us to live. Some of them are essential for our survival while most are used for satisfying our needs.

Renewable

Replenished in days to several hundred years through natural processes as long as it is not used up faster than it is renewed.

e.g., solar energy, air, water, soil, plants

Non-Renewable

Exist in a fixed quantity in the Earth's crust and can be depleted much faster when their rate of consumption exceeds the rate than they are formed.

e.g., coal, oil, metals, non-metals

Our resources are limited...and it matters!

Tragedy of the Commons

- A common-property or free-access resource, which is owned by no one but is available to all users free of charge.
- Degradation occurs because the user reasons: "If I do not use it someone else will. The little bit I use or pollute is not enough to matter."
- Example: Nobody really owns the groundwater; it is technically up for grabs. However, individual pumping of too much groundwater can result in the exhaustion of the resource. Eventually, depletion by a few means depletion for all. That is the 'tragedy'.
- Solution:
  - ✓ Use shared renewable resources at rates well below their estimated sustainable yields.
  - ✓ Convert open-access renewable resources to private ownership.

Ecological Footprint

MEASURES

how fast we consume resources and generate waste

Energy

Settlement

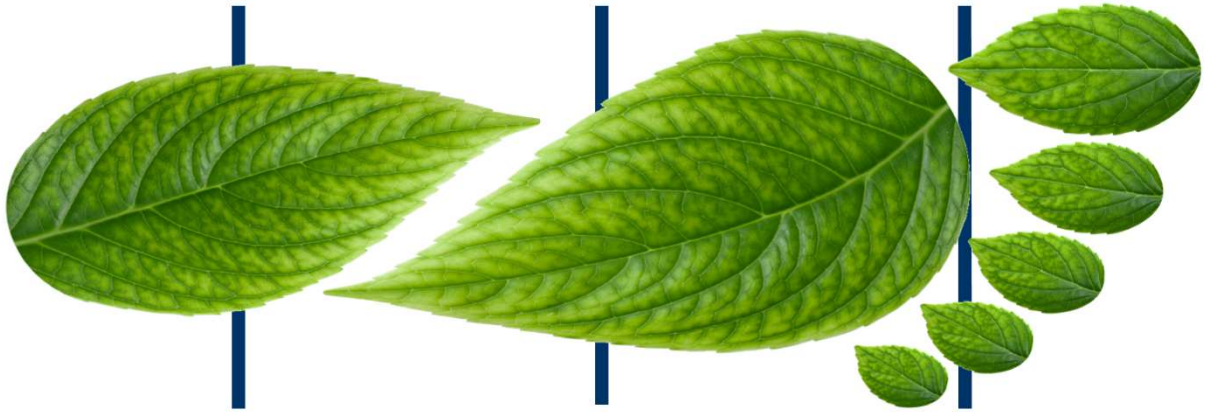
Timber & Paper

Food & Fiber

Seafood

COMPARED TO

how fast nature can absorb our waste and generate new resources



Carbon Footprint

Built-up Land

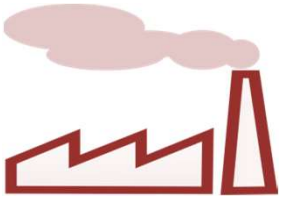
Forest

Cropland & Pasture

Fishing Grounds

Components of Ecological Footprint

The Ecological Footprint measures the biological productive area that people need for provision of renewable resources, occupy with infrastructure, or require for absorption of CO_2 waste, using global hectare (gha) as the unit of measurement. What are the components of the footprint?



CARBON

Represents the amount of forest land that could sequester CO_2 emissions from the burning of fossil fuels.

GRAZING LAND

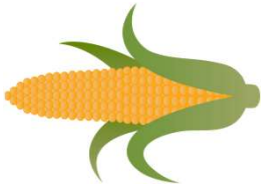
Represents the amount of grazing land used to raise livestock for meat, dairy, hide and wool products.

FOREST

Represents the amount of forest required to supply timber products, pulp and fuel wood.

BUILT-UP LAND

Represents the amount of land covered by human infrastructure, including transportation, housing, industrial structures and reservoirs for hydropower.



CROPLAND

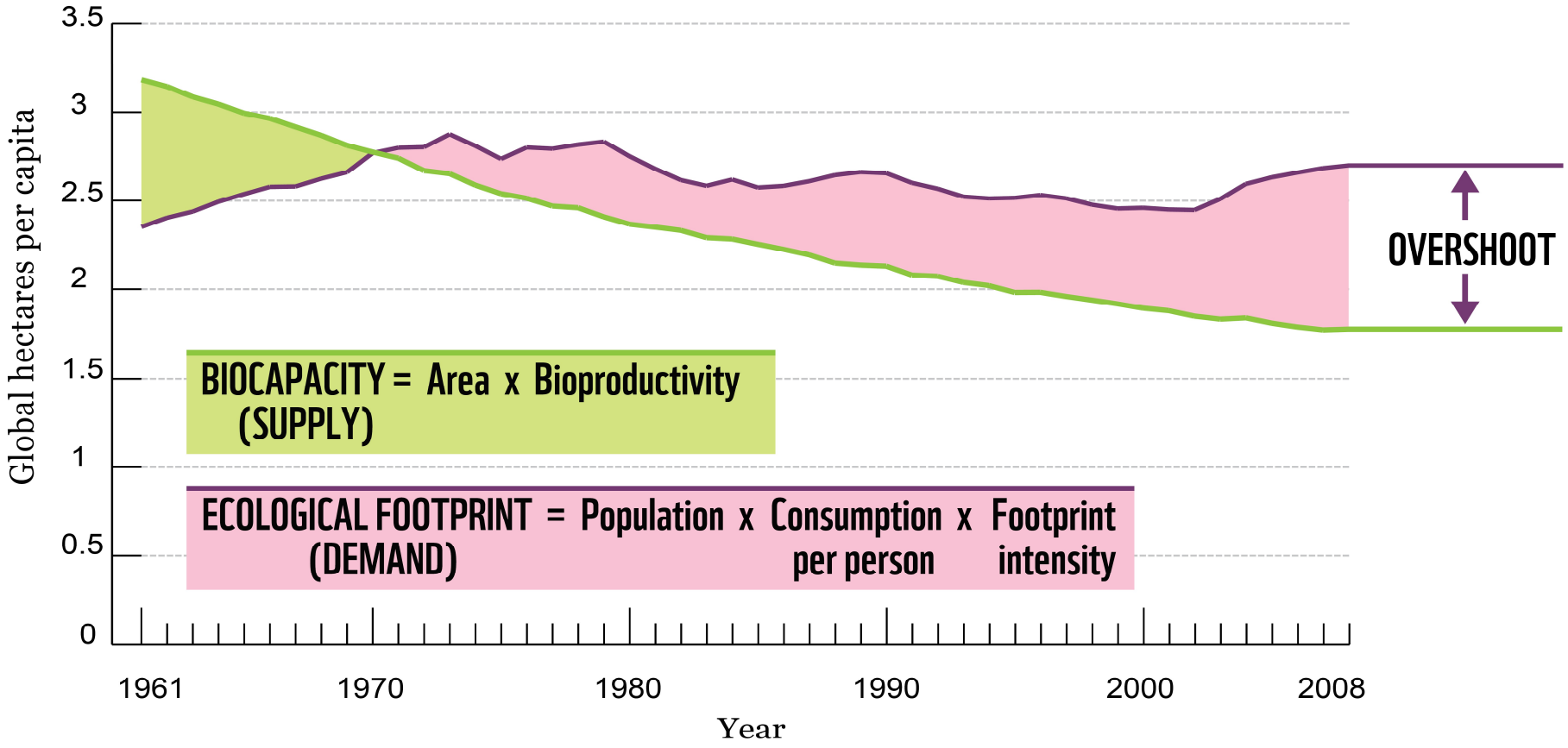
Represents the area used to grow crops for food and fibre for human consumption as well as the area for animal feed.

FISHING GROUNDS

Calculated from the estimated primary production required to support the fish and seafood caught.

Biocapacity & Bioproductivity

- Biocapacity quantifies nature's capacity to produce renewable resources, provide land for built-up areas and provide waste absorption services such as carbon uptake.
- Bioproductivity is the amount and rate of production which occur in a given ecosystem over a given time period.

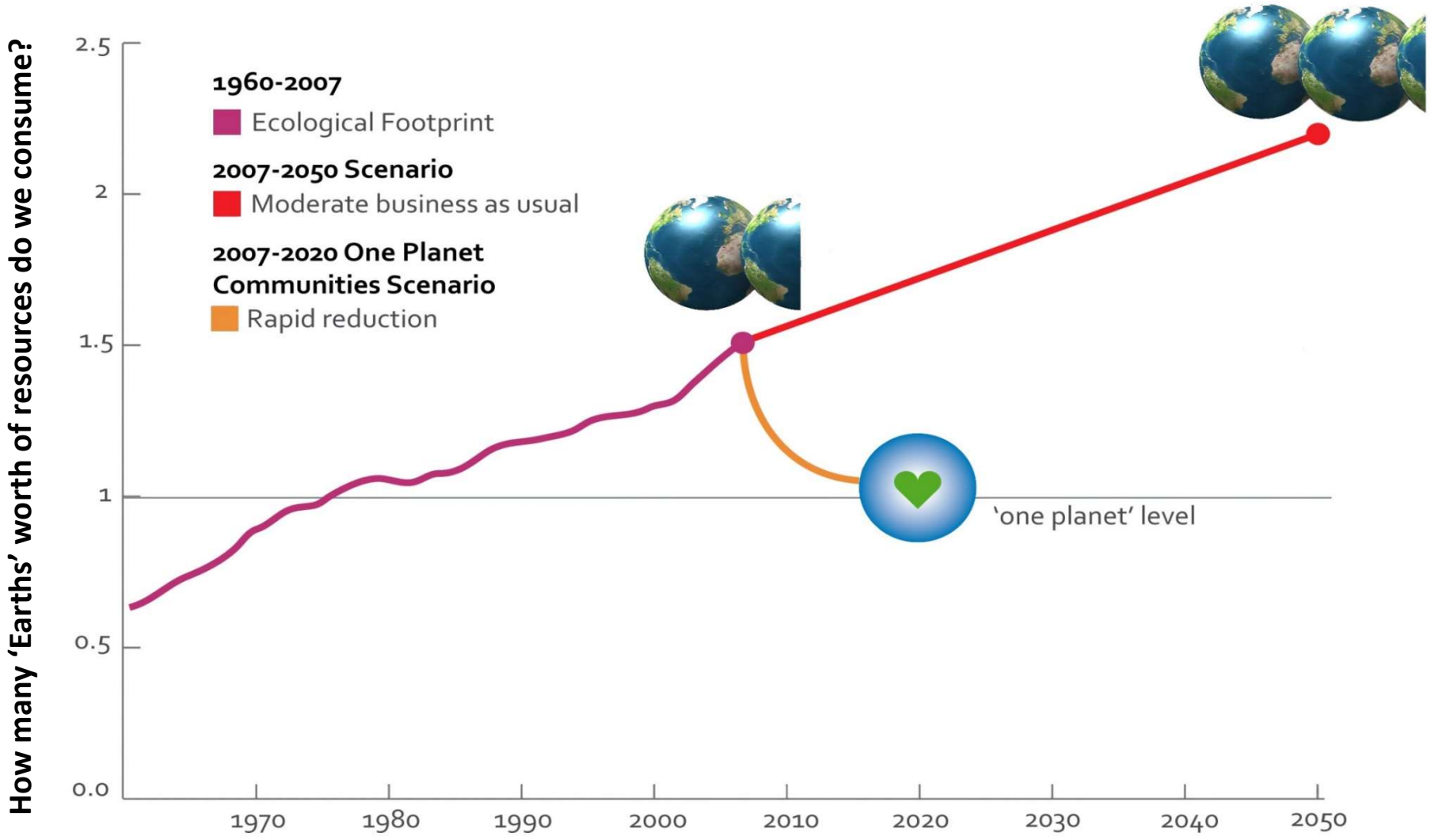


Ecological Deficit

- If a region's (country's, or the world's) total ecological footprint is larger than its biological capacity to replenish its renewable resources and absorb the resulting wastes and pollution, it is said to have an ecological deficit.
- A region in ecological deficit meets demand by importing, liquidating its own ecological assets (such as overfishing), and/or emitting carbon dioxide into the atmosphere.
- If a region's biocapacity exceeds its Ecological Footprint, it has an ecological reserve.

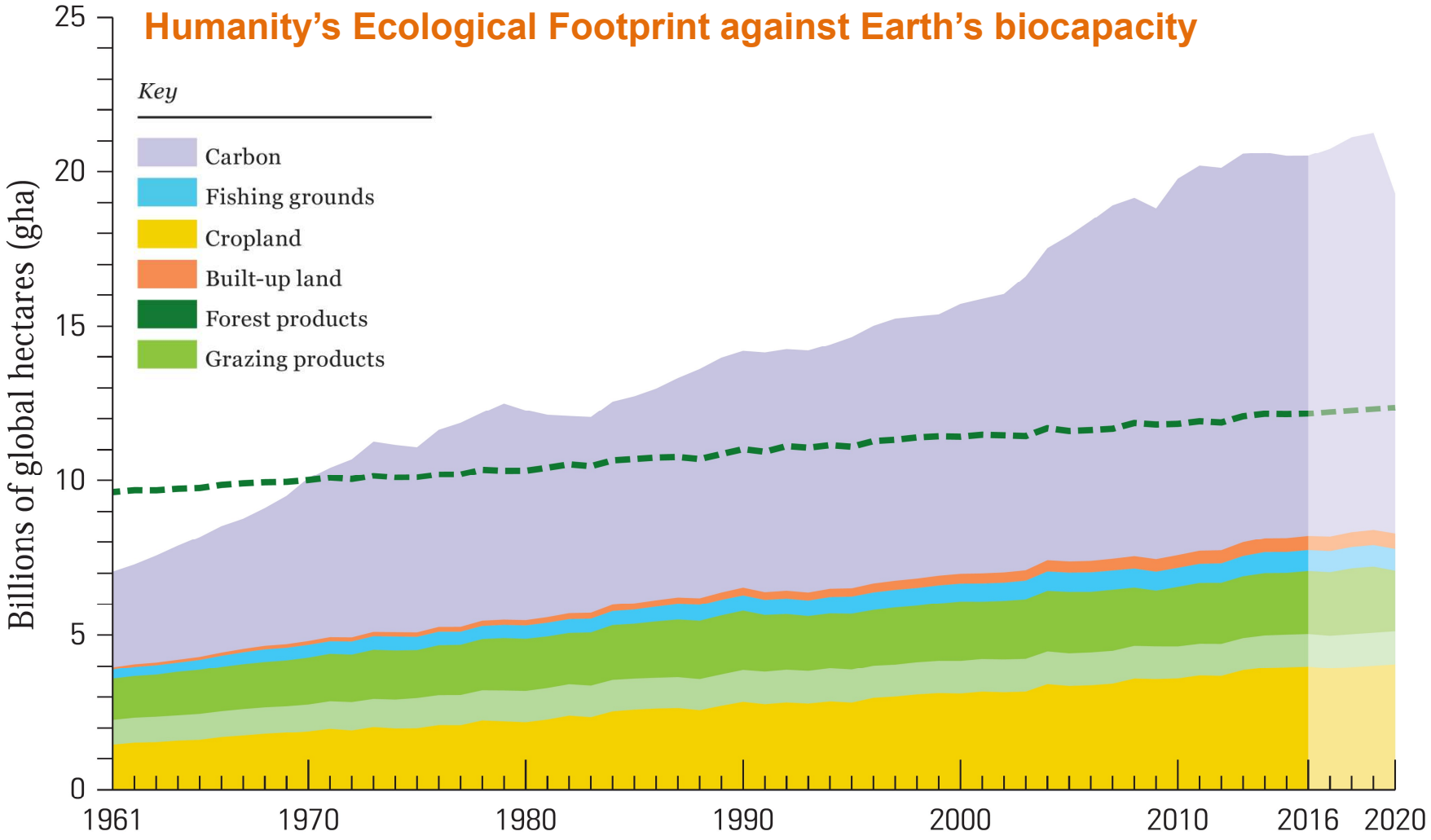
Overstepping Ourselves

- Today humanity uses the equivalent of 1.6 Earths to provide the resources we use and absorb our waste.

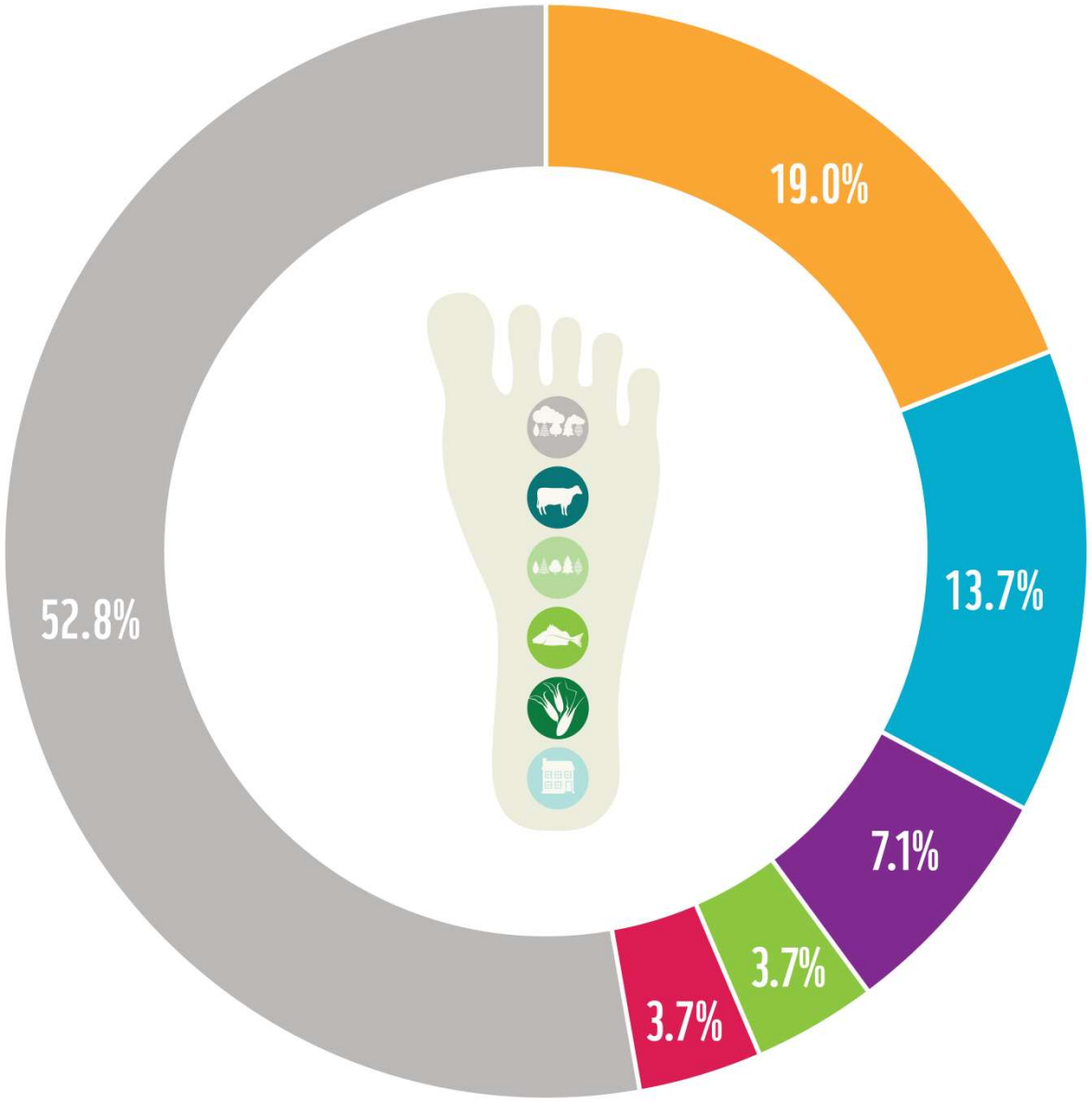


Overstepping Ourselves

- For more than 40 years, humanity's demand on nature has exceeded what our planet can replenish.



Overstepping Ourselves



Share of total ecological footprint among the top five countries with the highest demand and the rest of the world. If everyone lived like an average resident of the USA, a total of four Earths would be required to regenerate humanity's annual demand on nature.

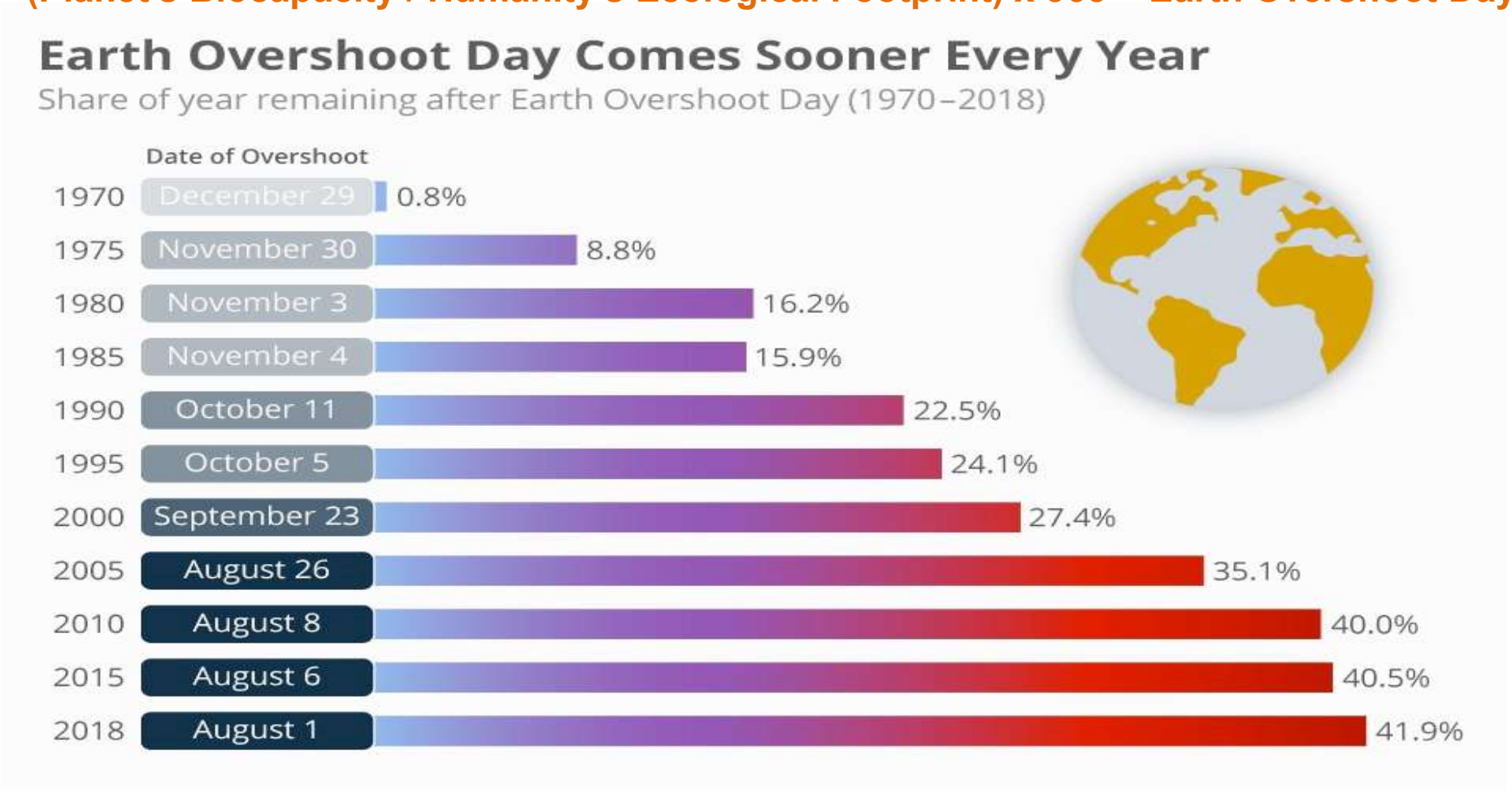
Key

- China
- United States of America
- India
- Brazil
- Russia
- Rest of world

Earth Overshoot Day

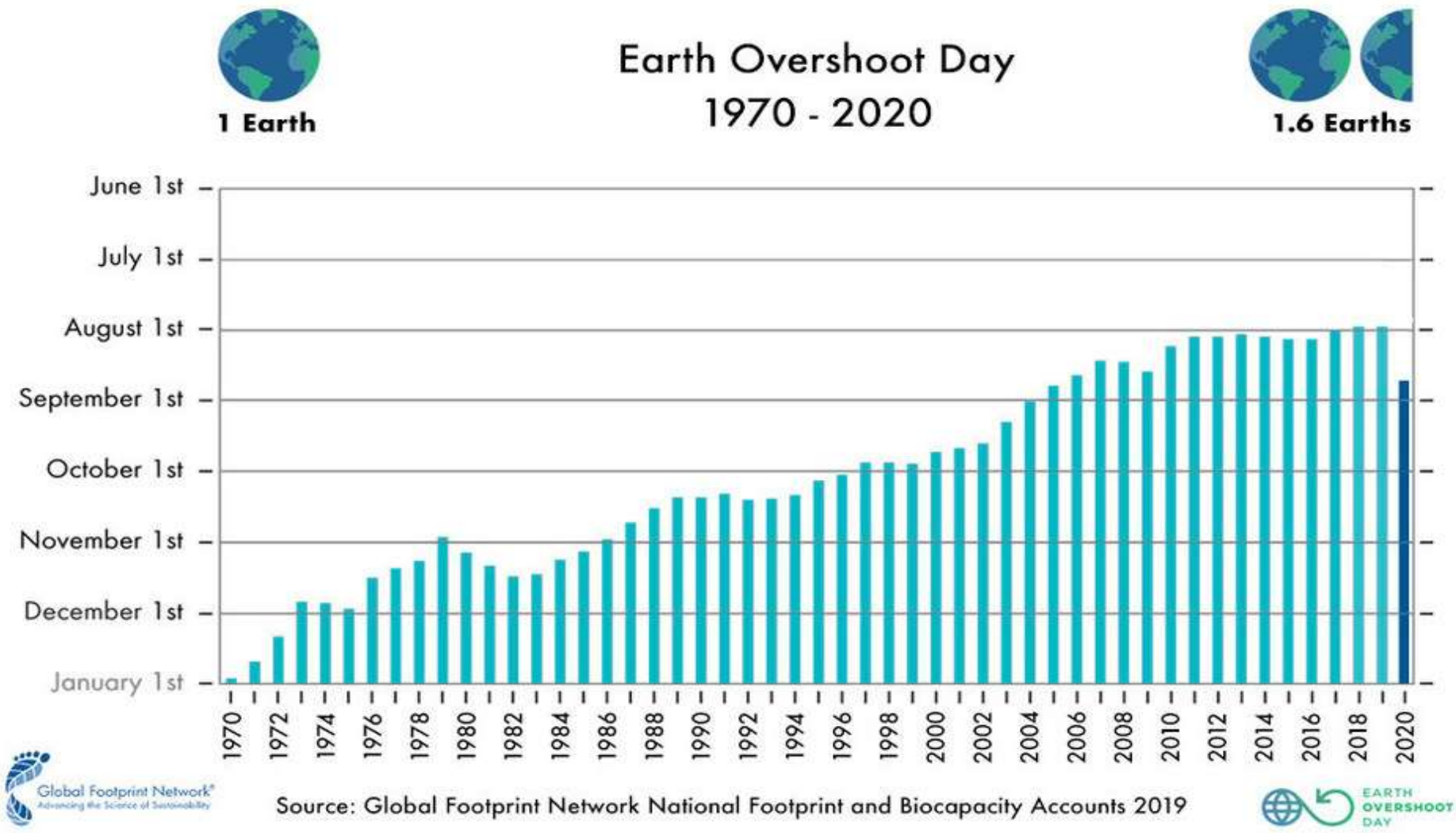
- Earth Overshoot Day marks the date when humanity's demand for ecological resources and services in a given year exceeds what the Earth can regenerate in that year.

(Planet's Biocapacity / Humanity's Ecological Footprint) x 365 = Earth Overshoot Day



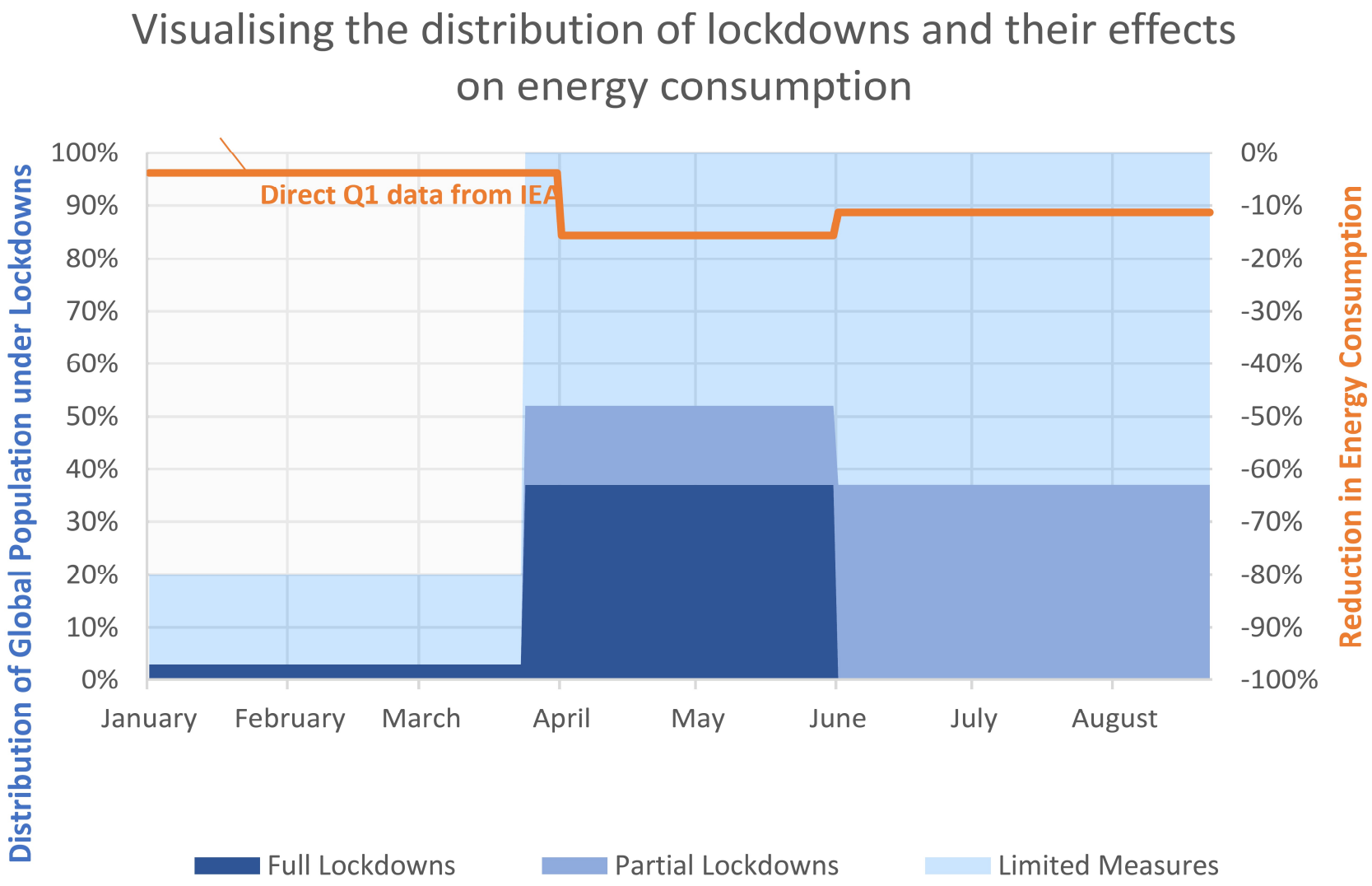
2020 Earth Overshoot Day: 22 August

- In 2020, Earth Overshoot Day fell on 22 August. The ongoing COVID-19 pandemic has caused humanity's ecological footprint to contract.



2020 Changes to Ecological Footprint

- **Change in Carbon Footprint: 14.5% reduction**



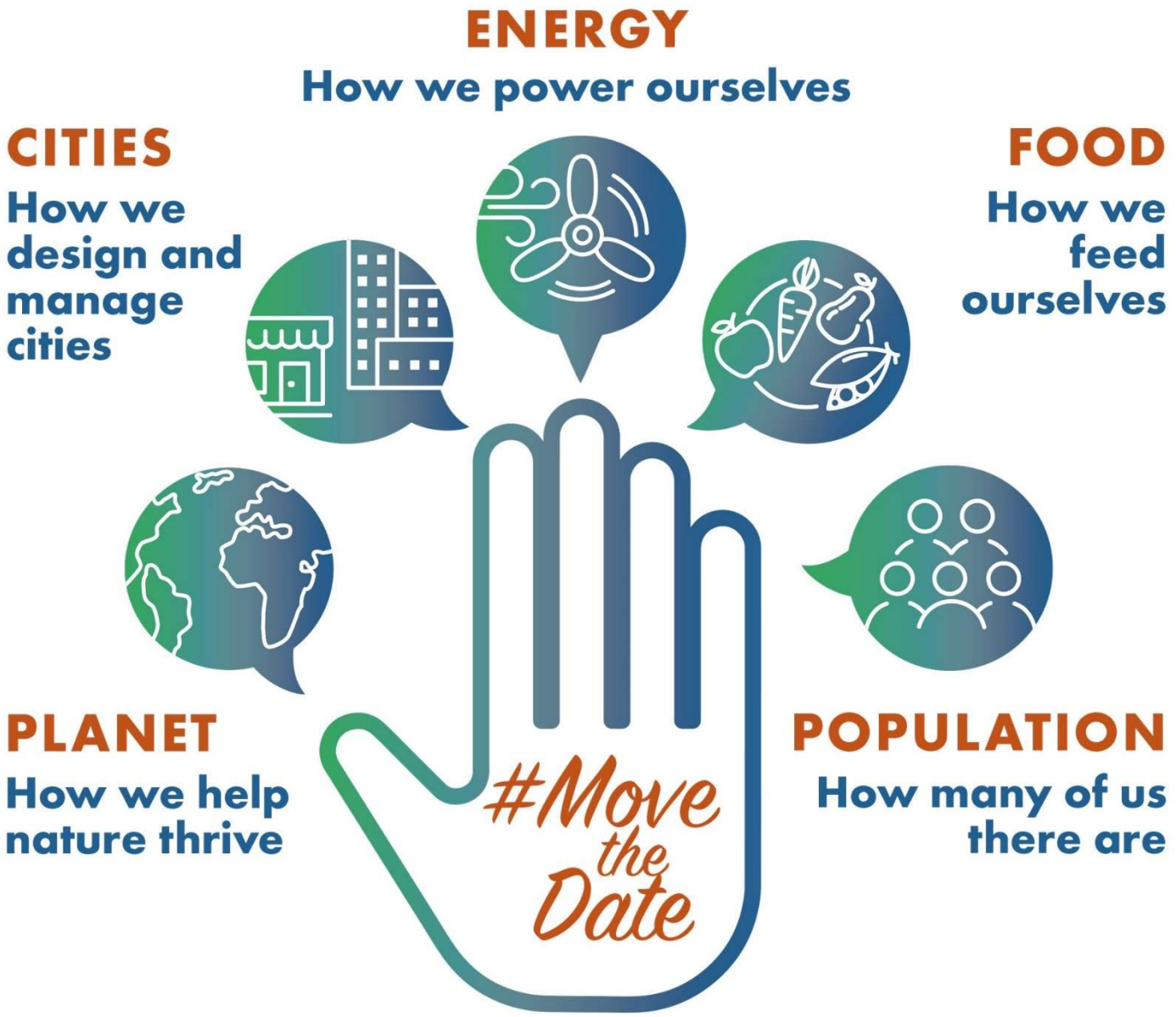
2020 Changes to Ecological Footprint

- **Forests Product Footprint: 8.4% reduction**
  - Reduced demand for forest products due to economic slowdown
  - Increased pressure on forests from COVID-19 induced internal migration

Lessons from COVID-19

- Governments are capable of acting swiftly, both in terms of regulations and spending, when they put human lives above all else.
- Humanity is one biology and is stronger when we act together:
  - Businesses and individuals alike can effectively align and collaborate in the pursuit of a shared goal when people recognize that their own lives, and that of the people they love, may be at risk.
  - The necessary actions required to protect oneself, one's household, and one's community also protect others; one's decisions at all levels have consequences for all.

#MoveTheDate



When calculating Ecological Footprint, contaminants such as toxic waste and radioactive waste are not taken into account. Does the absence of these factors make ecological footprint less useful/reliable as a sole indicator of environmental impact of a certain action?


Overconsumption

IPAT Environmental Impact Model

- Proposed by Paul Ehrlich and John Holdren in the early 1970s, the IPAT model determines the environmental impact of human activities.

$$I = P \times A \times T$$

Total Human Impact

Population

$$\text{Affluence} = \frac{\text{Goods \& Services}}{\text{Person}}$$

$$\text{Technology} = \frac{\text{Impact}}{\text{Goods \& Services}}$$

IPAT Environmental Impact Model

- What are the factors that influence the amount of gasoline we burn in automobiles?

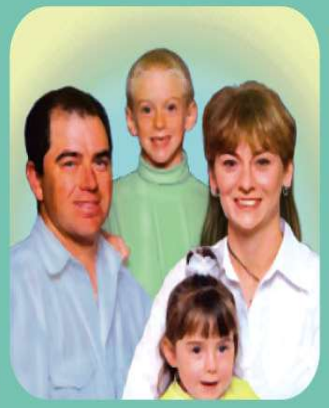
$$\text{gasoline} = \text{number of cars} \times \frac{\text{miles driven}}{\text{car}} \times \frac{\text{gasoline}}{\text{mile}}$$

Impact "I" = population "P" × $\frac{\text{service provided}}{\text{car}}$ "A" × technology "T"

IPAT Connections

Developing Countries

Population (P) × **Consumption per person (affluence, A)** × **Technological impact per unit of consumption (T)** = **Environmental impact of population (I)**

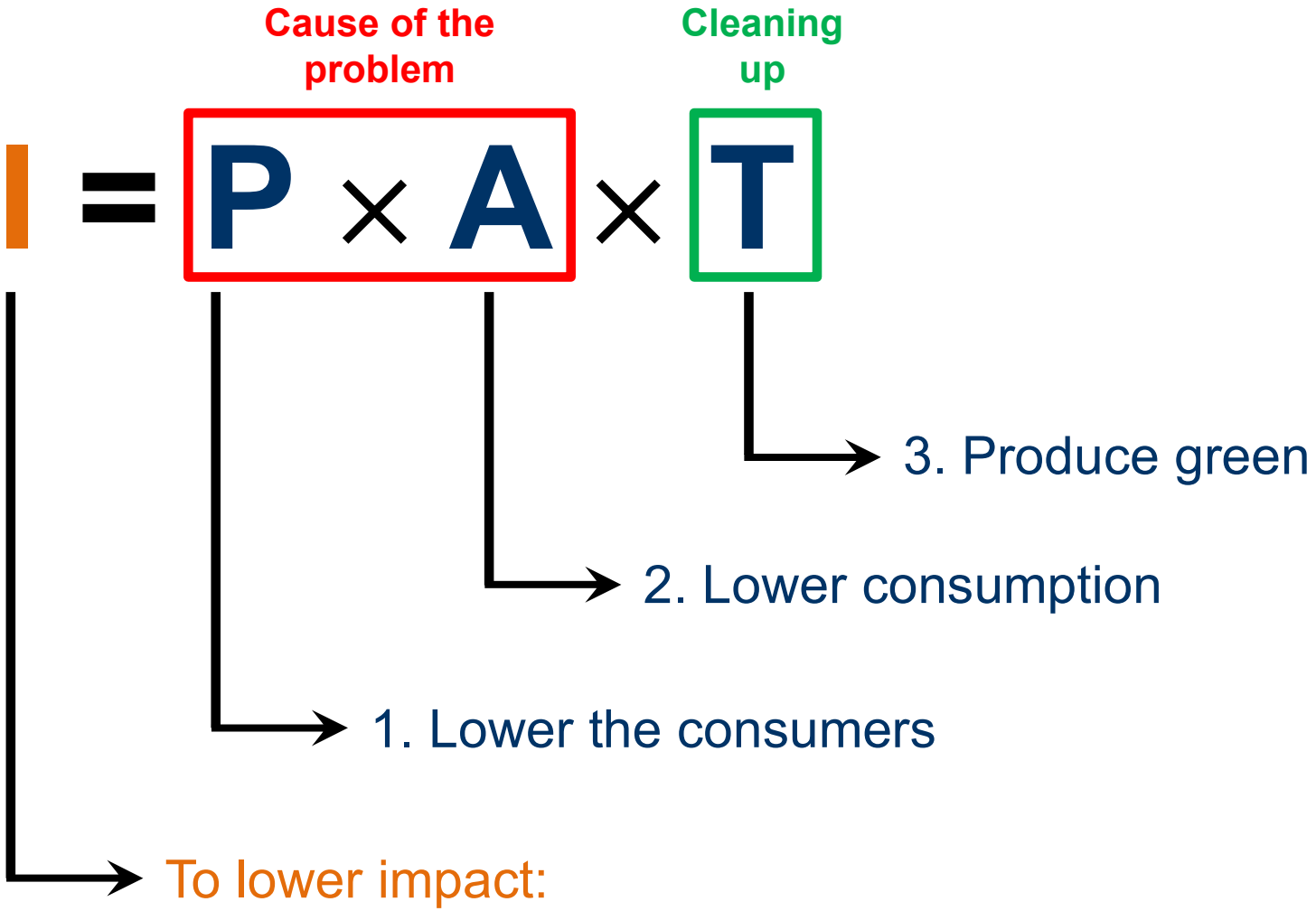


Developed Countries

Affluence has harmful and beneficial effects

- Many consumers in developed countries have become addicted to buying more and more stuff in their search for fulfilment and happiness.
- Affluenza is the unsustainable addiction to overconsumption and materialism exhibited in the lifestyles of affluent consumers in the developed countries.
- Affluence have harmful environmental impact due to
  - high levels of consumption.
  - high levels of pollution.
  - unnecessary waste of resources.
- Affluence can, however, provide funding for developing technologies to reduce
  - pollution.
  - environmental degradation.
  - resource waste.

Reducing Environmental Impact

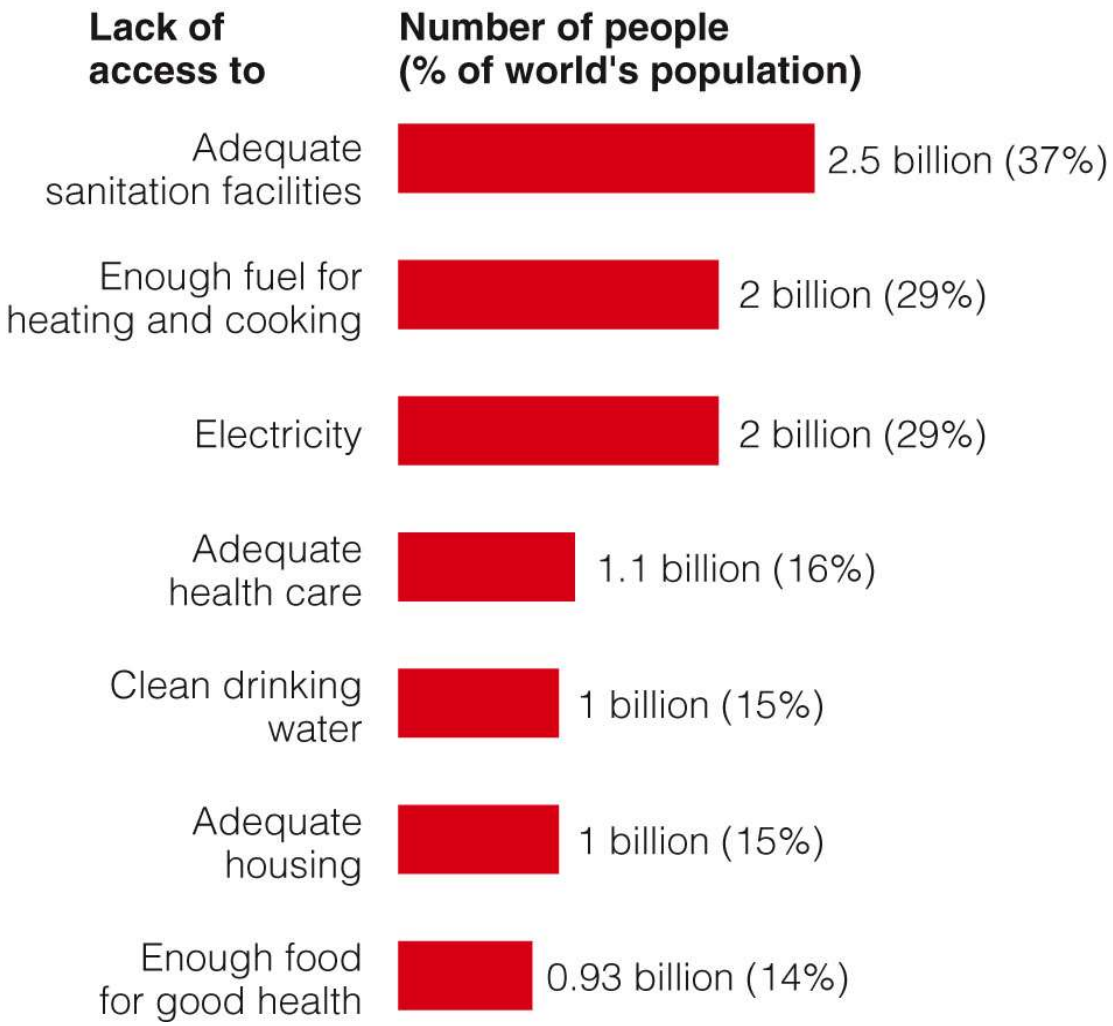


Each year, as much as **$605 billion** is spent on advertising worldwide, and advertisements have been linked to rising materialism, childhood obesity, and other maladies. Would you favor curbs on advertising? How would you respond to the argument that restrictions on advertising are violations of a right to freedom of speech?


Poverty

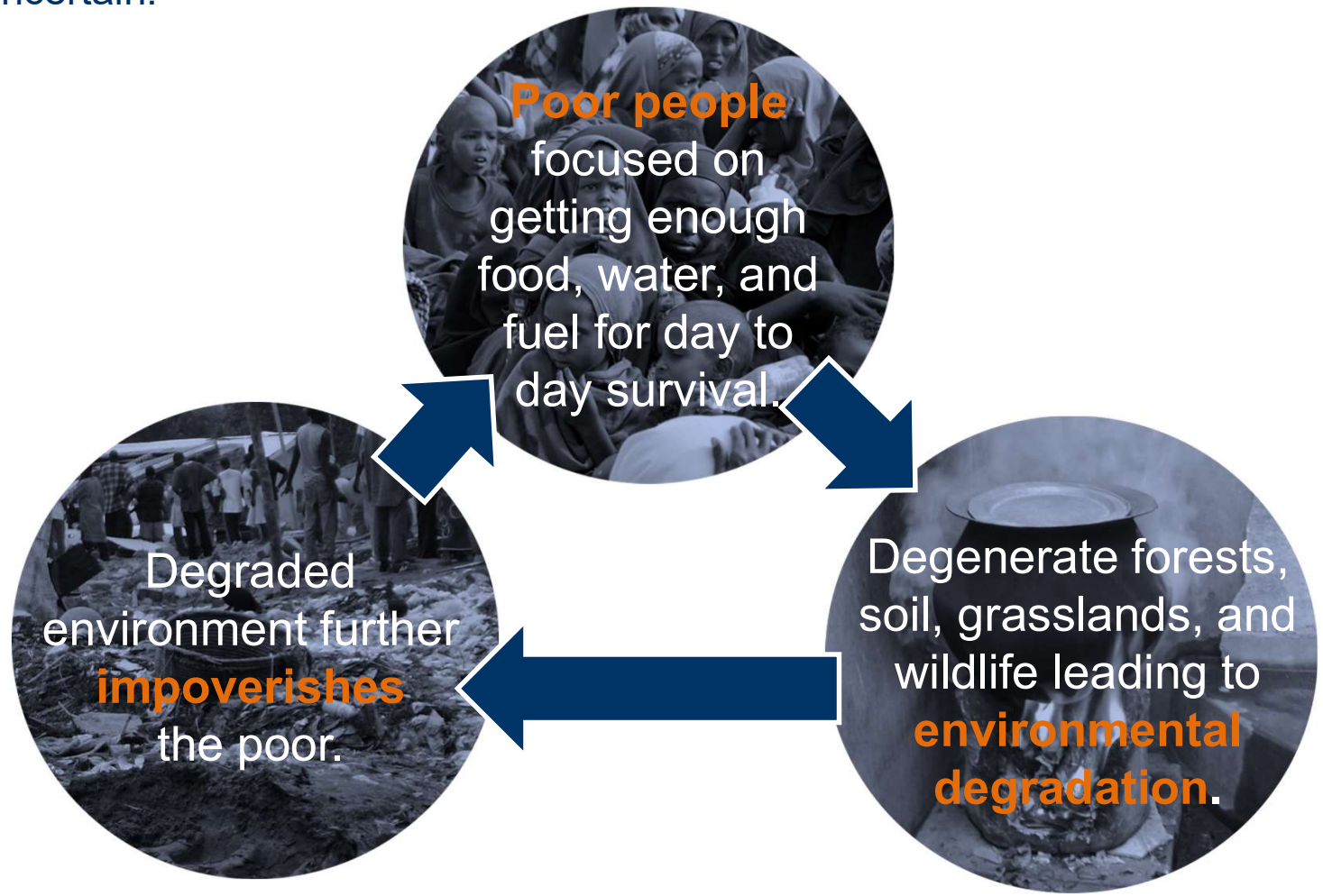
Poverty Has Many Harmful Effects

- Many of the world's poor do not have access to the basic necessities for a healthy, productive, and decent life.



Poverty Has Many Harmful Effects

- Poverty and environment are linked in a downward spiral; poor people are forced to overuse environmental resources to survive from day to day, and their impoverishment of their environment further impoverishes them, making their survival ever more difficult and uncertain.




Excluding Environmental Costs

Prices Do Not Include Value of Natural Capital

- Nature provides resources at no cost. Human activities degrade these resources but do not pay the cost.
- Example:
  - ❖ Timber companies pay the cost of clear-cutting forests but do not pay for the resulting environmental degradation and loss of wildlife habitat.
  - ❖ Fishing companies pay the costs of catching fish but do not pay for the depletion of fish stocks.
- Taxes and fines aim to fix this problem but it is not enough.

People Have Different Views

Planetary Management

- We are apart from the rest of nature and can manage nature to meet our increasing needs and wants.
- Because of our ingenuity and technology, we will not run out of resources.
- The potential for economic growth is essentially unlimited.
- Our success depends on how well we manage the earth's life-support systems mostly for our benefit.

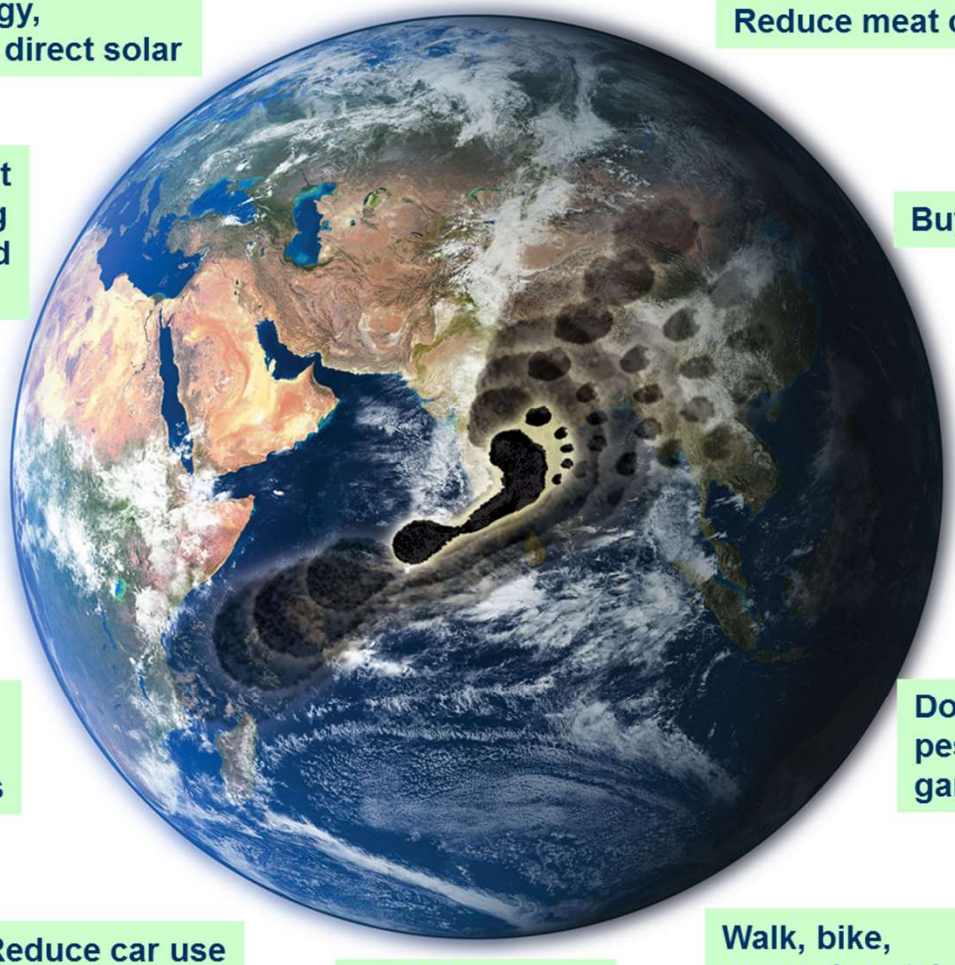
Stewardship

- We have an ethical responsibility to be caring managers, or stewards, of the earth.
- We will probably not run out of resources, but they should not be wasted.
- We should encourage environmentally beneficial forms of economic growth and discourage environmentally harmful forms.
- Our success depends on how well we manage the earth's life-support systems for our benefit and for the rest of nature.

Environmental Wisdom

- We are a part of and totally dependent on nature, and nature exists for all species.
- Resources are limited and should not be wasted.
- We should encourage earth-sustaining forms of economic growth and discourage earth-degrading forms.
- Our success depends on learning how nature sustains itself and integrating such lessons from nature into the ways we think and act.

We Can Solve Environmental Problems



Insulate your house and plug air leaks

Use renewable energy, especially wind and direct solar

Reduce meat consumption

Use energy-efficient heating and cooling systems, lights, and appliances

Buy locally grown food

Reduce, reuse, and recycle

Buy or grow organic food

Use water-saving appliances and irrigation methods

Don't use pesticides on your garden or lawn

Reduce car use

Drive an energy-efficient vehicle

Walk, bike, carpool, or take mass transit whenever possible