

Sustainability

Introduction

- The very notion emerged in the 90's
- However, only recently did it pick momentum
- The very notion takes now part in corporate marketing strategies
- Some claim that this implies a change in business practices (same as TQM

Introduction

- Not long ago, “sustainability” simply referred to “making profits year after year”.
- Today, sustainability and its associated jargon, have become part of everyday life of corporate managers, scientists, and engineers.
- The food industry is quickly catching up with the topic of sustainability as a response to stakeholders’ pressure, new regulations and mainly the depletion of natural resources that the whole economic system is based on.
-maybe add a few words on CSR?

Definitions

Definition

“[D]evelopment that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

“[S]ustainability occurs when we maintain or improve the material and social conditions for human health and the environment over time without exceeding the ecological capabilities that support them.”

“Sustainability requires that businesses use resources in ways that meet the needs of the enterprise and its stakeholders today, while protecting, sustaining, and enhancing future resources and the environment.”

“Business strategies and practices that promote the long-term well being of the environment, society and the bottom line.”

“A sustainable product or process is one that constrains resource consumption and waste generation to an acceptable level, makes a positive contribution to the satisfaction of human needs, and provides enduring economic value to the business enterprise.”

Reference

United Nations General Assembly, 1987

Sikdar, 2003

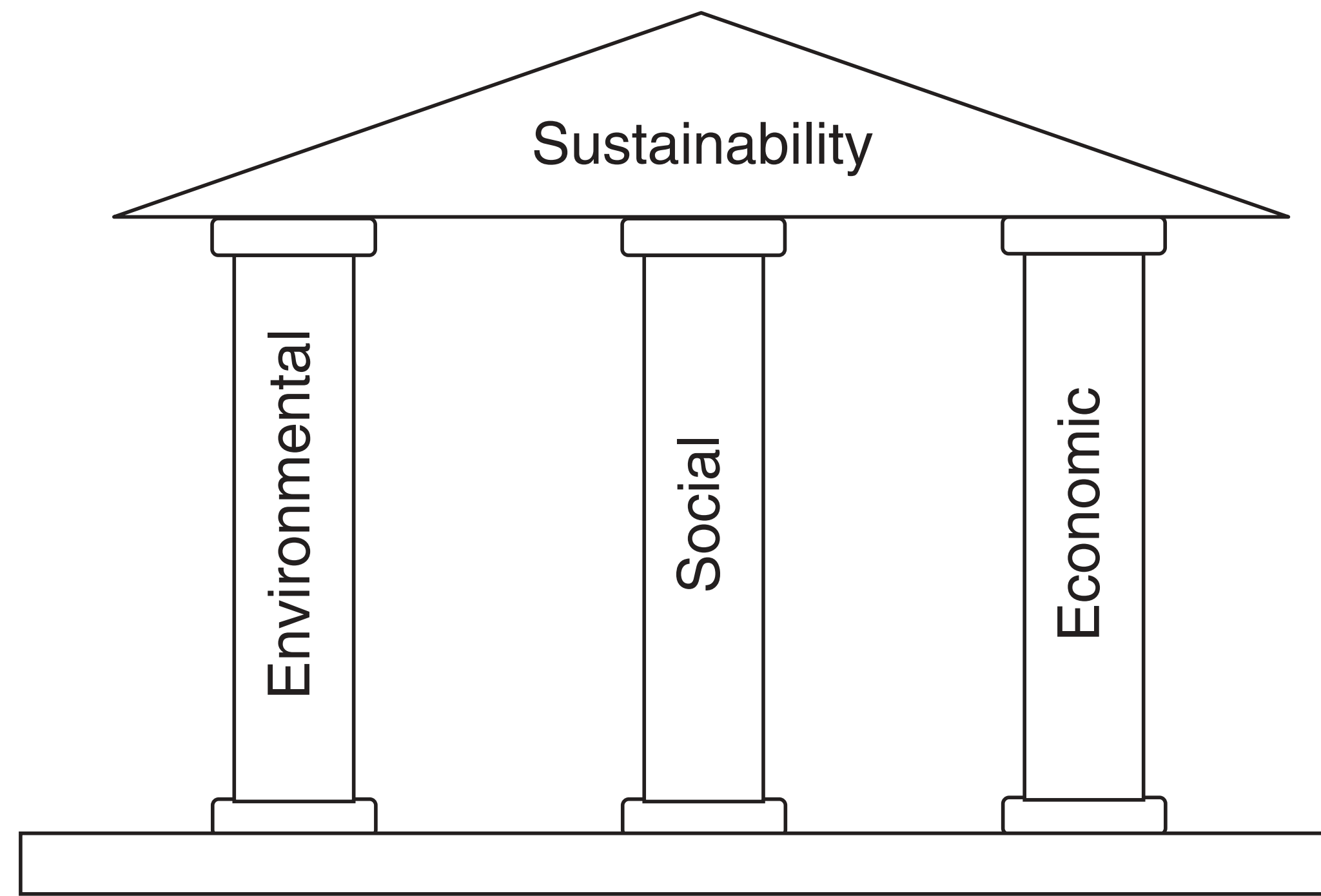
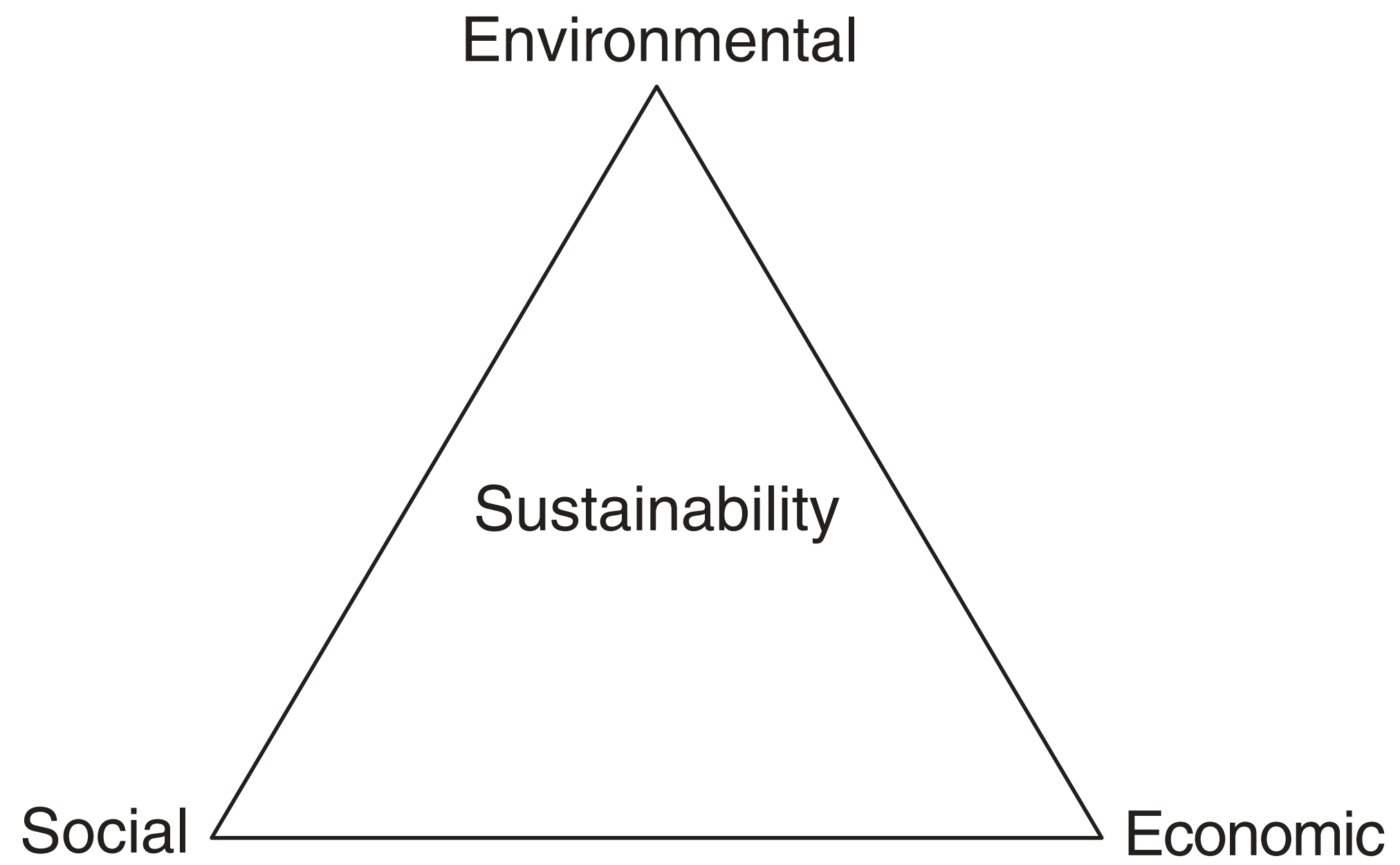
Gorman and Krehbiel, 1997

Food Marketing Institute Sustainability Task Force, n.d.

Bakshi and Fiksel, 2003

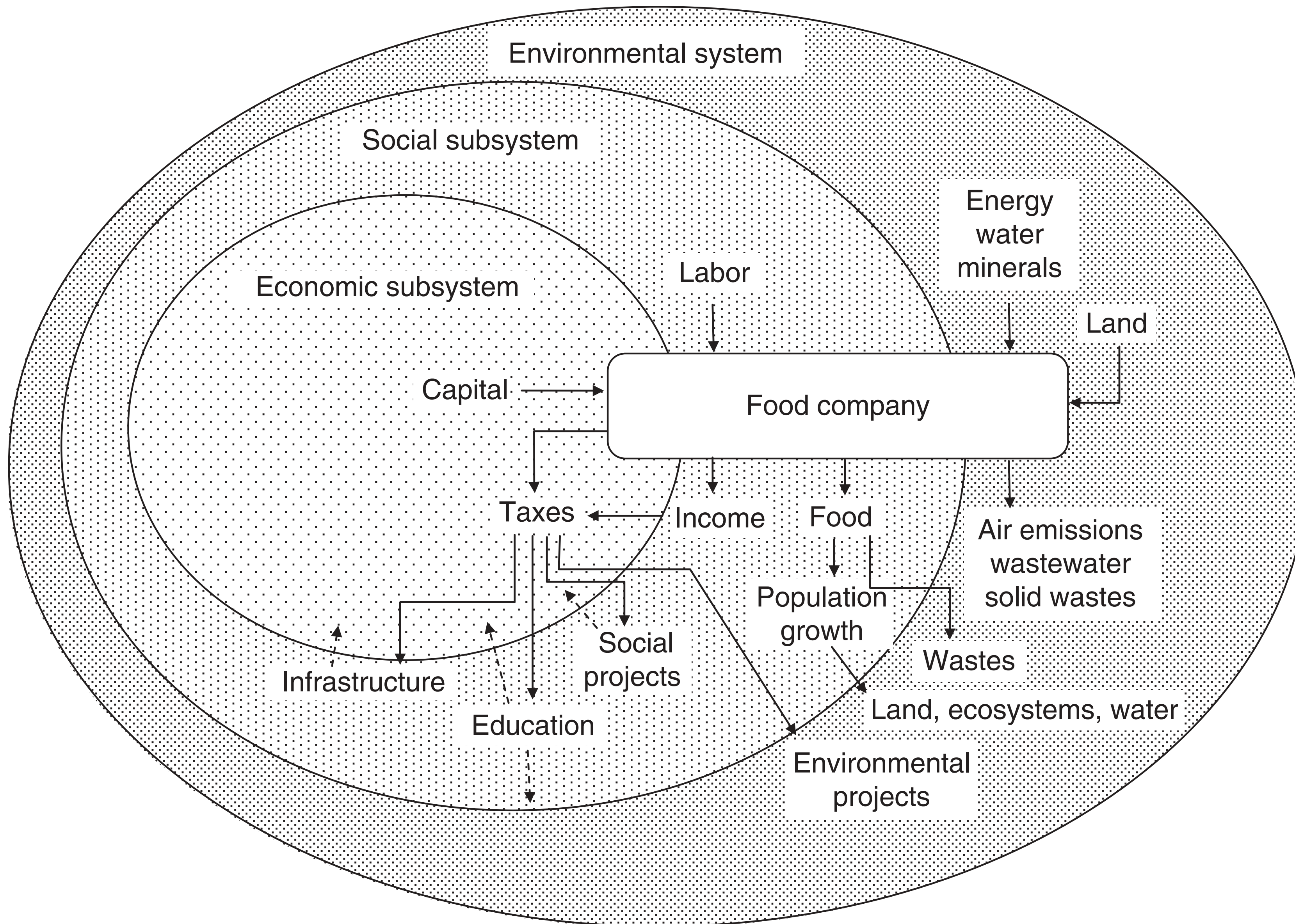
Three dimensions

- A sustainable company is an organization that keep itself alive in time.
- To be viable and lasting, a company needs:
 - **profits**;
 - **resources**, including capital, energy, and raw materials;
 - **customers** and a **workforce**.
- These three needs are also called by some the “three dimensions of sustainability,” and there is fair consensus among organizations about its validity.
- These days most corporations talk about the three components of sustainability as economic, social, and environmental.

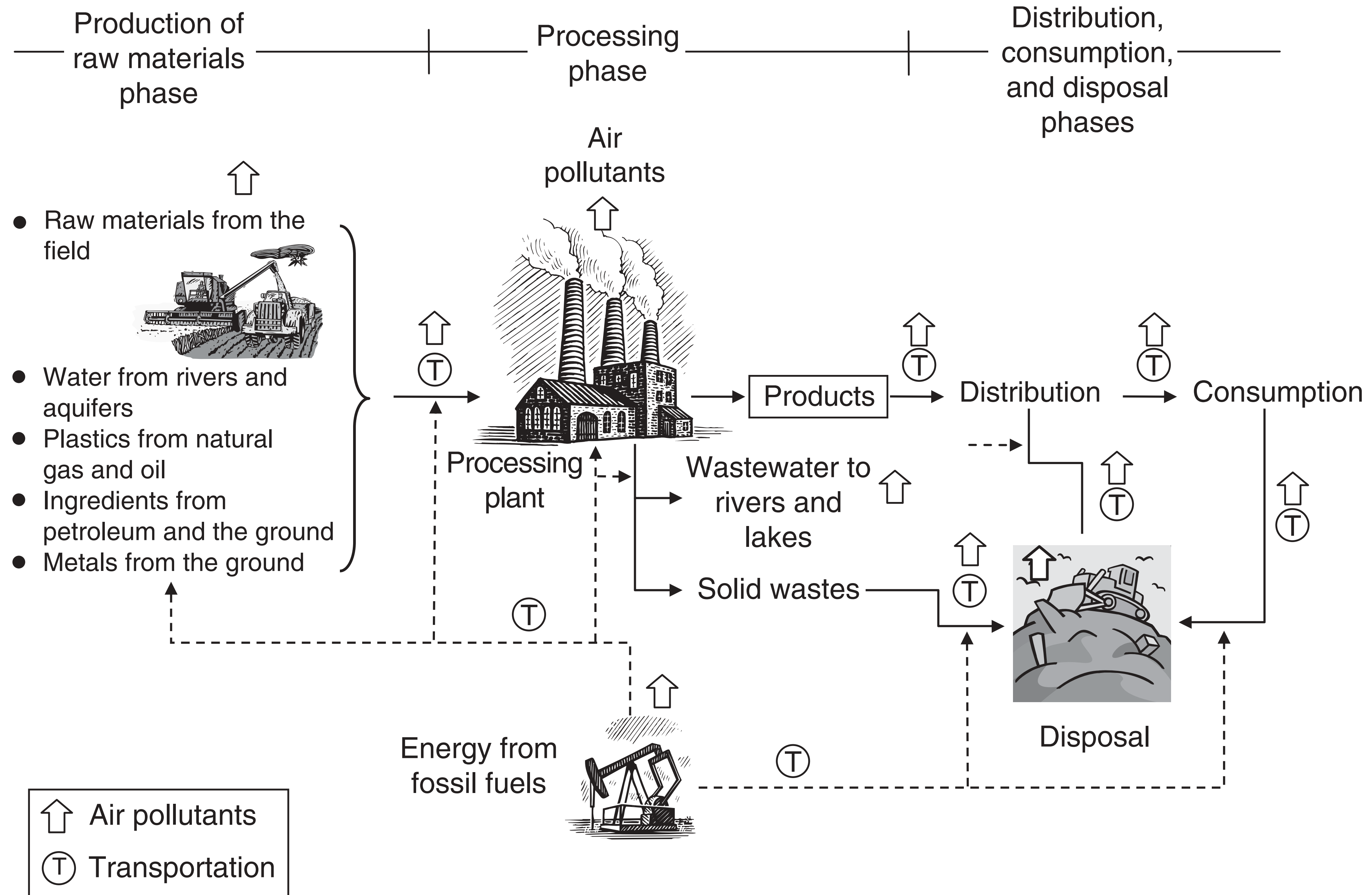


Three dimensions

- The weakness of portraying sustainability as a mix of three dimensions is that they are all taken as interchangeable and of equal weight.
- The environment is the ultimate system that supports both the social and economic systems
- Matter of fact: everything is a subsystem of the environment.



The non sustainable food company



The sustainable food company

1. Relies exclusively on renewable energy.
2. Depends on ingredients and materials made from renewable resources with renewable energy.
3. Is water neutral.
4. Has net-zero air emissions.
5. Produces completely biodegradable liquid and solid wastes at a rate and level that could be easily degraded by nature.

Reliance on renewable energy

- Finding replacements for fossil fuels with renewable energy is the most significant challenge.
- Moreover, fossil fuels are so energy dense, still inexpensive, transportable, and easy to use that it is difficult to find a straight renewable replacement for them.
- Replacing fossil fuels with renewable energy would produce the highest contribution toward sustainability

Ingredients and materials from renewable resources

- With exceptions of glass, metal, wood, paper, cotton, cellophane, and polylactate, the rest of packaging materials used by the food industry are made from fossil feedstocks.
- In a 100-percent sustainable food company all the ingredients and materials would come from renewable sources and would be made using renewable energy.

Water neutral

- Food production is an water-intensive operation.
- Considerable amounts of water are used during food processing, but agricultural operations to produce raw materials in the fields are even more water intensive.
- Part of the water used for processing and agriculture comes from superficial water (rivers, lakes, and in some cases, from desalinated seawater) and the rest from aquifers.
- Aquifer depletion is a problem in many areas of the world.
- A sustainable food company would use primarily surface water with minimal tapping of subterranean water to allow aquifers to replenish.

Net-zero air emissions 1

- In the food production system, air emissions come from agricultural activities, transportation to the processing plants, processing, transportation to distribution centers, storage, transportation to selling points, and storage at selling points.
- air emissions means anthropogenic emissions of the greenhouse gases relevant to food production with the potential of a global climate effect.
- Air emissions come in different forms at each step of food production. Methane is produced mainly during the agricultural phase through enteric fermentation, animal waste, rice cultivation, and to a less extent, during crop residue burning. In the processing and consumption phases, methane is produced during decomposition of solid and liquid wastes.

Net-zero air emissions 2

- Carbon dioxide is produced at the agricultural phase, during processing, at all transportation and storage phases, and preparation of food at home. Carbon dioxide is the main by-product of burning any type of carbon-containing material and decomposition of carbon-rich materials in the fields or as wastes.
- In food production, the largest amount of nitrous oxide is released during fertilization of soils, followed by animal solid wastes, and stationary combustion to produce power, electricity, and transportation.
- When compared with carbon dioxide and methane, nitrous oxide is released in small amounts from human activity, but its 100-year global warming potential of 310 (how measured???? index??? unit???) makes it an important contributor as a greenhouse gas

Net-zero air emissions 3

In a sustainable food company, emissions of greenhouse gases would be eliminated or reduced to levels manageable by the Earth systems.

At the agricultural phase, carbon dioxide emissions would be reduced by **changing agricultural practices** and the use of soil as a carbon sink for carbon sequestration. Carbon dioxide emissions during processing, transportation, and waste treatment would be virtually taken to zero by using renewable fuels and renewable energy.

Methane production could be reduced by **changing agricultural practices** and the use of wastes to produce renewable fuel through anaerobic fermentation. The only promising approach to reduce methane from enteric fermentation is to **improve productivity and efficiency** of livestock production (EPA, 2007).

Nitrous oxide emissions from fuel combustion and nitric acid production (use for production of fertilizers) could be addressed by **technical modifications**. Excess emissions of nitrous oxide from overuse of synthetic fertilizers could be reduced by **better management practices**.

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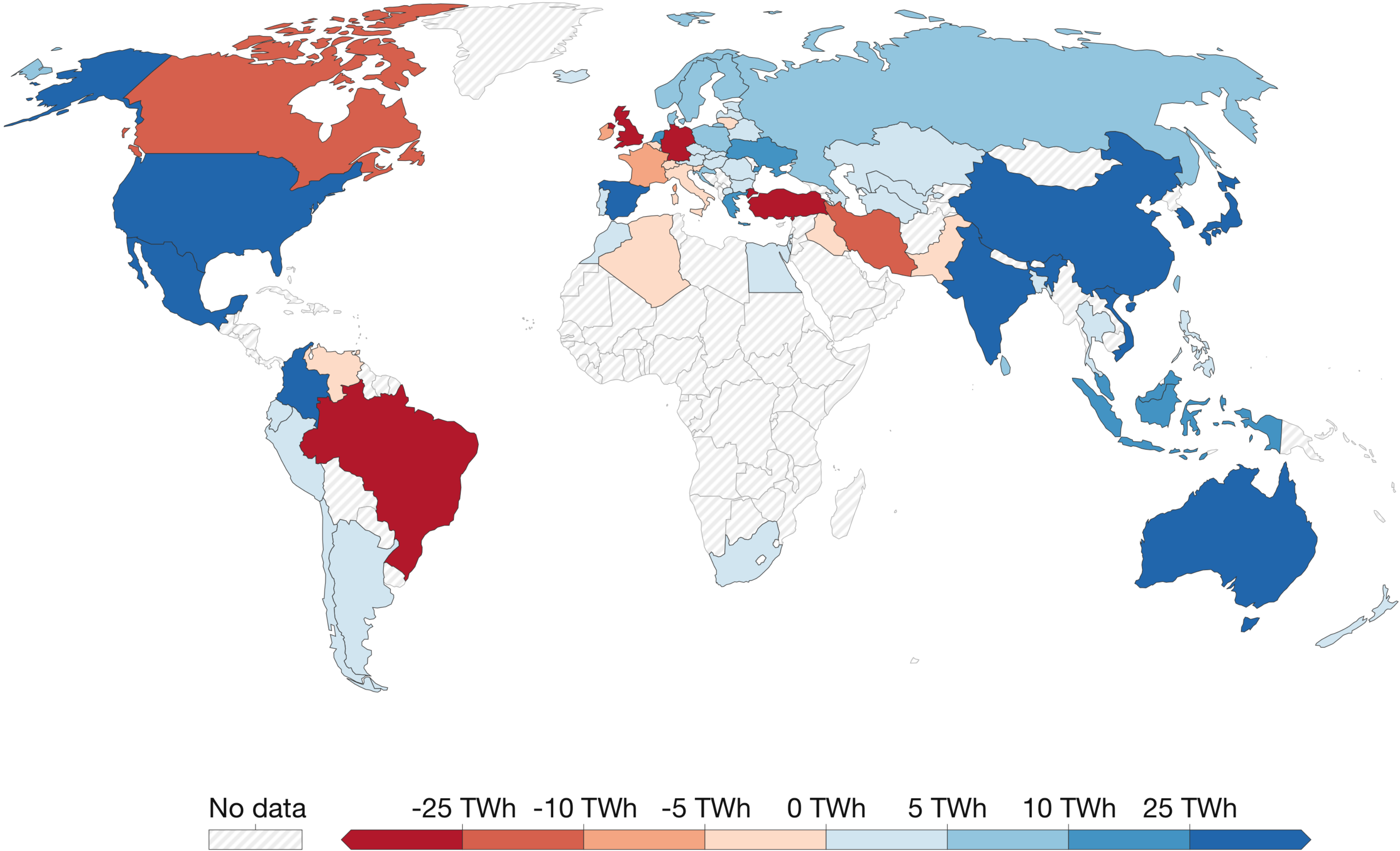
Is a 100% sustainable food company attainable?

The first block: renewable energy

- A 100% sustainable food company would be desirable, but unfortunately it is unrealistic at the moment.
- The first road block to 100% sustainability is the lack of renewable energy.
- There are many initiatives to produce renewable energy from wind, solar, and biomass sources. However, it is far from being enough to satisfy the demand of the food industry and the industries that support food production.
- It looks like the first block is lack of renewable energy.
- Have a look at what data say...

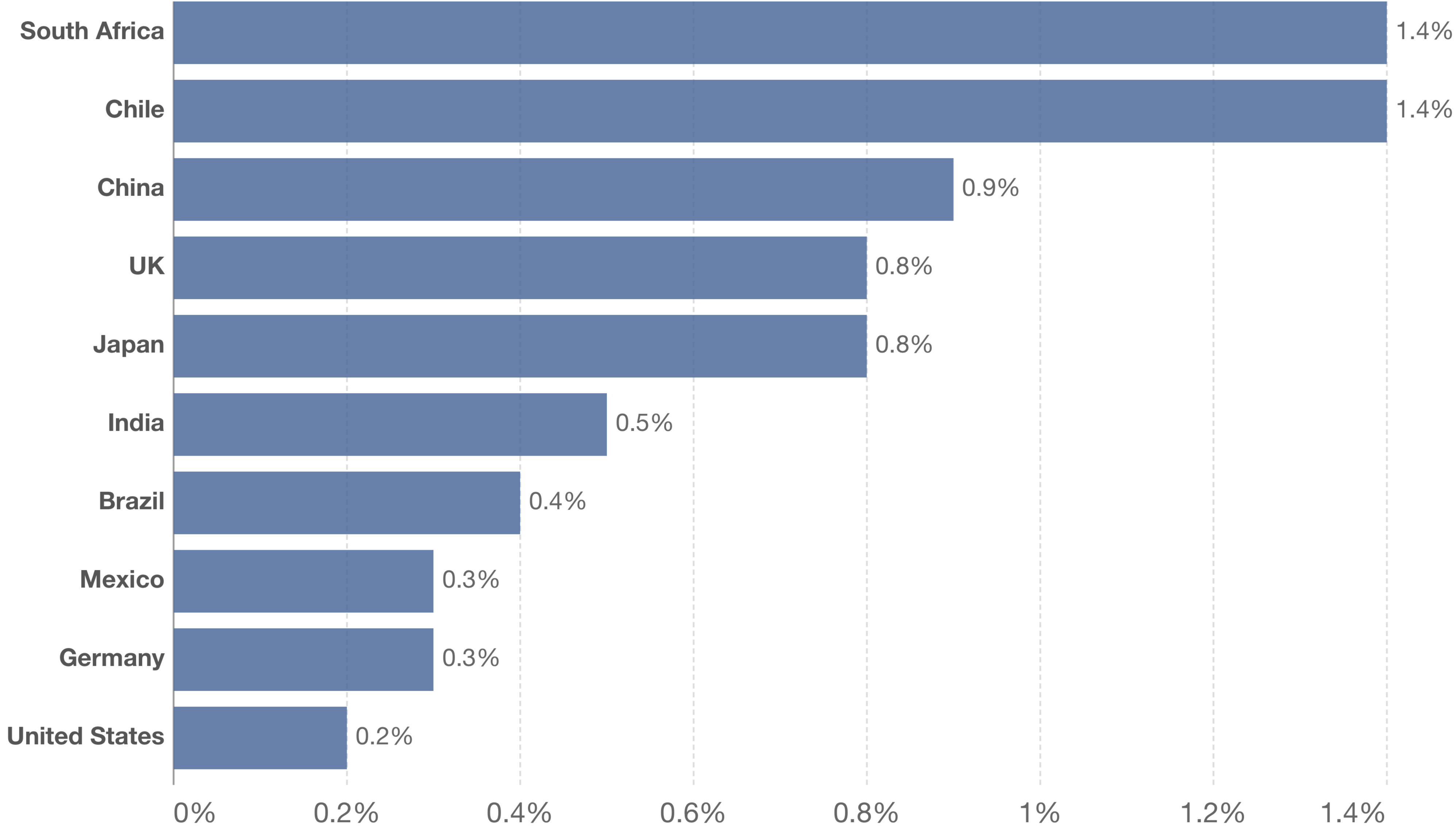
Annual change in renewable energy generation, 2021

Shown is the change in renewable energy generation relative to the previous year, measured in terawatt-hours. This is the sum of energy from hydropower, solar, wind, geothermal, wave and tidal, and bioenergy.



Renewable energy investment, 2015

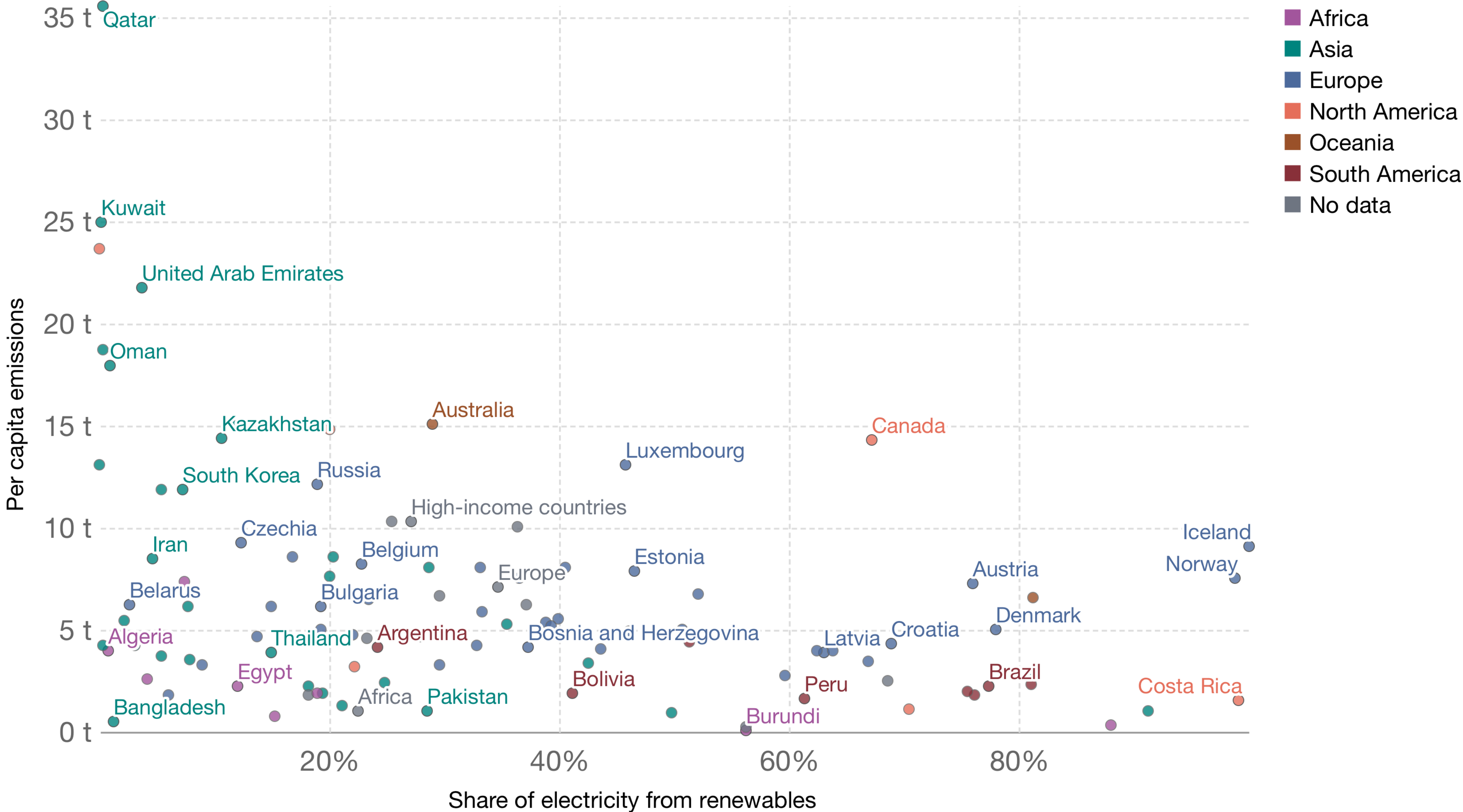
Investment in renewable energy, given as the percentage of each nation's gross domestic product (GDP) in 2015



Source: Bloomberg New Energy Finance; World Bank

CO₂ emissions per capita vs. share of electricity from renewables, 2021

Carbon dioxide (CO₂) emissions per capita, measured in tonnes per year versus the share of total electricity output from renewables.



Source: Our World in Data based on the Global Carbon Project, BP Statistical Review of World Energy and Ember (2021)

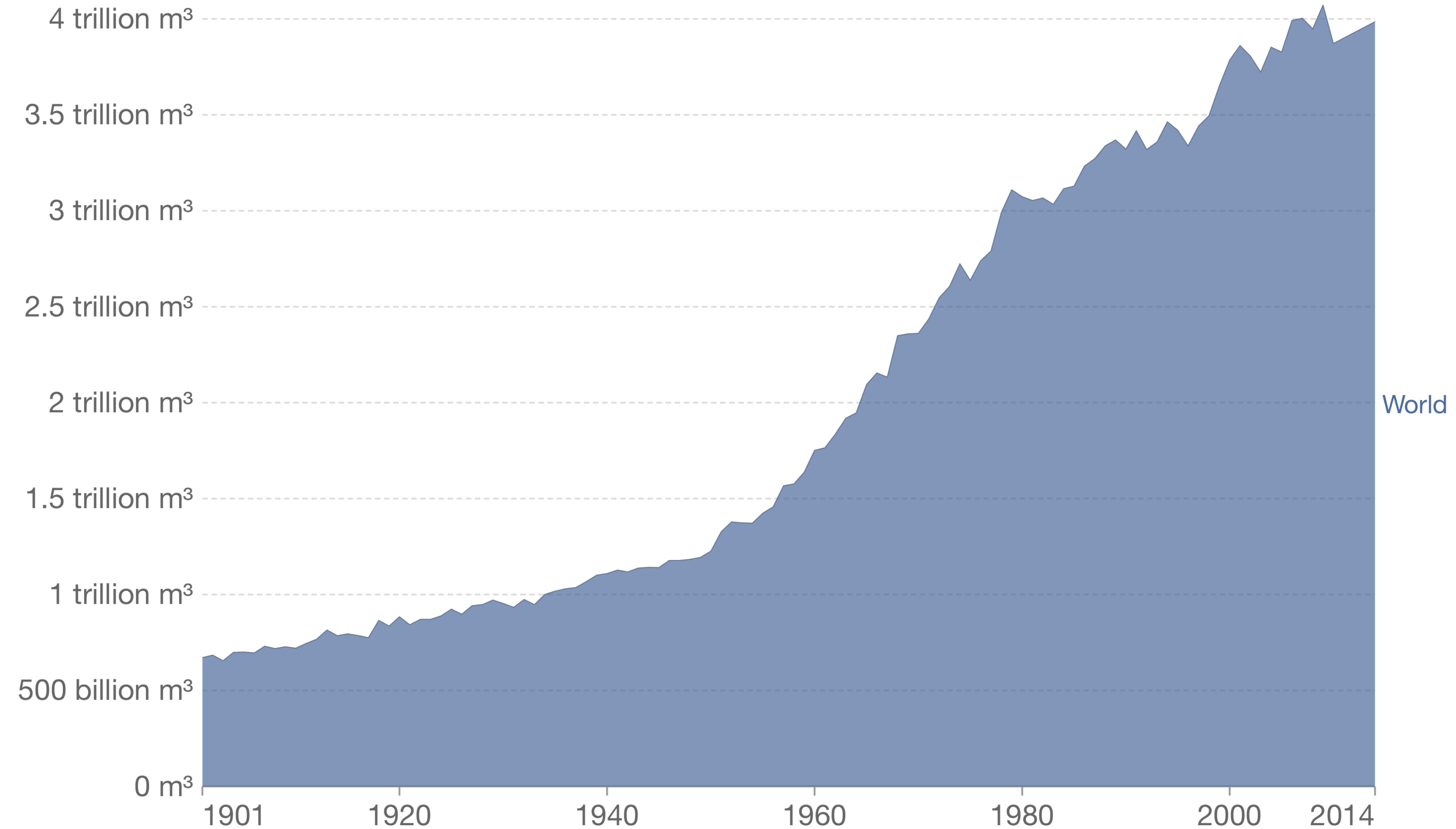
Is a 100% sustainable food company attainable?

The second block: water use.

- During the processing phase, water use can be minimized and water even reused if it is treated with membranes using renewable energy.
- However, water use for crop irrigations is having a devastating effect on aquifers in many parts of the world.
- One solution is switching to surface water, but the problem is that surface water is not available in most places where fertile soils exist.
- As usual, have a look at data...

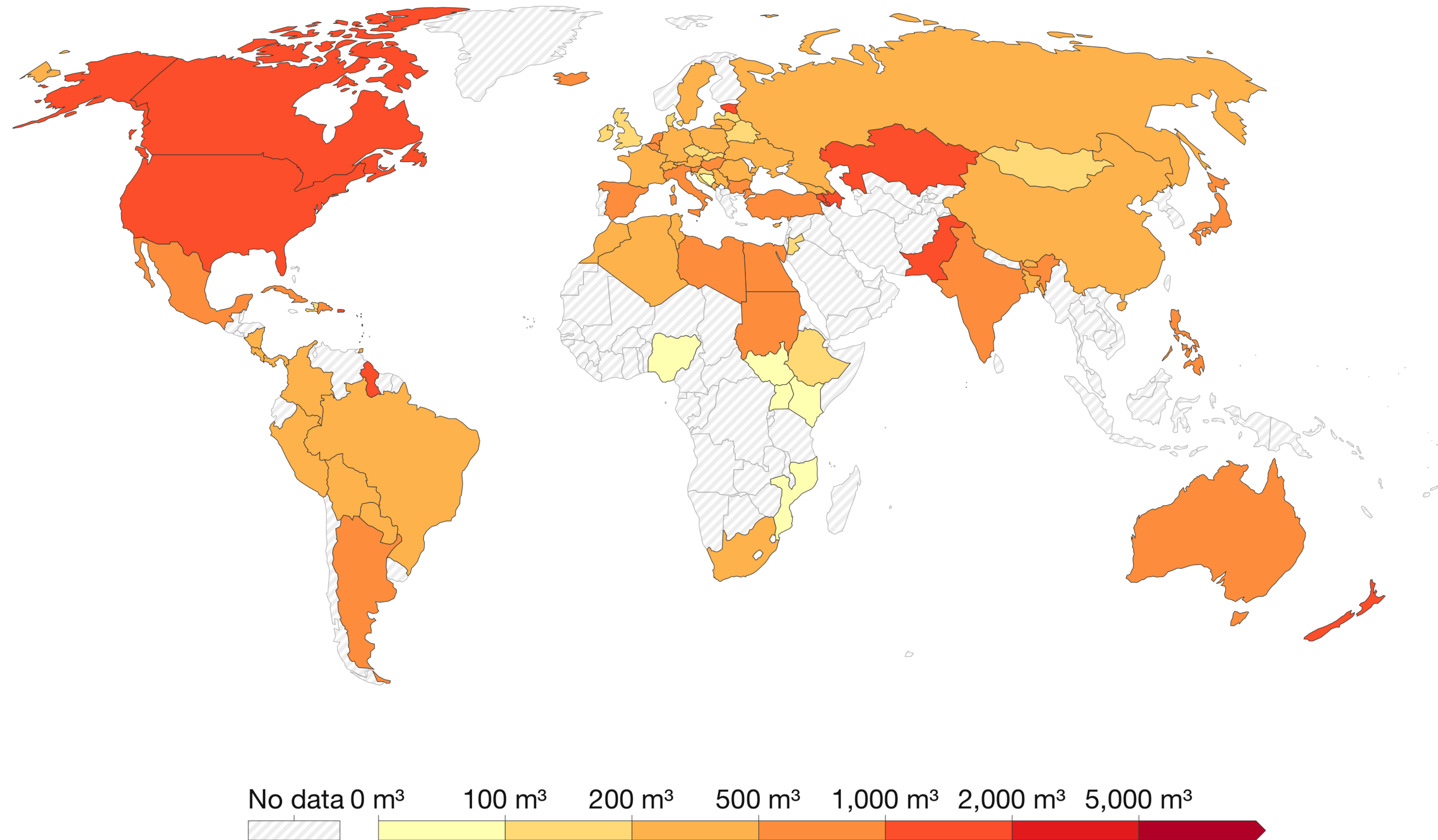
Global freshwater use over the long-run

Global freshwater withdrawals for agriculture, industry and domestic uses since 1900, measured in cubic metres (m³) per year.



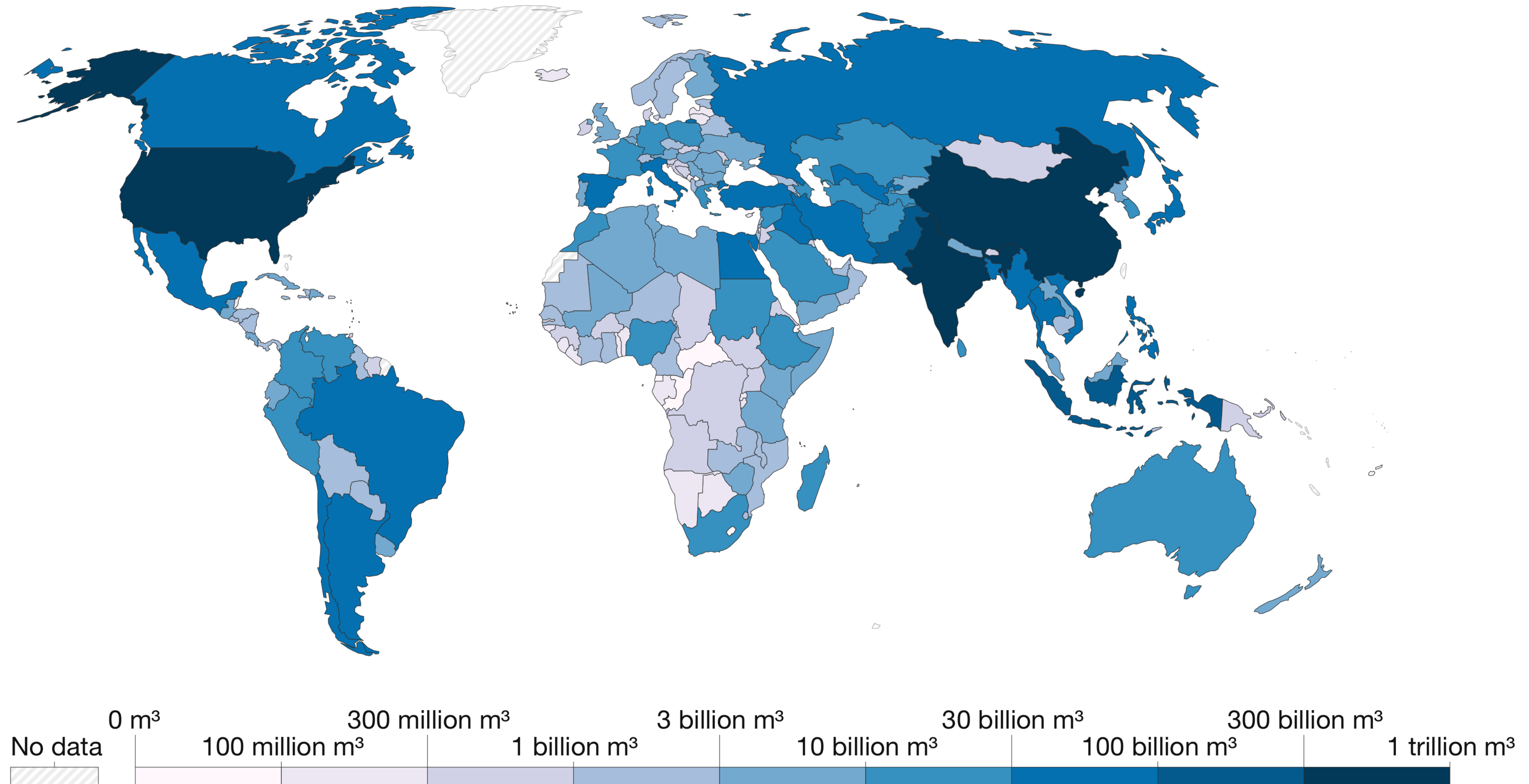
Water withdrawals per capita, 2015

Total water withdrawals from agricultural, industrial and municipal purposes per capita, measured in cubic metres (m³) per year.



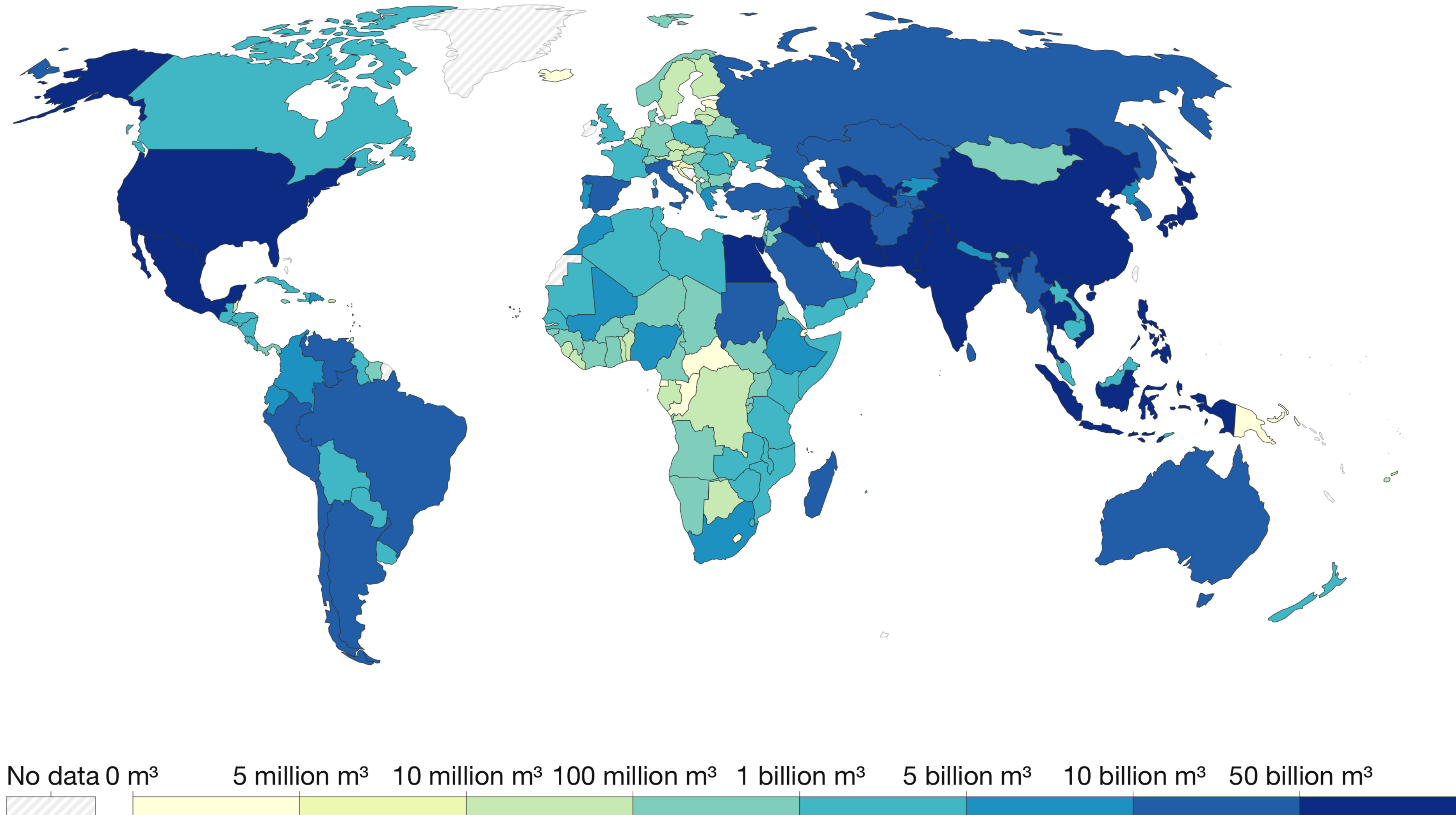
Annual freshwater withdrawals, 2017

Annual freshwater withdrawals refer to total water withdrawals, not counting evaporation losses from storage basins, measured in cubic metres (m³) per year. Total water withdrawals are the sum of withdrawals for agriculture, industry and municipal (domestic uses). Withdrawals also include water from desalination plants in countries where they are a significant source.



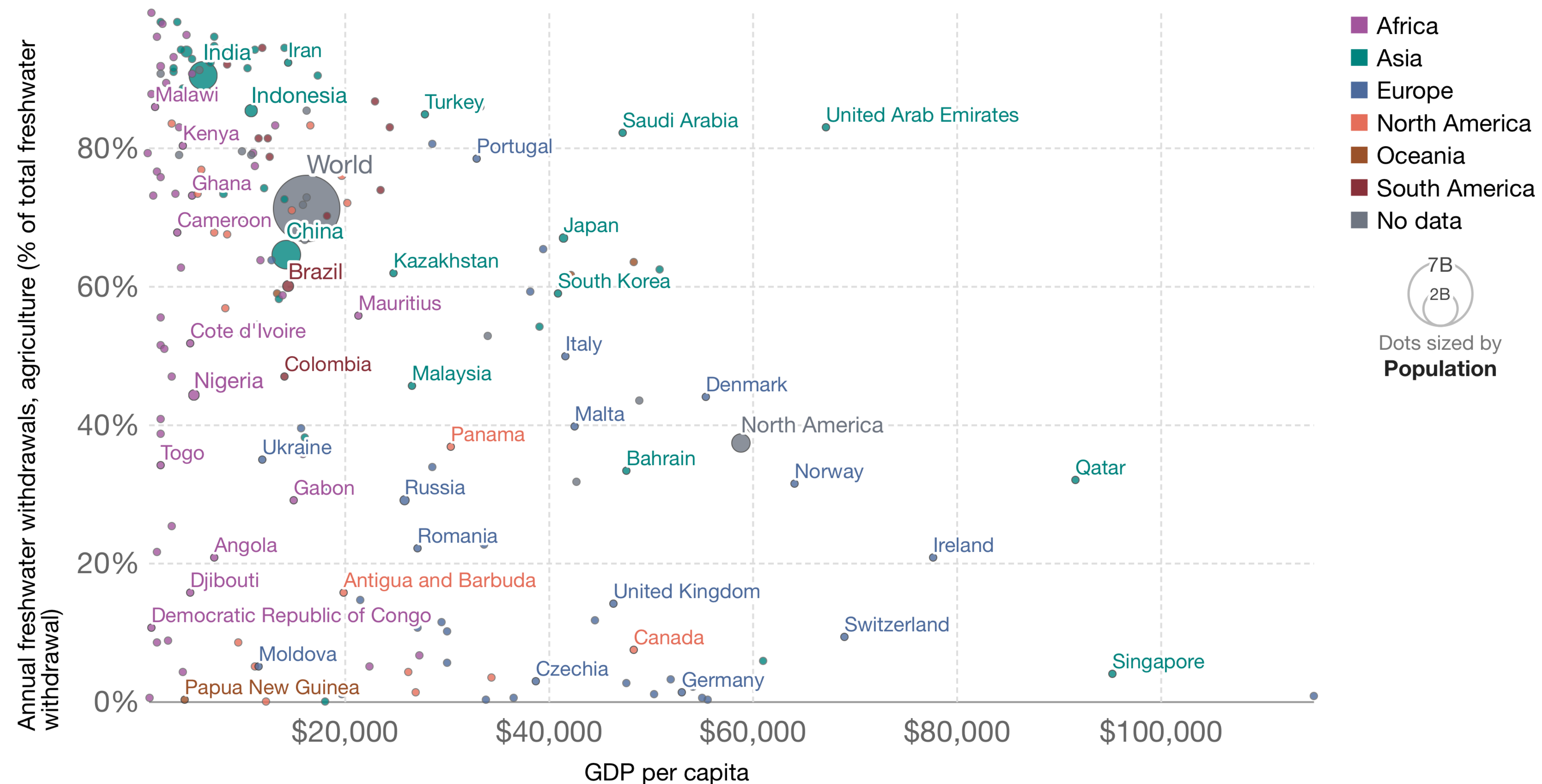
Agricultural water withdrawals, 2015

Total agricultural withdrawals, measured in m³ per year. Agricultural water is defined as the annual quantity of self-supplied water withdrawn for irrigation, livestock and aquaculture purposes.



Agricultural water withdrawals vs. GDP per capita, 2017

Share of total water withdrawals (which is the sum of water withdrawals for agriculture, industrial and domestic uses) used in agriculture versus gross domestic product (GDP) per capita, measured in constant international-\$. Agricultural water withdrawal is defined as self-supplied water withdrawn for irrigation, livestock and aquaculture purposes.



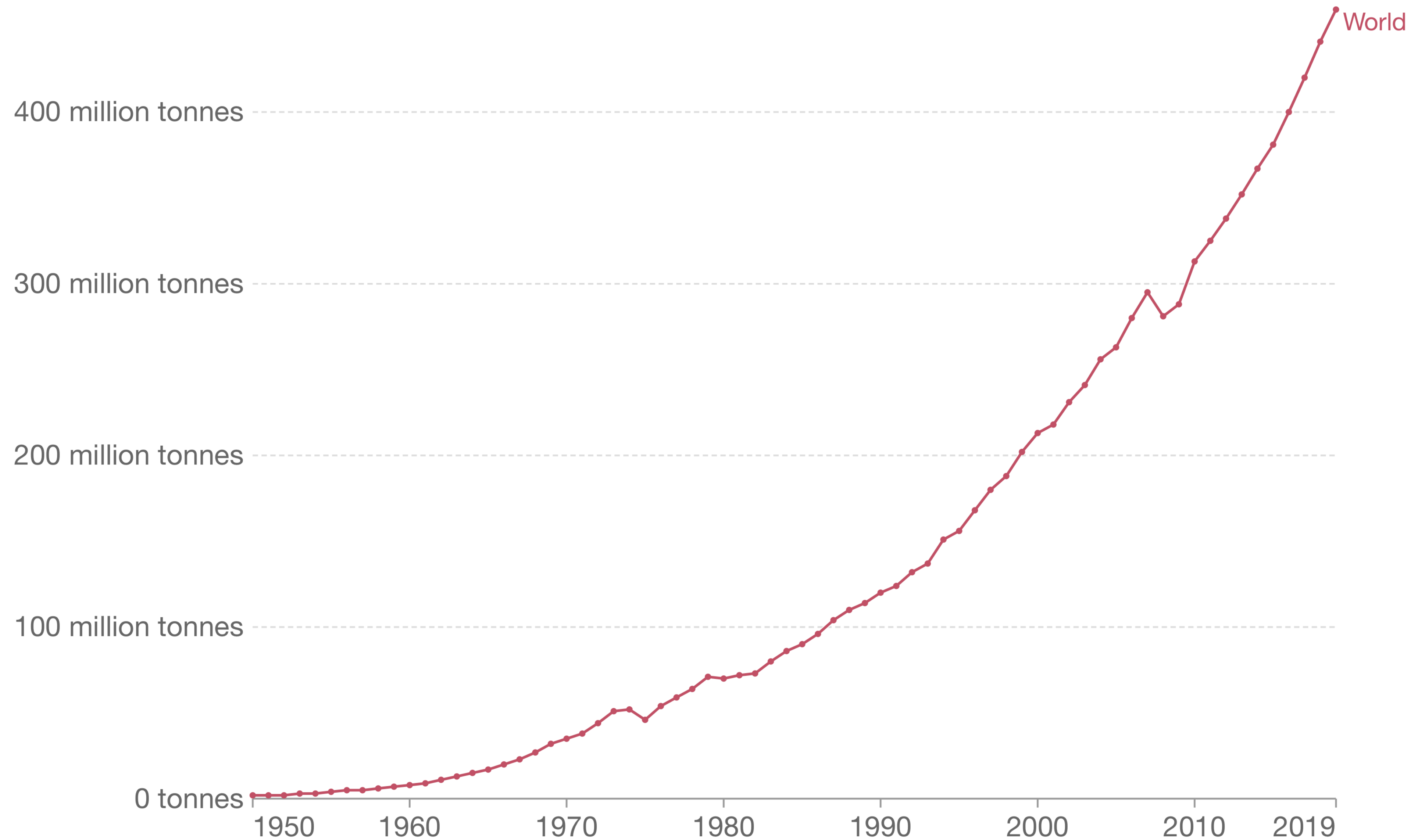
Is a 100% sustainable food company attainable?

The third block: packaging

- The fifth road block is lack of degradable packaging made from renewable resources.
- To a great extent, secondary and tertiary packaging is made from cellulosic fibers.
- However, with the exception of polylactide, most primary packaging still relies almost exclusively on plastics made from nonrenewable fossil raw materials.
- Polylactide is not the only plastic made from renewable resources, but it is the only one that is price competitive with homologous petroleum-based polymers.
- What the data say...

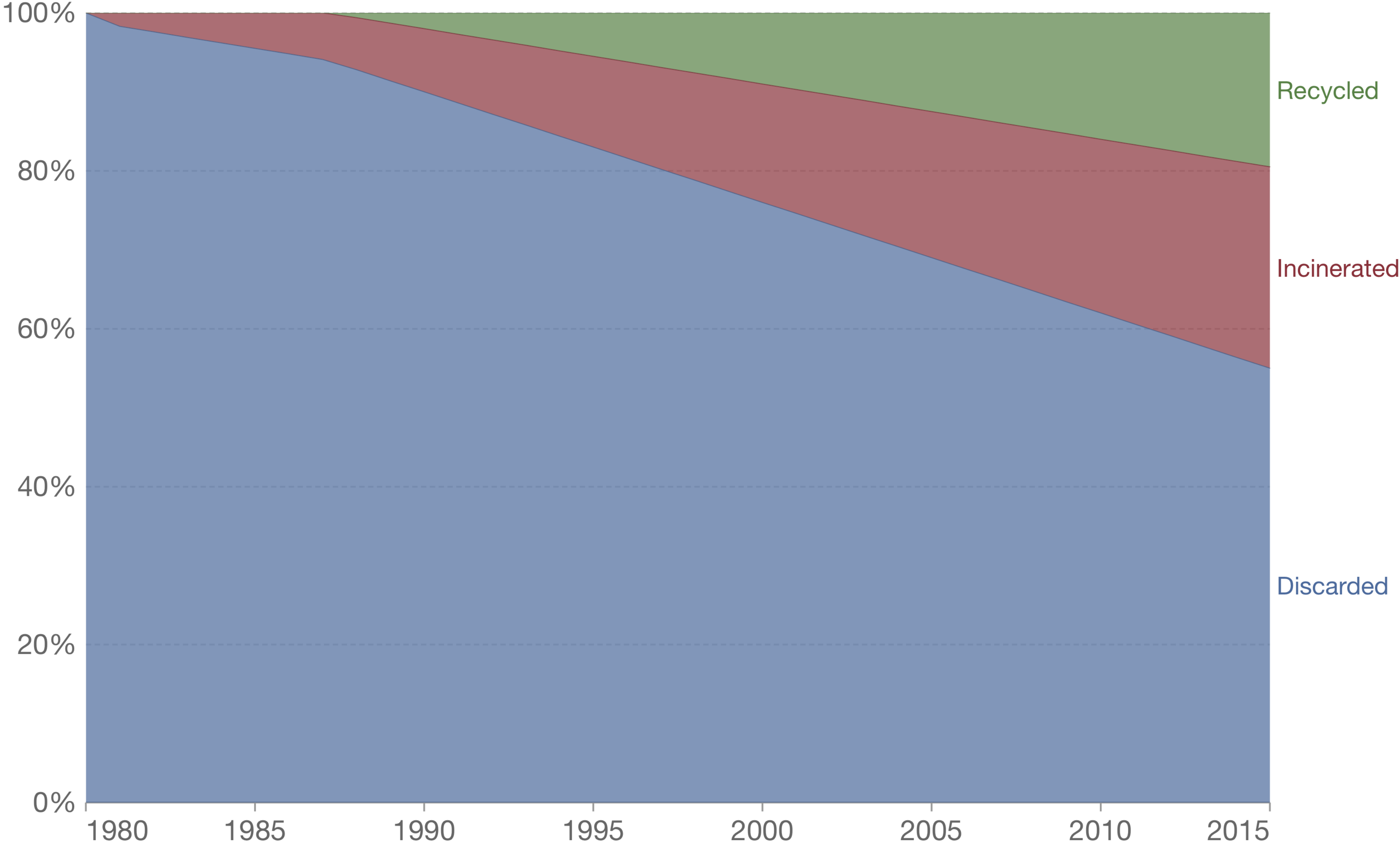
Global plastics production

Plastic production refers to the annual production of polymer resin and fibers.



Global plastic waste by disposal, 1980 to 2015

Estimated share of global plastic waste by disposal method.



Source: Geyer et al. (2017)

The pathway by which plastic enters the world's oceans

Estimates of global plastics entering the oceans from land-based sources in 2010 based on the pathway from primary production through to marine plastic inputs.

**Global primary plastic production:
270 million tonnes per year**

**Global plastic waste:
275 million tonnes per year**

It can exceed primary production in a given year since it can incorporate production from previous years.

**Coastal plastic waste:
99.5 million tonnes per**

This is the total of plastic waste generated by all populations within 50 kilometres of a coastline (therefore at risk of entering the ocean).

**Mismanaged coastal plastic waste:
31.9 million tonnes per year**

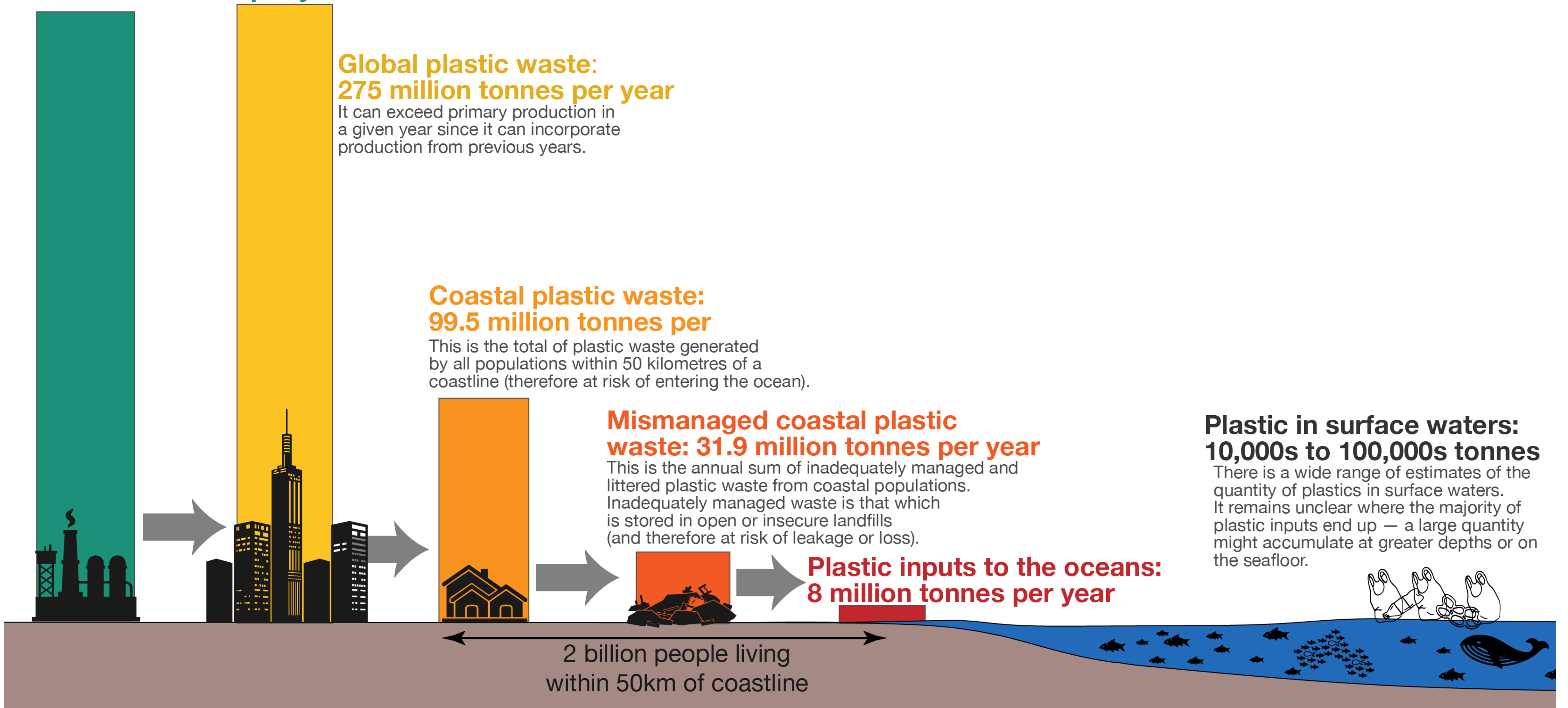
This is the annual sum of inadequately managed and littered plastic waste from coastal populations. Inadequately managed waste is that which is stored in open or insecure landfills (and therefore at risk of leakage or loss).

**Plastic inputs to the oceans:
8 million tonnes per year**

**Plastic in surface waters:
10,000s to 100,000s tonnes**

There is a wide range of estimates of the quantity of plastics in surface waters. It remains unclear where the majority of plastic inputs end up — a large quantity might accumulate at greater depths or on the seafloor.

2 billion people living
within 50km of coastline

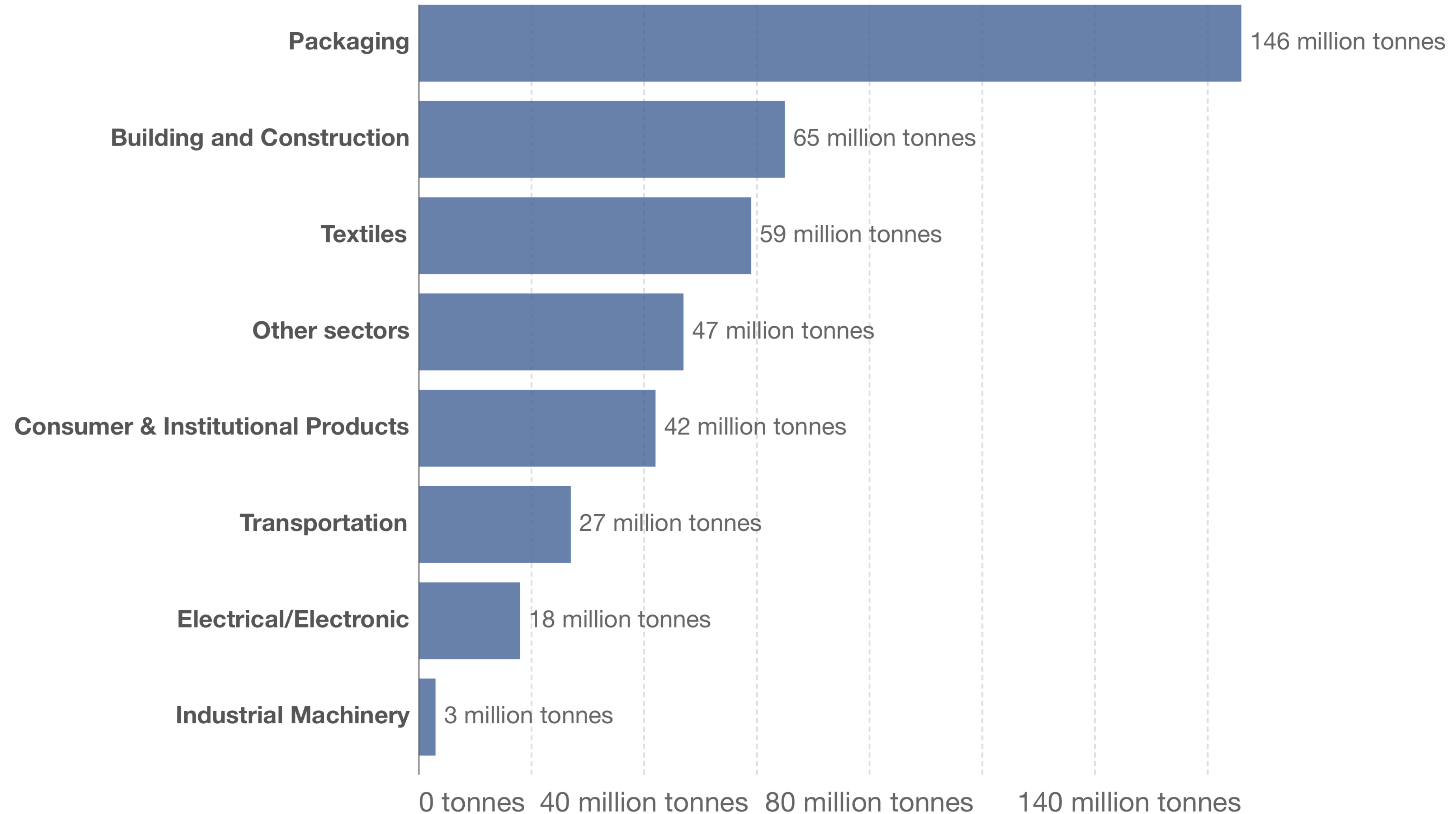


Source: based on Jambeck et al. (2015) and Eriksen et al. (2014). Icon graphics from Noun Project.

Data is based on global estimates from Jambeck et al. (2015) based on plastic waste generation rates, coastal population sizes, and waste management practices by country

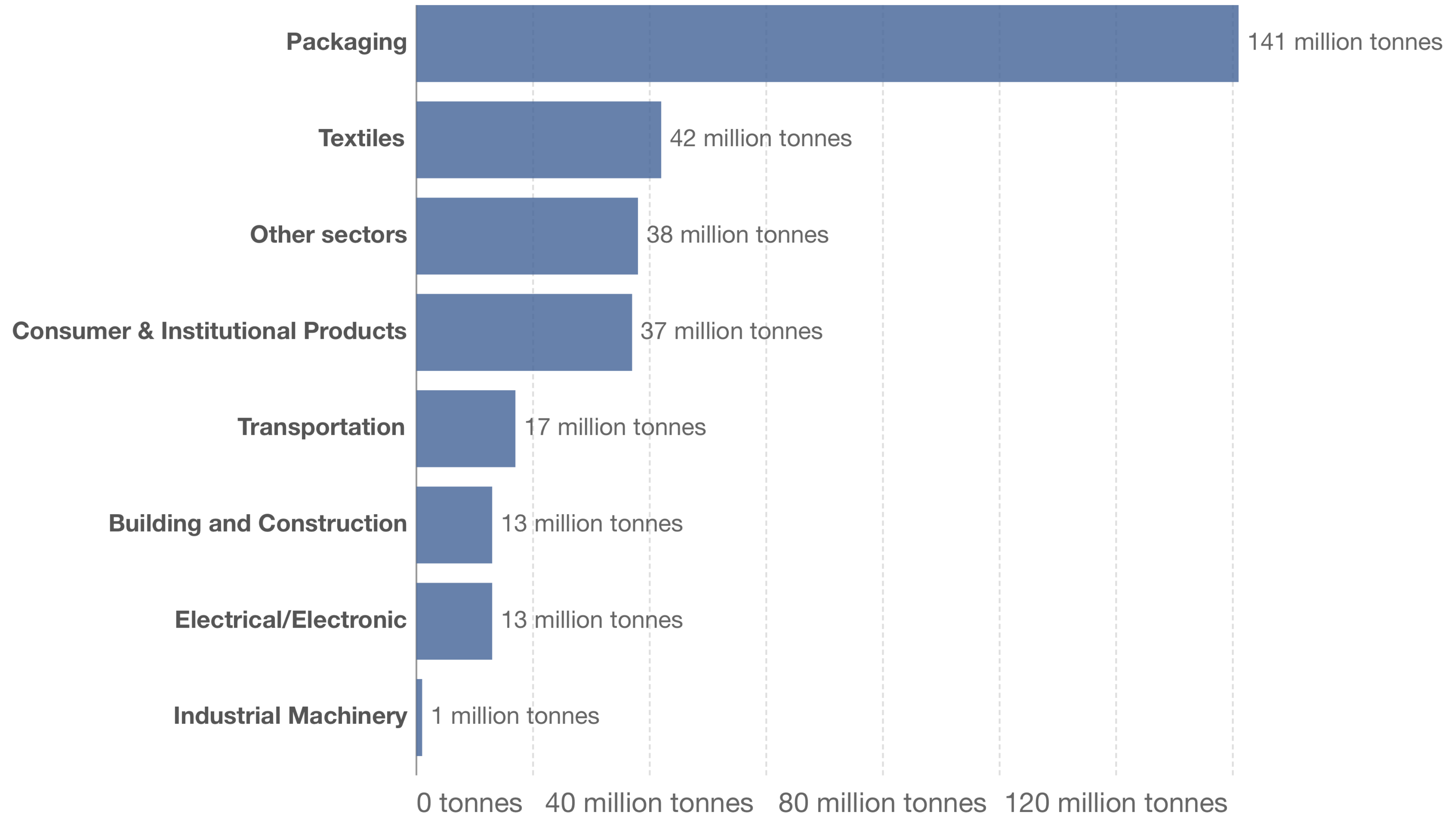
Primary plastic production by industrial sector, 2015

Primary global plastic production by industrial sector allocation, measured in tonnes per year.



Plastic waste generation by industrial sector, 2015

Global plastic waste generation by industrial sector, measured in tonnes per year.



Plastic waste generation per person, 2010

Daily plastic waste generation per person, measured in kilograms per person per day. This measures the overall per capita plastic waste generation rate prior to waste management, recycling or incineration. It does not therefore directly indicate the risk of pollution to waterways or marine environments.

