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Transitioning to a Net Zero World

Global Interdependencies

September 2023

Transitioning to a Net Zero World

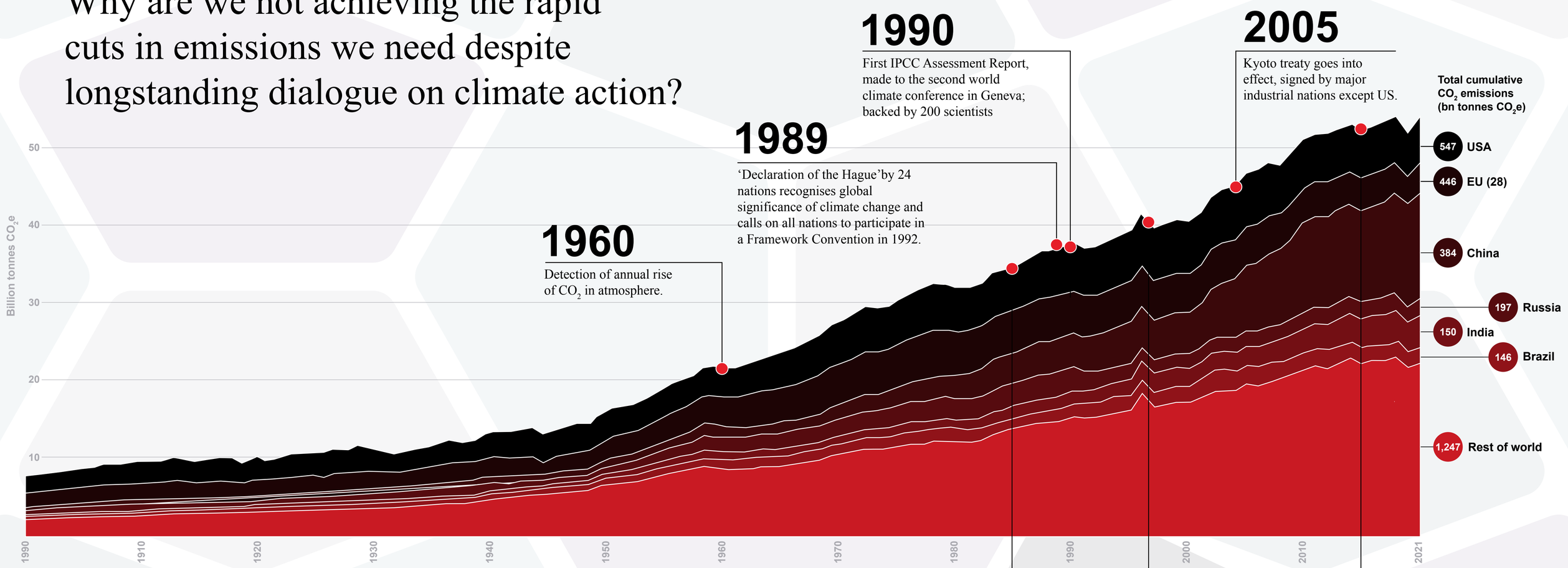
How can we shift from a period of limited change to transformational change?

Many technological solutions and visions for net zero cities, neighbourhoods, buildings, and products - while recently acknowledged at a mainstream level - have been discussed for decades. So, why is it that despite our knowledge of these ideas, and increasing attention towards them, we have not been able to make these solutions commonplace or achieve substantive reductions in global emissions?

When it comes to climate action, we primarily focus on what is needed in terms of solutions, actions, visions, plans. Our focus here is on exploring how we can effectively implement these solutions, and in particular the barriers in our path in doing so.

How do we achieve an at-scale transition towards a net zero world that goes beyond sectors and national boundaries? Our aim here is to bring attention to several issues and approaches that continue to be overlooked in the statements and solutions aiming to achieve net zero to date. We want to offer a unique and different perspective that takes a system level view, focuses on key barriers and corresponding enablers, and that highlights what is needed to truly achieve a transition to a net zero future.

Why are we not achieving the rapid cuts in emissions we need despite longstanding dialogue on climate action?



1960

Detection of annual rise of CO_2 in atmosphere.

1989

'Declaration of the Hague' by 24 nations recognises global significance of climate change and calls on all nations to participate in a Framework Convention in 1992.

1990

First IPCC Assessment Report, made to the second world climate conference in Geneva; backed by 200 scientists

1985

United Nations Environment Programme/ World Meteorological Organisation (UNEP/WMO) scientific conference calls for international action to curb emissions.

1997

Kyoto Protocol to the FCCC agrees nations to reduce emissions by 2012; signed by 163 countries.

2005

Kyoto treaty goes into effect, signed by major industrial nations except US.

2015

The Paris Agreement (ratified in 2016) signified international agreement (eventually by up to 125 countries) on strengthening the global response to climate change by aiming to reduce emissions and keep a global temperature rise this century 'well below 2 degrees Celsius above pre-industrial levels' and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

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Transitioning to a Net Zero World

Introduction

Achieving net zero at scale is more of a political, economic, legal, and financial struggle than a technical problem. Climate targets and regulations are set up nationally – while consumption and production take place globally.

Big businesses commonly announce targets to reduce their emissions but outsource emissions-intensive processes further down their supply chains. Large corporations still face little pressure from government to validate their statements on climate change targets. Net zero ambitions often serve more as marketing tools than as impetus for a truly transformed business model.

Governments around the world continue to struggle to understand the role they can play in driving change while delivering on urgent needs and maintaining socio-political stability. Scaling and implementing concepts such as a circular economy are still left to the market, overlooking the fact that the lack of clear regulatory and financial incentives for manufacturers and retailers backing the concept continues to favour an economy that relies on making and selling more new things. Far-off visionary net zero targets continue to lack near-term pressures to perpetuate the required level of change.

Through this study we question how pledges to action can be more effective. Are we focused on the right actions and commitments? Are we targeting the real barriers to a net zero transition?

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Transitioning to a Net Zero World

Introduction

What do we mean by a net zero world?

The debate around the phrase ‘net zero’* continues, as does an increase in global emissions. Critics of the term net zero rightly point out that it can be used to justify inaction and excessive dependency on unknown and unproven technological solutions to mitigate climate change. In this study, we use the term net zero to represent the scale of the challenge, the general direction of travel for emissions, and to recognise that sequestration mechanisms will be required to some degree to achieve climate goals. Greenhouse gas emissions must be minimised to prevent temperature increase above 1.5 degrees and those emissions which cannot be avoided must be offset (removed) through available means – either through nature-based or technological solutions.

But we take note and guard against the loopholes within the term net zero, by making clear: the focus is first on minimising emissions as much as possible while still enabling vibrant lives for people and maintaining individual freedoms. After all attempts to achieve this balance, we must seek to sequester enough carbon, through nature-based solutions and then technological mechanisms, to remove carbon from the atmosphere to ultimately achieve and maintain a stable temperature for the Earth. Action on net zero must align as closely as possible with the need to become a more sustainable world.

While reducing greenhouse gas emissions is a priority, the planet is past its capacity to sustain human consumption in more than one way. This means that if action can be taken to reduce greenhouse gas emissions and simultaneously address other environmental and social issues such as waste, degradation of land, water and air pollution, or exploitation of people and resources, then it is the preferred course of action and should receive priority over solutions which exclusively cut greenhouse gas emissions. Actions to manage greenhouse gas emissions must also be assessed to ensure they do not worsen existing social, environmental and public health issues over the long-term.

Due to the ongoing delay in action on climate change and continued accumulation of excessive greenhouse gases in the atmosphere, we recognise that the sequestration of emissions from the atmosphere may indeed need to go beyond offsetting ongoing emissions and capture more greenhouse gases from the atmosphere than are actually being emitted at the time, in other words to achieve a ‘net positive’ effect. In the context of this study this differentiation between ‘net zero’ and ‘net positive’ is rather immaterial. Our focus is on understanding and addressing the barriers that impede progress on the transformational change required to meet these agendas.

*Formally, the term ‘net zero’ implies that we need to apply a mixture of decarbonisation and sequestration measures to rebalance the amount of carbon present in the atmosphere to optimal levels to stabilise the planet’s temperature. Getting to zero emissions requires decarbonising current greenhouse gas emitting operations as much as possible (by finding alternative to carbon-intensive resources or reducing or eliminating hydrocarbon use), and then using nature and technology to remove any remaining carbon emissions from the atmosphere.


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Overview

Challenges for a transition to net zero

In this work, we highlight three fundamental challenges to a successful, at-scale transition to net zero emissions. The aim is to build a common understanding of the barriers we must overcome and the unresolved questions we must tackle to enable the transition to a net zero world.

This document is the first release of a four part Foresight report exploring systemic challenges to a net zero transition.

1. Global Interdependencies

Business, industry, and consumption take place across borders – yet climate action will be delivered in the context of a nation's individual priorities and agenda. What does cross-border alignment look like in practice?

Featured narrative & analysis

Country Profiles: Understanding national perspectives

The global nature of agriculture & industry

2. Complexity within sectors (Release date: October 2023)

Each sector is made up of a complex set of systems and actors – who makes decisions and holds responsibility to action change and eliminate contradictions?

Featured narrative & analysis

Mapping the transport sector: Great Britain

Mapping the energy sector: Great Britain

3. Feasibility for consumers (Release date: October 2023)

What is sustainable, and is it practical and affordable? Make sustainable choices the default and the most competitive option for consumers.

Featured narrative & analysis

How easy is to make homes more energy efficient? Examples from UK, Austria, France.

How easy is it to find sustainable products? Case study: tea & smartphones

(Release date: November 2023)

Government and big businesses must start using every lever of influence in their power

Government sets the framework for production and consumption. Businesses are the link between individual choices and systemic provisions across national boundaries. Consistent and aligned action from government and big businesses is a necessary condition to overcoming the key barriers to the net zero transition.

Featured narrative & analysis

Recognising all levers of influence: Businesses | Government

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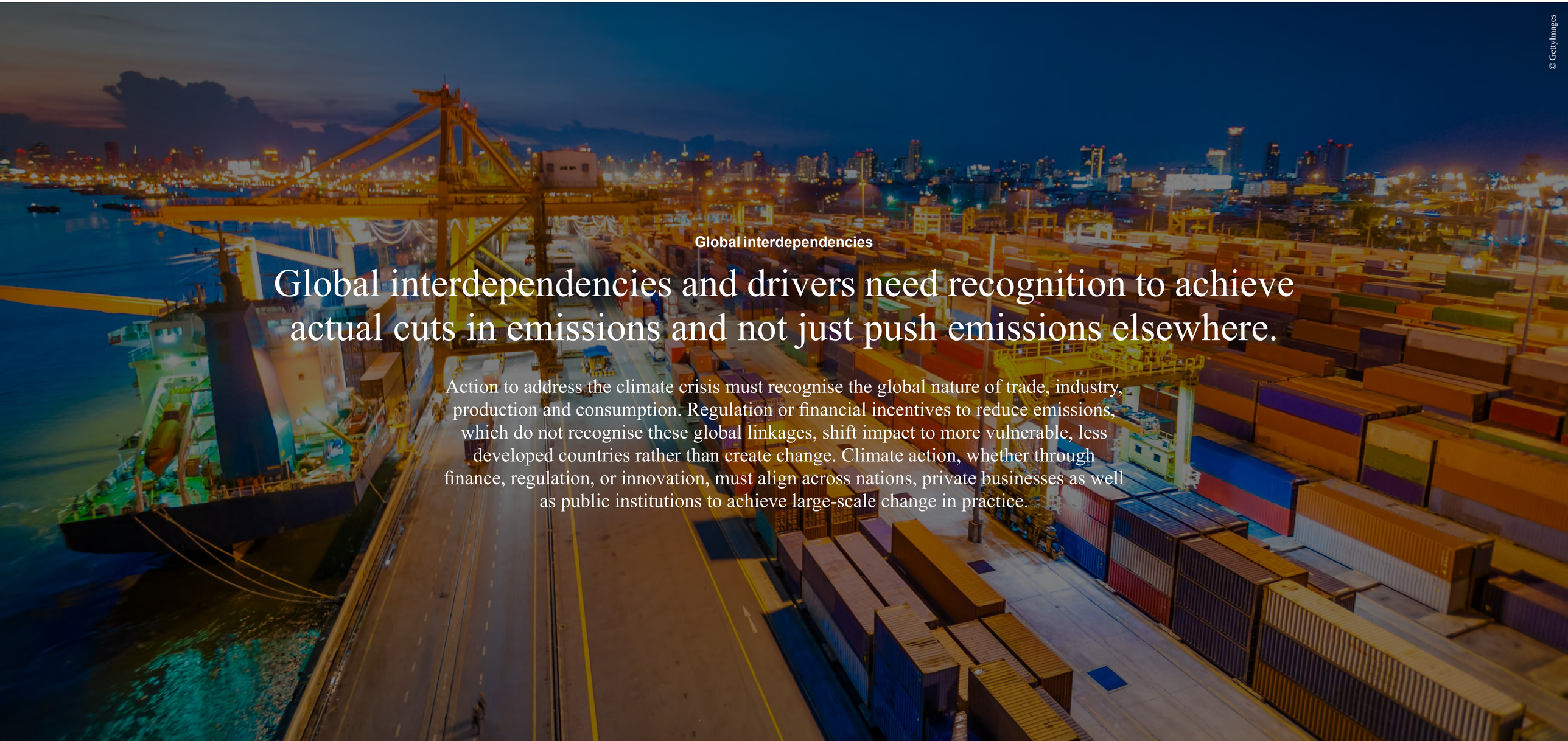

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Global interdependencies

Global interdependencies and drivers need recognition to achieve actual cuts in emissions and not just push emissions elsewhere.

Action to address the climate crisis must recognise the global nature of trade, industry, production and consumption. Regulation or financial incentives to reduce emissions, which do not recognise these global linkages, shift impact to more vulnerable, less developed countries rather than create change. Climate action, whether through finance, regulation, or innovation, must align across nations, private businesses as well as public institutions to achieve large-scale change in practice.

Global interdependencies

Featured narrative & analysis

Global interdependencies

Agriculture and Industry

More than other sectors, agriculture and industry are particularly globally interdependent, together making up nearly 48% of global greenhouse gas emissions[1].

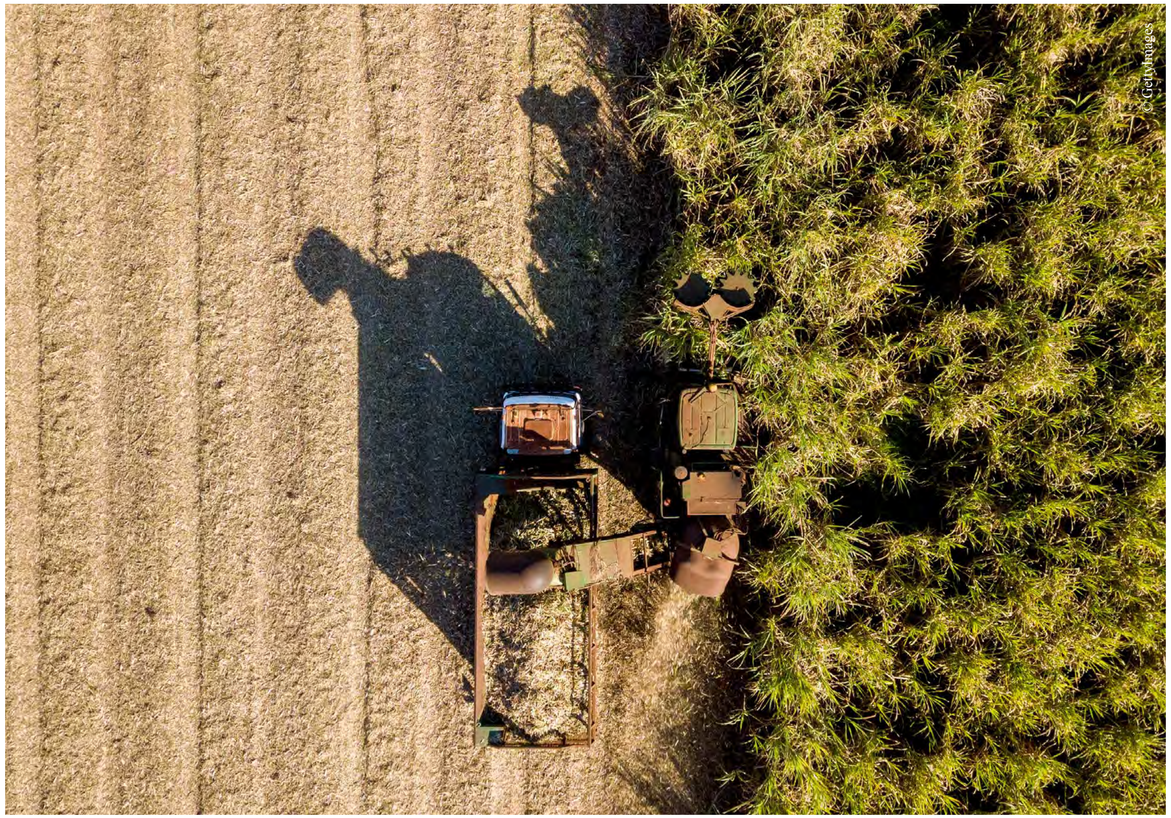
Global trade and international supply chains in these sectors drive their market, scale of activity, and operations. Climate, geography, politics and access to natural resources have shaped the role individual countries play in the global agriculture and industry markets.

Action to achieve net zero emissions within these two sectors requires coordinated global effort and strategies so that:

- Outcomes are regionally equitable and context sensitive.
- Emissions are reduced in total, and not shifted from one nation to another.
- The needs of the most vulnerable (environmentally and economically) regions are recognised and supported.

We cannot overlook the fact that domestic actions within the agriculture and industry sectors have strong and immediate international implications. Without a more sophisticated understanding of the roles played by different actors and regions across key supply chains, of the critical drivers for emissions-intensive activities, and without greater coordination on action – isolated local efforts to move towards net zero emissions lead to little change or even give way to larger perverse unintended consequences somewhere else.

This section explores some of the key areas of tension, and complexities specific to the agriculture and industry sectors. It considers how solutions, roles, and areas of focus must vary by region. Finally, we raise questions highlighting specific challenges and perspectives that must be addressed in these sectors in order to transition to a net zero world.



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Agriculture

Food production and consumption take place across a global network

A sustainable path to net zero agriculture requires more than just reconsideration of domestic farming practices in individual countries. It requires understanding of how consumption patterns in one part of the world drive production, land management, and economic trends in another. It also requires recognising the role of all actors that influence agriculture and food consumption, from the individual farmer, to the multinational food corporation, government, and the consumer.

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Food products

A simple chocolate bar

A well-established UK brand produces a classic chocolate bar containing only eight ingredients, yet still relies on an intricate supply chain extending across four continents.

As can be imagined on this basis, for more sophisticated products, supply chain complexity increases immensely. Most products we use every day rely on distinct materials, skills and knowledge, and processes across different nations to be manufactured. We know it is common for the design, ownership, and demand for a product to sit in an entirely different part of the world from where the product is actually created (and where the associated emissions intensive activities required to create the product take place). The role and responsibility of different nations, therefore, in reducing agricultural and industrial emissions is not as simple as tracking and measuring their domestic activities.

Note: This map considers the process entailed in producing one brand's classic chocolate bars just in the UK. This chocolate bar, however, is also produced in other parts of the world.

5.8kg CO_2
Average carbon footprint of chocolate per kg

47,000
Total tonnes of chocolate

0.27 $MtCO_2$
Estimated total annual emissions. Equal to driving 60,500 gasoline-powered vehicles for a year.

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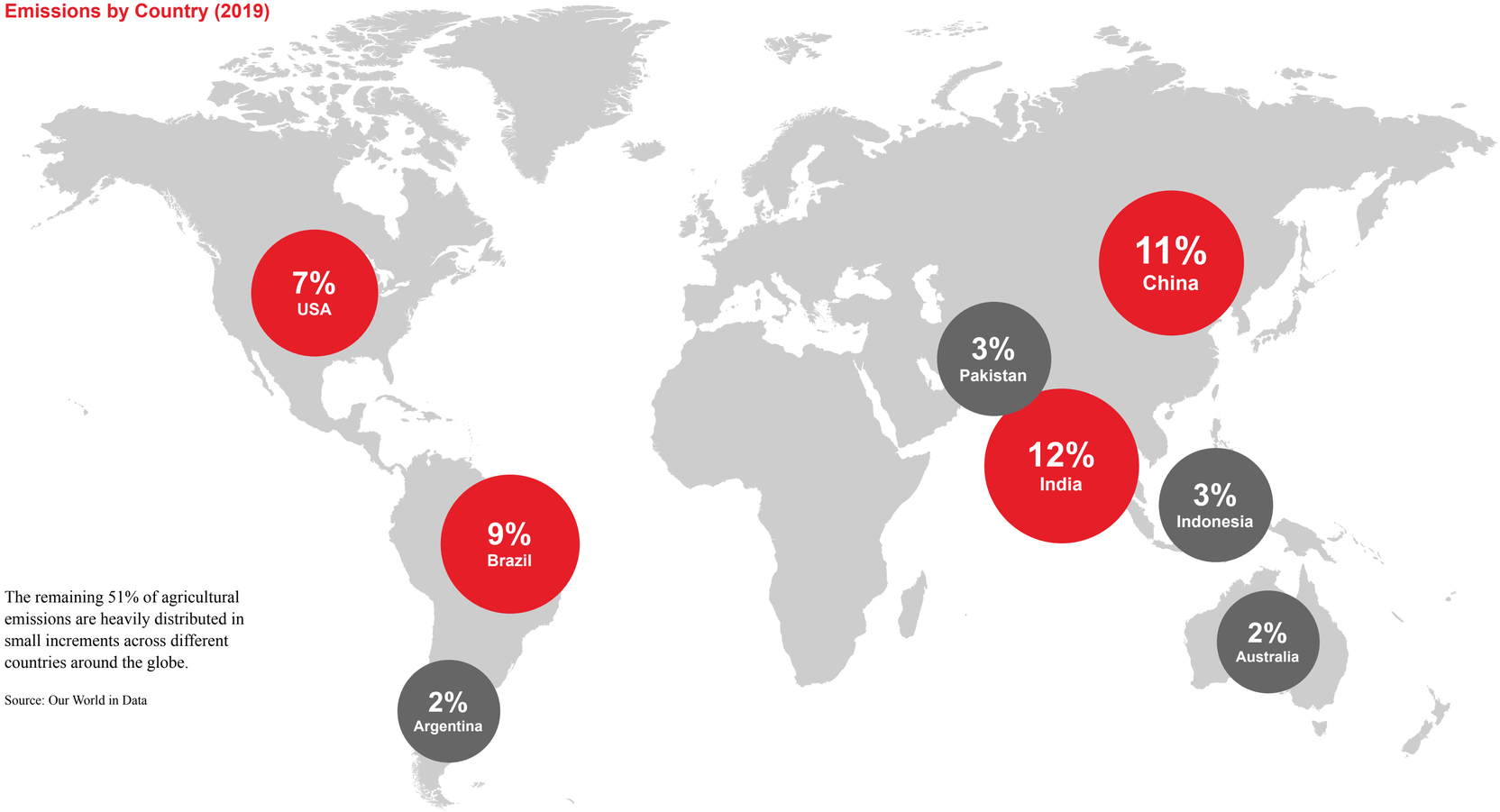
Agriculture

What drives agricultural emissions in individual countries?

The graph on the right conceals and simplifies the story of agriculture emissions. Are emissions particularly high in China, India, and Brazil due to the fact that they have higher populations, greater wastage, and poor farming practices, or due to their high exports and an emphasis on agriculture in their economies?

Share of Global Agricultural Emissions by Country (2019)



The remaining 51% of agricultural emissions are heavily distributed in small increments across different countries around the globe.

Source: Our World in Data

Agricultural emissions are the end results of many globally tied factors –

the availability of land and resources, the preferences and needs of populations, trade relations, the allowance and management of waste, as well as farming practices.

Food products Agriculture

Top Agriculture Emitters

The countries with the highest agricultural emissions are some of the world's most populous as well as key suppliers globally of core agricultural goods such as sugar, milk, wheat, rice, and more.

China

With the world's second largest population, China is the world's largest producer, but also the largest net-importer of agricultural goods. A rising middle class with changing consumption habits, alongside increasing concern over the health safety of food due to excessive use of chemicals in farming, has increased China's reliance on imported food.[2] Between 2003 and 2021, China's food imports grew from $17 billion to $207 billion.[3]

India

India is the world's most populous country. It is a top producer of agricultural goods globally.[4] It is the largest exporter of rice in the world, with milk being another major agri-product.[5] Demand for imported food products is increasing due to factors such as reduction in tariffs, changes in consumer preferences and growing adaptability to international cuisine.[6]

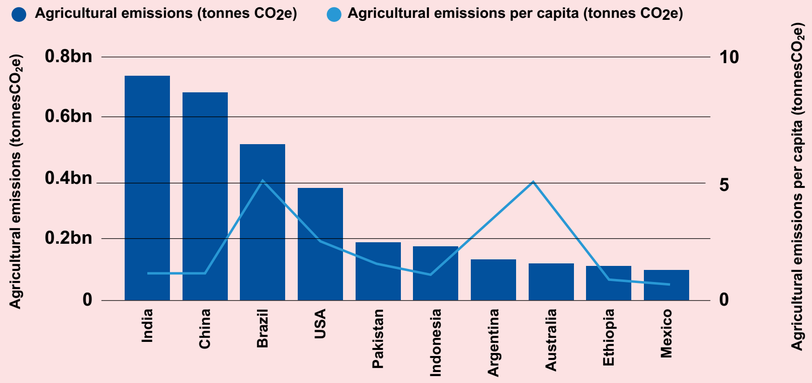
Brazil

Brazil has the world's seventh largest population and is the world's largest net exporter of agriculture goods. Brazil is the leading sugar producer and exporter of the world. About 75% of the sugar produced in Brazil is exported to more than 100 different countries.[7] Other major exports include soybeans, coffee, beef, poultry, and maize.

USA

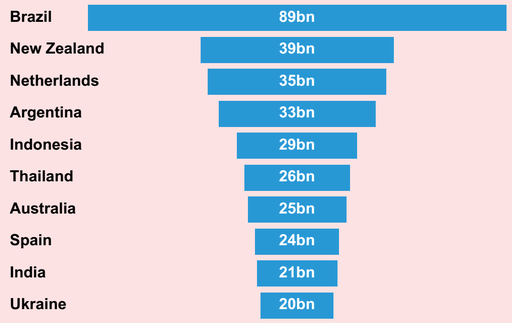
With the world's third largest population, the US is a top producer of agricultural goods globally. It is also one of the largest importers of some of the most emissions-intensive food products such as beef, chocolate, and coffee. More than 200 countries or territories supply approximately 32% of the fresh vegetables, 55% of the fresh fruit, and 94% of the seafood that Americans consume annually.[8]

Agricultural emissions and agricultural emissions per capita by country (2019)

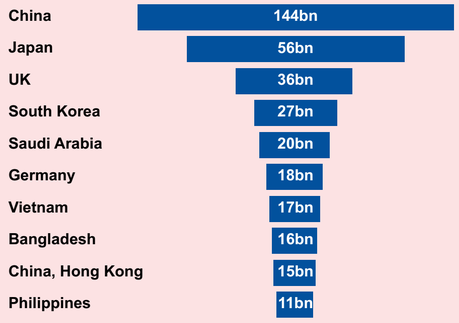


Data source: Our World in Data

Top 10 net exporters (2021) (USD)



Top 10 net importers (2021) (USD)



Data source: Food and Agriculture Organization of the United Nations

Top Importers

Many major importers of agri-goods are small, wealthy regions with a fast-growing appetite for emissions-intensive products.

Japan

Japan is the second largest net-importer of agricultural goods globally, while representing 1.5% of the world's population.[9] As of 2021 it relied on imports for over 60% of its food consumption,[10] and in particular it is amongst the top three importers worldwide for beef, pigmeat, and poultry meat (some of the most emissions-intensive agricultural products).

UK

After, China and Japan, the UK is the world's third largest net-importer of agricultural goods, while representing 0.84% of the world's population. When counting the source of ingredients required for food packaged in the UK, over 80% of food consumed in the UK is imported according to a 2019 estimate.[11]

Europe Union

When considered as a whole, the EU is the largest net exporter of agricultural goods globally,[12] but it is also the world's third largest overall importer of agricultural goods.[13] The EU's agri-food trade activities centre on importing low-value raw products (e.g. cocoa, fruits and soybeans), and exporting high-value products such as wine and chocolate – enabling it to show up as a major global net-exporter on a monetary value basis. As much as 40% of the food produced in the EU is never eaten.

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Agriculture

The role of different nations: importers

Food products Agriculture

An analysis of top net-importers for agricultural goods provides a picture of where demand is concentrated, which countries most heavily influence the market and production of agricultural goods, and how factors driving demand within these countries are evolving.

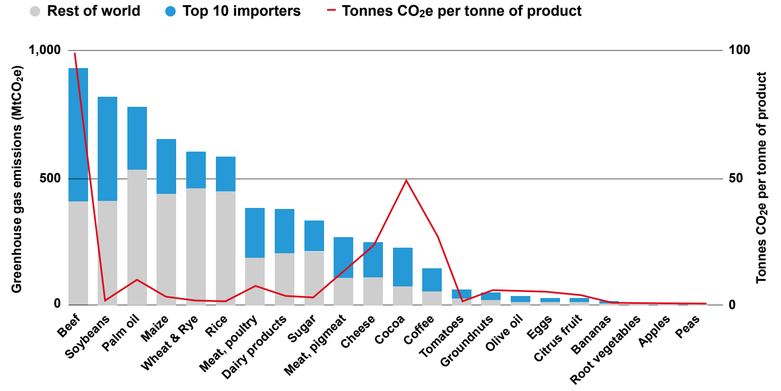
While China, Japan, and the United Kingdom come to the top for overall net imports in agriculture, the imports per capita graph shows how the top net-importing countries are re-ordered when their import levels are evaluated on a per-capita basis: Hong Kong, Saudi Arabia, United Kingdom, South Korea, Japan, Germany are the top 5 net importing countries on an import value per capita basis.

Which countries are the top importers of the most emissions-intensive agricultural goods?

Beef, palm oil, soybeans, maize, and wheat have the highest cumulative emissions (considering both the emission-intensity of the good along with the total quantity imported). In addition, for many of these emissions-intensive goods (e.g. beef, palm oil, soybeans, pork, cheese, coffee, and cocoa), nearly half of the total global imports (by value) are due to demand from a handful of countries. For example, in 2021 just the US, Germany, France, Italy, Canada, and Netherlands account for 46% of all coffee imports; China, US, Japan, Korea, and Hong Kong account for 50% of all beef imports; India, China, Pakistan, Netherland and US account for 45% of all palm oil imports. Some of these agricultural imports are driven by industry or further processing in these countries rather than final consumption – for example, reportedly 80% soybeans imported in China are processed to be used for animal feed.[14]

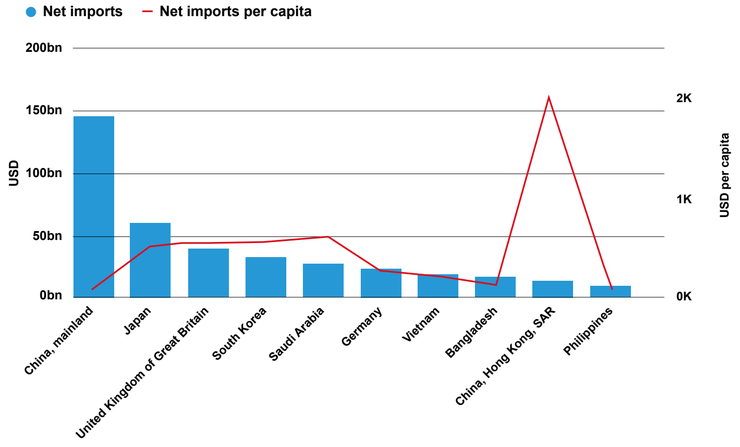
Calories per capita continues to remain highest in the higher income countries – the top 10 countries with the highest daily per capita calories intake are all located in North America and Europe at above 3500 kcal.[15] Demand for meat in Europe, Australia and North America remains at twice that of the Middle East region, and Western and Central Africa.

Top imported agricultural goods with highest total GHG emissions (2021)



Data source: Food and Agriculture Organisation of the United Nations

Top 10 net importing countries for agricultural commodities (2021)



Data source: Food and Agriculture Organisation of the United Nations

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Agriculture

The role of different nations: exporters

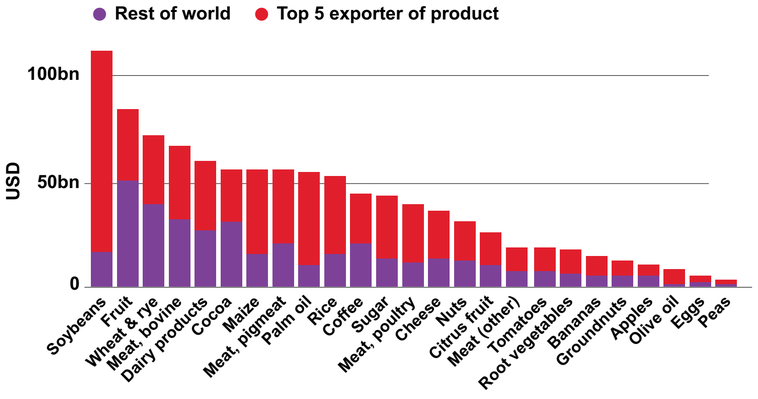
Food products Agriculture

A small number of countries are responsible for exporting the majority of the world's top traded agricultural commodities.

For most top traded commodities, 3 to 5 countries make up over 50% to 80% of all exports for each good. Agriculture contributes over 25% of the GDP and employs nearly 60% of the workforce in low-income countries, but makes up little over 1% of GDP in high-income countries, and employs on average 3% of the workforce.[16]

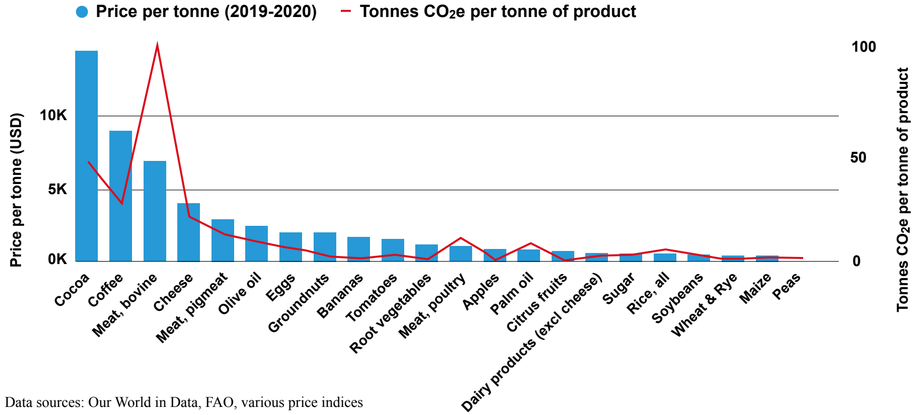
In today's economic context, these producing countries are against heavy incentives to continue responding to the growing global demand for the goods they produce – even if they are emissions intensive. On the other hand, consumers (importers) have little incentive to reduce or moderate consumption of carbon-intensive goods, given the mismatch between carbon-intensity and market price of such goods. Pressures faced by exporters, particularly in developing countries, to continue to maintain competitive production conditions for their top exported goods can lead to the implementation of measures that increase carbon emissions, decrease carbon sequestration capacity, and degrade land. This includes government incentives to boost production, which may lead to an increase in farming practices and loss of arable land over the long-term due to excessive use of fertilisers, or increased emissions due to waste.

Exports of emissions-intensive agricultural goods (2021)



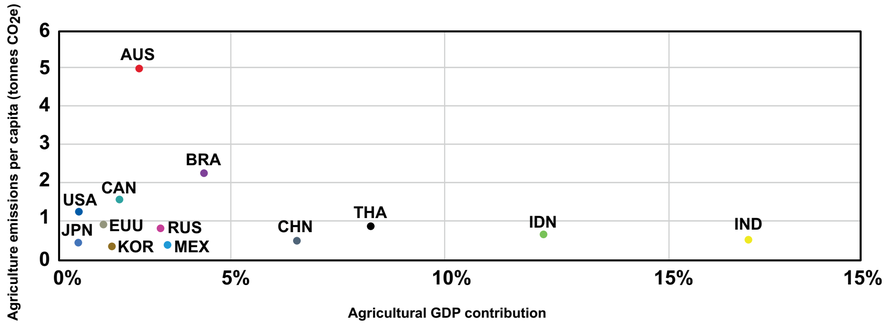
Data source: Food and Agriculture Organisation of the United Nations

Market price vs. emissions of agricultural goods



Data sources: Our World in Data, FAO, various price indices

Agricultural emissions per capita vs contribution to GDP (2019)



Data sources: Our World in Data, World Bank

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Agriculture

Competing visions for the same land

Forest land Agriculture

Many of the world's largest agricultural producers and exporters are also the same regions targeted for offsetting emissions.

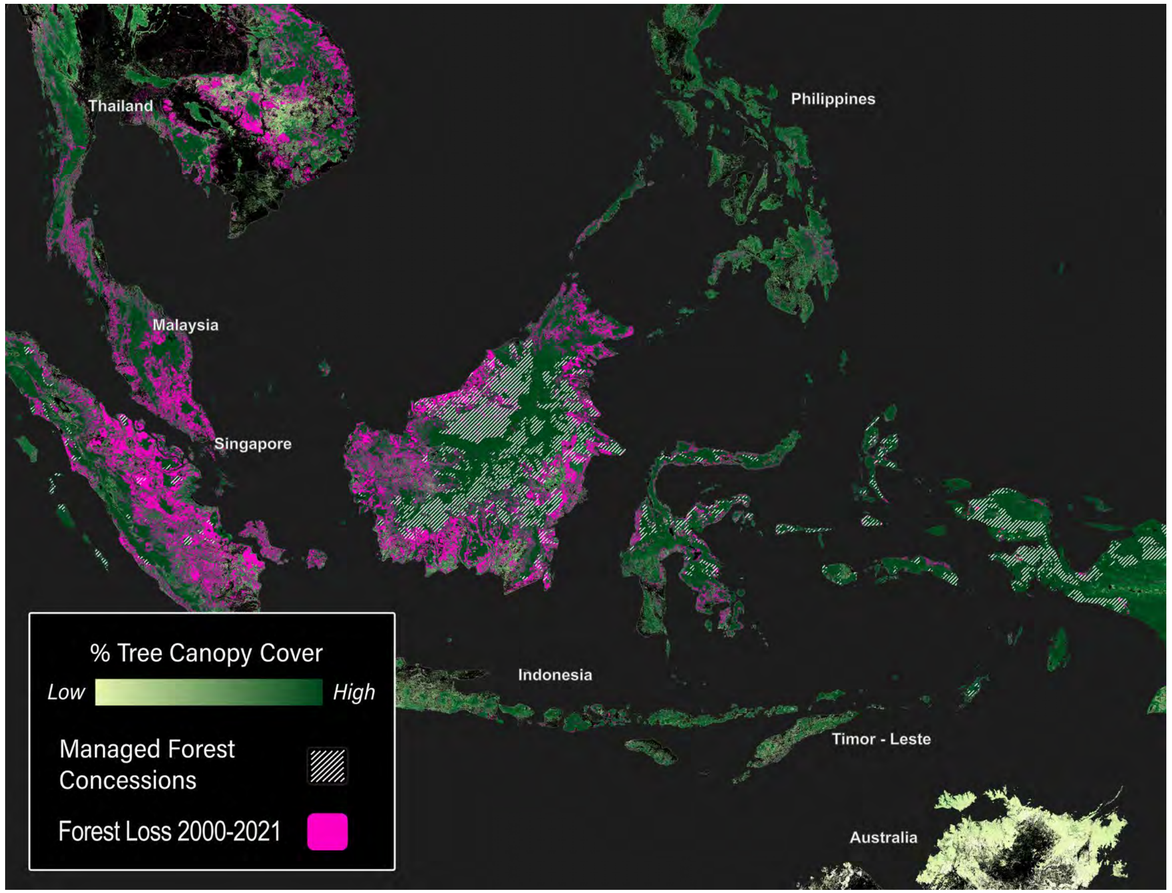
The prevalence of offsetting as a popular means to promise corporate emissions reduction, the growing global market for food products, the role of biofuels to reduce transport emissions, all culminate in competing visions for the same land, while increasing the risk of droughts and desertification.

Land at the centre of the debate around the future of food, resources, and the role of carbon sequestration is also often located in the world's most biodiverse and increasingly vulnerable areas. Land has borne the side effects of unsustainable scaling of food products and fragmented decision-making around agriculture practices and trade. In order to be sustainable, strategies to reduce emissions from agriculture must be considered globally, and cumulatively for their long-term impact on land and its role in enabling regions to be resilient in the face of climate change.

Some studies suggest that releasing 15% of farmlands could prevent 60% of species extinctions and sequester about 30% of the carbon in the atmosphere.[17] It is estimated that 55% of farmland could be restored to its natural state while maintaining current levels of food production by using existing agricultural land more effectively and sustainably.

Finding the funds to restore farmland to its original state is a challenge in the face of competing industry and corporate interests that rely on this land and resulting products. Integrated policymaking and regulation can serve as a critical link by finding the means to divert the large sums of annual subsidies for fossil fuels and unsustainable farming practices towards restoration of land.

Southeast Asia



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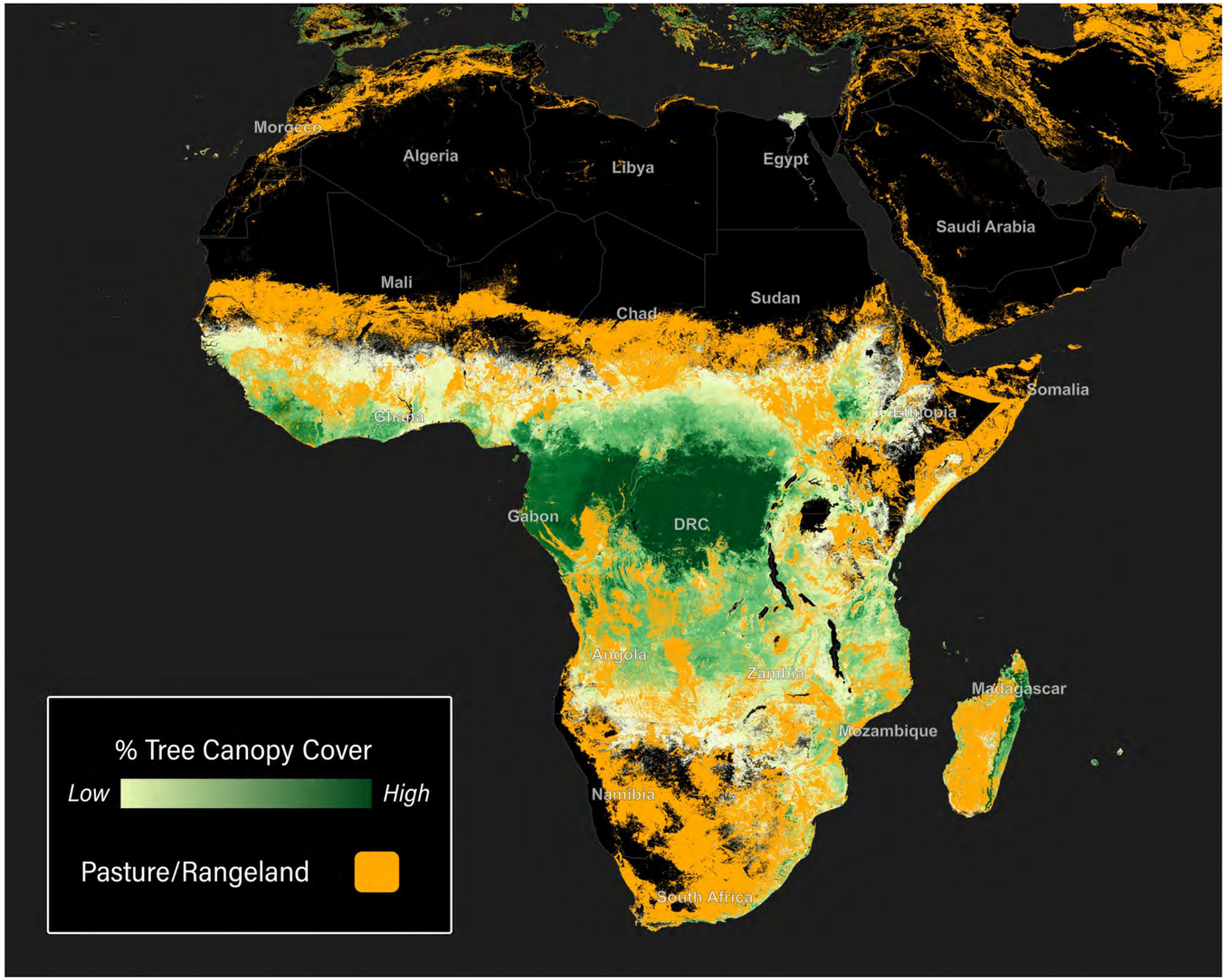
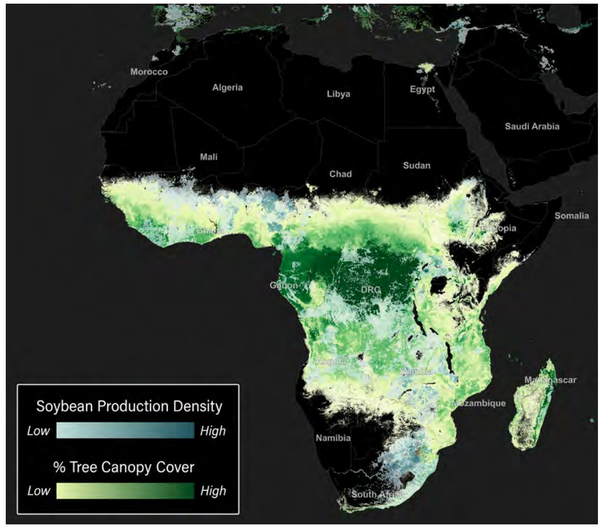
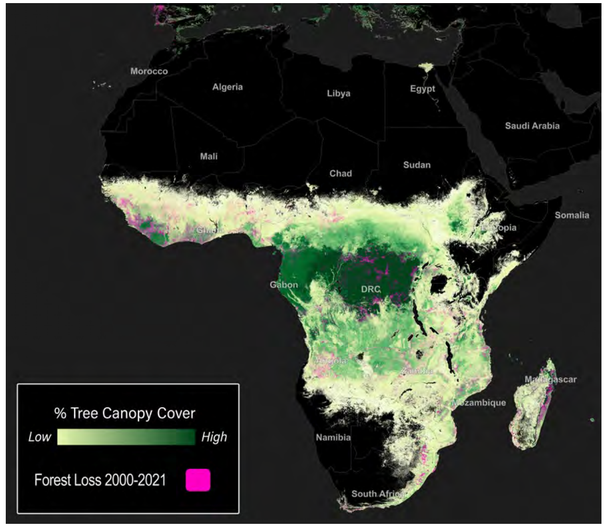
Africa







Forest land

Agriculture

Sources:
Global Forest Watch, 2014;
Earth Engine Partners 2021;
PANGAEA 2019;
Harvard dataverse, 2010

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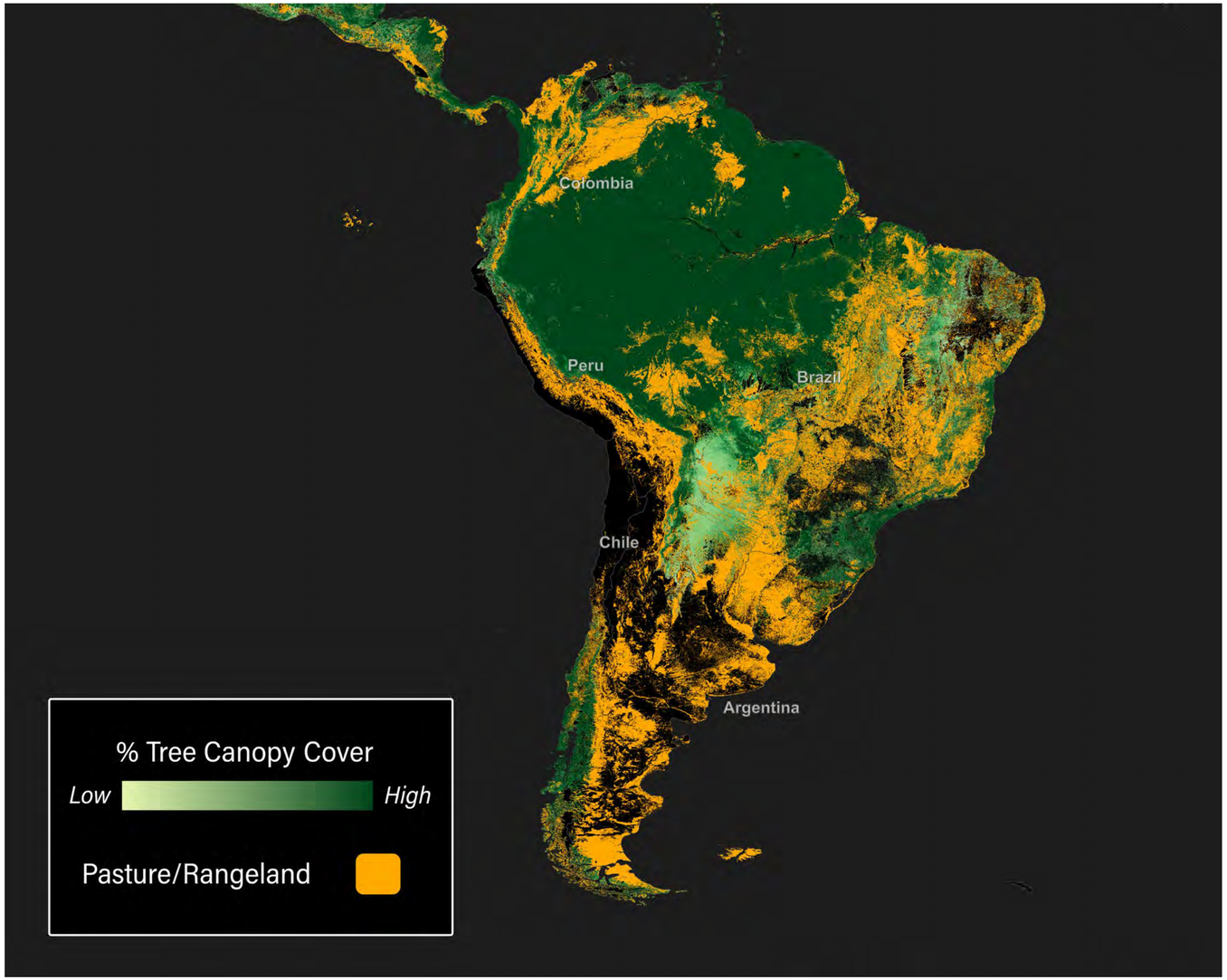
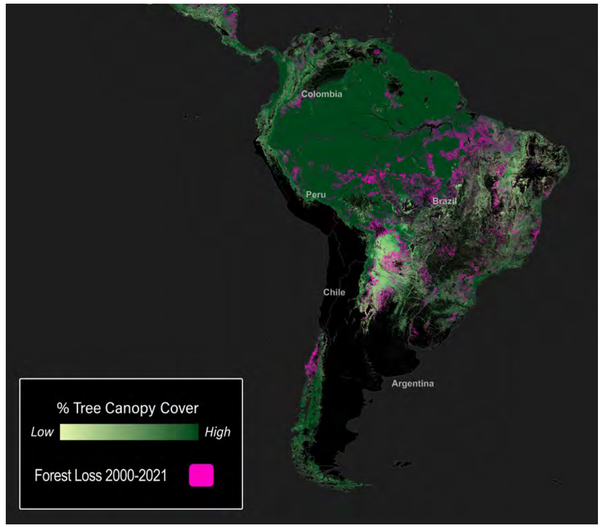
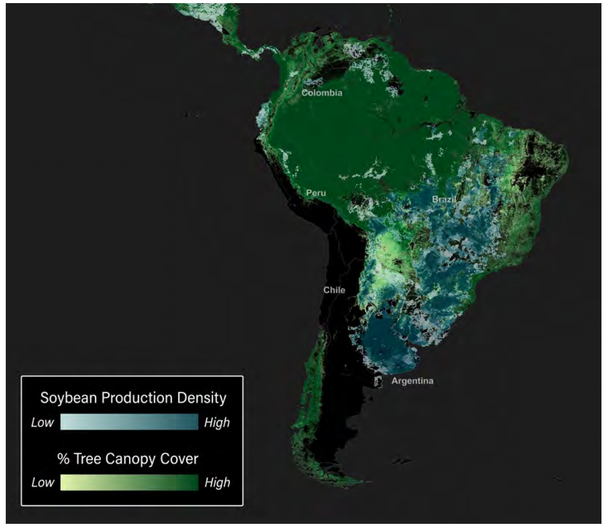
South America







Forest land

Agriculture

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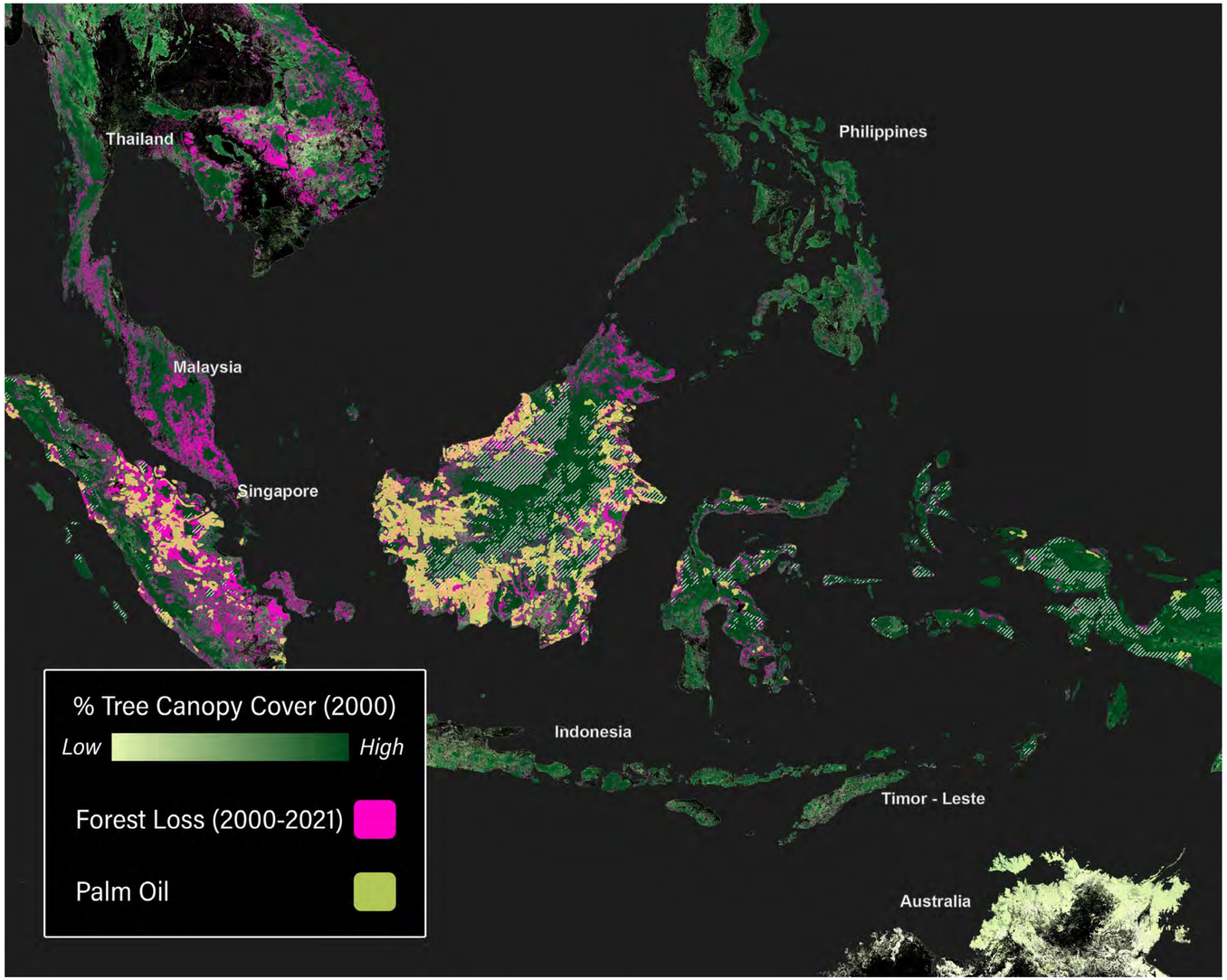
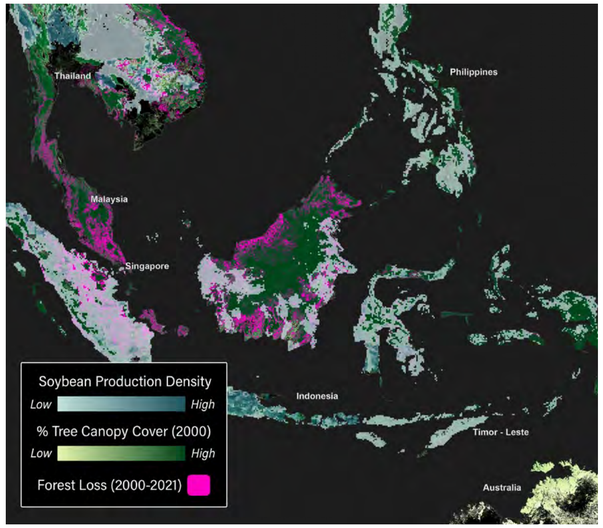
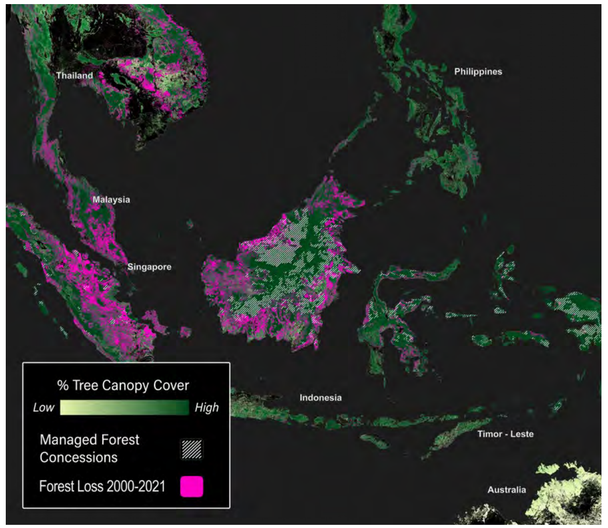
Southeast Asia







Forest land Agriculture

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Earth Engine Partners 2021;
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Harvard dataverse, 2010

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Agriculture

Variation in practice

Food products Agriculture

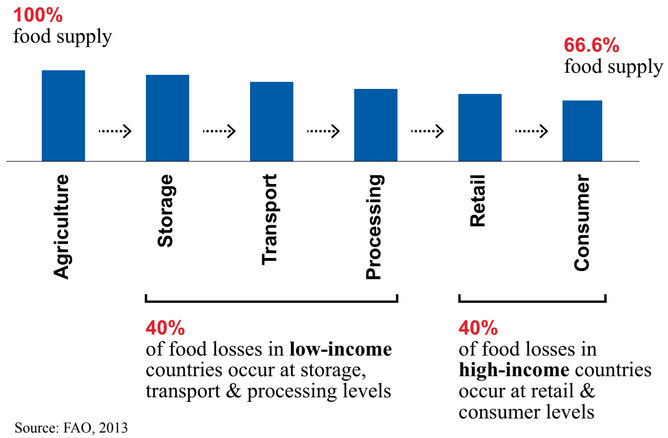
Managing demand for agricultural commodities – in particular by eliminating waste – and reforming farming practices are key to reducing the impact of agriculture on land and emissions.

However, the interventions needed to manage both waste and adopt best practice farming can vary substantively around the world. It has been estimated that nearly 30% of food produced globally is wasted or lost somewhere along the supply chain.[18] In mid- and high-income countries, most food is wasted by the consumer, whereas in lower-income countries most wastage occurs earlier in the supply chain, such as during crop transport.[19]

Emissions intensity and overall environmental impact of agriculture varies across regions due to differences in farming practices. Between farms producing the same product, emissions intensity can vary up to 12-fold,[20] and recommended actions to minimise emissions and enhance quality of land depend on soil and climate conditions.

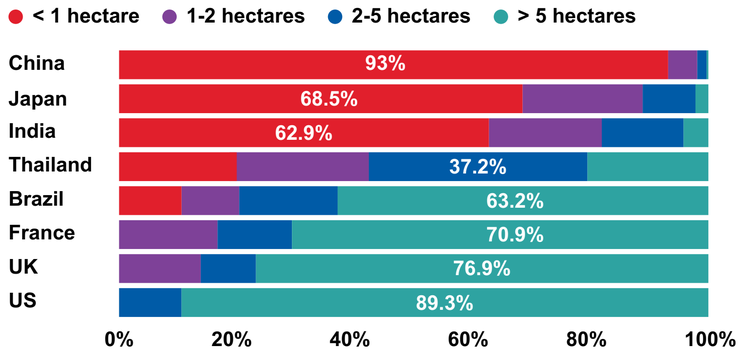
Large scale systematic change and implementation of measures to increase efficiency and cut down emissions is challenging due to capital constraints, limited access to technology, and adherence to local practices.[21] The fact that a majority of farms globally are small farms (over 80% of farms are less than two hectares of land[22]) further hinders quick scaling of solutions and action.

Food loss across supply chain



Source: FAO, 2013

Farm size comparisons



Source: Bloomberg, 2017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Achieving emissions reduction sustainably with regards to food and agriculture is an objective that ultimately intersects three key activities –

the management of forest land, the production and farming of food, and the manufacturing of food products.

These three dimensions are driven by different entities, with distinct and sometimes conflicting interests. A framework which consistently recognises all pillars of sustainability across these three spaces – including health of land, biodiversity, as well as people – can help carve a successful path to a truly net zero future for food and agriculture. Such an approach would centre on ensuring the global rate of extraction of resources does not exceed nature's ability to replenish these natural resources. There is a role for international law, coordination, and agreements to identify common parameters and principles across these competing agendas. International institutions and forums must step-up to ensure that short-term domestic politics or commercial interests do not undermine long-term needs of the planet, and that a growing culture of waste and overconsumption does not drive exploitation of finite resources in poorer nations.

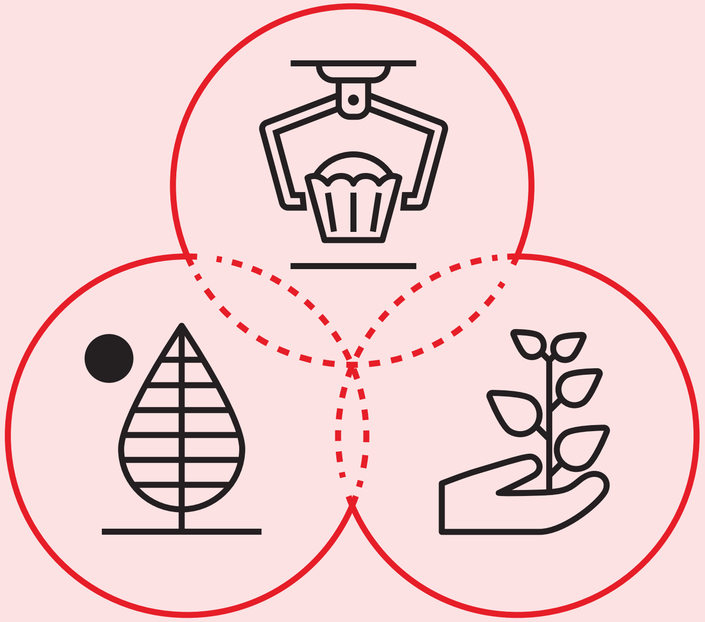
How would priorities in these three intersecting spaces stack up if sustainability was core to decisionmaking?

Priorities for manufacturing food products?

High – Providing access to nutritious food to global population; enabling preservation of food; minimising food waste & unhealthy food

Medium – Global trade of 'discretionary' food products

Low – Creating products to appeal to consumers



Priorities for forest land?

High – Maintain Earth's biodiversity and natural climate and weather patterns

High – Preserve capacity to sequester carbon

Low – Use forest land for extraction of industry resources

Priorities for agriculture?

High – Sustainable yields of food and staples to feed world population with minimal waste, care to earth and soil

Low – Discretionary production for economic purposes

Agriculture

Key implications

Agriculture, land use, and food systems are at the centre of various frontlines of different and sometimes conflicting efforts that aim to transition to net zero. Understanding how to reduce emissions from agriculture, while ensuring food security, sustainable land use, protection of critical ecosystems, and local economies lies at the heart of a global debate still lacking recognition and active prioritisation.

For effective climate action, efforts to reduce emissions from agriculture and food must question:

1. What role can different nations play to better coordinate and regulate prices of emissions-intensive commodities to reduce the carbon impact of agriculture and food systems globally?
2. How could demand for discretionary products be regulated to reduce pressure on land, and sharply reduce associated emissions?
3. What is the right way to prioritise use of land? What tools can countries use domestically to ensure prioritisation of sustainability in the face of economic risks and strong global corporate interests?

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Industry

Demand and consumption in one part of the world drive industrial production processes in another

Activities within the industry sector are driven by the things we consume, from building materials, to technology products, clothing, packaging, medicine and processed foods. Reducing consumption (even as world population grows), and increasing reusability of all materials and products, is critical to achieving net zero emissions across industry.

Like the agriculture sector, industry takes place across borders. Demand and consumption in one part of the world drive industrial production processes in another. Economic and political advantages incentivise corporations to set up global supply chains and invest in foreign ventures. Stricter regulations in one part of the world shift industry carbon to other parts, in place of creating net reductions.

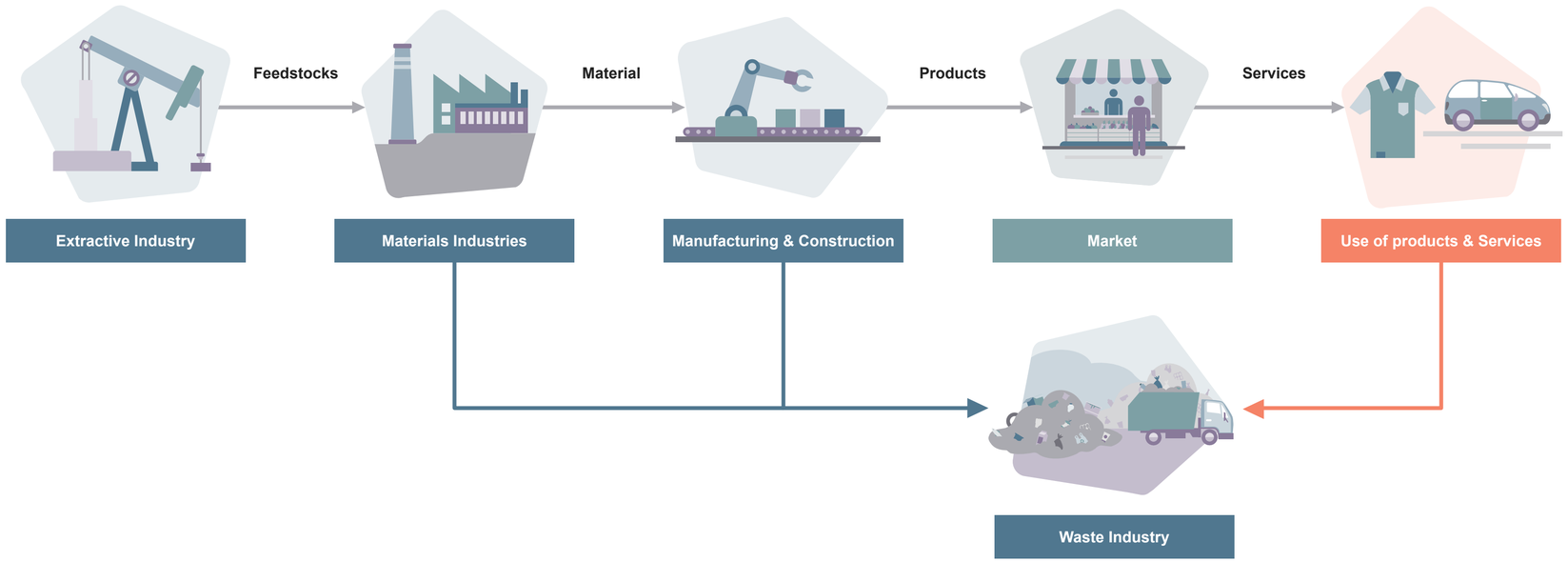
Industry

What is industry?

The industrial sector includes refining, mining, manufacturing, and construction. Globally, it accounts for the largest share of energy consumption of any sector.[23]

Emissions from industry have risen by 70% since 2000.[24] Activities within the industry sector consist of energy-intensive manufacturing, non-energy-intensive manufacturing, and non-manufacturing (agriculture, forestry, fishing, mining, construction). Energy-intensive manufacturing (often lower value commoditised products, includes the production of basic chemicals, food, iron and steel, non-ferrous metals, non-metallic minerals, paper, and refining) was 58% of total global industrial energy consumption in 2020.[25] Non-energy-intensive manufacturing (often higher value, finished products, such as transport equipment, medicines, computers, etc) made up 30% of total global industrial energy consumption, and non-manufacturing sectors 12% in 2020.

The industrial sector operations can be split across four key stages: raw material extraction, processing, manufacturing, and waste management. The majority of process emissions originate from the manufacture of minerals, metals, ozone-depleting substances, and the electronics industry. Decarbonising the industrial sector is particularly challenging as many of these processes continue to be needed to produce low-carbon goods such as photovoltaics, and rare earth elements for electric vehicles.



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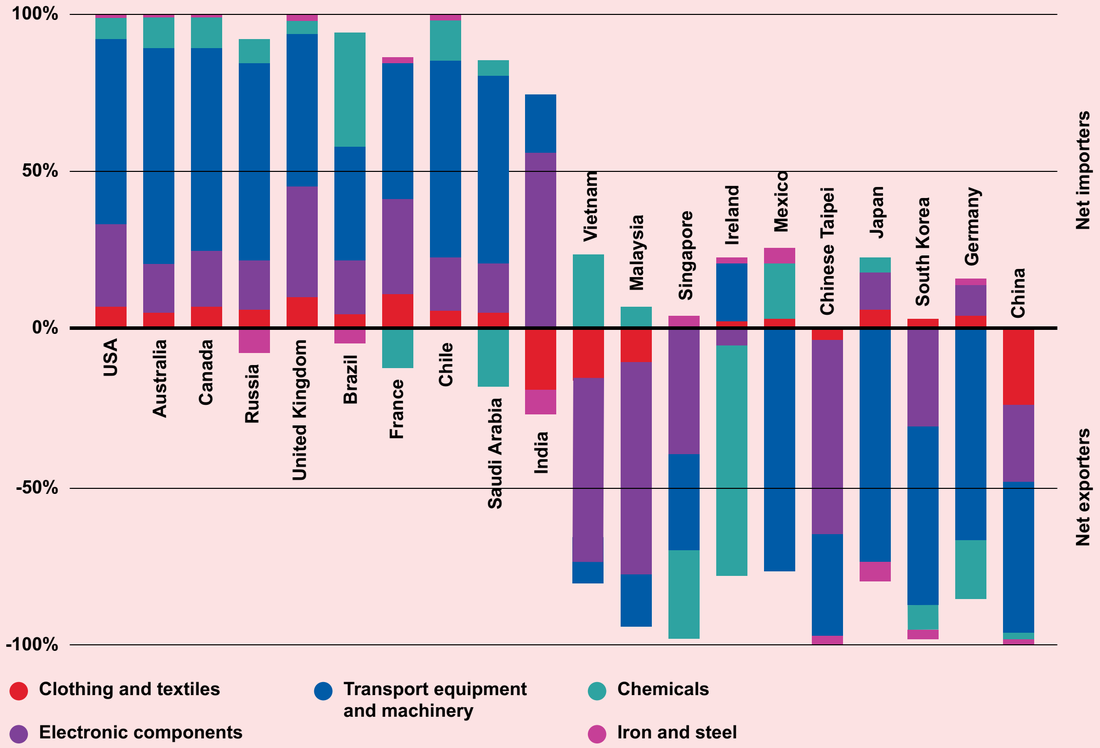
What is industry?

Reporting Economy	Top net exporters (2021) (USD Millions)
China	1,461
Germany	544
South Korea	482
Japan	362
Taiwan	333
Mexico	152
Ireland	114
Singapore	108
Malaysia	104
Vietnam	90
Switzerland	77
Belgium	72
Thailand	61
Czech Republic	54
Netherlands	44
Italy	37
Slovakia	36
Hungary	25

Reporting Economy	Top net importers (2021) (USD Millions)
USA	1,774
Australia	253
Canada	239
Russia	222
United Kingdom	195
Brazil	169
France	112
Chile	81
Saudi Arabia	81
India	75
Norway	70
United Arab Emirates	65
Indonesia	58
Colombia	58
Argentina	52
New Zealand	44
Peru	44
Iraq	40

Source: World Trade Organisation

Top net manufacturing countries imports/exports (2021)



Source: World Trade Organisation

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Industry

The world's factories

The international movements of demand, materials, goods, and waste mean that policies that only operate within the borders of a single nation are largely ineffective in creating the desired change in the overall sector.

Manufacturers and suppliers can tap into many markets to avoid regulation, or divert costs and impact.

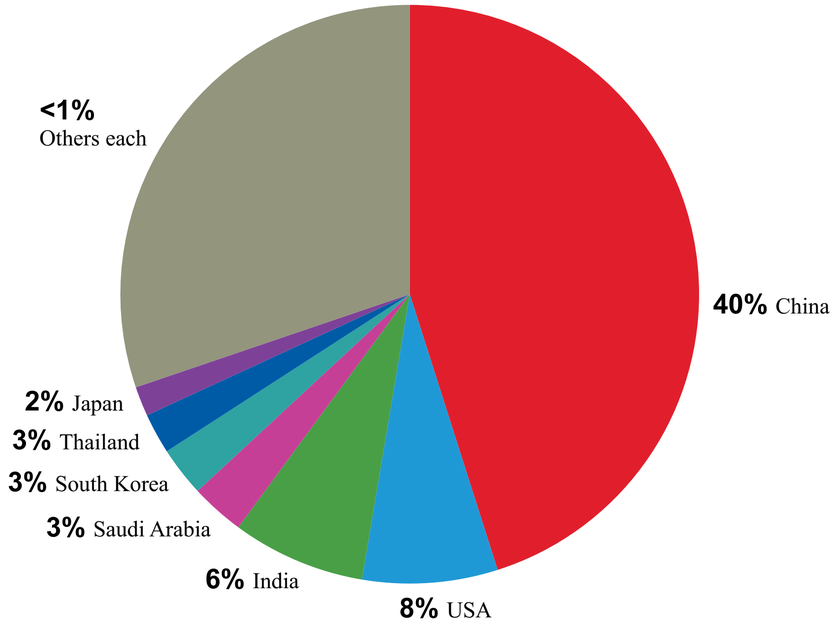
While extraction, production and processing are to a large extent concentrated in Asia, top net-importers worldwide range across the Americas, Europe, and to a lesser extent Asia. A research study on the material footprint of nations showed that with every 10% increase in gross domestic product, the average national material footprint increased by 6%.[26] As wealth grows, countries simply shift their domestic need for extracting materials through international trade.

Energy-intensive manufacturing, which includes the production of iron and steel, food, paper, refined oil products, non-metallic minerals, aluminium, and basic chemicals, is increasingly concentrated in Asia. India and China combined accounted for approximately 46% of global output for energy-intensive manufacturing in 2020.[27] Due to the heavy dependence on coal in both India and China, industrial processes in these countries are particularly emissions intensive. In 2020, China consumed 32% of the world's industrial energy and accounted for more than 64% of the world's industrial coal consumption.[28]

Growth in India's steel and cement sectors makes India the country with the highest industrial coal growth rate in the world. By 2050, the U.S. Energy Information Administration's (EIA) International Energy Outlook forecasts that more than two-thirds of worldwide industrial coal will be consumed in India and China.[29]

While not considered an energy-intensive industry, textile production is known to be one of the most polluting industries in the world. Over 60% of textiles are used to make clothing and a significant share of clothing manufacturing also takes place in China and India.[30]

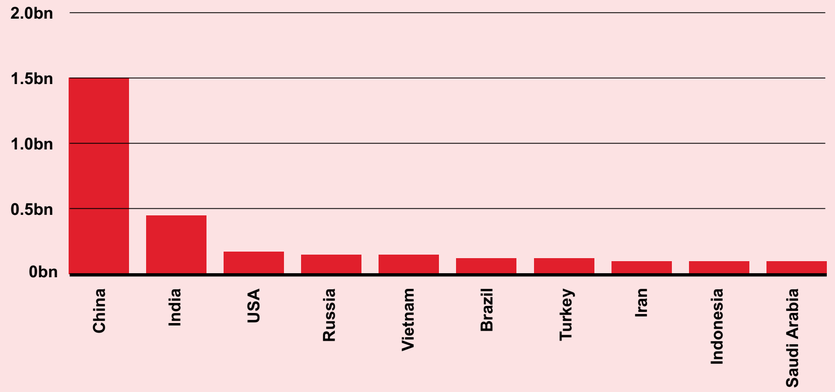
Share of global industry emissions by country (2019)



Source: Our World in Data

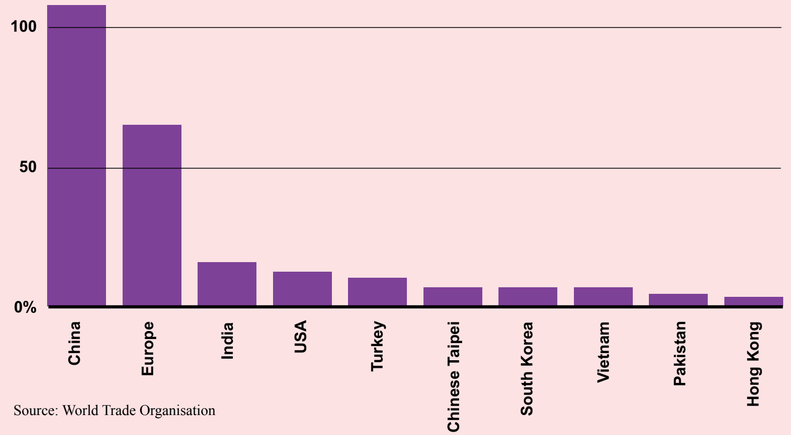
The world's factories

Cement production (metric tonnes) by country (2022)



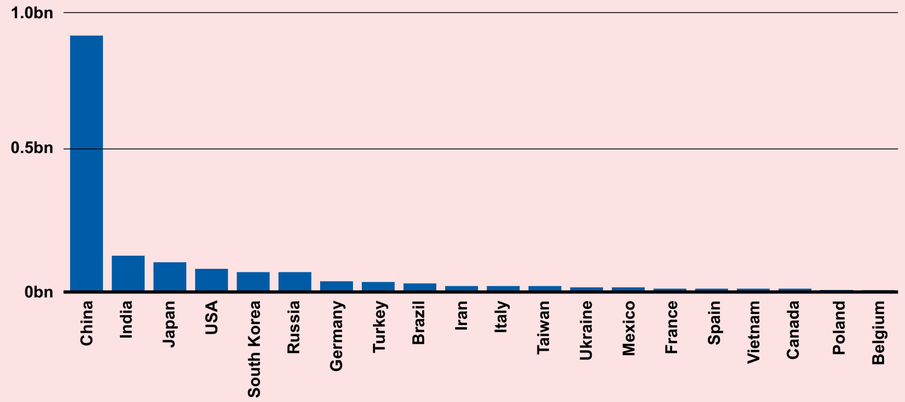
Source: Statista

Textile export (billion dollars) by country (2021)



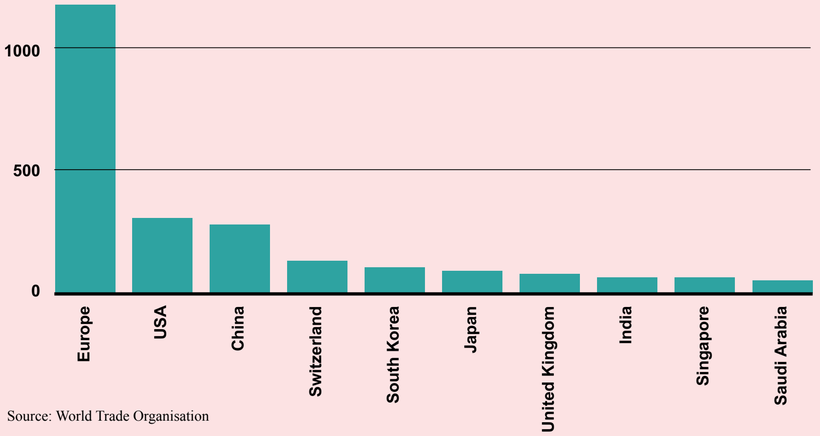
Source: World Trade Organisation

Steel production (metric tonnes) by country (2021)



Source: World Steel

Chemicals export (billion dollars) by country (2021)



Source: World Trade Organisation

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Industry

International waste

Who decides what to produce, how much, and how? In a world where achieving net zero emissions is a matter of national security, political stability, disaster prevention, and the planet's future viability, should this question continue to lie exclusively in the hands of private corporations?

Arguably, the social and economic benefits and risks of products and materials need to be considered and compared with those of available substitutes before they are chosen for mass production.

Materials cannot be created without an increase in greenhouse gas emissions due to the feedstock requirements and by-products of the chemical reactions involved. This implies that reducing consumption, even as world population grows, and increasing reusability of all materials and products is critical to achieve net zero emissions within industry. Yet, less than 10% of all material entering the economy is recycled.[31] For materials such as plastic to be recycled, hundreds of different types of plastics making up the discarded materials need to be adequately sorted, a process necessitating costly human labour or technological processes which are not yet economical or scalable.[32]

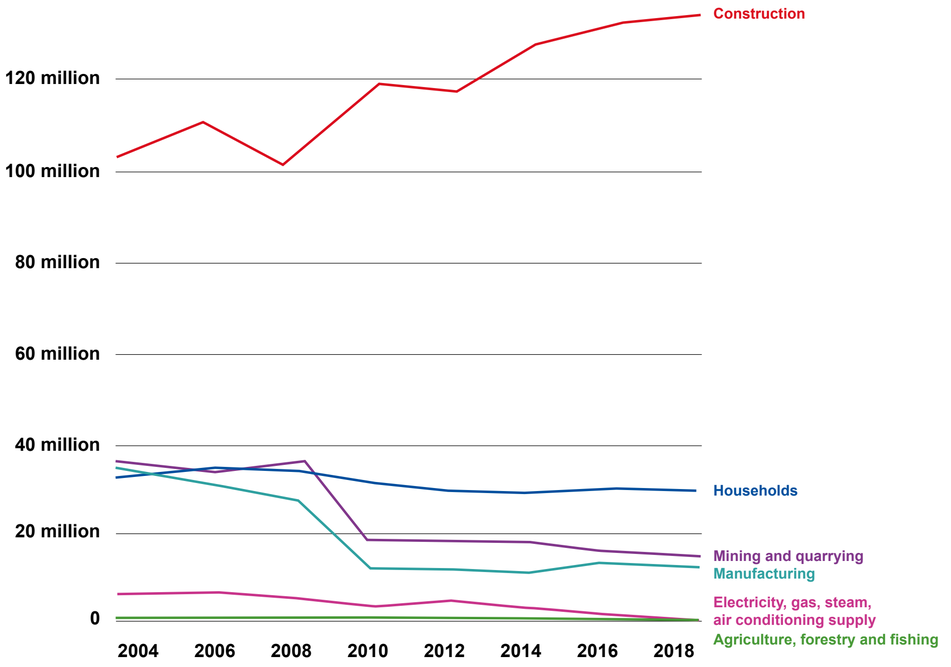
Rich economies make up 16% of the world's population but generate 34% of its waste.[33] From 2000 to 2015, while the world population grew by a fifth, clothing production doubled. Almost 60% of all clothing produced is disposed of within a year of production.[34] Besides taking up land, growing landfills contribute to air and water pollution and threaten biodiversity.

The flow of waste takes place in a highly interconnected international market. Trade can also include illegal transfers, ranging from toxic wastes to non-hazardous waste streams such as scrap metal, plastics, paper and textiles.[35] Until 2018, when it instituted a ban on importing waste, China had been a primary importer of recyclable materials waste from high-income countries for the purposes of recycling and extracting valuable material, which could be used for manufacturing. China imported $24 billion worth of recyclable materials, one quarter of the total value traded globally.[36]

The invisibility of costs and movement of waste across borders, within parts of the world most responsible for generating waste, perpetuates the continued overconsumption and production of material. This large-scale over-production and wastage continues to boost industrial emissions, degrades land, and overwhelms our environment.

Total waste generation, United Kingdom, 2004 to 2018

Total amount of waste generated by different activities, measured in tonnes



Source: Our World in Data

Industry

Value vs. impact

The key barriers to achieving net zero industrial emissions are economic and business challenges that play out on a global scale.

A clear understanding of how much carbon transfer occurs through foreign direct investment is still lacking due to gaps in current reporting requirements.[37] On the whole, studies show rich countries outsource embodied CO_2 emissions to poorer countries through foreign direct investment made by multinational enterprises (MNEs). New analysis suggests the direct activities and supply chains of 157 large MNEs jointly account for up to 60% of global industrial emissions.[38]

As developed parts of the world create more stringent environmental regulations, allocating emissions-intensive activities in foreign countries becomes increasingly attractive for big businesses (in addition to traditional advantages such as cheap labour, access to natural resources, etc.).

One research study published in 2020, showed that when considering the carbon footprint of MNEs, the European Union was the largest originating region of MNEs, followed by the United States, and Hong Kong.[39]

Historically, developing countries have actively sought to attract MNEs and foreign investment due to the significant number of benefits such as greater export opportunities, higher wages, enhanced local workforce skills and experience, and the knowledge and exposure gained by local businesses from the advanced global markets. These benefits boost the host country's economy e.g. via reduced unemployment, increases in average household income, and maturation of markets. However, with increased attention towards climate action and the need for major emerging economies to reduce emissions as they rapidly develop, research suggests that the emissions impacts resulting from the production activities of foreign firms on the host country are now generally believed to outweigh the economic value that they generate for the host country.[40]

At the same time, there is hope for change ahead. With increasing pressure and attention globally on net zero goals, foreign investment is beginning to move in a more positive direction. Global foreign direct investment (FDI) announcements in green sectors reportedly saw a 700 % increase between 2003 and 2021. Foreign investment in polluting sectors is estimated to have declined by 80% over the same period.[41] MNE operations in low-income countries are generally believed to be less carbon-intensive than local firms. Under the right set of government and business leadership incentives, they can help decarbonise local industries in the countries they locate operations in by sharing low-carbon technology and operational knowledge around sustainable practices. A clear framework and accounting of carbon, irrespective of national boundaries can help align incentives across stakeholder to be in favour of managing emissions, and hence redefine trade and production of goods to be more sustainable and climate friendly worldwide.

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Industry

Key implications

Reducing emissions from industry requires a global lens and recognition of the global consumption patterns and the power of multinational corporations that drive production levels in set locations. Instead of being two independent and separate streams of action, international policy to manage industry, trade, and consumption must integrate with stated international ambition to address climate change. The greenhouse gas emissions impact of all instituted actions and incentives must be considered directly against the perceived economic benefits.

For effective climate action, efforts to reduce emissions from industry must question:

1. Given the international nature of the manufacturing industry, how could action be coordinated across borders to prevent carbon and waste leakage and enable genuine reductions in emissions?
2. How could business models change globally to support a circular economy and cut down industrial emissions and waste?
3. How can nations, reliant on demand for their manufacturing industry, balance economic ambitions with a growing need to manage emissions and climate impact?

Global interdependencies

Nations must seek to address ongoing challenges in a new way

Tackling global emissions in vastly different national contexts is about more than naming targets and future horizons for cutting emissions. We reviewed some of the key social, political, and economic challenges facing nations whose actions are integral to combatting climate change. While there are significant differences in the specific contexts different nations must navigate, our study shows there are some core common barriers faced by countries in addressing climate change:

- Misalignment between actions taken for economic advancement and those needed to tackle climate change.
- Changing governments and/or political power and the resulting effects on near-term policies and national priorities.
- Lack of immediate and serious legal consequences due to missed climate and environmental targets.

To truly align actions across all agendas and support a long-term commitment towards tackling climate change, nations must embed the constraint of emissions reduction within every strategy and agenda, whether it relates to social or economic issues or ambitions and investment for technology and innovation. Climate change policy cannot be seen as an isolated agenda and item of action.

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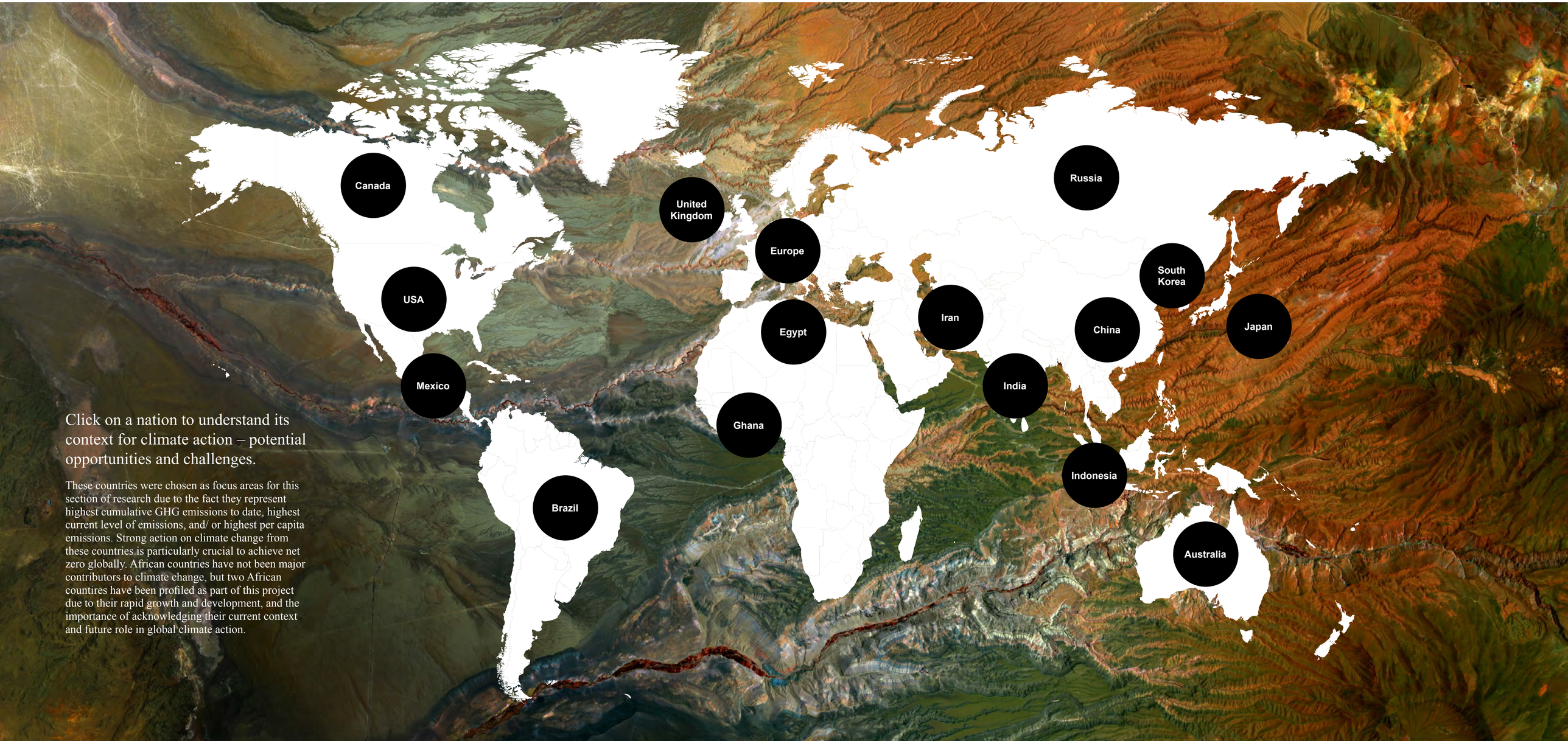

Click on a nation to understand its context for climate action – potential opportunities and challenges.

These countries were chosen as focus areas for this section of research due to the fact they represent highest cumulative GHG emissions to date, highest current level of emissions, and/ or highest per capita emissions. Strong action on climate change from these countries is particularly crucial to achieve net zero globally. African countries have not been major contributors to climate change, but two African countires have been profiled as part of this project due to their rapid growth and development, and the importance of acknowledging their current context and future role in global climate action.

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Nations

Australia

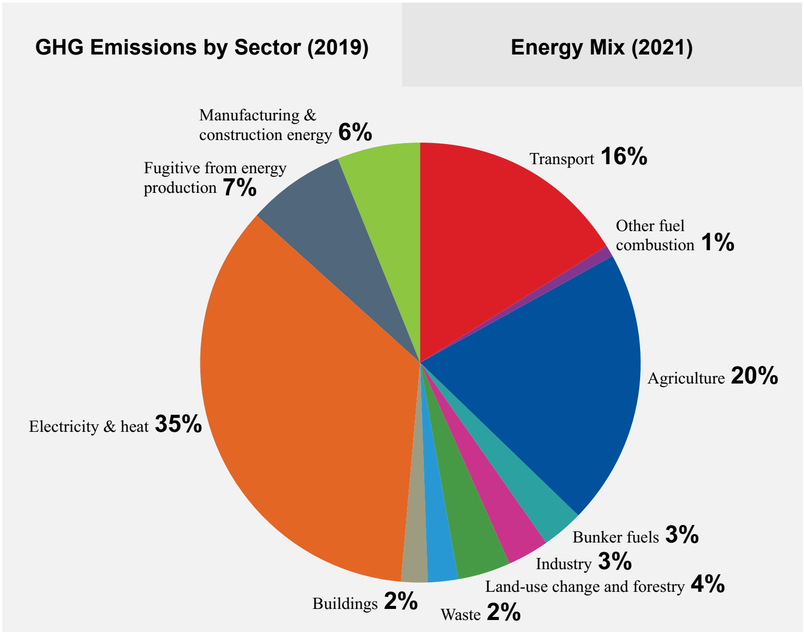
Global significance & challenges

Australia faces major questions around the direction of its economy due to changes in global trade patterns, the need to divest from fossil fuels and adapt to the immediate impacts of climate change.

Climate change policy has been a topic of intense debate in Australian politics, but there remains reluctance to take action.

Australia's efforts to building climate resilience have been stronger overall than its efforts to reduce emissions.

Click here to return to map



Source: Our World in Data, Climate Watch

GDP by sector (2017 est.)

3.6%
Agriculture

25.3%
Industry

71.2%
Services

Export partners (2017)

China **39%**
Japan **15%**
South Korea **7%**
India **5%**

Land use (2018 est.)

Agricultural land **46.65%**
Arable land **4.03%**
Permanent crops **0.04%**
Permanent pasture **42.58%**
Forest **17.42%**
Other **33.42%**

Source: CIA World Factbook 2022

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Nations

Brazil

Global significance & challenges

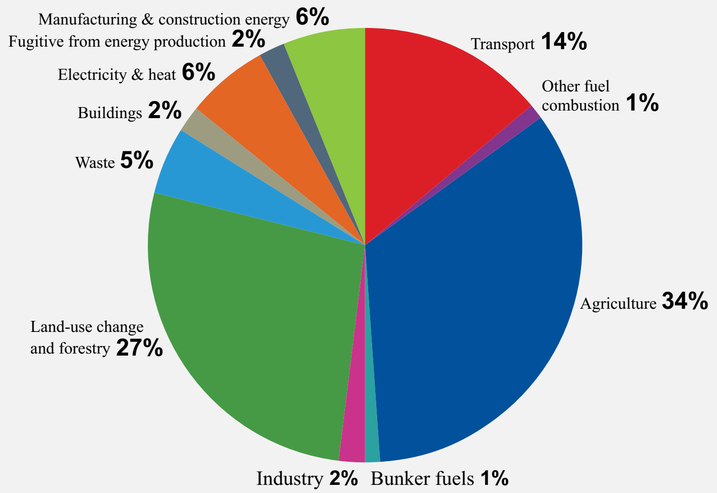
Brazil's forests, agriculture exports, and natural resources position it as a key influencer in global trade, investment, and in solutions for climate change mitigation.

Brazil has played a key role in international climate policy and commitment negotiations, particularly arguing for and influencing the roles and responsibilities of emerging and developing countries.

The rise of agribusiness and export agriculture poses significant challenges to Brazil's environmental policies and points to tensions between Brazil's international commitments and domestic policies.

Click here to return to map

GHG Emissions by Sector (2019)



Source: Our World in Data, Climate Watch

Energy Mix (2021)

GDP by sector (2017 est.)

6.6%
Agriculture

20.7%
Industry

72.7%
Services

Export partners (2019)

China **28%**
US **13%**

Land use (2018 est.)

Agricultural land **32.9%**
Arable land **8.6%**
Permanent crops **0.8%**
Permanent pasture **23.5%**
Forest:**61.9%**
Other **5.2%**

Source: CIA World Factbook 2022

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Nations

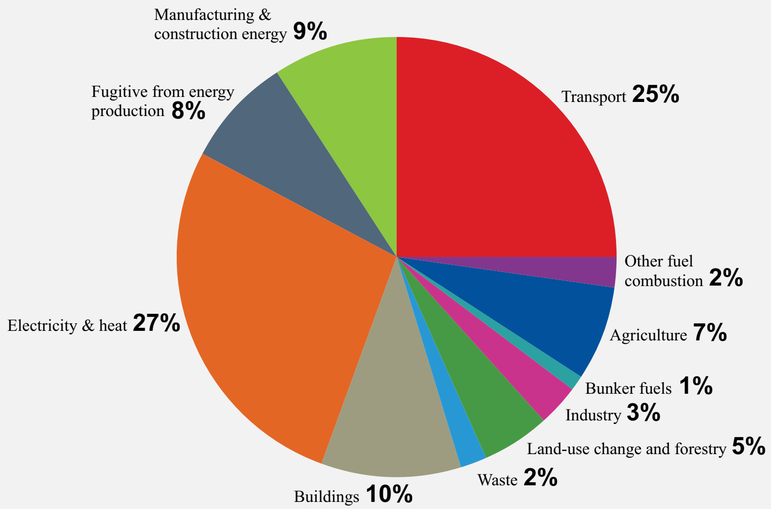
Canada

Global significance & challenges

- **Canada is facing significant socio-economic changes that will impact its course on genuine climate action.**
- **The strong political and economic influence of the oil and gas industry in Canada is a major barrier to its ability to act on climate change.**
- **Canada has significant natural resources and untapped capacity for renewable energy generation and carbon sequestration.**

Click here to return to map

GHG Emissions by Sector (2019) | **Energy Mix (2021)**



Source: Our World in Data, Climate Watch

GDP by sector (2017 est.)

1.6%
Agriculture

28.2%
Industry

70.2%
Services

Export partners (2019)

US **73%**

Land use (2018 est.)

Agricultural land **6.8%**
Arable land **4.7%**
Permanent crops **0.5%**
Permanent pasture **1.6%**
Forest **34.1%**
Other **59.1%**

Source: CIA World Factbook 2022

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Nations

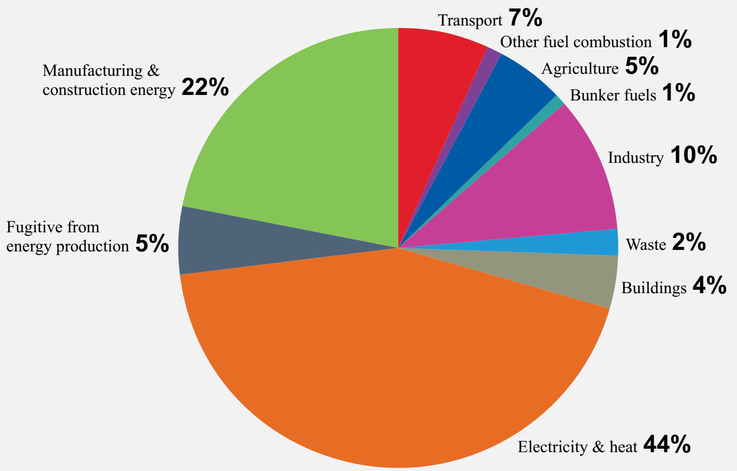
China

Global significance & challenges

- **China is a major player in global trade, production, and investment.**
- **Balancing its high ambitions for modernisation, economic competitiveness, and energy security with reducing carbon emissions will be a critical challenge for China to navigate in order to meet global net zero emissions.**
- **Climate change poses a major threat to China's major cities, its agriculture system, water availability, and its relationships with neighbouring regions.**

Click here to return to map

GHG Emissions by Sector (2019) | **Energy Mix (2021)**



Source: Our World in Data, Climate Watch

GDP by sector (2017 est.)

7.9% Agriculture

40.5% Industry

51.6% Services

Export partners (2019)

US **17%**
Hong Kong **10%**
Japan **6%**

Land use (2018 est.)

Agricultural land **54.7%**
Arable land **11.3%**
Permanent crops **1.6%**
Permanent pasture **41.8%**
Forest **22.3%**
Other **23%**

Source: CIA World Factbook 2022

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Nations

Egypt

Global significance & challenges

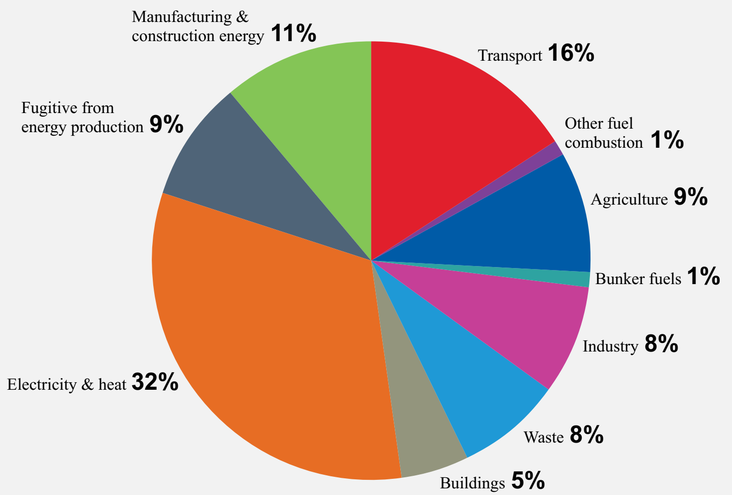
- **Egypt is the third largest country in Africa by population, after Nigeria and Ethiopia. The rapid growth of its population is creating significant challenges for natural resources, jobs, housing, education, and healthcare.**

- **Volatile politics, security, and social environment have limited Egypt's economic growth and efforts to overcome high unemployment, particularly amongst its young population.**

- **In the absence of solid adaptation and mitigation measures, Egypt's agriculture, tourism, and coastal communities will be at particular risk due to climate change.**

Click here to return to map

GHG Emissions by Sector (2019)



Energy Mix (2021)

Source: Our World in Data, Climate Watch

GDP by sector (2017 est.)

11.7%
Agriculture

34.3%
Industry

54%
Services

Export partners (2019)

United States **9%**
United Arab Emirates **6%**
Italy **6%**
Turkey **6%**
Saudi Arabia **6%**
India **5%**

Land use (2018 est.)

Agricultural land **3.6%**
Arable land **2.8%**
Permanent crops **0.8%**
Permanent pasture **0%**
Forest **0.1%**
Other **96.3%**

Source: CIA World Factbook 2022

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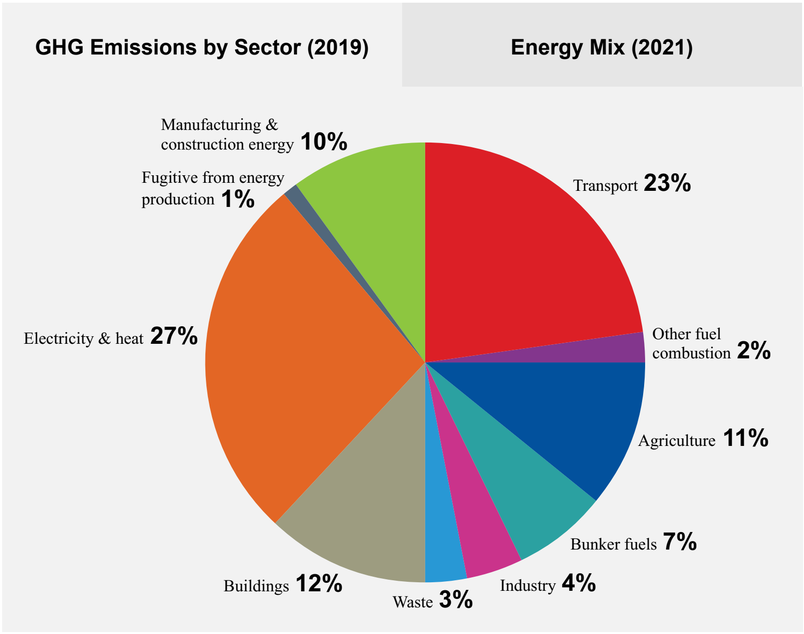
Nations

European Union

Global significance & challenges

While among the most technologically advanced regions, the EU faces multiple challenges in tackling climate change as a collective representing a varied group of nations.

The EU has set the net zero target as one of its three main priorities.



Source: Our World in Data, Climate Watch

GDP by sector (2017 est.)

1.6%
Agriculture

25.1%
Industry

70.9%
Services

Export partners (2016 est.)

United States **20.7%**
China **9.6%**
Switzerland **8.1%**
Turkey **4.4%**
Russia **4.1%**

Source: CIA World Factbook 2022

Click here to return to map

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Nations

Ghana

Global significance & challenges

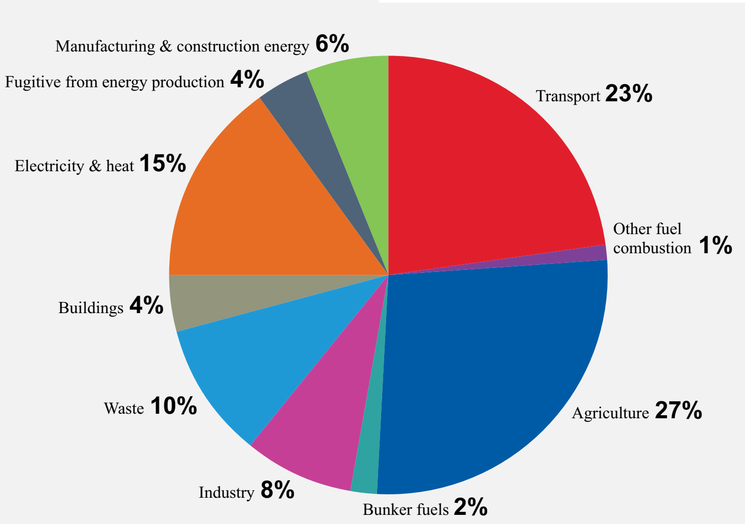
- Ghana is a relatively young country and known as one of the most stable and democratic in West Africa. However, it faces significant challenges in improving healthcare, education, and creating enough attractive job opportunities for its population.

- A lack of structural changes and diversification of the economy mean that Ghana remains dependent on extraction of natural resources with a significant environmental footprint.

- Ghana's government is taking an active role in responding to and developing plans to address climate change and mitigation.

Click here to return to map

GHG Emissions by Sector (2019)



Source: Our World in Data, Climate Watch

GDP by sector (2017 est.)

18.3%
Agriculture

24.5%
Industry

57.2%
Services

Export partners (2019)

Switzerland **23%**
India **17%**
China **12%**
United Arab Emirates **8%**
South Africa **8%**

Land use (2018 est.)

Agricultural land **69.1%**
Arable land **20.7%**
Permanent crops **11.9%**
Permanent pasture **36.5%**
Forest **21.2%**
Other **9.7%**

Source: CIA World Factbook 2022

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Nations

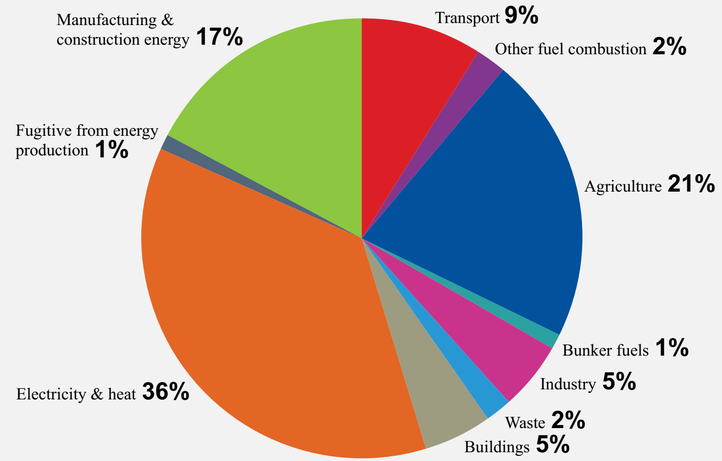
India

Global significance & challenges

- India is the world's fastest growing major economy and relies significantly on emissions-intensive industries.
- Agriculture is a major component of India's economy and energy and resources challenges.
- The future of the electricity sector in India will be crucial to reducing GHG emissions while meeting the country's social and economic goals.
- India is highly vulnerable to the impact of climate change – resilience and adaptation need to be a key part of its climate action plan.

Click here to return to map

GHG Emissions by Sector (2019)



Source: Our World in Data, Climate Watch

Energy Mix (2021)

GDP by sector (2016 est.)

15.4%
Agriculture

23%
Industry

61.5%
Services

Export partners (2019)

US **17%**
UAE **9%**
China **5%**

Land use (2018 est.)

Agricultural land **60.5%**
Arable land **52.8%**
Permanent crops **4.2%**
Permanent pasture **3.5%**
Forest **23.1%**
Other **16.4%**

Source: CIA World Factbook 2022

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Nations

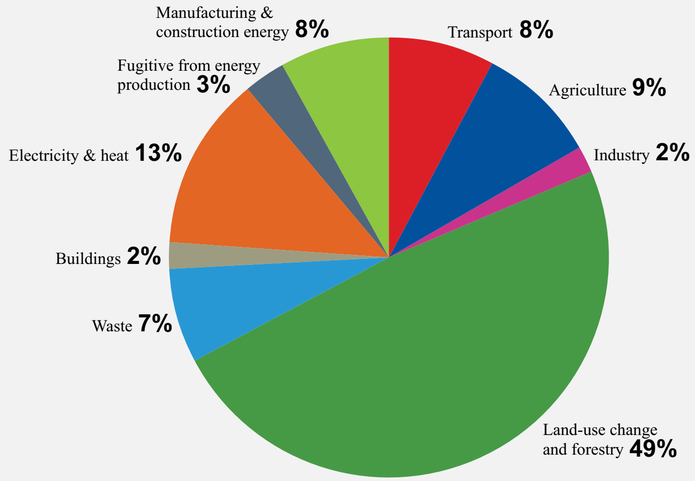
Indonesia

Global significance & challenges

- Economic growth, social well-being, and poverty alleviation are urgent priorities in Indonesia, strongly clashing with its ambition to reduce emissions.
- Deforestation and coal-based energy are primary drivers of emissions.
- Government policies often run counter to supporting transition, while governance and planning structures face significant challenges.
- Indonesia faces significant climate threats particularly due to sea level rise.

Click here to return to map

GHG Emissions by Sector (2019)



Source: Our World in Data, Climate Watch

Energy Mix (2021)

GDP by sector (2017 est.)

13.7%
Agriculture

41%
Industry

45.4%
Services

Export partners (2019)

China **15%**
US **10%**
Japan **9%**
India **7%**
Singapore **8%**
Malaysia **5%**

Land use (2018 est.)

Agricultural land **31.2%**
Arable land **13%**
Permanent crops **12.1%**
Permanent pasture **6.1%**
Forest **51.7%**
Other **17.1%**

Source: CIA World Factbook 2022

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Nations

Iran

Global significance & challenges

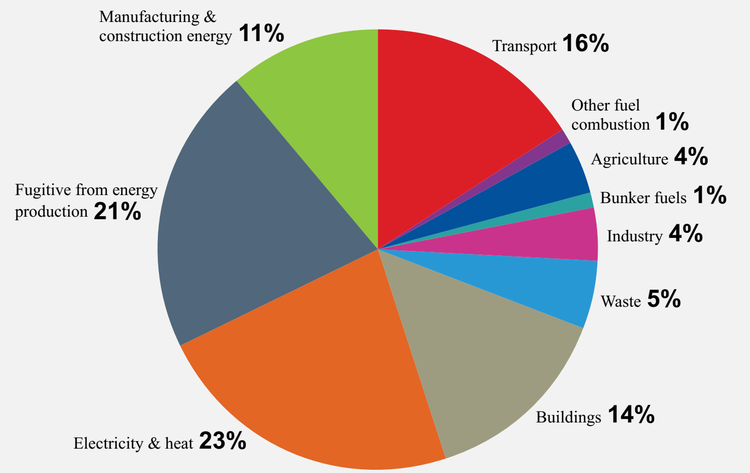
Iran's natural and political climate create significant challenges and tensions in its path to sustainability and net zero carbon.

For many people, poor governance, massive displacement, corruption and injustice are more urgent issues on the regional agenda than current and future impacts of climate change.

There is high risk of regional conflict due to water stress.

Click here to return to map

GHG Emissions by Sector (2019)



Source: Our World in Data, Climate Watch

Energy Mix (2021)

GDP by sector (2016 est.)

9.6%
Agriculture

35.3%
Industry

55%
Services

Export partners (2019)

China **48%**
India **12%**
South Korea **8%**
Turkey **6%**
UAE **5%**

Land use (2018 est.)

Agricultural land **30.1%**
Arable land **10.8%**
Permanent crops **1.2%**
Permanent pasture **18.1%**
Forest **6.8%**
Other **63.1%**

Source: CIA World Factbook 2022

ARUP

Nations

Japan

Global significance & challenges

- **Japan's strategic priorities have been heavily influenced by the challenges and opportunities posed by its ageing population, geopolitical relations, and high emphasis on technological consumption and advancement.**
- **Japan's natural environment and geography gives way to a distinct set of obstacles and potential solutions for addressing climate change.**
- **Japan faces a critical uphill battle in expanding the role of nuclear energy in meeting its net-zero commitments.**

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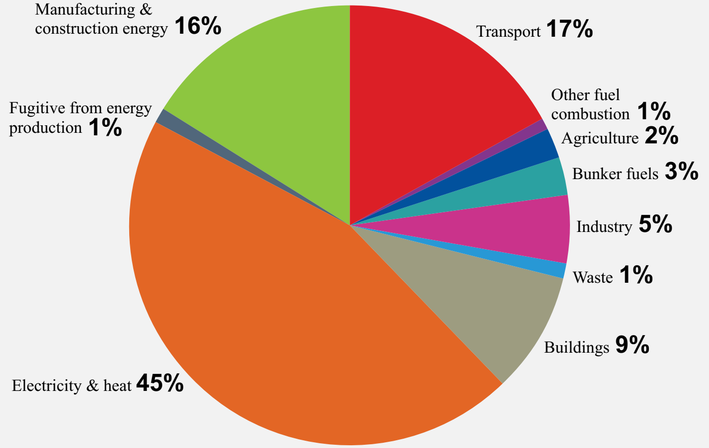
GHG Emissions by Sector (2019)



Source: Our World in Data, Climate Watch

Energy Mix (2021)

GDP by sector (2017 est.)

1.1% Agriculture

30.1% Industry

68.7% Services

Export partners (2019)

US **19%**
China **18%**
South Korea **6%**
Taiwan **6%**

Land use (2018 est.)

Agricultural land **12.5%**
Arable land **11.7%**
Permanent crops **0.8%**
Permanent pasture **0%**
Forest **68.5%**
Other **19%**

Source: CIA World Factbook 2022

ARUP

Nations

Mexico

Global significance & challenges

- **Mexico has strong economic potential, but faces significant economic and political structural problems, including low wages, high underemployment, inequitable income distribution, and limitations to prosperity for its indigenous population in southern states.**

- **Lack of clean water and deforestation are considered national security issues by the Mexican government.**

- **Mexico is considered a proactive member of the climate change community, but a clear path toward achieving stated targets remains to be identified.**

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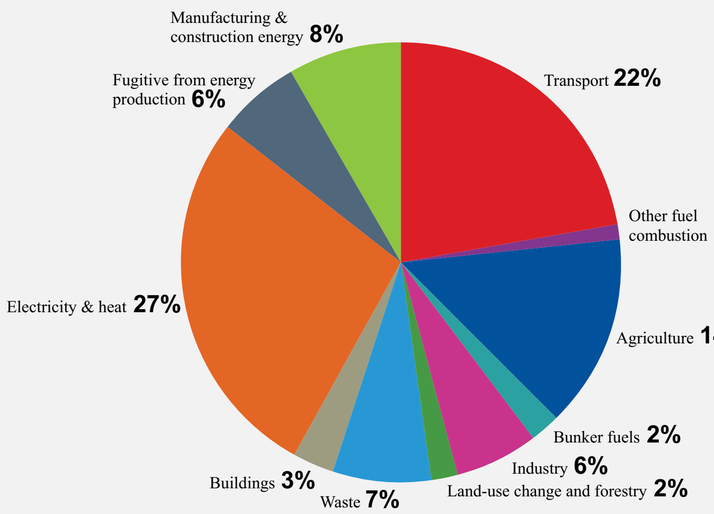
GHG Emissions by Sector (2019)



Source: Our World in Data, Climate Watch

Energy Mix (2021)

GDP by sector (2017 est.)

3.6%
Agriculture

31.9%
Industry

64.5%
Services

Export partners (2019)

US **75%**

Land use (2018 est.)

Agricultural land **54.9%**
Arable land **11.8%**
Permanent crops **1.4%**
Permanent pasture **41.7%**
Forest **33.3%**
Other **11.8%**

Source: CIA World Factbook 2022

ARUP

Nations

Russia

Global significance & challenges

- **Russia's heavy economic dependence on oil and gas due to its abundant natural access within the nation, coupled with the need to maintain social stability, pushes climate change action to the background.**

- **Given its uniquely extreme environment (land and climate), climate change poses a significant cost for Russia and the need to change and adapt at a more rapid pace than other global countries.**

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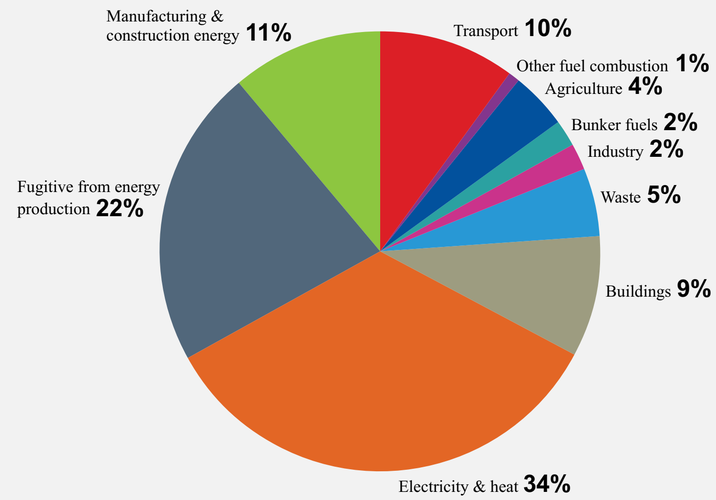
GHG Emissions by Sector (2019)



Source: Our World in Data, Climate Watch

Energy Mix (2021)

GDP by sector (2017 est.)

4.7%
Agriculture

32.4%
Industry

62.3%
Services

Export partners (2019)

China **14%**
Netherlands **10%**
Germany **5%**
Belarus **5%**

Land use (2018 est.)

Agricultural land **13.1%**
Arable land **7.3%**
Permanent crops **0.1%**
Permanent pasture **5.7%**
Forest **49.4%**
Other **37.5%**

Source: CIA World Factbook 2022

ARUP

Nations

South Korea

Global significance & challenges

South Korea has undergone one of the greatest national economic transformations, rising from developing country status to becoming a globally connected, high-technology, economic power with the 10th highest GDP (2020).[207]

While South Korea has shown an intention to address climate change, its emissions have been on the rise and current targets do not offer adequate provisions to meet the aims of the Paris Agreement.

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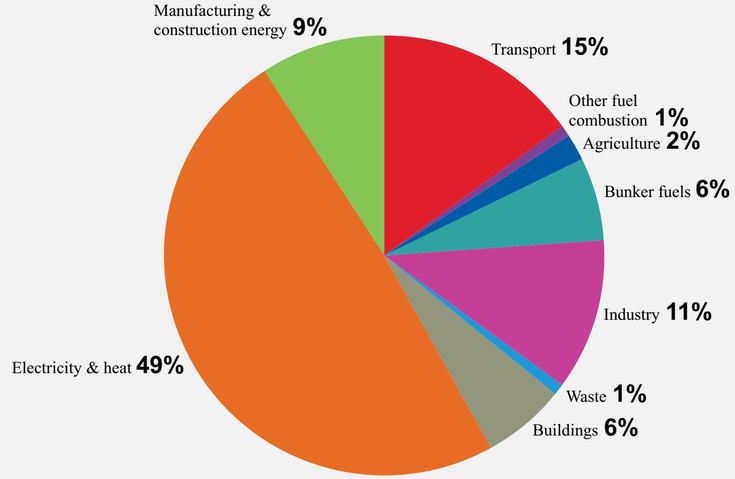
GHG Emissions by Sector (2019)



Source: Our World in Data, Climate Watch

Energy Mix (2021)

GDP by sector (2017 est.)

2.2%
Agriculture

39.3%
Industry

58.3%
Services

Export partners (2019)

China **25%**
United States **14%**
Vietnam **9%**
Hong Kong **6%**
Japan **5%**

Land use (2018 est.)

Agricultural land **18.1%**
Arable land **15.3%**
Permanent crops **2.2%**
Permanent pasture **0.6%**
Forest **63.9%**
Other **18%**

Source: CIA World Factbook 2022

ARUP

Nations

United Kingdom

Global significance & challenges

The UK has made relatively strong climate change mitigation commitments and shown early progress in reducing its emissions, particularly through the scaling of renewable energy.

The UK's contribution to global emissions through its consumption patterns and relationship with large global businesses is significant and not yet addressed within the scope of its current climate action.

The UK is using its influence in global financial markets as means to accelerate green finance and supporting regulation.

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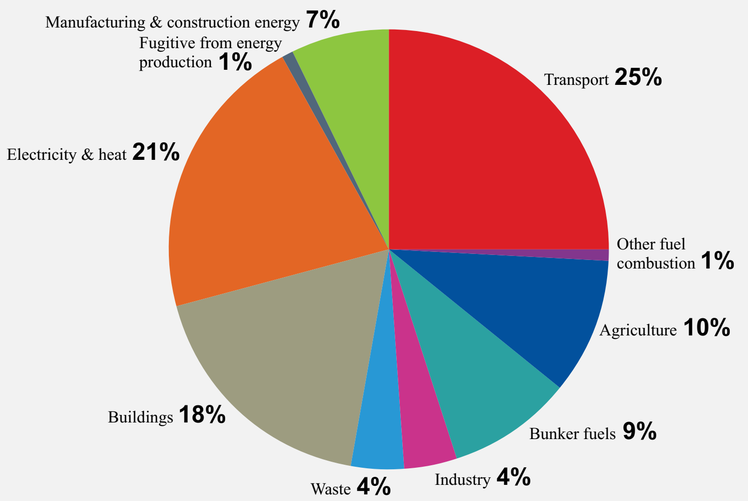
GHG Emissions by Sector (2019)



Source: Our World in Data, Climate Watch

Energy Mix (2021)

GDP by sector (2017 est.)

0.7%
Agriculture

20.2%
Industry

79.2%
Services

Export partners (2019)

United States **15%**
Germany **10%**
China **7%**
Netherlands **7%**
France **7%**
Ireland **6%**

Land use (2018 est.)

Agricultural land **71%**
Arable land **25.1%**
Permanent crops **0.2%**
Permanent pasture **45.7%**
Forest **11.9%**
Other **17.1%**

Source: CIA World Factbook 2022

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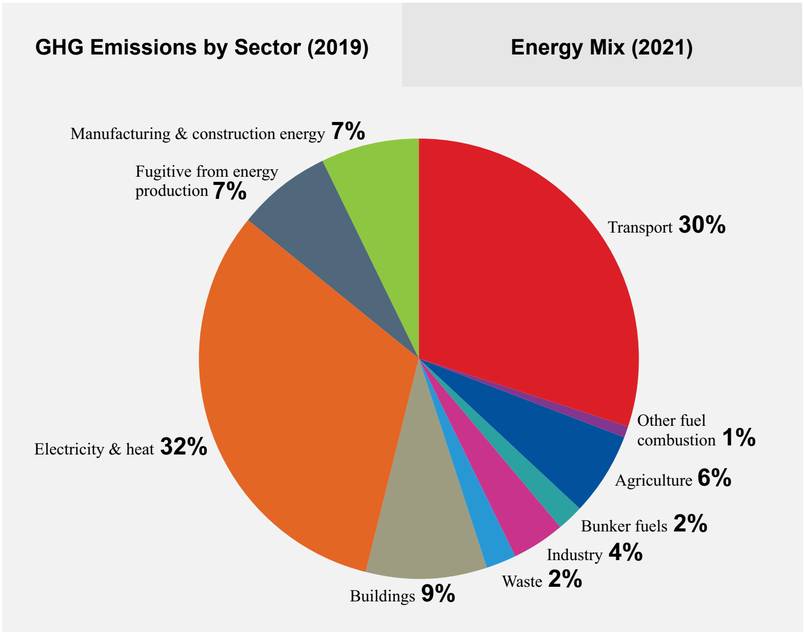
Nations

USA

Global significance & challenges

- The United States (US) faces a unique set of pressures as the world's largest economy and also as one with increasing levels of inequality and political division in key areas of public policy.
- Climate change is a highly divisive issue in US politics and comprehensive government action is regularly countered by members of the Republican Party.
- The concept of climate risk is fast gaining attention in the US.



Source: Our World in Data, Climate Watch

GDP by sector (2017 est.)

0.9% Agriculture

19.1% Industry

80% Services

Export partners (2019)

Canada **17%**
Mexico **16%**
China **7%**
Japan **5%**

Land use (2018 est.)

Agricultural land **44.5%**
Arable land **16.8%**
Permanent crops **0.3%**
Permanent pasture **27.4%**
Forest **33.3%**
Other **22.2%**

Source: CIA World Factbook 2022

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Nations

Key implications

Addressing rising global emissions in vastly different national contexts requires embedding the constraint of reducing emissions within each aspiration of a nation's political, economic, and development agenda.

Effective climate action requires:

1. Understanding and identifying how climate action can align with and integrate into broader national priorities, rather than continue to be treated as a separate agenda.
2. Questioning how nations can ensure economic and political security as they divest from fossil-fuel based economies and developing clear, resilient strategies to achieve this.
3. Identifying, rethinking, and evenly regulating the products and systems that create demand for emissions-intensive activities and commodities *internationally* (e.g. deforestation, oil/coal production, land/energy intensive crops, etc.).

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