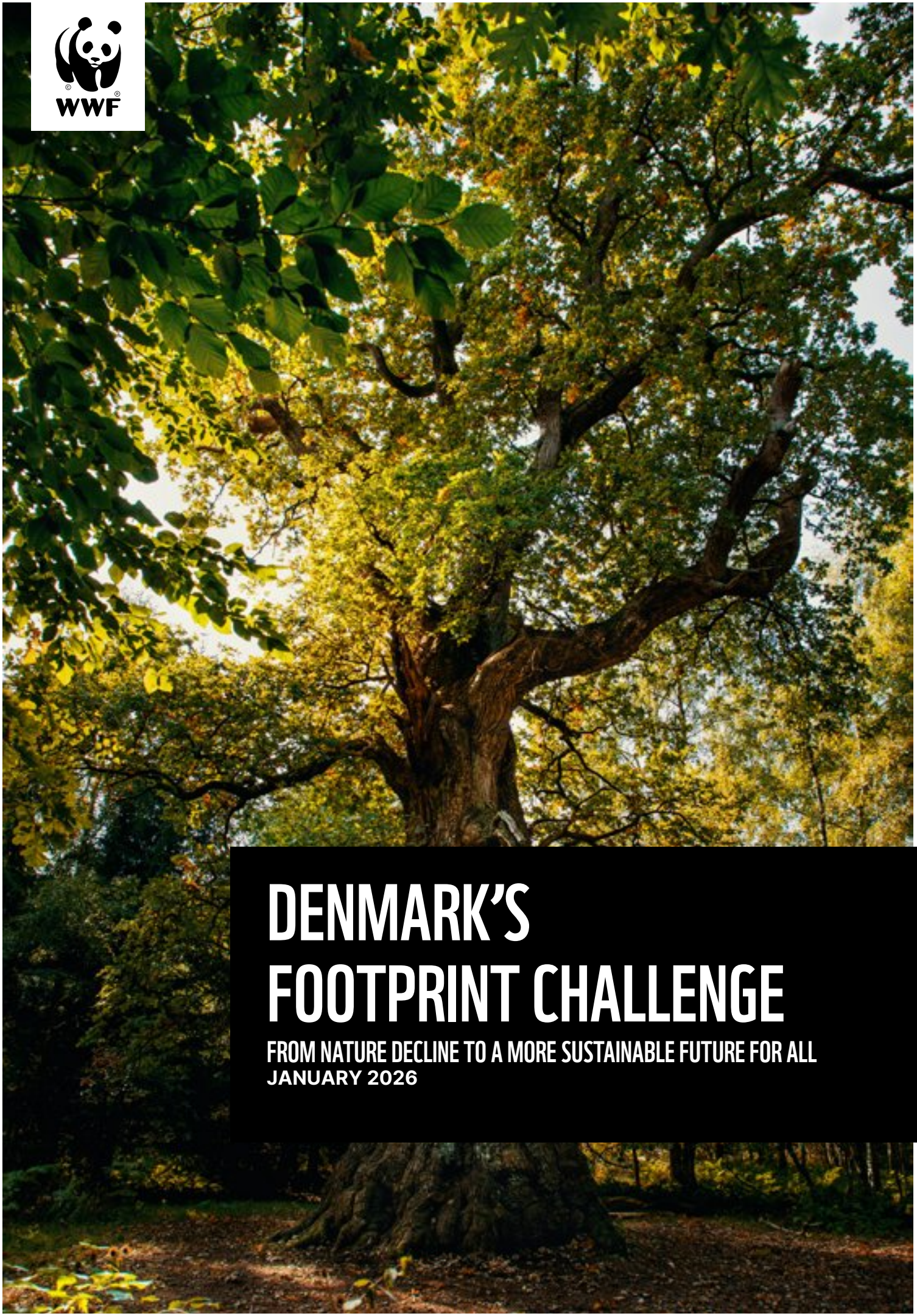

DENMARK'S FOOTPRINT CHALLENGE

FROM NATURE DECLINE TO A MORE SUSTAINABLE FUTURE FOR ALL

JANUARY 2026

WWF is one of the world's largest independent conservation organisations, with over 5 million supporters and a global network active in more than 100 countries. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

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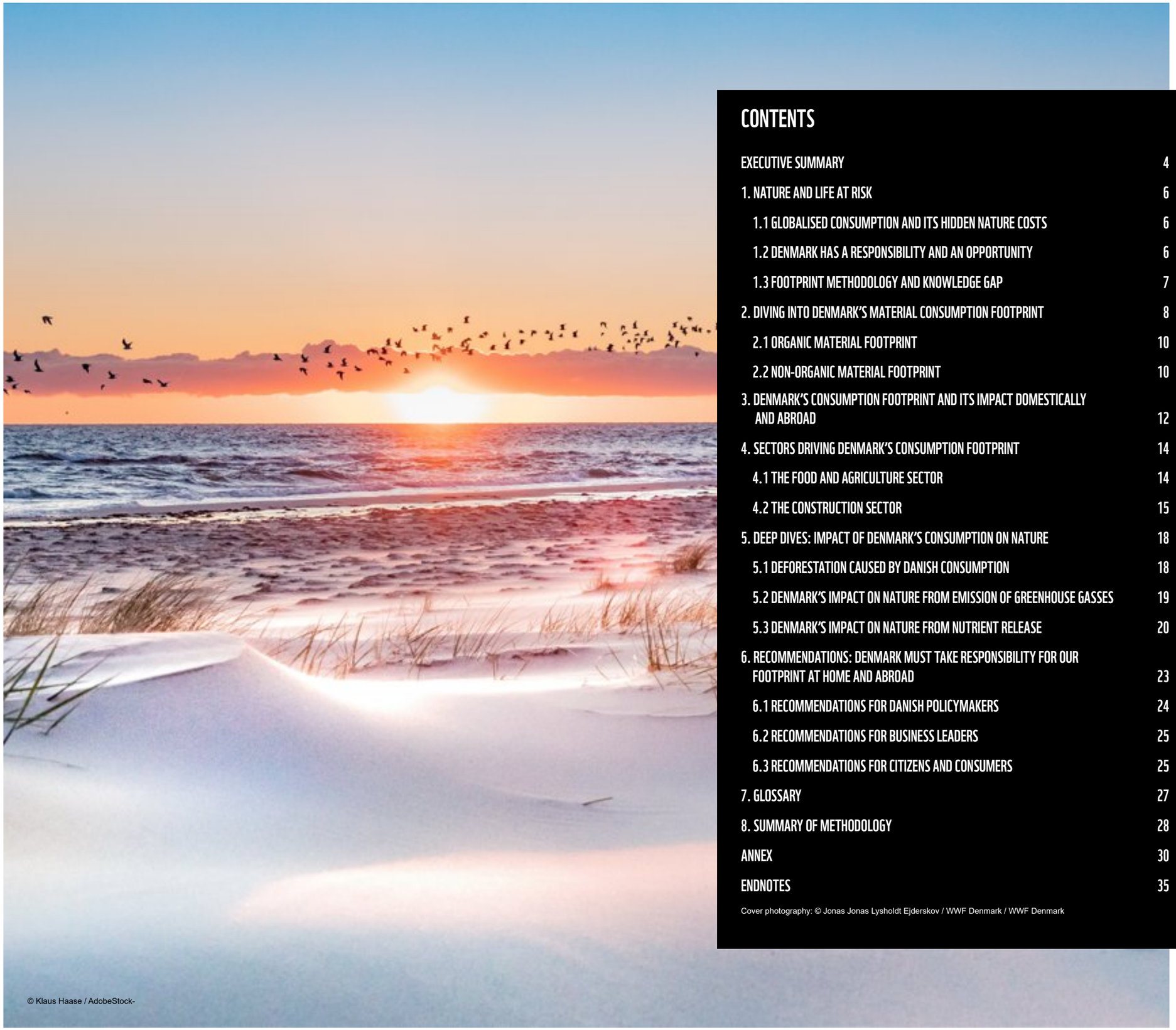

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EXECUTIVE SUMMARY

Unsustainable consumption generates a footprint that fuels the climate and nature crises.[1] Human activities have destroyed or substantially altered roughly 75%[2] of our planet's ecosystems, causing nature loss at an unprecedented rate with wildlife populations declining 73%[3] since 1970. According to the World Economic Forum, more than half of the global economy is moderately or highly dependent on nature. This dependence means that environmental degradation threatens communities, countries, and economies.[4] Land degradation alone affects the well-being of 3.2 billion people worldwide, and costs at least 10% of global GDP each year.[5]

Denmark has a disproportionately high global footprint. Denmark's consumption places a disproportionate strain on Earth's nature and is consistently among the first countries to reach *Earth Overshoot Day*, yet the structure and patterns of Denmark's consumption abroad remain understudied.[6]

We need to take action to reduce our footprint – along with the global consensus. The Kunming-Montreal Global Biodiversity Framework (GBF) identifies unsustainable consumption as a major driver of nature loss. Under GBF Target 16, the parties commit to "reduce the global footprint of consumption in an equitable manner" by 2030.[7] A crucial first step is for countries to revise their National Biodiversity Strategies and Action Plans (NBSAPs), setting clear ambitions and targets for nature at home and abroad.

With this report, WWF analyses Denmark's consumption footprint and the impacts on nature nationally and abroad. The science is clear: we must reduce the impact of our consumption on the natural environment. This report assesses Denmark's material consumption footprint, defined as Denmark's consumption of goods produced domestically and abroad, the direct impacts of this consumption on nature (shown in Figure 1), and the sectors responsible for driving the footprint.

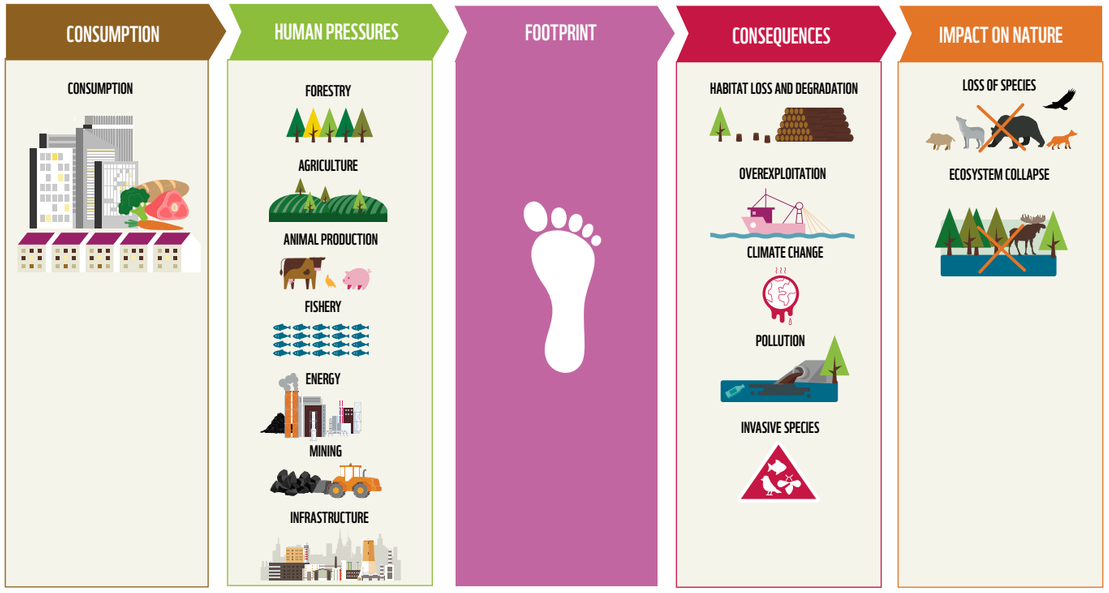

Figure 1: The connection between consumption, resource extraction, footprint and impact

OUR FINDINGS

Half of Denmark's consumption footprint is found outside its borders

- Organic material footprint: 42% of Denmark's footprint from agriculture, forestry, livestock production, and fishing occurs abroad
- Non-organic material footprint: 51% of Denmark's footprint from metals, minerals, and fossil fuels occurs abroad

Denmark's footprint continues to drive deforestation, climate change and pollution

- Deforestation: 98% of the deforestation caused, both directly and indirectly, by Denmark's consumption of agricultural and forest products occurs abroad. Denmark's consumption is estimated to cause 4,000 hectares of deforestation per year, equivalent to 6,000 soccer fields
- Climate change: 57% of greenhouse gas emissions from Danish consumption occurs abroad
- Pollution: Phosphorus and nitrogen pollution of Danish ocean and freshwater is directly driven by Denmark's production and consumption of livestock

High-impact sectors drive the majority of Denmark's footprint

- Food and agriculture sector: accounts for 75% of the organic material footprint and is responsible for most of the deforestation
- Construction sector: accounts for 75% of the non-organic material footprint
- Energy and energy-intensive industries: accounts for 50% of the greenhouse gas emissions

We have an opportunity to make Denmark a frontrunner by reducing our footprint. Urgent action is needed from policymakers, business leaders, and citizens to address Denmark's high consumption footprint. By leading the way, Denmark can demonstrate how legislation should be designed to work with nature and take responsibility for impacts on nature domestically and abroad.


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WWF recommends:

- **Policymakers** should Implement GBF Target 16 by establishing mechanisms to reduce Denmark's global consumption footprint by 2030; set fair, ambitious sector-specific targets for 2030, 2040, and 2050 to transform high-footprint sectors (construction, food and agriculture, energy and energy-intensive industries); and create national mechanisms that incentivise the reduction of our footprint from production and consumption.
  - Recommended step 1: Use the upcoming Nature and Biodiversity Law as a framework to set ambitious national targets for reducing Denmark's footprint at home and abroad, with clear guidelines and a government partnership approach comparable to the Climate Law
- **Business leaders** should map their value chains in Denmark and abroad to assess environmental impacts and nature dependencies and commit to transparent footprint-reduction targets embedded in core strategies with clear actions to achieve them. Take accountability by transforming value chains by avoiding and reducing negative impacts, and work towards tracking and disclosing nature-related performance
- **Citizens and consumers** should contribute to reduce Denmark's footprint by demanding transparency and accountability from business leaders and policymakers, and supporting those that demonstrate environmental responsibility through e.g. adopting responsible consumption habits


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1. NATURE AND LIFE AT RISK


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Nature is the basis of all life on Earth, yet it is now under unprecedented pressure. Human activities have pushed ecosystems to the brink, degrading forests, wetlands, oceans, and grasslands on a scale never seen before. This loss of nature, including its biological diversity – or biodiversity – is also a direct threat to economic stability, climate resilience, and human well-being. As nature declines and ecosystems collapse, the services they provide – clean air, fertile soil, fresh water, pollination and climate regulation – are disappearing, putting our future at risk. Nature loss and climate change are interlinked problems that reinforce each other, and we are only now beginning to understand how they disrupt the natural processes that sustain all life on Earth.

One of the most significant drivers of nature loss is habitat destruction. To meet a growing demand, ecosystems such as forests, wetlands, and grasslands are converted into farmland, cities, or industrial zones. This habitat loss and fragmentation deprive species of their homes, food sources, and breeding grounds, making it the leading cause of species extinction worldwide.[8]

Pollution further accelerates the decline. Industrial emissions, agricultural runoffs, and waste degrade ecosystems, creating toxic conditions where many species cannot survive. Resource extraction adds another layer of pressure. Mining, logging, and overfishing destroy habitats and disrupt ecological balance.[9]

Climate change multiplies these threats to nature. Rising temperatures, shifting rainfall patterns, and more frequent extreme weather events alter habitats and threaten species, forcing them to adapt at an unprecedented pace or face extinction. [10]

1.1 GLOBALISED CONSUMPTION AND ITS HIDDEN NATURE COSTS

We are severely depleting our natural world. This is driven by overconsumption, unsustainable resource extraction rates, and harmful production methods. Our economy treats nature as an externality, and its services are most often assumed to be free, infinite, and always stable. However, that is not the case: our demand for natural resources is responsible for over 90% of global biodiversity loss and 50% of greenhouse gas emissions.[11] Mankind has now breached six out of nine planetary boundaries – the limits for how much we can produce and consume without risking ecological and societal collapse.[12]

Within global value chains, the link between consumption and impact on nature is often not visible. One reason for this is our globalised markets. Long, complex value chains and vast geographical distances make the environmental impacts of our consumption less apparent. While direct impacts like habitat destruction are evident, the indirect impacts of consumption are often more pervasive and challenging to address. For example, the demand for cheap goods in Denmark fuels resource extraction and manufacturing in other countries, often leading to deforestation, pollution, and biodiversity loss in those regions.

Understanding these indirect links is vital for developing effective strategies to mitigate nature loss. Bringing society and the economy back within planetary boundaries will require transformation of production systems, innovation of products and technologies, changes in consumption patterns, and implementation of new legislation. While some reduction in consumption is necessary, the most effective levers for footprint reduction is through how we produce, trade, and consume goods.[13]

1.2 DENMARK HAS A RESPONSIBILITY AND AN OPPORTUNITY

Denmark has a disproportionate footprint on the Earth's systems and our planet's nature. We must therefore take responsibility for our production and consumption nationally and abroad by setting binding reduction targets and implement legally binding legislation that enforces those targets. The Kunming-Montreal Global Biodiversity Framework (GBF) identifies unsustainable consumption as a major driver of biodiversity loss. Under GBF Target 16, parties commit to 'reduce the global footprint of consumption in an equitable manner' by 2030. [14]

Denmark has an opportunity to be a global frontrunner and integrate nature in future legislation. A critical first step at a national level is to update the Danish National Biodiversity Strategies and Action Plans (NBSAPs) to reflect our consumption as well as include Danmark's impact on nature, both domestically and abroad, in the Nature and Biodiversity Law.

1.3 FOOTPRINT METHODOLOGY AND KNOWLEDGE GAP

We provide insights on Denmark's footprint, since there is currently limited research on how Denmark's consumption footprint impacts nature. Denmark's footprint is understudied, including its scale relative to other countries, where it occurs, the sectors driving it, and ways it can be mitigated. However, Denmark's greenhouse gas (GHG) emissions have been the subject of extensive study.[15] To address this knowledge gap, this report presents new insights into Denmark's consumption footprint, its effect on nature and, which sectors are the main drivers of it.

SUMMARY OF REPORT METHODOLOGY

This report analyses **Denmark's consumption footprint**, which covers goods produced domestically, goods produced abroad and imported for consumption in Denmark, and the direct impacts of consumption activities. It examines six specific consumption areas in detail: organic material footprint, non-organic material footprint, greenhouse gas (GHG) impact, deforestation impact, phosphorus impact, and nitrogen impact.

Our work is based on best available data and builds on the analysis 'Policy Guidelines on national implementation of target 16 of the Kunming-Montreal Global Biodiversity Framework' by WWF, Stockholm Environment Institute, and Alauda Consulting. This framework identifies which footprint is best used as indicators when implementing target 16 in the GBF at a national level.[16]

A methodology summary is provided at the end of the report, with full details in the Annex.

2. DIVING INTO DENMARK'S MATERIAL CONSUMPTION FOOTPRINT

DENMARK'S MATERIAL FOOTPRINT

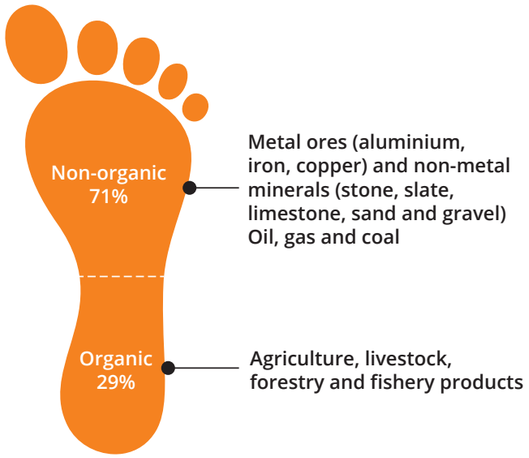

Figure 2: Denmark's material footprint

Denmark's overall material footprint can be split into two categories: organic and non-organic materials (Figure 2). The following section will deep dive into what they each represent.

This section will summarise key features of each type of footprint, assess whether each footprint occurs mainly domestically or abroad, identify the largest contributing sectors, and the reduction targets needed to adhere to our planetary boundaries (see Annex for calculations).

The organic material footprint in this analysis is smaller in mass (tonnes) than the non-organic footprint. However, a larger mass does not imply a larger impact on nature as the two types of footprints cause several types of impact on nature through resource extraction and production methods as well as regional location.

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2.1 ORGANIC MATERIAL FOOTPRINT

What is an organic material footprint? Organic material footprint refers to Denmark's consumption of agricultural, livestock, forestry, and fishery products produced domestically and abroad. The reader should be aware that this is often referred to as a biomass footprint in the literature.

What data was analysed? Eurostat data on material flows from 2022.[17]

Where does the footprint occur? In 2022, 42% of Denmark's organic material footprint occurred abroad, up from 37% in 2015, showing that an increasing share of Denmark's consumption footprint is generated outside the country.

Which sector is the largest contributor? Denmark's organic material footprint comprises two main import categories: food and feed, and wood. Food and feed accounts for 78% of Denmark's organic material footprint, most of which is used in the food and agriculture sector (75%). The remaining 3% of food and feed is used in other sectors.

Wood accounts for the remaining 22%, mainly used as biomass, in the form of wood, for energy production. While most wood is sourced domestically, some is imported from areas like the Baltics.

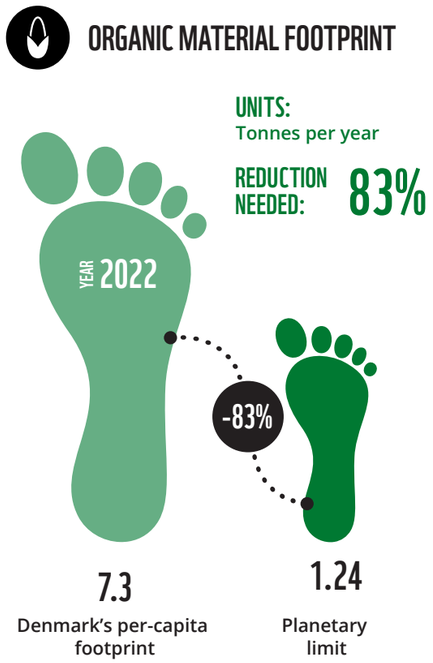

Figure 3: Denmark's organic material footprint per capita compared to the planetary limit.

What **reduction is needed?** In 2022, Denmark's organic material footprint was 7.3 tonnes per capita, over three times the global footprint (2.4 tonnes per capita) and nearly six times the planetary limit (1.24 tonnes per capita). To consume within planetary boundaries, Denmark would need to reduce its organic material footprint by 83% (see Figure 3). See Annex on how planetary limits are downscaled to *per capita*.

Example: Denmark's organic material footprint and its negative impact abroad

The main sector contributing to the organic material footprint is the food and agriculture sector, which includes feed for livestock. One of the main commodities imported to feed our livestock in Denmark, especially pigs and cows, is soy. Soy imported into the EU is mainly produced in South America and causes nearly one-third of the deforestation associated with crop and livestock products imported into the EU.[18] The expansion of soy production drives large-scale conversion of grassland and savannah ecosystems, including the threatened Cerrado in Brazil, the Great Plains in the USA, and the Gran Chaco and Pampas in Argentina.

Denmark's sizable imports (1.5 tonnes per capita) amount to one of the largest deforestation footprints in Europe.

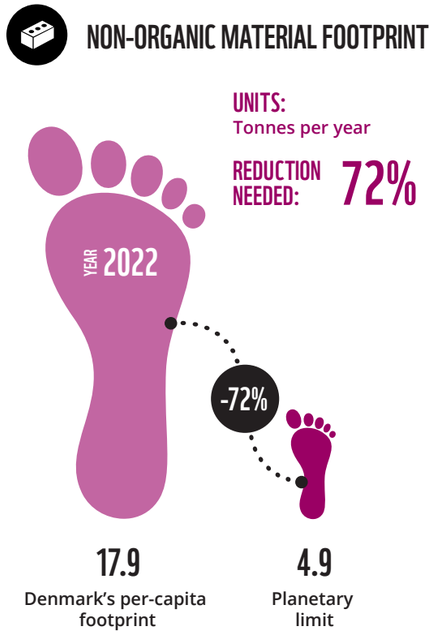

Figure 4: Denmark's non-organic material footprint per capita compared to the planetary limit.

2.2 NON-ORGANIC MATERIAL FOOTPRINT

What is a non-organic material footprint? A non-organic material footprint refers to the total amount of raw materials extracted to produce goods and services consumed in Denmark. Three categories of materials are included: metal ores (aluminium, iron, copper), non-metal minerals (stone, slate, limestone, sand, and gravel), and fossil energy carriers (oil, gas, and coal).

What data was analysed? Eurostat data on material flows from 2022.[19]

Where does the footprint occur? In 2022, 51% of Denmark's non-organic material footprint occurred abroad.

Denmark's non-organic material footprint is almost entirely composed of non-metal minerals (74%), followed by fossil energy carriers (26%) and metal ores (1%).

Which sector is the largest contributor? The construction sector contributes 75% to Denmark's non-organic material footprint, consistent with other analyses of Denmark's material footprint.[20]

What reduction is needed? In 2022, Denmark's non-organic material footprint was estimated at 17.9 tonnes per capita – nearly twice the global footprint (9.5 tonnes per capita) and more than three times greater than the planetary limit (4.9 tonnes per capita). To stay within planetary boundaries, Denmark would need to reduce its footprint by 72% (see Figure 4).

3. DENMARK'S CONSUMPTION FOOTPRINT AND ITS IMPACT DOMESTICALLY AND ABROAD

A considerable proportion of Denmark's consumption footprint occurs abroad. This trend is evident across many high-income countries and reflects the structure of global markets.[21] Countries like Denmark, which rely heavily on imports of metals, minerals, fossil fuels, food, livestock feed, and other commodities, typically have a much of their footprint generated abroad.

This highlights the large global impact that Denmark's consumption has internationally, and the importance of incorporating it into legislation and corporate decision-making to reduce harm on nature.

How much of Denmark's consumption footprint is domestic, and how much occurs abroad?

About half of Denmark's consumption footprint is found outside of its borders (see Figure 5):

- Organic material footprint: 42% of Denmark's footprint from agriculture, forestry, livestock production, and fishing occurs abroad
- Non-organic material footprint: 51% of Denmark's footprint from metals, minerals, and fossil fuels occurs abroad

How much of the impact on nature from Danish consumption occurs domestically versus abroad?

Denmark's footprint continues to cause climate change and deforestation outside its borders (see Figure 5):

Deforestation: 98% of Denmark's deforestation occurs abroad. Denmark's consumption causes over 4,000 hectares of deforestation per year, equivalent to the 6,000 soccer fields

Climate change**:** 57% of greenhouse gas emissions from Danish consumption occur abroad

DENMARK'S FOOTPRINT ABROAD AND IMPACTS HEREOF

A significant proportion of Denmark's consumption footprint occurs abroad. Products imported and consumed in Denmark have embedded impacts in the countries in which they are produced and processed

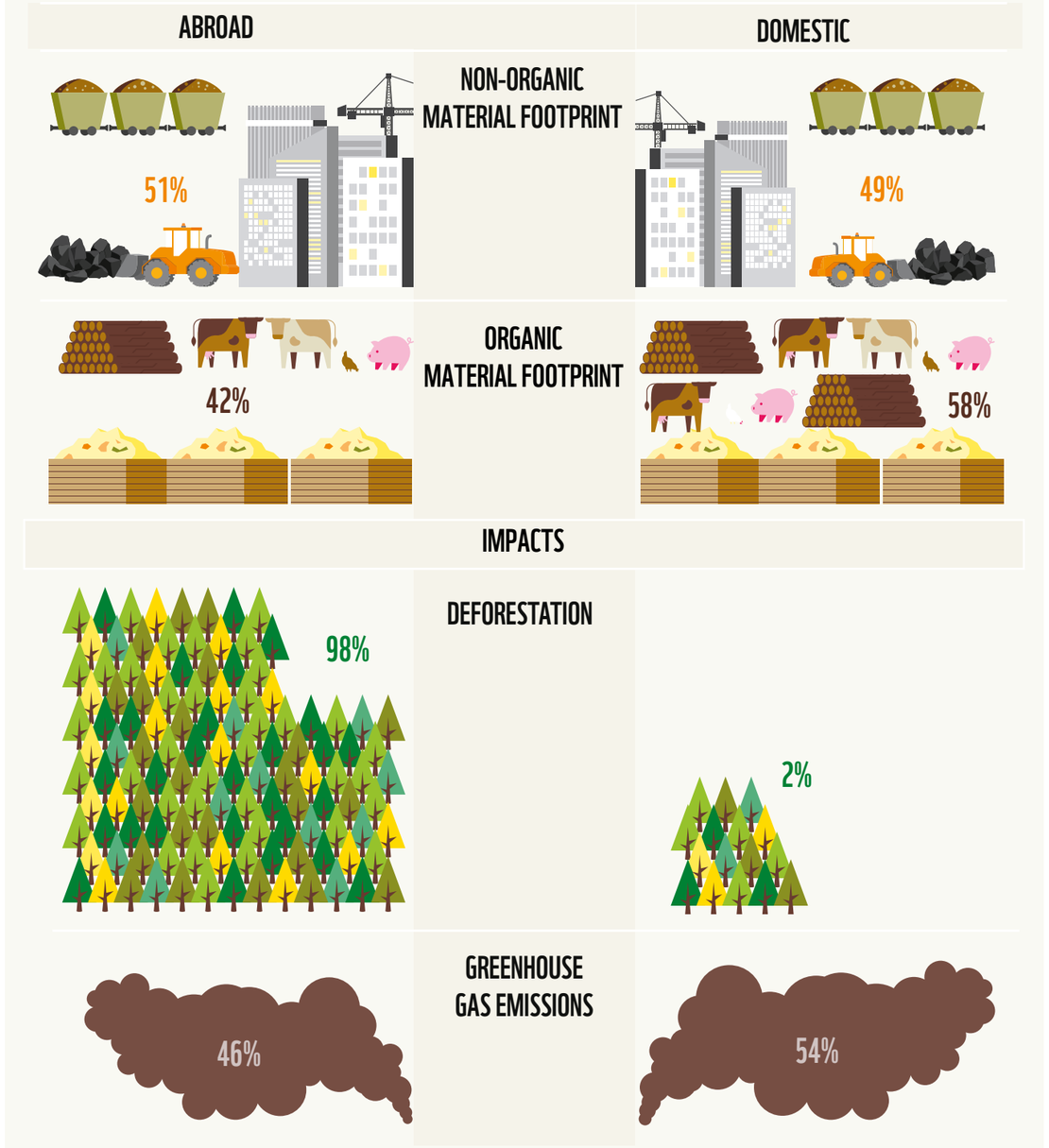

Figure 5: Denmark consumption footprint and impacts hereof occurring domestically and abroad

4. SECTORS DRIVING DENMARK'S CONSUMPTION FOOTPRINT

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Which sectors account for the largest share? Across the two main footprint categories, two sectors dominate. The construction sector accounts for the largest share of the non-organic material footprint, while the food and agriculture sector accounts for the largest share of the organic material footprint.

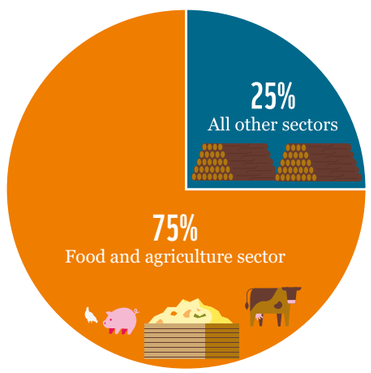
4.1 THE FOOD AND AGRICULTURE SECTOR

The food and agriculture sector is a major contributor to the organic material footprint and to greenhouse gas emissions. The sector accounts for 75% of Denmark's organic material footprint and 17% of greenhouse gas emissions. The food and agriculture sector includes growers, producers, food and beverage processors, commodity traders, packaging companies, retailers and wholesalers, and food service providers.

The food and agriculture sector has a major impact on nature across the globe. Globally, agriculture is the leading cause of deforestation and land conversion, driven by demand for high-risk commodities like soy. The Food and Agriculture Organization (FAO) estimates that 88% of global forest loss is due to land conversion for agricultural purposes.[22]

Intensive farming systems causes land degradation and loss of nature. Intensive farming fuels nutrient run-off and water pollution through fertilisers, pesticides, and livestock effluents and has been estimated globally to be consuming 70% of global freshwater.[23] These pressures contribute to biodiversity loss. Agriculture alone threatens 86% of species at risk of extinction **(**24,000 of the 28,000 that are evaluated as being at risk)[24] - and accelerate climate and ecosystem breakdown. It is therefore essential to address the impacts of the food and agriculture sector through systemic change of the farming practices.

ORGANIC MATERIAL FOOTPRINT



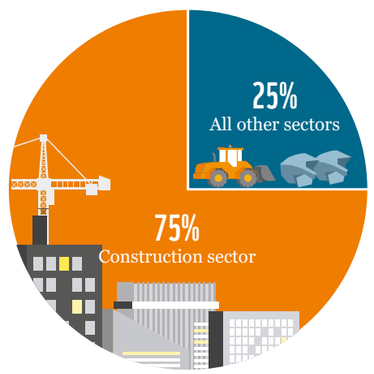
4.2 THE CONSTRUCTION SECTOR

The construction sector is the world's largest consumer of non-organic materials and accounts for around 75% of Denmark's non-organic material footprint – equivalent, in theory, to constructing 220 Empire State Buildings annually. The sector spans a wide range of actors, including property owners and developers, architects, engineering firms, contractors, asset managers, housing associations, material suppliers, material manufacturers, and related businesses.

The construction sector's high non-organic material footprint is largely driven by the extraction and use of non-metal minerals, including sand, gravel, limestone, and clay for the production of concrete, cement, mortar, and bricks. In addition, the sector relies heavily on steel, iron, aluminium, copper (and other metals), petroleum-based asphalt and bitumen, timber and wood-based materials, and mineral-based insulation. Together, these material groups dominate resource use, particularly abroad, and and contribute to substantial pressure on nature and climate.

The impact on nature mainly happens upstream in the value chain (material extraction, mining and manufacturing) and is 'embedded' within the fabric of the building (see Figure 6). One study states that 95% of the construction sector's impact on nature is associated with upstream (supply chain) activity compared to only 5% of impacts occurring at the location of the construction site.[25] It is therefore essential to address the impacts of the construction sector through the value chain and not only focus on on-site impacts and mitigation.

NON-ORGANIC MATERIAL FOOTPRINT



ENERGY

MINING

TIMBER

BIODIVERSITY

CARBON

NATURE

Embodied

Operational

Embodied

Operational

MANUFACTURING

SAND

CONSTRUCTION

ONSITE

SOIL

FUEL

RECYCLING

DISPOSAL

WATER

Figure 6: Impacts on nature onsite and offsite in the construction sector. (Adaptation of illustration made by WBCSD, 2023)

5. DEEP DIVES: IMPACT OF DENMARK'S CONSUMPTION ON NATURE

Where do we find the most prominent impact on nature from Danish consumption? Denmark's consumption footprint affects nature in many ways, but some of the most visible pressures come from deforestation, greenhouse gas emissions, and the release of nutrients into soil and water. Understanding these impacts helps identify the areas where we must act first.

5.1 DEFORESTATION CAUSED BY DANISH CONSUMPTION

Deforestation and conversion of ecosystems is the leading driver of biodiversity loss worldwide.[26] When forests are cut down and ecosystems are converted to agricultural or industrial use, nature and people are affected. These changes in land use drive biodiversity loss, disrupt freshwater cycles, erode soils, drive climate change, and marginalise communities that depend on the ecosystems. The expansion of agriculture and pasture accounts for about 90% of tropical and global deforestation.[27] It is therefore important to investigate how much deforestation is linked to Denmark's consumption to understand the country's share of responsibility. This can be assessed by looking at Denmark's consumption of agricultural and wood products.

What is a deforestation impact measurement? A deforestation impact measurement is based on Denmark's consumption of agricultural and wood products domestically and abroad. Other products and industries also cause deforestation, such as mining, but these are not assessed due to insufficient data and weak supply chain traceability. For the same reason, the conversion of non-forest ecosystems is also not considered in this analysis. Consequently, the impact of Denmark's footprint on deforestation and conversion of other ecosystems is likely higher than the figure presented in this report.

What data was analysed? Data from the GEIC database, 2022.[28]

Where does the impact occur? 98% of the deforestation caused, both directly and indirectly, by Denmark's consumption of agricultural and forest products occurs abroad. Most imports come from just a few countries, including Brazil, Côte d'Ivoire, and Democratic Republic of Congo.[29]

Which sector is the largest contributor? The data indicates that the food and agriculture sector accounts for over 75% of the direct and indirect deforestation caused by Denmark's footprint. Other sectors account for smaller shares, notably production companies (e.g., leather, oleochemicals derived from palm oil, and starch derived from cassava), the pharmaceutical sector (starches derived from maize and cassava), the energy sector (wood products), and the constructions sector (wood products).

Which commodities are the largest contributors? The highest-ranking commodities leading to deforestation include cattle meat and co-products, soy (for animal feed), palm oil, cocoa, cassava, and industrial roundwood (wood products). Together, these commodities are responsible for the majority of Denmark's consumption-related deforestation abroad. Knowing this allows us to focus efforts on the areas of greatest concern and determine where action should come first.

Addressing the conversion of all ecosystems, not just forests

Deforestation receives most attention, however Danish demand is also driving conversion of other, less scrutinised ecosystems. Non-forest ecosystems such as grasslands, savannahs, and wetlands are also biodiverse and provide vital ecosystem services to local communities. For example, soy production in Brazil, linked to Danish consumption, is contributing to the conversion of the Brazilian Cerrado, a savannah ecosystem. To avoid shifting the negative impact from forests to other ecosystems, all forms of habitat conversion driven by Danish consumption - not only deforestation – must be addressed.

What reduction is needed? In 2022, deforestation directly or indirectly caused by Danish consumption was estimated at 4,160 hectares. Equivalent to each Danish citizen causing 7 m² of deforestation in 2022.[30] Experts agree that deforestation and conversion of other natural ecosystems should be eliminated from international supply chains.[31] This conclusion is reflected in various international agreements, including the UN Sustainable Development Goals, the UN Framework Convention on Climate Change, and the UN Forum on Forests. Denmark must therefore reduce its deforestation impact by 100% as soon as possible.

Implementation of EU deforestation regulation is key

The European Union Deforestation Regulation (EUDR) aims to ensure that certain products imported to, sold within or exported from the EU are not linked to deforestation or forest degradation. The law will, require companies to demonstrate that cattle and key commodities – such as soy, palm oil, wood, cocoa, coffee, and rubber – and their derived products are deforestation-free and legally produced in their country of origin. Implementation of the EUDR will therefore be a central and important lever to help Denmark to reduce its deforestation impacts abroad.

5.2 DENMARK'S IMPACT ON NATURE FROM EMISSION OF GREENHOUSE GASSES

Climate change plays an increasingly important role in the decline of nature. Climate change has altered marine, terrestrial, and freshwater ecosystems around the world. It has increased diseases, driven mass mortality of local species, and even the extinction of some. Climate change is not a uniform phenomenon across the globe - its extent and effects vary locally, resulting in some regions warming more quickly than others, and some habitats and species being more severely affected than others.[32]

Preventing the loss of carbon stocks in Earth's ecosystems is critical to address the nature and climate emergencies. About one-third of the greenhouse gas emissions reductions needed in the next decade could be achieved by improving nature's ability to absorb emissions.[33] Despite massive and ongoing losses, forests still cover more than 30% of the planet's terrestrial areas with tropical rainforest being the largest carbon sink by sequestering (capture and store) carbon in biomass. Peatlands cover only 3% of the world's land, but store twice as much carbon as all forests combined as they accumulate carbon slowly in dense soil reservoirs. Ocean habitats such as seagrasses and mangroves can sequester carbon dioxide from the atmosphere at rates up to four times higher than terrestrial forests can. Their ability to sequester carbon makes mangroves highly valuable in the fight against climate change.[34] Conserving and restoring natural systems, both on land and in water, is essential for reducing and removing carbon emissions and adapting to an already changing climate.

What is a greenhouse gas impact measurement? The greenhouse gas (GHG) impact measurement is based on all global GHG emissions attributable to Denmark's consumption of goods and services, produced domestically or abroad.

What data was analysed? Data from the Danish Energy Agency 2022.[35]

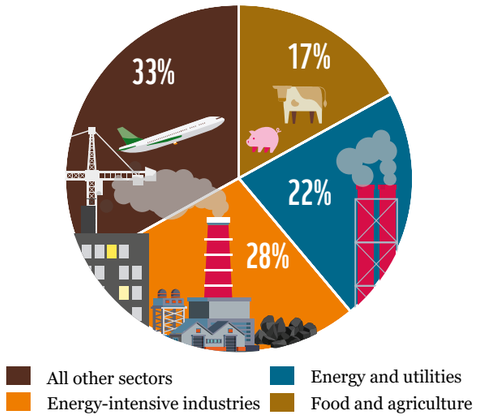
Where does the footprint occur? In 2022, approximately 57% of GHG emissions associated with Denmark's consumption occurred abroad. Between 1990 and 2020, domestic GHG emissions linked to consumption halved, mainly due to a higher share of renewable energy in Denmark's electricity production.[36]

In the same period, emissions abroad linked to Danish consumption increased by 30%, with the largest share occurring in other EU countries (34%) and China (20%).[37] The shift in footprint distribution from Denmark to other countries highlights the need for Denmark to introduce measures to reduce GHG emissions abroad.

What reduction is needed? In 2022, Denmark's GHG footprint was estimated at 10.8 tonnes CO2e per capita, nearly seven times greater than the planetary limit of 1.61 tonnes.[38] To remain within planetary boundaries, Denmark would need to reduce GHG emissions by 85%.

Which sector is the largest contributor? Three sectors dominate the Danish GHG footprint: energy and utilities (22%), energy-intensive industries including manufacturing (28%), and food and agriculture (17%).

GREENHOUSE GASSES



How do the energy and utilities and energy-intensive industries contribute? Energy consumption for private housing as well as industries is a major contributor to Denmark's consumption footprint. The energy and utilities sector includes wind power developers, coal mining companies, and utility companies that generate and supply electricity, gas, and heat. The energy and utilities sector is the second-largest contributor to both Denmark's GHG emissions driven by fossil fuels and the organic material footprint stemming from the use of woody biomass as fuel.

Energy-intensive industries such as metals, cement,

petrochemicals, and pulp and paper producers consume large amounts of energy for their production and are the largest contributor to Denmark's GHG emissions. Denmark has relatively few of these producers domestically; they are typically located abroad in regions with more fossil-based energy systems. Together, energy-intensive industries and the energy and utility sector account for half of Denmark's GHG emissions. These numbers make it clear why a rapid transition from fossil fuels to renewables is essential.

Energy and utilities and energy-intensive industries' impact on nature

Energy-intensive industries impact nature by emitting large quantities of greenhouse gases, such as carbon dioxide, leading to climate change, air and water pollution, and habitat degradation. The extraction of raw materials, manufacturing processes requiring high temperatures, and the generation of waste all contribute to environmental damage, including acid rain, soil contamination, and ecosystem loss.

Denmark's renewable energy use has been rising from 6% in 1990 to 42.8% in 2022.[39] However, behind this achievement lies a dependence on woody biomass, which now accounts for up to 68% of the total renewable energy use. Woody biomass is imported to Denmark from countries such as Estonia and Latvia, with 52% of wood chips and pellets coming from these two nations. The biomass industry in these countries has been reported to cause land-use changes and forest degradation.[40]

Burning trees and crops is an inefficient use of biomass, land, and public funds. For example, meeting the EU's biofuel consumption requires an area almost the size of Denmark. Solar panels could produce the same energy, at a lower cost, using just 2.5% of the land. Moreover, renewable energy sources such as solar and wind already offer lower electricity production costs, and these costs continue to decline. In contrast, power generation from biomass has not meaningfully reduced production costs, and biomass is likely to be an increasingly expensive resource.[41]

5.3 DENMARK'S IMPACT ON NATURE FROM NUTRIENT RELEASE

Excess phosphate, together with excess nitrate, harms freshwater and marine ecosystems. In Denmark, phosphorous discharged to water bodies dropped significantly in the early 1990s and has since remained constant.[42] However, phosphorus pollution continues to affect marine ecosystems, causing eutrophication and reducing eelgrass distribution.[43]

Elevated nitrate levels pose a serious risk to people and nature. In 2023, nitrate levels in Denmark's groundwater exceeded the quality threshold (max of 50 mg/l) in 13% of monitored wells.[44] Elevated nitrate levels pose serious health risks, particularly to infants and vulnerable persons, and have been linked to blue baby syndrome, reproductive and developmental defects, as well as some cancers.[45] Overall, nitrogen concentrations in Danish watercourses have declined by 40% since 1990.[46] However, eutrophication from nitrogen pollution remains a major issue in the majority of inland and coastal waters. Most Danish lakes and marine waters still have remarkably high nutrient levels and, as a consequence of this eutrophication, suffer from oxygen depletion. Over the past two decades, there has been little overall improvement in their condition, despite some reductions in nutrient content.[47]

Phosphorus and nitrogen pollution of our ocean and freshwater is directly related to production and consumption. Figure 7 illustrates that phosphorus enters the cycle from import of animal feed (i.e. Soy used in pig feed grown in South America) and through commercial fertilisers. The animal feed is converted to manure in livestock production and is the largest source of phosphorus fertiliser in Denmark - over 72% of the phosphorus applied to fields is contained in livestock manure.[48]

What is a nitrogen and phosphorus impact measurement? Nitrogen and phosphorous can be measured from the quantities entering the biogeochemical cycle to meet Danish consumption, whether produced domestically or abroad. Nitrogen, in the form of nitrate, is essential for plant growth and is widely applied in agriculture through synthetic fertilisers and manure to boost crop yields. Similarly, phosphorus is a plant nutrient applied to agricultural soils, where it is absorbed by plants as phosphate.

Which data were analysed? The most recent data on Denmark's nitrogen and phosphorus consumption are from 2015. To address this gap, more recent data on nitrogen and phosphorus pollution in Denmark has been supplemented from Denmark Statistics, 2022.[49] Unlike the *consumption*, which measures total nutrient applied, *pollution* captures the excess nutrients lost in the environment. Whereas the consumption has established planetary boundaries, pollution is essentially a measurement of a local impact.

Which sector is the largest contributor? The food and agriculture sector accounts for almost the entire nitrogen and phosphorous use in Denmark with smaller amounts used in other sectors in manufacturing.

What reduction is needed? Denmark's phosphorus and nitrogen consumption were in 2015, 4.4 kg per person[50] for phosphorus and 73.3 kg per person[51] for nitrogen. To remain within planetary boundaries, Denmark would need to reduce its phosphorus use with 81% (planetary boundary: 0.84 kg per person per year[52]) and nitrogen with 89% (planetary boundary: 8.4 kg[53] per person per year).

Uneven geographical distribution of livestock across Denmark causes uneven loss of nitrogen and phosphorus to the environment.

Livestock manure is broken down gradually, making nutrients available to plants over time, but not necessarily in line with the plants' nutrient uptake needs. In addition, manure from poultry, fur animals, and to some extent pigs, contains a greater surplus of phosphorus, since animal feeding has mainly focused on protein content. [54] An uneven distribution of livestock across Denmark leads to regional differences in overfertilization and phosphorus loss to the environment. When livestock are concentrated in specific regions of Denmark, the surplus nutrients can build up in the soil or run off into rivers, lakes, or coastal waters in those areas.[55]

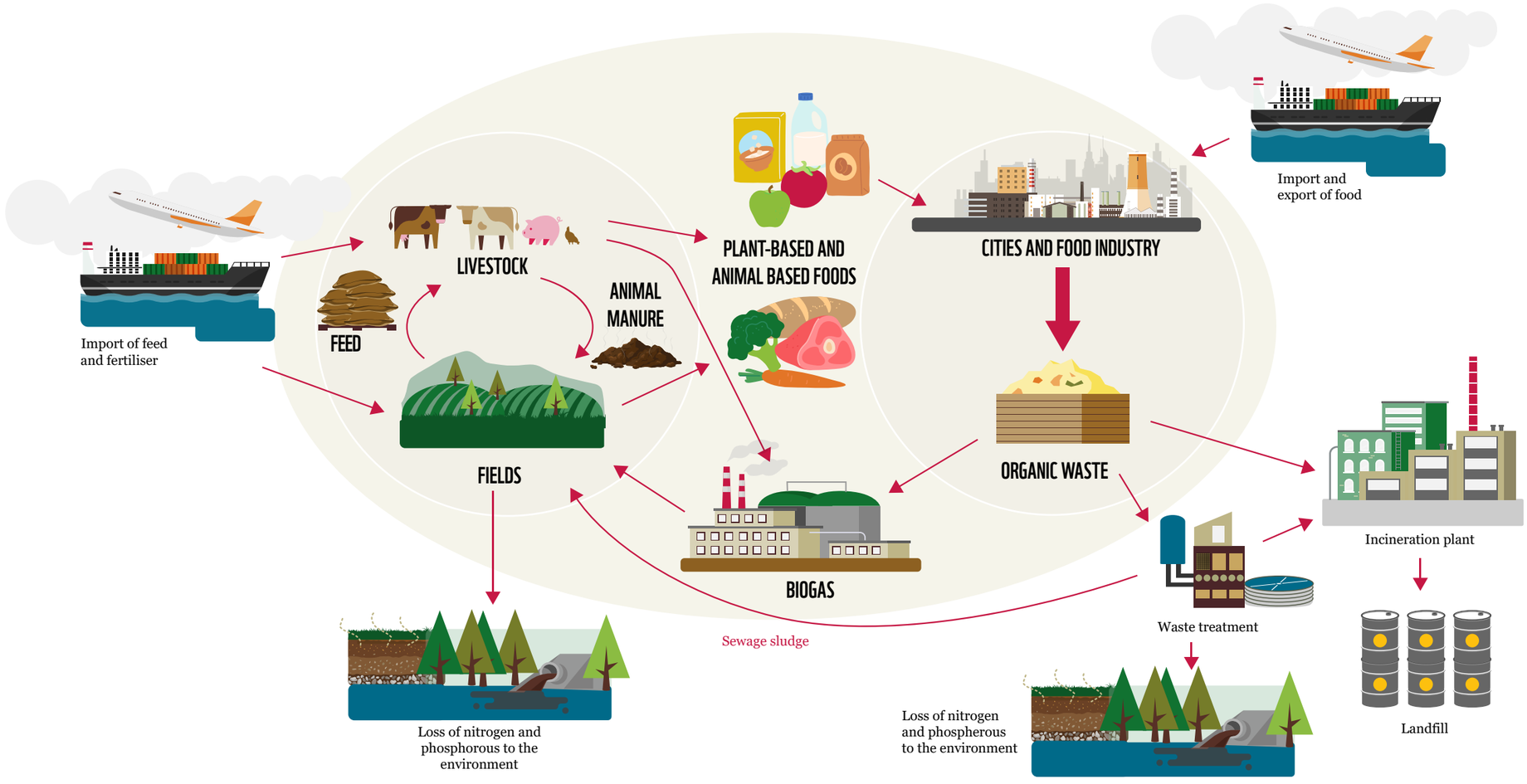


Figure 7: Denmark's Phosphorous cycle. (Adaptation of illustration made by Rådet for Grøn Omstilling 2021).

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6. RECOMMENDATIONS: DENMARK MUST TAKE RESPONSIBILITY FOR OUR FOOTPRINT AT HOME AND ABROAD

The conclusion is unmistakably clear: Denmark's consumption is pushing far beyond planetary boundaries, and the cost of inaction is high. Globally we are facing continued habitat loss, supply-chain disruptions, reputational damage, and rising regulatory costs. By reducing Denmark's footprint, we can deliver on our global commitments, unlock new markets, meet growing demands for sustainable products, and ensure that Denmark's economy and welfare remain.

This challenge is also an opportunity for Denmark to lead and build on the work of many frontrunners and initiatives introducing a more biobased and circular economy. By reducing the use of natural ressources, refurbishing, recycling and reusing we can reduce our footprint on nature. More than half of the global economy is dependent on nature, and more transparent and responsible supply chains can gain advantages – secure markets, strengthen supply chains, and build international credibility

By acting now, policymakers, businesses, consumers, and citizens have an opportunity to work together to bring Denmark's consumption within sustainable limits. By safeguarding nature and positioning Denmark and Danish businesses at the forefront, we can ensure that nature remains and continue to support our life here on Earth. We need to be a leading nation for change like we have done before.

Denmark should focus on its footprint nationally and abroad and set targets for high-impact sectors: food and agriculture, construction, energy and energy-intensive industries. The findings outlined in this report enables us to fill a knowledge gap around Denmark's footprint and therefore foster action. We now have several focus areas and an indicative baseline to measure progress against in coming years.

6.1 RECOMMENDATIONS FOR DANISH POLICYMAKERS

WWF recommends Danish policymakers to:

- **Implement the Kunming-Montreal Global Biodiversity Framework (GBF) Target 16** (reduce global footprint of consumption by 2030); Establish clear mechanisms to deliver GBF Target 16, with a particular focus on Denmark's footprint abroad.
- **Set sector-specific targets**: Identify where reductions must occur and set fair but ambitious medium and long-term targets for 2030, 2040 and 2050 and measure national progress to support the transformation of high-footprint sectors such as food and agriculture, construction, and energy and energy intensive industries.
- **Create national mechanisms focused on high-impact sectors** that incentivise the reduction of our footprint from both Danish production and consumption.

Recommended step 1:

Use the upcoming Nature and Biodiversity law to frame action on nature – just like we did for climate: The Nature and Biodiversity Law must be used as a framework under which it is agreed that we, in Denmark, set targets for reducing our footprint at home and abroad. In other word, the new law should commit to reduce national footprint on nature and set clear guidelines through a government partnership approach no less ambitious than the existing Climate Law.

Our analysis shows that a large part of Denmark's consumption footprint lies outside the country's borders, where resources are produced, extracted and processed. While improving domestic production systems and nature management is essential, Denmark should also support supplier countries to reduce the environmental impacts of their production by strengthening partnerships, increasing foreign aid investments in nature, and introducing policies, legislation, and economic incentives.

Under the GBF, Denmark should (and has committed to) integrate clear targets for its consumption footprint into the National Biodiversity Strategy and Action Plan (NBSAP). Denmark's current NBSAP lacks concrete targets and indicators beyond 2025, making it insufficient to halt and reverse biodiversity loss by 2030.[56]

For GBF Target 16, Denmark should define what constitutes "overconsumption," set measurable reduction targets, create indicators to track progress, and establish mechanisms to turn commitments into action.[57] Material footprints —such as organic and non-organic shown in this report—could serve as key indicators for implementing Target 16 nationally.[58]

Case example: Ireland's commitment to nature

Denmark can draw inspiration from Ireland, which has one of the most actionable NBSAPs among European countries. Integrated into national policy, Ireland's plan includes targets, actions, implementation partners and indicators for each objective. It is aligned with existing national policies, including the Climate Action Plan, CAP strategic plan, Forestry Programme and Forest Strategy, River Basin Management Plan, Nitrites Action programme and the proposed Marine Protected Areas Bill. The NBSAP sits on a statutory footing, making its implementation of actions a legal obligation, and Ireland has a committed clear intention to updating it by 2027 with a National Restoration Plan. Ireland has also developed a National Biodiversity Finance Plan to support the NBSAP's delivery.

The government's upcoming Nature and Biodiversity Law is an important step toward meeting the EU target of protecting 30% of land and 30% sea area by 2030.[59] Currently, Denmark only protects 2.3% of its terrestrial area (according to the Danish Biodiversity Council[60]), which is far below the target. While the upcoming nature and biodiversity law will be a key step towards EU's target, it should also address Denmark's global footprint: 51% of non-organic material consumption and 42% of organic material consumption occur abroad, along with 98% of deforestation and 57% of emissions linked to Danish consumption.

The Nature and Biodiversity Law should function as a framework under which long-term ambitious targets should be set that account for both national and global footprints. High impact sectors (construction, food and agriculture, and energy and energy-intensive industries) should be the focus point and a government partnership approach no less ambitious than climate partnership should establish targets for 2030, 2040, and 2050, ensuring that Denmark not only meets its obligations but leads in creating a nature-positive economy.

Domestic initiatives should be established to support the nature targets. Domestic initiatives such as educational campaigns, behavioural policies, legislation, taxes, subsidies, and financial incentives shall support the overall targets focused on high-impact sectors to ensure rooting throughout our society.

6.2 RECOMMENDATIONS FOR BUSINESS LEADERS

WWF recommends Danish business leaders to:

- **Assess value chains** – Businesses should map their value chains in Denmark and abroad to assess their overall environmental impact and dependencies on nature to ensure they are acting on the most material ones.
- **Commit to targets** – Businesses should set transparent footprint reduction targets clearly embedded in core strategies to avoid and reduce negative impacts, with clear actions to achieve them.
- **Transform value chains –** Businesses should take accountability for the impact they have on nature, avoid or reduce negative impact (following the mitigation hierarchy), and work towards investing in nature restoration in line with their footprint.
- **Disclose –** Businesses should track their performance and disclose nature related information throughout their journey.

WWF recommends using the High-level business actions on nature framework to steer nature governance. ACT-D guides businesses through the various tools, frameworks and initiatives available in the market to support them in assessing their relationships with nature, committing to action and target setting, transforming their practices and disclosing nature-related information.The ACT-D high level business actions on nature were developed in a collaboration by leading organisations including the Capitals Coalition, Business for Nature, The World Business Council for Sustainable Development, The Taskforce on Nature-related Financial Disclosures, Science Based Targets Network, World Economic Forum and WWF.

Businesses have a unique opportunity to lead the transition towards reducing Denmark's footprint. By assessing, committing, and transforming value chains businesses can turn environmental responsibility into long-term resilience and competitive advantage. Acting now is not just about compliance; it is about securing market position, reducing risk, and meeting growing consumer and investor sustainability expectations and requirements. A clear understanding of own value chain upstream and downstream is essential to reduce environmental impacts and risks, enhancing brand reputation, and complying with evolving European and global regulations and voluntary standards.

Actions for frontrunner businesses

Frontrunner businesses can use tools like WWF's Biodiversity Risk Filter or Water Risk Filter to assess their value chains and identify key locations or activities that contribute most to environmental footprints or pose high biodiversity and water risks. Precision allows for targeted and effective reduction efforts.

Businesses should also consider setting targets under Science-based Targets initiative (SBTi) and Science-based Targets for Nature (SBTN) to reduce their impacts on climate, water quality and quantity and to protect and restore terrestrial ecosystems. The SBTN methodology enables businesses to start by focussing on specific business units, areas with the greatest impacts, locations where data is most available, or a single issue, such as ocean, land, or freshwater.

Even for businesses that are not ready for a science-based targets, data-led action on a hotspot location or value chain activity is far better than ignoring the growing environmental risks – such as floods, droughts, and storms – that threaten commercial operations today.

6.3 RECOMMENDATIONS FOR CITIZENS AND CONSUMERS

WWF recommends citizens and consumers to:

- **Citizens and consumers** can promote sustainable consumption and production practices by urging policymakers to act, and demand transparency and accountability from both businesses and government.
- **Citizens and consumers** can help reduce Denmark's footprint by adopting more responsible consumption patterns and support environmentally responsible businesses.

While the primary responsibility for footprint reduction lies with policymakers and businesses, citizens and consumers can also contribute to reducing Denmark's footprint. By engaging actively, being curious and require information and transparency from businesses and policymakers, citizens and consumers can help reduce Denmark's footprint and ensure that Denmark and the world work towards a more sustainable future.

7. GLOSSARY

Biodiversity: The biological diversity among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part, including diversity within species, between species, and of ecosystems.

Degradation: The reduction or loss of biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest or woodlands due to natural processes, land use or other human activities and habitation patterns. This includes land contamination, soil erosion, and the destruction of vegetation cover.

Eutrophication: The excessive enrichment of waters by nutrients, such as nitrogen and phosphorous. The most acute consequences are hypoxia (oxygen depletion) and harmful algal blooms, which can destroy aquatic life. Eutrophication is driven by intensive agricultural practices, industrial activities, and population growth that release nutrients into the environment.

Footprint: The total measure of goods produced domestically, goods produced abroad and imported for consumption in Denmark.[61] Footprints can be measured at different scales (e.g., global, national, sectoral), using different indicators (e.g., material, biomass, GHG) and different scopes (e.g. consumption, territorial).

- **Consumption footprint:** Measures the domestic consumption, including goods produced domestically and goods produced abroad and imported.
- **Organic material footprint**: The sum of all agricultural, animal, forestry and fishery products attributable to a country's domestic demand.[62]
- **Non-organic material footprint:** The total amount of raw materials extracted to produce goods and services consumed in Denmark. It includes four main resource categories: non-metal ores (mined minerals, stone, sand, and similar raw materials), metal ores, biomass (food, forest, and other plant or animal-based products), and fossil fuels.
- **Deforestation impact:** The deforestation associated with a country's consumption of agricultural and forest commodities, measured as forest cover loss using remote sensing data.
- **Greenhouse Gas (GHG) impact:** Attributes global greenhouse gas emissions to a country's activities. The major GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), while less prevalent but highly damaging gases include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6).
- **Nitrogen impact:** The use of nitrogen as a nutrient input in agriculture, added in mineral form (e.g., industrial fertilisers) or in organic form (e.g., manure). It excludes unintended nitrogen inputs, such as nitrogen oxides (NOx) emitted from transport and industry.
- **Phosphorus impact:** The use of phosphorus as a nutrient input in agriculture, added in mineral form (e.g. industrial fertilisers) or in organic form (e.g., manure).

Nature: The non-living components (geodiversity) and living components (biodiversity) of the natural world, including their dynamic processes, features, and interactions.

Planetary boundary/limit: The safe environmental limit for human activities within one of nine critical Earth system processes, including climate change, freshwater use, and biodiversity loss. Exceeding these thresholds increases the risk of destabilising Earth systems and triggering irreversible environmental change. The planetary boundary concept can be used to derive national or per-capita targets, enabling comparisons across countries and sectors.

8. SUMMARY OF METHODOLOGY

FOOTPRINT SCOPE AND FOCUS

Human pressures on the natural world can be reflected through a country's *footprint*, which measures the extraction, production, consumption, and related activities that consequently affect ecosystems and natural processes. Footprints are commonly reported in four categories: consumption, production, combined production and consumption, and territorial (see Figure 8).

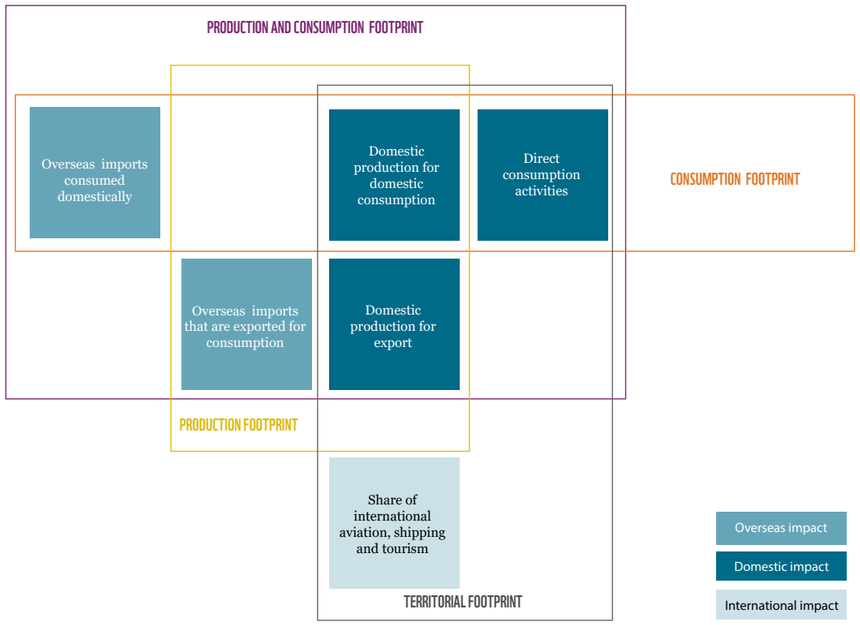

Figure 8: Footprint scopes

This report analyses **Denmark's consumption footprint**, which covers goods produced domestically, goods produced abroad and imported for consumption in Denmark, and the direct impacts of consumption activities (see Figure 8: Footprint scopes). It examines six specific consumption areas in detail: non-organic material footprint, organic material footprint, greenhouse gas (GHG) impact, deforestation impact, phosphorus impact, and nitrogen impact.

Consumption footprints were selected over other footprint scopes because they capture the pressures from the entire economy and avoid double-counting when assessing multiple countries. They are also recommended for monitoring progress toward GBF Target 16 and have better data availability than other scopes, partly because they are derived from reliable trade statistics using the formula: **consumption = (production + imports)– exports.**

ANNEX: DENMARK'S FOOTPRINT CHALLENGE: FROM NATURE DECLINE TO A MORE SUSTAINABLE FUTURE FOR ALL

This section presents the technical methodology used in the WWF Denmark report *Denmark's Footprint challenge: From nature decline to a more sustainable future for all*. It describes the footprint methodology, the individual categories, and underlying data sources.

FOOTPRINT SCOPE AND FOCUS

Human pressures on the natural world can be measured in several ways. Footprints are a specific type of measure that link production and/or consumption to environmental pressures. A country's 'footprint' reflects the extraction, production, consumption, and related socioeconomic activities that place demands on ecosystems.[63]

Global footprints are often divided into four categories: consumption footprint, production footprint, combined production and consumption footprint, and territorial footprint. Each footprint captures these demands differently. We define the four categories as follows (Figure 9):

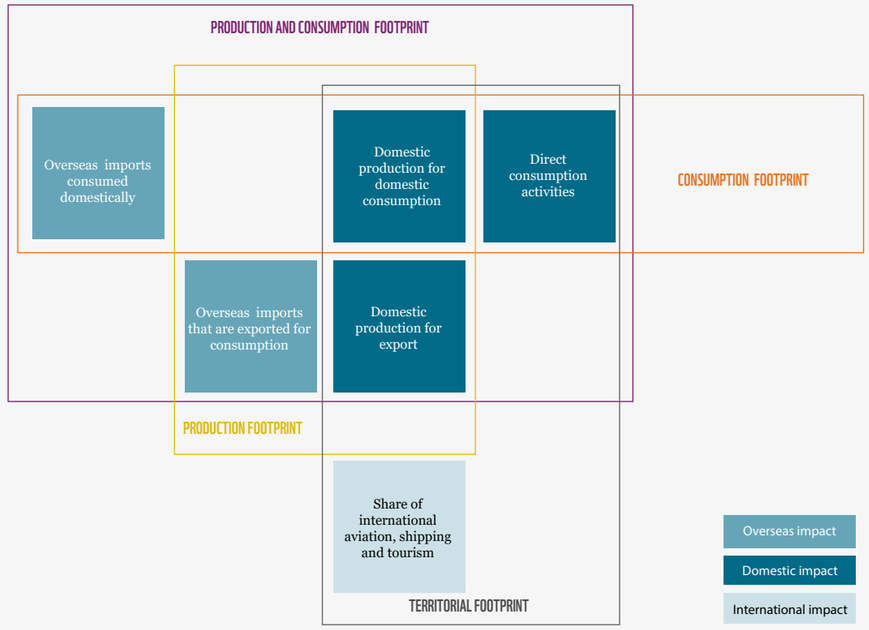

Figure 9: Footprint scopes

This report assesses **Denmark's consumption footprint**, which covers goods produced domestically, goods produced abroad and imported and consumed in Denmark, and the direct pressures of consumption activities (see *Figure 9: Footprint scopes*). It examines six specific consumption areas in detail: non-organic material footprint, organic material footprint, greenhouse gas (GHG) impact, deforestation impact, phosphorus impact, and nitrogen impact.

Consumption footprints were chosen over other scopes because they capture the pressures and demands of the whole economy while avoiding double-counting. Double counting occurs when the same emissions or resource use are recorded more than once, which can inflate or distort a system's overall footprint. Focusing on the consumption footprint rather than the production also helps address potential leakage (i.e., the risk that pressures are simply shifted to other regions or sectors).

Consumption footprints are well-suited for monitoring progress towards GBF Target 16 - reduce overconsumption - and generally have better data availability than other scopes, partly because they are often derived (directly or indirectly) from reliable trade data using the formula 'consumption = (production + imports) – exports'.[64]

FOOTPRINTS AS A CONCEPT

Footprints are a valuable tool to demonstrate the link between consumption and environmental pressures. They can indicate the extent to which planetary boundaries are exceeded, identify key industries contributing to these pressures, and allow comparisons between countries on a relative rather than absolute basis. For more information on the selection of footprints, see the Framework for National Footprint targets: technical document.

Footprints are used widely in scientific literature to measure a country's environmental pressures.[65] Their use requires careful interpretation and an understanding of both strengths and limitations. Limitations include the availability of up-to-date global datasets, the ability to capture national or subnational variations, and the sensitivity to changes in production activities.

Footprints are not direct measures of impact, similar to how measuring the concentration of a pollutant in a lake does not reveal how it will affect the people or wildlife that ingest the water. For example, the environmental impacts of iron in Denmark's non-organic material footprint depends on how and where it is mined and processed. Similarly, the risk of deforestation associated with agricultural commodities and timber varies according to how and where it is produced – whether it is sourced from verified deforestation and conversion-free suppliers – or from regions with higher deforestation risk. Again, careful research and interpretation is required.

UNDERLYING DATA

The data used in this analysis represents the best available and is based on guidance on implementing GBF Target 16 and associated indicators.[66] The specific datasets and any related caveats are outlined in the following sections for each footprint and summarised in Table 1 below.

Table 1: Sources of data for comparing Denmark's footprint with planetary limits

FOOTPRINT	DENMARK PER CAPITA FOOTPRINT	GLOBAL PER CAPITA FOOTPRINT	PLANETARY LIMIT PER CAPITA
Non-organic material footprint	Material flow account/Eurostat[67], Statistics Denmark	UN SDG Indicators[68] with biomass excluded	O'Neill et al. (2018)[69] adjusted for population with organic material footprint excluded
Organic material footprint	Material flow account/Eurostat[70], Statistics Denmark	UN SDG Indicators[71] with non-biomass excluded	O'Neill et al. (2018)[72] adjusted for population with non-organic material footprint excluded
Greenhouse gas measurement	Danish Energy Agency[73]	O'Neill et al. (2018)[74] adjusted for population	WWF & Metabolic (2020)[75] IPCC (2018)[76]
Deforestation measurement	Global Environmental Impacts of Consumption (GEIC) Indicator[77]	Steffen et al (2025)[78]	Richardson et al. 2023[79]
Phosphorous measurement	O'Neill et al. (2018)[80]	Steffen et al (2015)[81]	Steffen et al (2015)[82]
Nitrogen measurement	O'Neill et al. (2018)[83]	Steffen et al (2015)[84]	Steffen et al (2015)[85]

In the report, we use the latest available data from 2022 (non-organic material footprint, organic material footprint, GHGs, and deforestation). The nitrogen and phosphorus dataset are from 2015, which is the latest available data. We complemented this with more recent data on nitrogen and phosphorus pollution.

ESTIMATING A COUNTRY'S SHARE WITHIN PLANETARY BOUNDARIES

Many footprints have a threshold beyond which the risk of severe disruption to planetary systems rises significantly. This threshold is known as the 'planetary boundary' or 'planetary limit'.

The existence of planetary boundaries allows global – and by extension – national footprint and impact targets to be set with rigour. However, setting planetary boundaries is, to some extent, reliant on expert judgement. For example, the widely recognised 1.5° C threshold for climate change – the most rigorously studied planetary limit – represents a trade-off between what is perceived as achievable and the risks of exceeding it.

Countries do not contribute equally to planetary overshoot. A small number of countries are primarily responsible for the contributions – both currently and historically – while others may consume fewer planetary resources to meet their needs. Simply put, high-income countries tend to have larger footprints than low-income countries.[86]

Global sustainability requires not only reducing global consumption to be within planetary limits but also achieving convergence of footprints between and within regions and income groups. A country's role in reducing its global footprint must be set on the basis of equity, reflecting its relative contribution, while allowing for sustainable development and poverty eradication, particularly in low-income countries.[87]

This report uses the simplest method to estimate a country's share of planetary boundaries: **calculating the *per capita* planetary limit,** which quantifies each *global citizen's* fair share of a planetary resource**.** This value is then compared with the *per capita* national footprint to assess the direction and magnitude of change needed.[88] For example, the per capita planetary boundary for the non-organic material footprint is 4.9 tonnes. While Denmark would need to *reduce* its footprint from 17.9 to 4.9 tonnes per person per year to stay within this threshold, Sri Lanka could potentially *increase* its footprint from 3.8 to 4.9 tonnes per person per year.[89]

To calculate global and Danish per capita footprints, data on global and Danish populations for the stated reference year of each footprint were sourced from the World Bank.[90]

ESTIMATING SECTORAL CONTRIBUTIONS

It is possible to attribute components of the footprints to economic sectors where the data is sufficiently detailed. Where the end use of a footprint component is clear, it is assigned directly to the relevant sector. For example, in the organic material footprint, cereals are used almost entirely by the food and agriculture sector, either directly as human food or indirectly as animal feed. Where a component has multiple uses, the footprint is allocated based on the best available information. For example, in the organic material footprint, wood volumes consumed are mainly used by the energy sector (87%), the construction sector (7%), and by the manufacturing sector (5%), and so wood biomass is apportioned to these sectors according to those percentages.[91]

The nitrogen and phosphorous impact measurements are defined by the use of these nutrients in agriculture and, therefore, fall entirely within the food and agriculture sector.

To attribute footprints to specific sectors, we applied the classification used in the Danish Government's Climate Partnerships.[92] The Climate Partnership co-developed recommendations for key industries on how to reduce GHG emissions by 2030. These recommendations informed the Danish Climate Act, which sets legally binding targets for territorial GHG emission reductions. The sectors defined in the Climate Partnership are: energy and utilities, waste, water and circular economy, energy-intensive industries, production companies, life science and biotech, food and agriculture, land transport, aviation, Blue Denmark (including international sea transport), construction, trade, service, IT and consulting, and finance. By using established industry definitions, we aim to build on the collaboration already in place to reduce Denmark's GHG impact and extend this effort to address Denmark's consumption footprint.

Sectoral contributions in detail

The results for sectoral contributions to each footprint are clear, with each of the highlighted sectors contributing 50% or more to its respective footprint. However, assigning footprints to specific sectors always involves some uncertainty. For example, the Life Science and Biotech sector's intensive use of agricultural commodities and energy indicates that its contribution may be underestimated. This issue highlights the value of further disaggregating the sectors within each footprint to refine the analysis. While the overall results are unlikely to change, a more rigorous approach may reveal additional sectors with larger footprint shares than currently assigned.

DETAILED METHODOLOGY OF EACH CONSUMPTION FOOTPRINT

Table 2: How the overall material footprint is calculated:

	2022	(tonnes) %
Metal and non-metal	82,172,476	55%
Fossil Fuels	24,060,701	16%
Other	684,501	0%
Organic	43,308,998	29%

NON-ORGANIC MATERIAL FOOTPRINT

The material footprint measures the total amount of raw materials extracted for producing goods and services consumed within a country. It comprises three main resource categories: non-metal ores (such as mined minerals, stone, sand), metal ores, and fossil fuels.

Table 3: How the non-organic material footprint is comprised:

	%
Non-metallic ores	73.9
Metal ores	1.1
Fossil energy carriers	26.2
Waster for final treatment disposal	-1.1*
Other products	-0.07*

** These two categories are negative which means that Denmark exports more than it imports*

This report adopts the standard method for calculating the non-organic material footprint, as defined by Economy-Wide Material Flow Accounting procedures (EW-MFA).[93] According to this method, the non-organic material footprint is calculated as domestic production and import of materials, minus exports, inclusive of the materials needed to produce imported goods.

The EW-MFA data comes from Eurostat,[94] which employs one of the most clearly systematised approaches to recording and reporting material flows. Statistics Denmark applies the same methodology. The data used in this report is from 2022, the most recent year for which detailed subcategories of non-organic and organic flows are available.

Some studies estimate the material footprint in terms of *Raw Material Equivalent* (RME), which refers to the raw materials extracted to produce traded and consumed products, rather than the traded products themselves. Beyond year 2019, data for Denmark is unavailable through Statistics Denmark or Eurostat and was therefore not used.

The global footprint is based on SDG reporting of the global material footprint[95], with organic material footprint assumed to represent 20% of the total, following the methodology of Krausmann *et al.* (2008).[96] Proposed global limits for the material footprint range from 50 Gt [97] to 50.8 Gt per year.[98]

ORGANIC MATERIAL FOOTPRINT

The organic material footprint is the sum of all agricultural, animal, forestry and fishery products attributable to a country's domestic demand, measured in tonnes.[99] It is a sub-set of the broader material footprint.

In this study, organic material footprint was estimated using Eurostat's Material Flow Account data. [100] The global footprint is derived from SDG reporting on the global material footprint[101], with organic material assumed to be 20% of the total, following the methodology of Krausmann *et al.* (2008).[102]

The planetary limit for the organic material footprint has received relatively little attention, as organic material often is embedded within estimates for the material consumption limit. For this analysis, the threshold has been calculated as 20% of the material footprint. [103]

GREENHOUSE GAS IMPACT MEASUREMENT

The Danish Energy Agency recently estimated Denmark's GHG consumption, including all six major gasses listed in the Kyoto Protocol. The estimate includes a breakdown of domestic and overseas emissions, alongside a sectoral analysis.[104]

The Planetary limit for GHG is the planetary boundary for cumulative greenhouse gas emissions from 2018 onwards, capped at 420 $GtCO_2eq$.[105] This threshold offers a two-thirds probability of limiting global warming to 1.5°C, according to the best available scenarios.[106] On a per capita basis, this equates to an annual limit of 1.61 tonnes.[107]

DEFORESTATION IMPACT MEASUREMENT

The deforestation data is from 2022 and is sourced from the Global Environmental Impacts of Consumption (GEIC) Indicator.[108]

The GEIC framework only considers the consumption of agricultural products and timber, as there is limited data on the extent of deforestation caused by other factors and a lack of information on supply chains (e.g., mining). The expansion of agriculture and pasture accounts for roughly 90% of both tropical[109] and global deforestation,[110] making the indicator highly relevant. Nevertheless, it is likely to underestimate Denmark's deforestation footprint, as not all drivers of deforestation are captured, for example is deforestation caused by mining of minerals not covered.

The GEIC model links deforestation data derived from satellite imagery to national, crop-specific land use models. Crop-specific deforestation estimates are then linked to consumption by modelling commodity trade data. Full details of the methods are provided in Croft *et al.* (2022).[111] While the deforestation measurement is expressed in hectares, it is better understood as a measure of deforestation risk: the actual area of deforestation linked to Denmark's supply chains could be higher or lower. For example, if Denmark sourced all its palm oil from verified deforestation-free sources, the deforestation for palm oil would be zero. Equally, sourcing from areas in the producer countries that

have a higher deforestation risk could result in a larger deforestation impact.

The Planetary Boundaries framework sets global forest cover thresholds at 85% of Holocene levels for tropical and boreal forests, and 50% for temperate forests—equating to a 75% weighted average across biomes. All of these boundaries have been exceeded. As such, when applied to a limit, a 'zero-deforestation' limit is justified. This approach aligns with numerous high-level policy commitments, including the Glasgow Declaration on Forests and Land Use[112], the UN Forum on Forests[113], the New York Declaration on Forests,[114] and Sustainable Development Goal 15 (Target 15.2).[115]

NITROGEN AND PHOSPHORUS IMPACT

MEASUREMENTS

The treatment of the nitrogen and phosphorus measurements differs from that of others assessed in this report. While latest information on nitrogen and phosphorus pollution is available for Denmark, the most up-to-date consumption data is for 2015 – too old to be useful on its own. As such, it is supplemented with more recent data on nitrogen and phosphorus pollution.

Data on Denmark's nitrogen and phosphorus consumption is derived from O'Neill *et al* (2018)[116], while the planetary limits are based on Steffen et al. (2015).


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