28 January 2024

# Food Value Chain Background Paper

## Development of Eligibility Criteria of the Climate Bonds Standard & Certification Scheme

First Draft



| Revision | Date | Summary of changes |
|---|---|---|
| 0.1 | 13/02/2025 | Draft for public consultation |

## Acknowledgements

Climate Bonds gratefully acknowledges the Technical and IWG members who supported the development of these Criteria. Members are listed in ***Appendix A.***

Special thanks are given to Ruth Rennie, the lead specialist and Aishwarya Sankar and Marian Rodriguez for coordinating the development of the Criteria through the TWG.

The IWG provided critical and useability focused consultation and feedback on the Criteria, but this does not automatically reflect endorsement of the criteria by all members.

The development of the Food Value Chain Criteria was made possible through the generous support of the Gordon and Betty Moore Foundation.

# List of acronyms

| | |
|---|---|
| **AHRI** | Air-conditioning, Heating and Refrigeration Institute |
| **ANSI** | American National Standards Institute |
| **ASHRAE** | American Society of Heating, Refrigerating and Air-Conditioning Engineers |
| **CBS** | Climate Bonds Standard |
| **CBSB** | Climate Bonds Standard Board |
| **CO2** | Carbon dioxide |
| **CO2eq** | Carbon dioxide equivalent |
| **EU** | European Union |
| **FSC** | Forest Stewardship Council |
| **FVC** | Food Value Chain |
| **GAFSP** | Global Agriculture and Food Security Program |
| **GHG** | Greenhouse gases |
| **GWP** | Global Warming Potential |
| **HFC** | Hydrofluorocarbon |
| **IFC** | International Finance Corporation |
| **IPPC** | Intergovernmental Panel on Climate Change |
| **ISCC** | International Sustainability and Carbon Certification |
| **ISO** | International Standards Organisation |
| **IWG** | Industry Working Group |
| **KPI** | Key performance indicator |
| **LCA** | Life cycle assessment |
| **LED** | Light-emitting diode |
| **PEFC** | Program for Endorsement of Forest |
| **RSB** | Round Table for Sustainable Biomaterials |
| **RTRS** | Round Table of Responsible Soy Association |
| **SBTi** | Science Based Targets initiative |
| **SFI** | Sustainable Forestry Initiative |
| **SLB** | Sustainability-linked bond |
| **SLD** | Sustainability-linked debt |
| **TWG** | Technical Working Group |
| **UoP** | Use of Proceeds |

# Table of contents

## List of figures



## List of tables

# 1. Introduction

## 1.1 Overview

This document serves as a reference document to the Criteria Document for the food value chain criteria. The purpose of this document is to provide an overview of the key considerations and issues that were raised during development of the food value chain Criteria and provide the rationale for why requirements were chosen and set.

The Criteria were developed through a consultative process with TWGs and IWG, and through public consultation. The TWGs comprised academic and research institutions, non-profit organizations, multilateral banks and specialist consultancies whereas IWGs are represented by industry experts including potential bond issuers, investors and financial institutions. A 60-day period of public consultation offers the opportunity to any member of the public to comment on the Criteria.

This document begins with an introduction to the challenges in financing a low carbon and climate resilient world and the role that bonds can play in meeting this challenge, particularly through the standardisation of green definitions. This is followed by **Section 2** which is an introduction to the food value chain sector and the implications of climate change on the sector in terms of both emissions and climate risks. **Section 3** synthesizes the discussions arising from the TWGs, IWGs, and public consultation and presents the resulting Criteria that have been finalized and published by Climate Bonds.

Supplementary information available in addition to this document include: **LINKS TO BE ADDED ON PUBLICATION**

Food value chain Criteria brochure: a 2-page summary of the food value chain Criteria.

Food value chain Criteria document: the complete Criteria requirements.

Climate Bonds Standard V4.2: the umbrella document laying out the common requirements that all Certified Climate Bonds need to meet, in addition to the sector-specific Criteria

Climate Bonds Standard & Certification Scheme Brochure: an overview of the purpose, context and requirements of the Climate Bonds Standard & Certification Scheme.

For more information on the Climate Bonds Initiative and the Climate Bond Standard & Certification Scheme, see https://www.climatebonds.net/standards.

## 1.2 Funding the goals of the Paris Agreement

The current trajectory of climate change, expected to lead to a global warming of 2.7-3.1°C by 2100,[1] poses an enormous threat to the future of the world's nations and economies. The aim of the Paris Agreement is to limit warming to a global average of no more than 2°C higher than pre-industrial levels by the end of the century, and ideally no more than 1.5°C. The effects of climate change and the risks associated even with a 2ºC rise are significant: rising sea levels, increased frequency and severity of hurricanes, droughts, wildfires and typhoons, and changes in agricultural patterns and yields. Meeting the 2ºC goal requires a dramatic reduction in global greenhouse gas (GHG) emissions.

At the same time, the world is entering an age of unprecedented urbanisation and related infrastructure development. Global infrastructure investment is expected to amount to USD 90 trillion by 2030, more than the entire current infrastructure stock.[2]

To ensure sustainable development and avoid dangerous climate change, this infrastructure needs to be low-carbon and resilient to physical climate impacts, without compromising the economic growth needed to improve the livelihoods and wellbeing of the world's poorer citizens. Ensuring that the infrastructure built is low-carbon

[1] Climate Action Tracker

[2] The Global Commission on the Economy and Climate (2018), 'Unlocking the Inclusive Growth Story of the 21st Century: Accelerating Climate Action in Urgent Times'

raises the annual investment needs by 3–4%.[3] Climate adaptation needs add another significant amount of investment, estimated at USD 280–500 billion per annum by 2050 for a 2ºC scenario.[4]

## 1.3 The role of bonds

Traditional sources of capital for infrastructure investment (governments and commercial banks) are insufficient to meet these capital needs; institutional investors, particularly pension and sovereign wealth funds, are increasingly looked to as viable actors to fill these financing gaps.

Capital markets enable issuers to tap into large pools of private capital from institutional investors. Bonds are appropriate investment vehicles for these investors as they are low-risk investments with long-term maturities, making them a good fit with institutional investors' liabilities (e.g., pensions to be paid out in several decades).

Bond financing works well for low-carbon and climate-resilient infrastructure projects post-construction, as bonds are often used as refinancing instruments. Labelled Green Bonds are bonds with proceeds used for green projects, mostly climate change mitigation and/or adaptation projects, and labelled accordingly. The rapid growth of the labelled green bond market has shown in practice that the bond markets can provide a promising channel to finance climate investments.

The Green Bond market can reward bond issuers and investors for sustainable investments that accelerate progress toward a low-carbon and climate-resilient economy. Commonly used as long-term debt instruments, Green Bonds are issued by governments, companies, municipalities, commercial and development banks to finance or re-finance assets or activities with environmental benefits. Green Bonds are regular bonds with one distinguishing feature: proceeds are earmarked for projects with environmental benefits. Green Bonds are in high demand and can help issuers attract new types of investors.

A green label is a discovery mechanism for investors. It enables the identification of climate-aligned investments even with limited resources for due diligence. By doing so, a green bond label reduces friction in the markets and facilitates growth in climate-aligned investments.

Currently Green Bonds only account for less than 0.2% of a global bond market of USD 128 trillion.[5] The potential for scaling up is tremendous. The market now needs to grow much bigger, and quickly.

## 1.4 Introduction to the Climate Bonds Standard and Certification

Activating the mainstream debt capital markets to finance and refinance climate friendly projects and assets is critical to achieving international climate goals, and robust labelling of green bonds is a key requirement for that mainstream participation. Confidence in the climate objectives and the use of funds intended to address climate change is fundamental to the credibility of the role that green bonds play in a low carbon and climate resilient economy. Trust in the green label and transparency to the underlying assets are essential for this market to reach scale but investor capacity to assess green credentials is limited. Therefore, Climate Bonds created the Climate Bonds Standard & Certification Scheme, which aims to provide the green bond market with the trust and assurance to achieve the required scale.

The Climate Bonds Standard & Certification Scheme is an easy-to-use tool for investors and issuers to assist them in prioritising investments that truly contribute to addressing climate change, both from a resilience and a mitigation point of view. It is made up of the overarching CBS detailing management and reporting processes, and a set of Sector Criteria detailing the requirements assets must meet to be eligible for certification. The Certification Scheme requires applicants to obtain independent verification, pre- and post-issuance, to ensure the bond meets the requirements of the CBS.

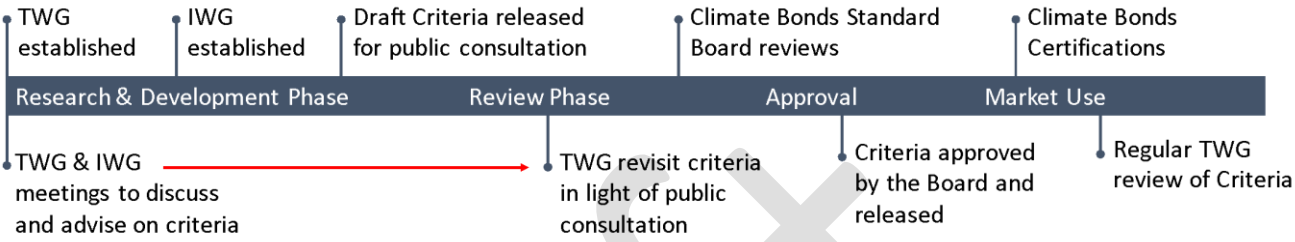
Existing Sector Criteria cover solar energy, wind energy, marine renewable energy, geothermal power, buildings, transport (land and sea), biofuel production, forestry, agriculture, waste management, hydrogen, electrical utilities and water infrastructure. In addition to the food value chain criteria, additional Sector Criteria currently under development include alternative proteins, update to the waste and bioenergy criteria. Criteria are available at www.climatebonds.net/standards/sector-criteria.

[3] The Global Commission on the Economy and Climate (2016), 'Better Growth, Better Climate'.
[4] UNEP (2018), 'Adaptation Gap Report 2018':
[5] International Capital Market Association, Bond Market Size.

## 1.5 Process for Sector Criteria Development

The CBS has been developed based on public consultation, road testing, and review by the Assurance Roundtable (a group of verifiers) and expert support from experienced green bond market participants. The Standard is revisited and amended on an annual basis in response to the growing green bond market. Sector specific Criteria, or definitions of green, are developed by TWG made up of scientists, engineers, and technical specialists. Draft Criteria are presented to IWG before being released for public comment. Finally, Criteria are presented to the CBSB for approval (see diagram below).

*Figure 1. Criteria development process*




## 1.6 Structure of this document

This document provides background to the development of the Food Value Chain Criteria. It captures the issues raised and discussed by the TWG and the IWG, as well as the arguments and evidence in support of the Criteria. It is structured as follows:

- Section 2 provides a brief overview of the sector: its current status, trends and role in mitigating and adapting to climate change.
- Section 3 outlines the principles and boundaries of the Criteria. It states that assets must pass 2 sets of requirements to be eligible for certification: (i) mitigation requirements and (ii) adaptation, resilience and other environmental and social requirements.
- Section 4 describes the rationale used to define the mitigation requirements
- Section 5 describes the approach to setting climate adaptation and resilience requirements a
- Section 6 describes the approach to defining environmental and social safeguards.

# 2. Sector Overview

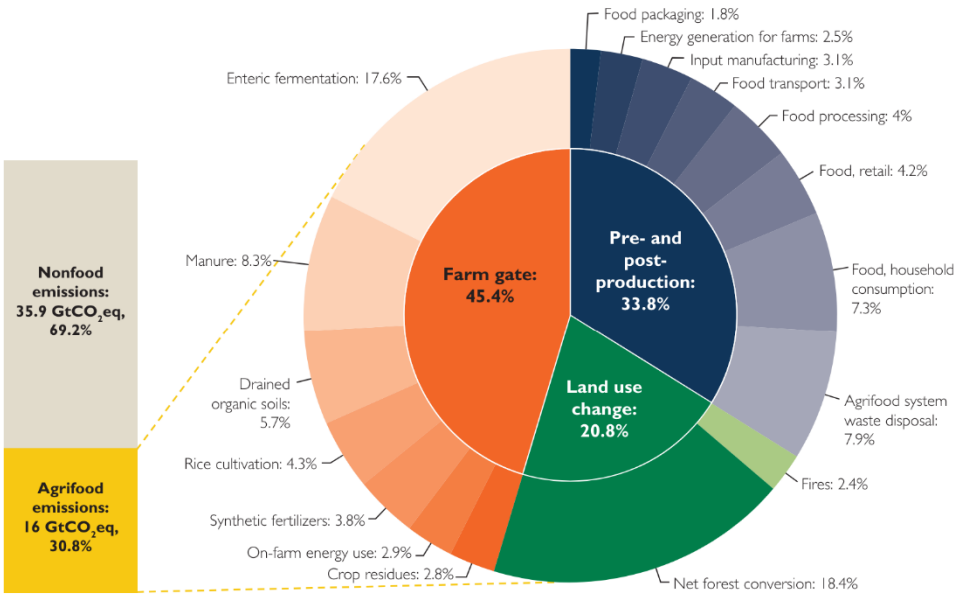
## 2.1 What is the Food Value Chain

The Food Value Chain (FVC) comprises all activities that occur beyond the farm gate to bring food and beverage products to consumers and to dispose of related waste. This includes food transport, processing, manufacturing, packaging, storage and distribution, retail, food preparation by hospitality and food service providers, and waste disposal. For the purposes of these criteria the Food Value Chain does not include activities at household level such as food preparation and storage, as these lie outside of the direct control of actors in Food Value Chains. However the Criteria do include actions by food value chain actors to influence household level consumption patterns which are one of the main drivers of rising emissions.

## 2.2 The Food Value Chain and climate change

The Agrifood sector as a whole generates almost a third (31%) of the world's total GHG emissions, averaging around 16 billion metric tons of carbon dioxide equivalent (CO2eq) per year[6]. This is higher than previously thought because earlier calculations focused mostly on emissions from agricultural production and land use changes. The majority of agrifood sector emissions are indeed produced at farm level through production processes (45.4%) and land use changes (20.8%). However, a third of agri-food emissions (33.8%) occur at the post-production stage. The main sources of emissions are food system waste (7.9%), household consumption (7.3%), food retail (4.2%), food processing (4%), food transport (3.1%) and packaging (1.8%).

*Figure 2: Global agri-food systems emissions sources*




*Source:* World Bank analysis based on data from FAOSTAT 2023a.
*Note:* Left: Mean annual global greenhouse gas (GHG) emissions from the agrifood system as a share of total GHG emissions, 2018–20. Right: Emissions broken down by the three main subcategories and their individual components. $GtCO_2eq$ = gigatons of carbon dioxide equivalent.

*Source: Sutton, William R., Alexander Lotsch, and Ashesh Prasann. 2024. Recipe for a Liveable Planet: Achieving Net Zero Emissions in the Agrifood System.*

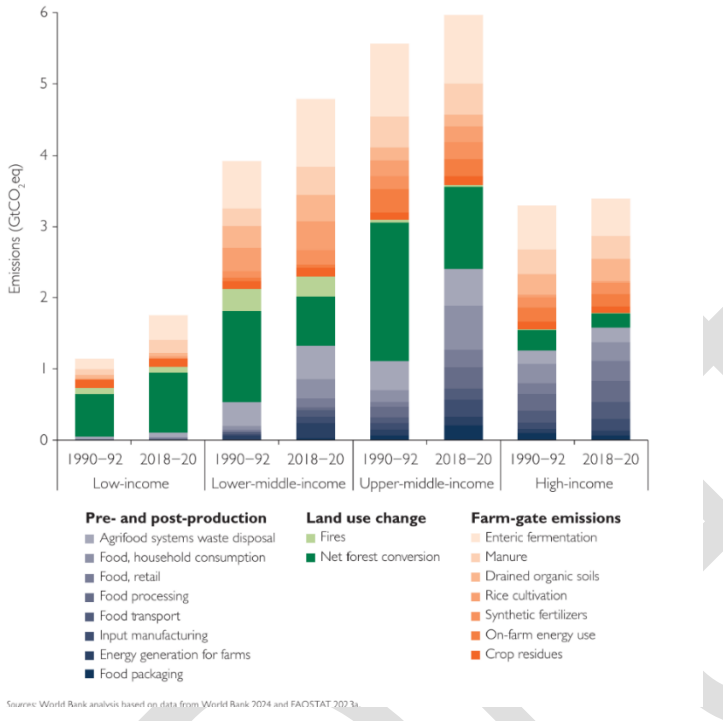
Food value chain emissions account for an increasing proportion of agri-food emissions, especially in high income, and increasingly in middle income, countries. Food Value Chain emissions are also rising faster than farm or land-use related emissions, driven by the rising global population and shifts in consumption patterns. Recent analysis has shown that post-production food value chain emissions are growing faster than emissions at farm gate and from land use change. Globally, between 1990 and 2019 emissions from food retail rose more than sixfold (631%), emissions from household consumption more than doubled (142%) and emissions increases from food packaging

[6] Crippa, M., Solazzo, E., Guizzardi, D. *et al.* Food systems are responsible for a third of global anthropogenic GHG emissions. *Nat Food* **2**, 198–209 2021.

(87%) and food transport (79%) were almost twice as high as emissions increases from farm level sources (9%-42%).[7]

Agri-food systems are highly diverse, fragmented and context specific. Nonetheless, there is a clear trend that as country income levels grow and economies adopt modern agri-food systems, emissions in the food value chain substantially increase both in absolute terms and as a proportion of total sector emissions. In developed countries post-production emissions make up the majority of agrifood emissions. However post production emissions are rising fastest in middle income countries. See Fig 3 Below.

*Figure 3: Agri-food systems emissions sources by country income level*




*Source: Sutton, William R., Alexander Lotsch, and Ashesh Prasann. 2024. Recipe for a Liveable Planet: Achieving Net Zero Emissions in the Agrifood System.*

## 2.3 Main drivers of Greenhouse Gas Emissions in the Food Value Chain

Eight key factors have been identified that play the greatest role in driving emissions across Food Value Chains:

### Energy use

The Global Food and Beverage sector is estimated to account for almost one-third of the world's total final energy demand. In high income countries three quarters of this demand comes from the post-harvest food value chain including food processing and distribution (45%), and retail, food preparation and cooking (30%). Demand from electricity and thermal energy for food processing alone is expected to double by 2050 compared to 2019 levels[8]. Across the Food Value Chain, GHG emissions from energy consumption vary greatly depending on the type of product produced, processes and technologies used including the need for refrigeration, type and efficiency of equipment, and the source of energy used. In food processing and manufacturing thermal energy for heating processes is estimated to account for 75% of the final energy use on average with 25% for electricity[9]. The retail

[7] Tubiello et al.: GHG emissions from pre- and post-production processes increasingly dominate greenhouse gas emissions from agri-food systems, Earth Syst. Sci. Data, 14, 1795–1809, 2022
[8] Teske, Sven (Editor), *Achieving the Paris Climate Agreement Goals Part 2: Science-based Target Setting for the Finance industry — Net-Zero Sectoral 1.5˚C Pathways for Real Economy Sectors*, Springer, 2022
[9] ibid

industry has been identified as one of the top 10 most carbon-intensive business sectors and retail stores have one of the highest energy intensities - 500 to 1.000 kWh/ m2 /y [10].

## Transport

Absolute levels and intensity of GHG emissions in Freight transport in food value chains are shaped by the complex interplay of distances travelled, modes of transport used, fuel mix and the refrigeration needs of products transported. More than half of food and beverage related freight transport is by road, including almost all domestic food freight transport across the world. Shipping is the most common mode of transport for food exports and imports. Different methods for comparing emissions across transport modes all reveal that overall shipping and rail are the most energy efficient and least emissions intensive forms of freight transport.

***Table 1. Emissions comparisons for different freight transport modes***

| Transport mode | Share of global food miles[11] | Share of global logistics transport emissions[12] | Emissions intensity (KgCO2 per ton-Killometer*)[13] | Distance covered for 5 kg of food with the same amount of fuel[14] |
|---|---|---|---|---|
| Road transport | 31% | 64% | 0.08–0.72 | 740 km |
| • *Light Commercial Vehicles* | | *50%* | 0.72 (petrol van)<br>0.25 electric van | |
| • *Heavy commercial vehicles (HGV)* | | *14%* | 0.49 HGV rigid <7.5t<br>0.08 HGV articulated >33t | |
| Shipping | 59% | 26% | 0.01 | 3800 km |
| Rail | 10% | 4% | 0.03 | 2400 km |
| Air | 0.16% | 6% | 2.30 (short haul flight)<br>1.02 (long haul flight | 43 km |

*tkm, a unit for measuring freight transport, representing the transport of 1t of goods by a given transport mode over a distance of 1 km

## Buildings

There are no clear indications of the extent to which emissions related to built infrastructure contribute to agri-food sector emissions. However, a number of building design elements have been identified that would support greater energy efficiency and therefore contribute to emissions reduction in food value chain facilities, particularly at the retail level. Buildings are included so as to expand the applicability of the Climate Bonds Building Criteria that currently do not cover industrial buildings and only cover supermarkets in a small number of countries due to a lack of globally applicable data. These criteria therefore offer a viable framework for investments in food value chain related buildings and facilities that could be financed under a Climate Bond.

## Cold Chain

Refrigeration is one of the fastest rising source of emissions in the Agri-food sector. The main source of emissions from refrigeration are from: electricity consumption of refrigeration equipment (60%), fuel consumption of refrigerated transport vehicles (18%), and direct emissions from refrigerants (22%). Many refrigerants still in common use have very high global warming potential (GWP), sometimes thousands of times higher than Carbon dioxide emissions. Emissions from fluorinated gases in the food value chain have doubled since 1990, particularly

[10] Ferreira Ana, Manuel Duarte Pinheiro , Jorge de Brito , Ricardo Mateus, Decarbonizing strategies of the retail sector following the Paris Agreement Energy Policy 135, 2019

[11] Joseph Poore and Thomas Nemecek, Reducing food's environmental impacts through producers and consumers, June 2018, *Science* 360(6392):987-992,

[12] Tinnes, Elliott. Fernando Perez, and Matthew Kandel with Tanner Probst. Operations Practice Decarbonizing logistics: Charting the path ahead Mckinsey & co. June 2024.

[13] Food & Drink Federation (FDF), Achieving Net Zero: A Handbook For The Food And Drink Sector Practical guidance for food and drink manufacturers to achieve Net Zero emissions, 2021.

[14]Sovacool, Benjamin K., Morgan Bazilian, Steve Griffiths, Jinsoo Kim, Aoife Foley, David Rooney,"Decarbonizing the food and beverages industry: A critical and systematic review of developments, sociotechnical systems and policy options"', *Renewable and Sustainable Energy Reviews*, Volume 143, 2021,

in industrialised countries[15].Emissions from F-gases (2% of global food-system emissions), mostly linked to refrigeration in the retail stage, were predominantly from industrialized countries (8% of their overall GHG emissions). The increased use of refrigeration also increases energy -related emissions across food processing, transport and retail.

At the same time refrigeration plays a key role in food preservation and reducing emissions from food loss and waste. Studies estimate that 12% of food produced globally in 2017 was lost due to an insufficient cold chain[16], with much higher losses in developing economies[17].It has been estimated that an «improved» cold chain with more refrigeration equipment, and better energy and environmental performance, would allow a reduction of almost 50% of the $CO_2$ emissions of the current cold chain, and avoid 55% of the food losses attributable to the current cold chain[18].

## Packaging

Packaging is one of the fastest growing sources of agri-food emissions and demand is increasing. Globally, food packaging accounts for 1.8% of agri-food sector emissions. However it contributes 10% on average of global food groups GHG emissions. On average, the packaging process causes 3.0-3.5% of the climate impact of packaged food but this varies greatly for different products and packaging solutions[19]. One of the greatest factors driving packaging -related emissions is the production of plastics based on fossil-fuels. Fossil-fuel based plastics also have high emissions from disposal in landfill (40% of plastic packaging) and incineration (17%). Recycling can reduce cradle-to-grave emissions of plastic packaging by 30 to 40%. For example the carbon footprint of recycled PET (rPET) is up to 70% lower than virgin PET, and 47% lower than cardboard. However, In 2021 only 12% of plastics, and 2% of single use plastics were produced from recycled feedstocks.

Natural fibre-based packaging such as paper and wood can have high emissions from deforestation and land-use change if they are not sustainably sourced. Bio-based plastic (such as Bio-PE, Bio-PET, PL etc) can also use food resources such as corn or cane sugar and may compete with food production and increase pressure on agricultural land.

End of life disposal of packaging is also driving emissions in Food Value Chains. Globally, 40% of plastic food packaging ends up in landfill and over 30% leaks into the environment. At the same time 14% of plastics-related emissions (including $Co_2$ and $CH_4$ -Methane) come from disposal of plastic packaging, including controlled incineration and open burning. Yet currently only 13% of food and beverage plastic bottles are recycled. Many governments are setting targets and incentives and using Extended Producer Responsibility (EPR) systems to increase circular packaging solutions.

## Food Loss and Waste

Food waste disposal is a major source of post-production agrifood sector emissions . Direct emissions associated with agrifood waste management accounts for 7.9% of sector emissions, including significant emissions from methane gas (CH4) from decomposition of organic material in landfills and open dumps where the majority of solid food waste ends up in most countries[20]. Some studies suggest that including indirect emissions from production and energy use to produce wasted food, cradle-to-grave emissions from food loss and waste represent half of total GHG emissions from food systems[21] .Emissions from agrifood waste disposal in middle income countries is around four times higher than that generated by high or low income countries[22]. Moreover the majority of food loss and waste in developed countries occurs at consumption level, whereas in emerging economies the majority of losses occur across the Food Value Chain, particularly in handling and storage. See Figure 4 below.

---

[15] Sutton, William R., Alexander Lotsch, and Ashesh Prasann. Recipe for a Liveable Planet: Achieving Net Zero Emissions in the Agrifood System. Agriculture and Food Series. Conference Edition. World Bank, Washington, DC. License: Creative Commons Attribution 2024
[16] Sarr J. et al. 2021
[17] Adekomaya et al. Sustaining the shelf life of fresh food in cold chain - a burden for the environment. Environment, 2016,
[18] Sarr J. et al. 2021
[19] Ecoplus, BOKU, denkstatt, OFI (2020). Food Packaging Sustainability: A guide for packaging manufacturers, food processors, retailers, political institutions & NGOs. Vienna,
[20] Sutton et al. 2024
[21] Zhu, J., Luo, Z., Sun, T. *et al.* Cradle-to-grave emissions from food loss and waste represent half of total greenhouse gas emissions from food systems. *Nat Food* **4**, 247–256 (2023).
[22] Chiriac, Daniela., Harsha Vishnumolakala, Paul Rosane], 2023. Landscape of Climate Finance for Agrifood Systems. Climate Policy Initiative

*Figure 4: Percentage of food calories lost or wasted at different stages of the Food Value Chain (by region)*


*Note:* Numbers may not sum to 100 due to rounding. Data are for the year 2009.
*Source:* WRI analysis based on FAO (2011c).

*Source: Searchinger, T. et al. (2018). Creating a Sustainable Food Future—A Menu of Solutions to Feed Nearly 10 Billion People by 2050. World Resources Institute*.

## Sourcing

Sourcing Practices are a major factor shaping emissions not only from production but alsofrom food transport and storage, including cold chain emissions, because they determine the origin and quantities of products moving across supply chains. They also play a critical role in shaping emissions from food loss and waste, particularly at retail and food service level, by determining the quantities of products that can be stocked and sold without spoilage and waste. Sustainable sourcing practices that avoid driving emissions from deforestation and land use conversion, and support climate friendly agricultural practices can therefore play a significant role in mitigating emissions in the Agri-food sector. Optimised demand management and sourcing practices can also support mitigation across the whole Food Value Chain.

### Consumption Patterns

Household food consumption patterns are a major driver of emissions across the entire food value chain because the drive demand. The most significant consumption -related emissions driver is the demand for animal-sourced diets which accounts for almost 60% of total agrifood emissions across all emissions categories[23]. Animal-based food emissions come not only from direct production, but also from land use change, feed production, and product refrigeration across the value chain. Demand for emissions intensive animal-based food is highest in high income countries and increasing in middle income countries as incomes rise[24]. Estimates suggest that worldwide adoption of the EAT-Lancet planetary health diet[25], would cut current global annual dietary emissions by 17% largely due to shifts away from red meat to plant-based proteins[26]**.** Removing animal-derived food products entirely from diets would halve global agrifood GHG emissions[27]. Shifts to diets with more plant-based than animal-based foods also have other environmental and social benefits including reducing water use and land use and improving human health[28].

[23] Xu, X., P. Sharma, S. Shu, T.-S. Lin, P. Ciais, F. N. Tubiello, P. Smith, N. Campbell, and A. K. Jain. 2021. "Global Greenhouse Gas Emissions from Animal-Based Foods Are Twice Those of Plant-Based Foods." *Nature Food* 2: 724–32.
[24] Sutton, William R., Alexander Lotsch, and Ashesh Prasann. 2024. *Recipe for a Liveable Planet: Achieving Net Zero Emissions in the Agrifood System*. Agriculture and Food Series. Conference Edition. World Bank, Washington, DC. License:
[25] Willett, Walter et al. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems *The Lancet*, Volume 393, Issue 10170, 447 – 492. February 02, 2019
[26] Li, Y., He, P., Shan, Y., Li,Y., Hang, Y.,Shao, S., Ruzzenenti, F. & Hubacek, K. Reducing climate change impacts from the global food system through diet shifts. *Nature Climate Change* 14, 943–953 (2024).
[27] Sutton et al. (2024)
[28] Willet et al (2019)

Beyond animal proteins, overconsumption of a wide range of foods, particularly in developed economies, is driving emissions by creating demand for overproduction of food which is then often lost or wasted. The global agrifood system's impact on driving overconsumption of certain food types is also associated with unhealthy diets and diet-related diseases particularly in high income countries, and unequal access to nutritious food[29].It has been estimated that more than half (56.9%) of the global population, which is presently overconsuming, would save 32.4% of global emissions through these diet shifts. The total reduction would be offset by a 15.4% increase from under consuming populations moving towards healthier diets[30].

## 2.4 Investment need

Climate financing for the agrifood sector is disproportionally low compared to its share of global emissions. Overall, climate finance has almost doubled in the last decade but the majority of this has been targeted on other sectors. Of a total of $660.2 billion for climate financing in 2019–20 just over 4% (on average of $28.5 billion pa) was allocated to projects in the agrifood sector including mitigation, adaption and dual-benefit investments. Of the US$588.4 billion allocated specifically to mitigation actions only 2.4% of this was received by the agrifood sector (US$14.4 billion in 2019–20). Similarly, the agri-food sector received only 1.11% of the total climate adaptation finance (amounting to US$ 7.3 billion) even though agrifood systems and farmers are highly vulnerable to climate risks. Annual investments in reducing agrifood emissions will need reach 18 times their current level, to $260 billion, to reduce current food system emissions by half by 2030[31].

Climate finance for the agrifood system is distributed unevenly the value chain. The vast majority (83%) of agrifood project level climate finance is allocated for agricultural production and forestry, while less than 1% (US$1.1 billion) is targeted to promoting low-emissions diets or reducing food loss and waste which are essential for climate mitigation. This represents a minor fraction of annual needs, estimated at US$48-50 billion[32].

A Planet Tracker analysis of funding in the agrifood system calculates that agrifood financing totals USD 8.6 trillion with the potential to provide annual funding of around USD 630 billion. On average 60% of public equity (67%) and bank finance (58%) is received primarily by actors in the manufacturing and distribution parts of the food value chain[33] (Figure 5).

This is largely due to the fact that these actors are the most able to mobilise and deploy climate mitigation finance, including to other parts of the value chain. Manufacturers and distributors have concentrated buying power in relation to producers and can therefore make investments in their supply chains to producer level. It is also due to the unequal distribution of profits across supply chains. The vast majority (81%) of profit in the agrifood system is captured at post-production level, with 34%, captured by manufacturers and distributors. Food & beverage manufacturers also have by far the largest aggregate profit and have the second-highest profit margin (after farm input providers)[34]. These findings further support the conclusion that actors in the post -production food value chain, particularly manufacturers and distributors are well placed to raise and deploy capital to deploy comprehensive strategies for emissions reduction across agrifood value chains (Figure 6).

[29] FAO, IFAD, UNICEF, WFP and WHO 2022. *The State of Food Security and Nutrition in the World 2022: Every Country Can Harness Priority Opportunities to Achieve Net Zero Agrifood Emissions139 Repurposing Food and Agricultural Policies to Make Healthy Diets More Affordable*. Rome: FAO.
[30] Li et al (2024)
[31] Chiriac et al, 2023
[32] Planet tracker, Financial Markets Roadmap For Transforming The Global Food System, A Guide for the Financial Sector, March 2023.
[33] Planet Tracker 2023
[34] Planet Tracker 2023

*Figure 5: Global food system funding mix*

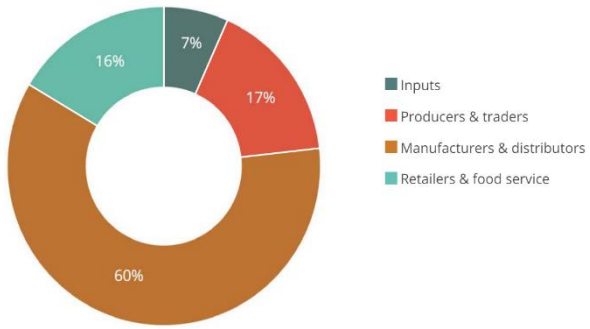
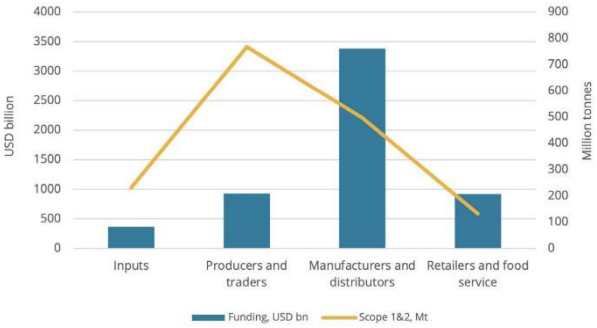



*Figure 6: Funding level and GHG emissions by value chain actor*




*Source: Planet Tracker, Financial Markets Roadmap For Transforming The Global Food System, A Guide for the Financial Sector.*

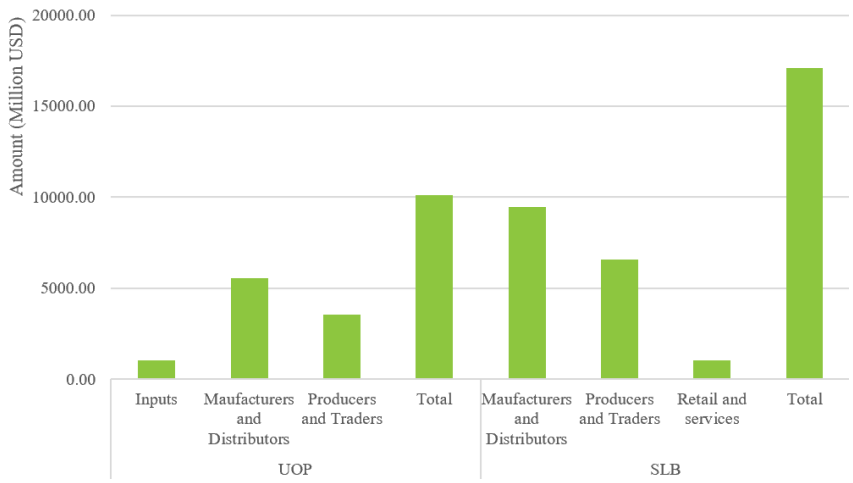
The same study shows that that quoted equity finance accounts for the largest proportion of funding (41%) with an additional 5% coming from private equity. Bank lending (net of cash) accounts for 16% with listed bonds accounting for only 1% of financing.

## 2.5 Deals already seen in the sector

Analysis from Climate Bonds own data also shows that Manufacturers and Distributors received the largest proportion of climate bond financing for both Use of Proceeds and Sustainability Linked Bonds. Twenty one Use of Proceeds (UoP) bonds have been issued to finance specific assets or projects at the food value chain level to a value of around US$10bn. Over half of this value was issued to Manufacturers and Distributors.

Sustainability-linked bonds (SLBs) are linked the fulfilment of key performance indicators (KPIs) against entity level sustainability performance targets, and generating additional payments to bondholders accrued if those KPIs are not met. From a total of US$24.2bn SLB finance mobilised by issuers in the agrifood sector, more than US$15bn was issued to actors at the post-production level with over half of this issued to manufacturers and distributors[35]. (Figure 7)

*Figure 7: Value of Use of Proceeds (UoP) and Sustainability Linked Bonds (SLBs) by agrifood system actor*




*Source: Climate Bonds Initiative*

Sustainability Linked Bonds have been used to support initiatives to address a number of the key emissions drivers in the food value chain including waste, product governance and the circular economy. The French retailer Carrefour has raised US$3.5bn through 5 bonds since 2022 which have included KPIs related to GHG emissions scopes 1 and 2, GHG emissions on partial scope 3, tonnes of packaging avoided, and food waste generated in

[35] Climate Bonds 2024 *Sustainability-Linked Bonds, Building a High Quality Market*

store[36], Alignment of SLBs with Climate Bonds criteria is rising as issuers gain more experience with them. In 2023 US$6.2bn of SLB finance was deployed to the agrifood sector, of which 60% was assessed to be aligned with CLB criteria. This was spread across 17 bonds, 35% of which were aligned to Climate Bonds criteria[37]. The main reasons for lack of alignment are lack of GHG targets, incomplete scope coverage or lack of alignment with relevant decarbonisation pathways.

# 3. Principles and Boundaries of the Criteria

## 3.1 Guiding Principles

The objective of Climate Bonds has been to develop food value chain Criteria that can maximize viable bond issuances with verifiable environmental and social outcomes. This means the Criteria need to balance the following objectives:

- They form a set of scientifically robust, verifiable targets and metrics; and
- They are usable by the market, which means they must be understandable for non-scientific audiences, implementable at scale, and affordable in terms of assessment burden.

The Criteria should:

- Enable the identification of eligible assets and projects (or use of proceeds) related to the identified actors for the food value chain investments that can potentially be included in a Certified Climate Bond;
- Deploy appropriate eligibility Criteria under which the assets and projects can be assessed for their suitability for inclusion in a Certified Climate Bond; and
- Identify associated metrics, methodologies and tools to enable the effective measurement and monitoring of compliance with the eligibility Criteria.

*Table 2. Key principles for the design of a Climate Bond Standard Sector Criteria*

| Principle | Requirement for the Criteria |
|---|---|
| **Ambitious** | Compatible with meeting the objective of limiting global average warming to 1.5º temperature rise above pre-industrial levels set by the Paris Agreement. |
| **Material** | Criteria should address all material sources of emissions over the lifecycle. Scope 1 &2 emissions should be addressed directly and scope 3 considered. |
| **No offsets** | Offsets should not be counted towards emissions reduction performance. |
| **Resilient** | To ensure that the activities being financed are adapted to physical climate change and do not harm the resilience of the system them are in |
| **Scientifically Robust** | Based on science not industry objectives |
| **Granular** | Criteria should be sufficiently granular for the assessment of a specific project, asset or activity. Every asset or project to be financed must comply. |
| **Globally consistent** | Criteria should be globally applicable. National legislation or NDC's are not sufficient. |
| **Aligned** | Leverage existing robust tools, methodologies, standards |
| **Technology neutral** | Criteria should describe the result to be achieved. |

## 3.2 Definition of the Scope of the criteria

### 3.2.1 Why take a Value Chain Approach

Existing systems that classify and account for emissions based on the point at which they occur hide a complex set of interrelationships between emissions from production, supply chain and consumption. These interactions need

[36] BNP Paribas, Carrefour issues sustainability-linked bond to drive the food transition, 11 April 2022
[37] Climate Bonds 2024 *Sustainable Debt: Global State of the Market 2023*,

to be better understood to allow actors at different stages of the food value chain to take a whole systems approach in determining appropriate action and investment to reduce Agri-food emissions[38]. Consumption patterns in high income countries are driving emissions in other parts of the world where products are sourced, transported and consumed. For this reason, the levers for change lie predominantly with actors in food value chains in high income countries that can influence the upstream chain through procurement and sourcing practices, address emissions in their own operations, and influence consumer choices to reduce both downstream emissions and demand for high-emissions products that are driving upstream emissions.

Encouraging Manufacturers, distributors and traders to take a Food Value Chain approach is critical for defining and implementing pathways to reduce agrifood emissions due to their ability to secure financing and deploy investment and action across the food value chain from production level, to influencing consumption patterns and food loss and waste through product formulation, transport, storage, cold chain and packaging.

### 3.2.2 Eligible Assets and Use of Proceeds

The Food Value Chain Criteria enable certfication of Assets and Use of Proceeds that address the eight critical drivers of emissions beyond the farm gate. These are:

1. Energy use,
2. Freight transport,
3. Buildings, Storage and Facilities,
4. Green Cold Chain,
5. Packaging,
6. Food Loss and Waste Reduction,
7. Sustainable Sourcing.
8. Shifting Consumption Patterns

The impact of each of these factors in driving Food Value Chain Emissions is set out in section 2.3 Main drivers of Greenhouse Gas Emissions in the Food Value Chain.

To be eligible, Assets and Use of Proceeds must meet the following requirements:

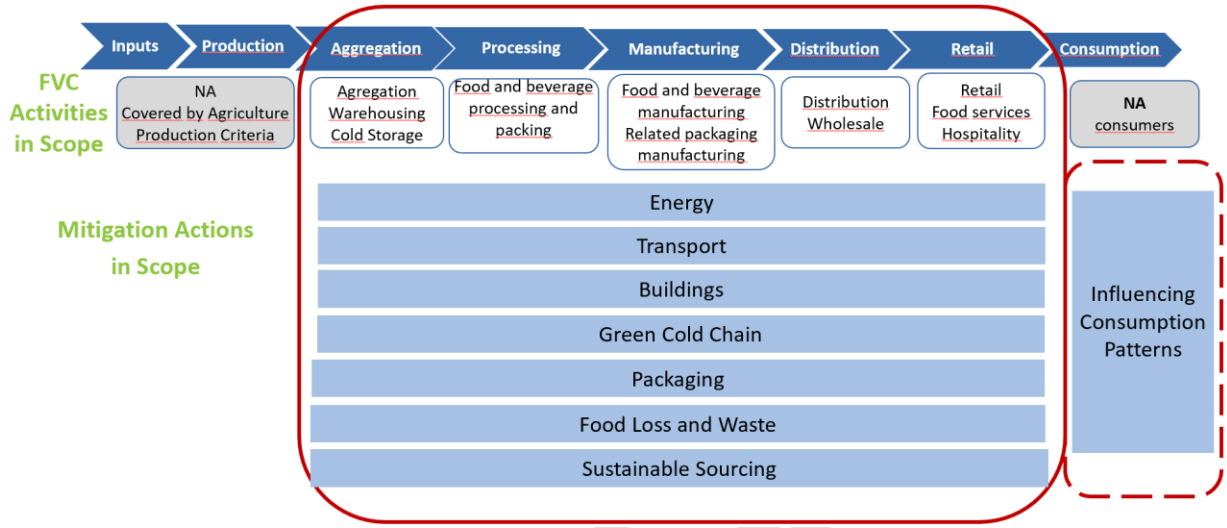
1. Mitigation requirements – ensuring that assets and UoPs achieve the desired level of ambition to support decarbonisation needs across the sector in line with the Paris Agreement. (see Section 4)
2. Adaptation and Resilience requirements – ensuring that assets and UoPs are resilient to climate change and not adversely impacting the ability of affected populations to adapt. (See Section 5)
3. Environmental and Social Safeguards – ensuring that funded assets and UoPs do not create negative environmental or social impacts (See Section 6)

### 3.2.3 Why eligible mitigation actions cut across Food Value Chain Activities

The Food Value Chain mitigation criteria are structured to focus on the eight main drivers of emissions in food value chains beyond the farm gate. However these emissions drivers are closely interconnected and the levers for climate mitigation are often applicable at multiple stages of the value chain. For example reductions in emissions from energy use is a key intervention to reduce emissions for all Food Value Chain actors, and the main mitigation levers such as shifting to renewable energy use, and implementing energy efficiency measures may be adopted by any actor along the chain. Food and Beverage value chains are highly complex and extremely diverse, cover a vast array of different products and operate in a huge range of different contexts across the globe. To be able to define criteria that could be meaningfully applied across such diverse activities and actors the requirements focus on defining Eligible Assets and Use of Proceeds in terms of generalisable strategies and actions that can be applied across a wide range of contexts. Examples of relevant assets and projects are provided for illustrative purposes but do not provide an exhaustive list of what can be certified

[38] Rosenzweig, C., Mbow, C., Barioni, L.G. *et al.* Climate change responses benefit from a global food system approach. *Nat Food* **1**, 94–97 (2020).

*Figure 8: Food Value Chain Criteria Boundaries and Activities in Scope*




### 3.2.4 Why Entity and Sustainability Linked Debt (SLD) certification are excluded

Certification at entity level and certification of Sustainability Linked Debt require clear definition of a science-based trajectory for the decarbonization progress required for companies to align with the global trajectory to reduce global heating to within 1.5o above pre-industrial levels, and to reach net-zero by 2050. Entity level certification is possible when relevant science based emissions reduction pathways have been defined for the sector in which they operate, against which companies can set targets and measure progress. Sustainability Linked Debt certification enables companies to set an entity specific science-based emissions reduction trajectory and to reach the targets from interventions across their operations.

Food and Beverage Value Chains encompass an enormous diversity of actors and activities, a vast range of different products produced, processes used and operating contexts, and highly complex interlinkages between emissions drivers and mitigation levers across supply chains. For this reason it has not been possible during the development of the Food Value Chain Criteria to attempt to define a science-based decarbonization pathway, or pathways, that could credibly guide realistic decarbonization transitions across such a diverse group of actors engaged in such a wide array of activities and operations.

Climate Bonds may pursue further work in the future to enable the certification of Entities and Sustainability Linked Debt in the Food Value Chain.

# 4. Definition of Climate Change Mitigation Requirements

The definition of mitigation requirements was undertaken as follows:

## 4.1 Prerequisite: Deforestation and Conversion free sourcing

All relevant Assets and Use of Proceeds that use biomass or involve actions directly related to the sourcing of agricultural ingredients must demonstrate that this sourcing is deforestation and conversion free. This is a requirement for all relevant Climate Bonds activities designed to ensure that these activities do not drive emissions from land use conversion. Issuers must demonstrate compliance with the Climate Bonds Agrifood deforestation and conversion free sourcing criteria or certification by an accepted proxy. that aligns with the following requirements of the CB Criteria:

This is particularly relevant for Assets and Use of Proceeds related to:

- Sourcing of Agricultural products
- Sourcing of biomaterials for packaging
- Sourcing of Biomaterials for insulation and passive cooling
- Sourcing of biomaterials for energy production

Sourcing of biomaterials for transport fuel is not eligible under any Climate Bonds Criteria due to concerns about competition with food production inherent in the production of biofuels at the scale necessary to decarbonize the transport sector.

## 4.2 Energy related criteria

Energy use is a major driver of emissions across all parts of Food and Beverage Value Chains. Therefore the shift to renewable energy, both for electricity and thermal energy, and increases in energy efficiency across the Food Value Chain are essential elements in achieving emissions reductions in line with 1.5°s.

Given the diversity of food value chains, studies of energy consumption, related GHG emissions and decarbonisation options have tended to focus on specific sectors, processes, products or countries. Opportunities for action to reduce emissions from energy use also vary greatly in different parts of the world depending on the availability of renewable energy and low emissions technology. The TWG discussed several options for setting thresholds for decarbonisation of energy but concluded that it is not possible to identify thresholds to guide mitigation of energy-related emissions within food value chains with global applicability across so many diverse activities and contexts.

### 4.2.1 Adoption of Renewable Energy for Electricity Generation

Climate Bonds has defined criteria for the generation of renewable electricity by electricity providers and for electrical utilities generally. A small number of sector criteria (eg Basic Chemicals) also address the adoption of renewable energy through onsite generation. Purchasing of electricity from renewable sources is not an eligible activity as it was not possible to identify an investable asset or use of proceeds for bond financing.

Substituting fossil fuel-based electricity generation by onsite generation of renewable energy is an unambiguous benefit to decarbonisation. For this reason measures supporting the adoption of renewable electricity through own generation from wind, solar and geothermal sources are automatically eligible. Electricity generation from biomaterials must meet the criteria set out in the Climate Bonds Bioenergy Criteria to avoid sourcing of biomaterials that contribute to emissions increases from deforestation and conversion of land use, or that use agricultural land in a way that competes with food production. Generation of hydroelectricity was not included as it is unlikely to be adopted widely by actors in food Value chains due to the need for costly infrastructure investment.

Own generation of renewable energy by actors in the Food Value Chain is not required to meet the efficiency criteria for wind, solar or geothermal energy generation set out in the relevant Climate Bonds Standards because the facilities are likely to be small and for own use. The efficiency criteria are maintained for energy generation from biomass to minimise the need for biomass inputs.

### 4.2.2 Decarbonising Process Heat

Substitute fossil-fuel based process heating with renewable heat sources is also an unambiguous benefit to decarbonisation. Similar to electricity generation, measures supporting thermal energy generation from wind, solar and geothermal sources are automatically eligible. Electricity generation from biomaterials must meet the criteria set out in the Climate Bonds Bioenergy Criteria including efficency factors for the reasons outlined in 4.2.1.

### 4.2.3 Energy Management measures: Combined Heat and Power (CHP) and Thermal Management and Heat Recovery

Recovery and reuse of waste heat, and the use of tri-generation systems using renewable energy use to produce both electrical and thermal energy and power an absorption chiller, create energy efficiencies that reduce the need for fossil fuel inputs and related emissions. These approaches are automatically eligible.

### 4.2.4 Energy Efficiency measures: HSO and CSO (Heat and Cold Supply Optimization) and Energy Efficiency measures.

Reducing energy consumption by improving energy efficiency for electric appliances or for equipment for heating or cooling can make a significant contribution to emissions mitigation. Energy efficiency measures of this kind are not automatically eligible for two reasons. Firstly this is because the aim of Climate Bonds certification is to drive ambition towards large-scale decarbonisation rather than small scale incremental improvements. Secondly this is to address concerns expressed in both the Technical and IWGs that energy efficiency measures do not always lead to credible emissions reduction as they are often implemented for productivity gains and may lead to the early replacement of equipment without fully accounting for their embedded carbon.

Optimisation of heat and cold supply equipment must therefore demonstrate that the equipment operates within the top 25% of energy efficiency rates for relevant equipment available in-country. The TWG felt that referring to energy efficiency rates for equipment may not be an effective approach in emerging economies where the choice of equipment may be limited and relevant energy efficiency ratings may not be available. The criteria therefore also include an alternative performance measure where no relevant energy ratings are available, that the replacement or refurbishment of equipment must achieve a measurable improvement of at least 30% from verified baseline over the course of the Bond.

## 4.3 Transport related criteria

The majority of freight transport modes used across food value chains are currently dominated by fossil fuel use. The most promising levers for decarbonisation include the switch to renewable fuels across all transport modes, the electrification of road vehicle fleets, and the optimisation of logistics planning to reduce distances travelled and optimise fuel intensity (measured in fuel per ton-kilometre) across all modes of freight transport. The Criteria focus on the most commonly used freight transport modes – road freight and shipping, and for logistics optimisation that may support shifting to lower emissions transport modes.

The inclusion of mitigation measures regarding air freight was discussed. However, Climate Bonds decided that Air Freight would not be eligible at this time as more work is needed to define an robust emissions reduction pathway in this sector. Criteria for Rail freight are not included as these are already covered in the Land Transport Criteria.

### 4.3.1. Logistics Optimisation

Strategies to reduce fuel per ton-kilometre across all modes of freight transport through optimisation of networks, routes, schedules, and loads are eligible measures to mitigate transport-related emissions. Actions to shift freight transport to lower emissions transport modes such as shipping and rail are eligible as long as these transport modes meet the requirements set out in the relevant Criteria for Shipping and Land Transport.

The TWG favoured including a requirement requiring a life cycle assessment of freight emissions to ensure mitigation options are well targeted. However this was deemed to be too complex as the Climate Bonds Land Transport Criteria do not require Life Cycle Assessment. A simpler requirement was included to ensure that issuers measure and understand the mitigation impact. They must Identify and measure expected improvement in efficiency (fuel per ton-kilometre) with related emissions savings against a verified baseline.

The TWG also debated the use of thresholds to guide ambition and performance in mitigating transport-related emissions. These included a single threshold for freight transport set out in the EU taxonomy and the Climate Bonds Land Transport Criteria, and several options for mode-specific thresholds including those defined by the industry led First Movers Coalition[39] and specific decarbonisation pathways for freight transport defined in an academic study[40]. The use of mode specific thresholds was rejected because there it was felt that the First Mover Coalition's targets may not drive sufficient ambition, there was doubt that the global mode-specific pathways would be achievable in emerging economies and because mode -specific thresholds do not provide a sufficient incentive to shift to lower emissions modes of transport which can be a more effective mitigation option.

The single emissions intensity threshold set out in the EU taxonomy and the Climate Bonds Land Transport Criteria is retained because it provides a guide for issuers to take a portfolio approach for freight transport, allowing for a balance of reductions across different modes and across contexts where reductions may be easier or harder to achieve. Eligible assets and UoPs must meet progressively declining emissions thresholds for freight activity by year of issuance from 2026 to 2050 measured in grams of carbon dioxide equivalent per ton of food transported per kilometer (g CO2eq per t-km.)

### 4.3.2 Road Transport: Electrification of fleets and Electric mobile refrigeration

The electrification of fleets and the shift to zero tailpipe emissions fleets is an important measure to shift road freight transport away from use of fossil fuels. All zero direct emissions transport along with key components and

[39] https://www3.weforum.org/docs/WEF_FMC_Trucking_2022.pdf
[40] Teske, Sven (Editor), *Achieving the Paris Climate Agreement Goals Part 2: Science-based Target Setting for the Finance industry — Net-Zero Sectoral 1.5˚C Pathways for Real Economy Sectors*, Springer, 2022,

dedicated supporting infrastructure are eligible for certification under the Climate Bonds Land Transport Criteria and this approach is maintained in the Food Value Chain Criteria.

Hybrid Vehicles are not eligible under the Land Transport Criteria because of the risk of locking in technologies that prolong the use of fossil fuels. However, the Food Value Chain TWG felt it was important to differentiate the criteria for developed and emerging markets, considering that hybrid vehicles already represent an improvement in emerging economies that may have low availability of Electic vehicles and EV infrastructure. Therefore, under the Food Value Chain Criteria hybrid vehicles are not eligible in developed economies but eligible in emerging economies with a sunset date adjusted for availability of relevant technology and infrastructure.

The use of Electric mobile refrigeration to reduce emissions from refrigeration units used for freight transport is also eligible. electric mobile refrigeration units powered by electric vehicles are automatically eligible. Electric mobile refrigeration units, powered separately from the vehicle diesel motor of freight transport vehicles are also eligible as an interim measure with a sunset date for the shift to fully electric vehicles in line with net zero by 2050. The TWG felt that this is a pragmatic approach to reducing emissions from refrigerated transport given the significant increase in fuel use and emissions from refrigeration in transport and the limited available options for fully electrifies Heavy -Duty and medium-Duty Goods Vehicles, especially in emerging economies.

### 4.3.3 Road Transport: Low Carbon Fuels

The adoption of low carbon fuels of non-fossil origin are eligible mitigation measures because they reduce the use of fossil fuels. The use of sustainably sourced low carbon fuels from municipal or organic waste, or renewables are automatically eligible. The TWG felt that the use of fuel mixes should also be eligible as these do enable issuers to reduce their transport-related emissions even in contexts where full shifts to low carbon options are not available. Fuel mixes are therefore eligible with a sunset date for the elimination of the fossil fuel component. Different dates were set for developed and emerging economies, recognising that emerging economies may have more limited options and require a longer timeframe to transition to fully low-carbon fuels. The fossil fuel component of fuel mixes must be eliminated by 2040 in developed countries and by 2050 in developing economies. This was felt to be realistic although it is not based on specific research into feasibility.

The use of Biofuels is not eligible in line with the requirements of the Climate Bonds Land Transport Criteria, largely due to the risk of biomaterial production at the scale required to produce transport fuel may drive emissions from deforestation and conversion of land use, or compete with food production. Similarly, to avoid the creation of upstream emissions from low carbon fuels, CO2 is eligible as long as it is captured from industrial processes or directly from the atmosphere and not specifically produced for the purpose of fuel production. Low carbon Hydrogen is also eligible as long as it not produced from fossil fuels and complies with the Climate Bonds Hydrogen Criteria.

### 4.3.4 Road Transport: Fuel Efficiency Improvement

Greater fuel efficiency to reduce fuel use per ton-kilometre in road freight transport can make a useful contribution to mitigating transport-related emissions. In line with the approach adopted for logistics optimisation measures a requirement was included to ensure that issuers measure and understand the mitigation impact. They must identify and measure expected improvement in efficiency (fuel per ton-kilometre) with related emissions savings against a verified baseline. Both the Technical and IWGs highlighted that, while it is desirable for issuers to measure the overall impact of efficiency measures, it will be very difficult to measure the contribution of individual efficiency measures to achieving overall emissions intensity thresholds for freight activity. Therefore this is only required “where possible” at the Issuer’s discretion.

### 4.3.5 Sea Transport (Shipping): Low Carbon Fuels

The use of low carbon fuels in newbuild & retrofitted zero emission vessels is eligible in line with the requirements of the Climate Bonds Shipping Criteria.

## 4.4 Buildings related criteria

There are no clear indications of the extent to which emissions related to built infrastructure contribute to agri-food sector emissions. However, a number of building design elements have been identified that would support greater energy efficiency and therefore contribute to emissions reduction in food value chain facilities, particularly at the retail level.

Climate bonds has defined criteria for low carbon buildings focusing on commercial and residential buildings. These criteria do cover supermarkets, with defined emissions intensity thresholds for a limited number of geographies. However, these criteria do not cover facilities for processing, manufacturing, packaging, storage and distribution which are relevant to the Food Value Chain. For this reason the Food Value Chian criteria has adopted the requirements of the Buildings Criteria for both new buildings and retrofits for investments in buildings (other than commercial offices) in the Food Value Chain. The criteria also include specific requirements for buildings to shift to net zero energy sources and support low carbon mobility. they leverage existing green building certifications as accepted proxies for carbon mitigation.

Both the Technical and IWGs supported this approach, particularly Leveraging voluntary certifications which are recognised globally, or equivalent local building standards. They also felt that differentiating between new build and retrofits is a pragmatic approach.

The TWG discussed the possibility of mandating local sourcing of building materials to reduce emissions from transport, particularly from imports. However this was not included because it would not be possible in all contexts, especially where necessary inputs are not produced locally or where development finance imposes the use of imported materials. It was also felt that such a requirement would be difficult as there is not always sufficient traceability to establish where materials come from. There were also concerns that there could be environmental and social risks from requiring locally sourced materials for buildings in fragile environmental contexts (eg where resources are scarce or protected).

## 4.5 Cold chain related criteria

Reducing emissions from cold chain activities is important as refrigeration is one of the fastest rising emissions drivers in Food Value Chains. Because the Cold Chain includes activities that span across all aspects of Food Value Chains many relevant measures for decarbonizing cold chains are covered in other sections of the Criteria document. Electricity use and transport are key drivers of cold-chain related emissions and relevant mitigation measures are covered in these sections. Mitigation measures related to the builds component of cold storage facilities are covered in the buildings section. Optimisation of demand management and sourcing which can also support reducing the need for refrigeration are covered under Sourcing-related mitigation criteria.

Requirements included in the Green Cold Chain criteria relate to reducing the use of refrigerants with high Global Warming Potential, managing refrigerant leakage and the adoption of alternatives to refrigeration such as passive cooling approaches.

Reducing emissions from cold chains needs to factor in the trade- off between emissions from refrigeration and avoided emissions from food loss and waste. There was a discussion about whether reductions in emissions from food loss and waste should be incorporated into the calculation of cold chain emissions. The TWG recommended that if we chode to include this we should propose the method for this calculation. However, it was decided that this would be too complex to include at this stage as measurement of food loss and waste and related emissions is not currently accepted widespread practice.

The TWG felt that to fully understand the trade-offs a full life cycle analysis of specific products would be needed to analyse how and when products need to be cooled and to identify where improvement is needed and where incentives are required. In addition, tradeoffs and priorities may be different in developed and emerging economies. The greatest gains may come from increasing efficiency of refrigeration in developed economies but from increasing refrigeration capacity to reduce food loss in emerging economies.

### 4.5.1 Development of Green Cold Chain

The TWG recommended that the requirements for developing Green Cold Chains should be bundelled together to give issuers flexibility to invest in the most relevant actions in their own context. It was felt that issuers would struggle to identify the contribution of specific actions in each area to achieving an overall goal of reducing emissions from refrigerant use and including these all under one bundle is more pragmatic.

Reducing emissions from the use of refrigerants with Global Warming Potential, which can be thousands of times higher than that for CO2, is a key mitigation measure to reduce cold chain related emissions. This is also a requirement under the 1987 the Montreal Protocol to phase out hydrochlorofluorocarbons (HCFCs) and chlorofluorocarbons (CFCs) due to their impact on ozone depletion, and the more recent 2016 Kigali Amendment to phase down the production and consumption of hydrofluorocarbons (HFCs) by over 80% by 2047 with target

dates and reduction pathways for different parts of the world. However, there was doubt as to whether issuers would raise bond finance for this kind of activity in isolation.

Replacing the use of high GWP refrigerants with low GWP refrigerants including natural refrigerants such Propane, Hydrogen or Ammonia that is not produced with fossil fuels is eligible as one of several measures for developing a green cold chain. The TWG considered a range of options for setting thresholds to guide ambition in the shift to refrigerants with lower GWP. The choice of refrigerant depends on the type of equipment and the desired performance and a range of other technical factors. Several lists of recommended alternative refrigerants based on different refrigeration processes are available[41] [42]. The TWG considered the use of such guidelines to support the criteria but decided that it was preferable to adopt the EU single threshold for GWP for refrigerants which, in practice, would only allow for natural refrigerants to be used. This sets a clear level of ambition that is already supported by legislation at EU level.

Some Low GWP refrigerants, including natural refrigerants have higher flammability and toxicity risks than higher GWP alternatives. The TWG therefore felt that it is to require a full life cycle assessment for refrigerants that include safety (flammability, toxicity etc) and environmental pollution factors as well as emission. Safety requirements for handling of refrigerants, including compliance with national laws and international standards for handling flammable refrigerants are also included to ensure the transition does not lead to unintended harm. The TWG pointed out that good practice guidance already exists on the use of natural refrigerants which are already used in many industrial applications which can be leveraged by issuers to comply with the criteria.

Minimising refrigerant leakage during installation, charging, servicing and normal operations and ensuring safe end of life recovery, recycling and disposal of refrigerants are also eligible mitigation measures as leakage represents an uncontrolled release of emissions into the atmosphere. The TWG felt that it is not necessary (or possible) to set thresholds for refrigerant leakage rates, but that it is important for issuers to measure and report leakage rates and related emissions. This is not common practice in the sector but it is a first important step in building awareness for the required behaviour change. A requirement to measure and report using an accepted methodology was therefore included, along with an example[43]. Issuers must demonstrate progress in reducing leakage rates and related emissions against a verified baseline. The IWG pointed out that leakage reduction is not an appropriate measure for new equipment. A requirement to demonstrate that new equipment operates at or above the industry average for leakage rates for relevant equipment type was included, inline with the approach taken for energy efficiency measures. The TWG also supported referencing good practice guidance for avoiding and reducing refrigerant leakage to support issuers to comply with requirements

The TWG felt it was important to include specific criteria to address the disposal of equipment to address emissions from decommissioned systems. Existing frameworks were leveraged to formulate requirements for safe end of life treatment of refrigerants including that refrigerant recovery and recycling equipment must meet accepted safety standards set out in the AHRI standard 740 , and that reclamation or destruction of refrigerants must demonstrate certification and chain of custody records from an authorised facility.

### 4.5.2 Passive cooling systems and technologies

Avoiding emissions from refrigeration using alternative cooling solutions is also eligible. The TWG recognised that the use of insultation materials for cooling, such as plastics or biomaterials requires adequate safeguards to avoid potential negative impacts on the environment and human health. They advocated for leveraging safety standards for insulation materials (eg toxicity, health and safety etc) that already exist in many industries. Requirements were included to ensure issuers provide evidence of sustainable sourcing and sustainable disposal of insulation materials to avoid negative environmental impacts. They must also provide evidence of compliance with safety standards for insultation materials to avoid risks to human health and the environment such as no PFAs, including food quality and safety standards which were in direct contact with food.

[41] Domanski P. A., Brignoli R., Brown J. S., et al, Low-GWP refrigerants: performance assessment and selection tradeoffs. International Institute of Refrigeration, 2022,
[42] Environment and Climate Change Canada, Federal Offset Protocol: Reducing Greenhouse Gas Emissions from Refrigeration Systems Version 1.1 December 2023.
[43] ibid

## 4.6 Packaging related criteria

Reducing emissions from packaging is critical as it is one of the fastest growing sources of agri-food sector emissions and demand is increasing. The most effective mitigation measures relate to the reduction in the use of plastics feedstocks produced from fossil fuels, sustainable sourcing of biomaterials for packaging to avoid production related emissions from land use change, and supporting circular solutions and improved waste management to minimise the contribution of packaging to emissions from landfill and incineration.

Several Frameworks for sustainable packaging exist that consider a range of factors beyond climate impact including food safety, resource efficiency, responsible sourcing, circularity, and harmful substances. Many countries have introduced regulations governing packaging sustainability including food safety, use of harmful substances (PFAS), circularity and waste management. There is also evidence that packaging options with the lowest carbon emissions are not always the most sustainable option when the full range of sustainability factors is considered[44]. In addition, packaging plays a key role in extending food shelf life, protecting food safety and quality, and reducing food loss and waste. Research shows the climate and environmental impacts of packaging are often smaller than the impact of food loss and waste[45]. The TWG recommended that the criteria include a focus on the full range of sustainability impacts rather than taking a narrow focus on emissions. This is why the requirement for a life cycle assessment based on a recognised sustainable packaging framework are included or all eligible assets and use of proceeds.

The TWG approved the inclusion of packaging production in the Food Value Chain criteria even though this may be done by Food Value chain companies directly. This was included because all food value chain actors need to be shifting to more sustainable packaging solutions by engaging with packaging producers to adopt recycled or bio-based materials. The inclusion will allow packaging producers to certify investments under the criteria provided they meet the requirement that at least 90% of the funded Assets and UoPs are used for food and beverage related activities. The TWG also emphasised that the criteria should cover all stages of packaging, from production to end use.

### 4.6.1 Increase use and content of recycled plastic feedstocks in packaging

Increasing recycled content to reduce use of virgin fossil-fuel-based polymers in packaging is a key mitigation measure to reduce packaging-related emissions. This includes mechanical and chemical recycling processes to produce recycled feedstocks. Both the TWG and IWG discussed whether it is possible to set thresholds for the use of recycled content in packaging. The TWG considered the requirements for Minimum recycled content in plastic packaging (based on *EU Packaging and Packaging Waste Regulation (PPWR) 2024)*. However they did not support their inclusion in the criteria because they can only work if readiness and infrastructure to support these measures is in place and may not be feasible for emerging economies. The TWG also considered the current low use of recycled feedstocks (in 2021 only 12% of plastics, and 2% of single use plastics were produced from recycled feedstocks) and that even "Ambitious" projections predict renewable and recycled plastics can replace 65% of fossil-fuel based plastics by 2050, with circular feedstocks responsible for 52% of emissions reduction[46].

Given the wide diversity of packaging solutions used in the agri-food sector, the low availability of recycled feedstocks globally and the diversity of contexts covered, it was agreed that it is not feasible at this stage to set thresholds for recycled content that could be applied across the Food Value Chain.

It was however agreed that issuers should report on recycled content using a recognised methodology, and two options for this were identified, either the method used in the EU Packaging and Packaging Waste Regulation (PPWR) 2024, or Evidence of recycled content by a credible certification eg Recycled Content Certification.

A further requirement was included that the related packaging should shift to 100% recyclable, reusable or compostable during the term of the bond. This is to ensure that packaging using recycled feedstocks does not contribute to raising emissions at end of life.

### 4.6.2 Use of low carbon feedstocks in packaging

[44] McKInsey, True packaging sustainability: Understanding the performance trade-offs, July 2021
[45] Ecoplus, (2020),
[46] Plastics Europe, *the Plastics Transition, Our industry's roadmap for plastics in Europe to be circular and have net-zero emissions by 2050*, 2024

The use of low carbon feedstocks to replace fossil fuel-based feedstocks in packaging, particularly in developing alternative plastics is also eligible. The TWG considered the evidence that the availability of alternative feedstocks such as biomass, captured carbon and low-carbon hydrogen is low and has high production costs and low technical suitability for food packaging. This means that many companies are not on track to meet their targets for reducing use of virgin plastics due to a lack of viable alternatives[47].

Assets and UoPs to develop and use feedstocks low carbon hydrogen or carbon captured from industrial processes or directly from the atmosphere are all eligible. They must also include a Lifecycle analysis based on a recognised sustainable packaging framework and the related packaging must be 100% recyclable, reusable or compostable.

Solutions to develop packaging feedstocks, materials and products from sustainably sourced biomaterials are eligible provided they meet the criteria for sustainable sourcing, including the precondition for deforestation and conversion free sourcing. The TWG discussed whether the criteria should focus on waste biomass to avoid risks related to deforestation, land use change and competition with food production. However concerns were raised about the technical complexity of using waste biomass, including the need for cleaning of inputs which can be energy-intensive may not significantly reduce overall emissions. The consensus was to prioritize high-impact, scalable solutions such as bioplastics from virgin feedstocks as these are the only solutions that are likely to be scaleable.

### 4.6.3 Increase recyclability and recycling of packaging

Development and use of packaging designed for collection and recycling and implementing systems and Infrastructure to support recycling of packaging are eligible. The TWG considered the option of adopting targets from the EU Packaging and Packaging Waste Regulation (PPWR) 2024, that require Packaging to be recyclable by 2030, and for recyclable packaging to be recycled at scale by 2035. This was rejected because the concept of the "recyclability" of packaging is not seen to be a useful measure of progress unless the packaging is actually recycled. In addition raising the level of recycling requires collaboration between companies, public authorities and consumers. Companies cannot be expected to set up recycling infrastructure on their own, although it is worth noting that many governments are setting targets and incentives and using Extended Producer Responsibility (EPR) systems to increase circular packaging solutions. The availability of relevant infrastructure also varies greatly in different parts of the world so a EU-focused requirement that all recyclable packaging be recycled at scale by 2035 would not be achievable in emerging economies (and indeed may not be achievable even in the EU).

The group also noted that referring to single use plastics is not very helpful as most packaging material at consumer level is single use. The important point is what happens to packaging at end of life. For this reason requirements have been included for all packaging solutions to focus on appropriate end of life disposal – by recycling, reuse or effective composting.

### 4.6.4 Reuse and Refill Packaging Solutions

Reuse and refill packaging solutions are eligible as a means to reduce emissions from packaging production and waste management. The TWG highlighted that highlighted that reuse solutions are very appropriate for emerging economies and are already often common practice. However the group agreed that reusable and refillable packaging solutions come with their own environmental trade-offs, such as higher emissions from transport and cleaning processes. There is also very limited evidence about the scalability of such approaches including consumer willingness to adopt them. Some pilot studies have shown that reuse solutions (eg with coffee cups) require such a number of uses to offset their carbon footprint that they end up having higher emissions than single-use alternatives. For this reason a lifecycle analysis is required based on a recognised sustainable packaging framework. An additional requirement to ensure that reuse solutions do not create large end of life emissions. Packaging must be 100% recyclable (or compostable) at end of life.

### 4.6.5 Reduce Packaging and Packaging Waste

Actions to reduce the use of packaging and therefore avoid emissions from packaging production and waste management are eligible. The TWG discussed the importance of simplifying multilayer packaging which, although effective for food preservation, can make packaging difficult or impossible to recycle. Given the diversity of products, packaging solutions and operating contexts covered by the Food Value Chain it is not possible to set

[47] David Burrows, Packaging: the carbon dilemma for food companies, Just Food, November 11, 2022

targets for packaging and packaging waste reduction that will be meaningful for all actors. However Issuers must demonstrate reduction of packaging and related emissions against a verified baseline

### 4.6.6 Compostable Packaging

The development and use of compostable packaging, produced from bio-based non fossil fuel feedstocks is eligible because of its potential to reduce emissions from landfill and incineration. However both the TWG and the IWG pointed out that currently many so-called biodegradable plastics do not decompose effectively in natural environments. Most compostable packaging requires industrial composting facilities which are not widely available[48]. Even compostability certification is only really useful in places where the infrastructure is in place to compost packaging at scale. In addition the majority of compostable packaging is neither composted not due to the use of per- and polyfluoroalkyl substances (PFAS) to repel water and oil which contaminates organic waste streams[49].

For the use of compostable packaging to be an effective lever for mitigation of emissions and for waste management both groups highlighted the need for it to be aligned with available infrastructure, be supported by investment in composting infrastructure and/or for clearer labelling to prevent greenwashing. The IWG also identified the need to include clear technical definitions eg to clarify that compostable plastics must break down without the need for specialised composting facilities. It is not clear how practical it is for issuers to align the use of packaging with available composting infrastructure in specific locations so a number of potential options have been included for issuers to demonstrate that this issue has been taken into account in the development of related assets and use of proceeds.

### 4.6.7 Improved Waste Management for packaging waste

Given the importance of effective waste management infrastructure in ensuring the appropriate treatment of compostable and bio-based packaging, infrastructure for composting and anaerobic digestion are eligible. They must comply with the relevant requirements in the Waste Management Criteria. Both the TWG and the IWG expressed some doubt that companies in the food value chain would raise bond finance for this kind of investment as such infrastructure is costly and requires strong collaboration with public authorities and a shift in consumer behaviour. However including these activities in the criteria may facilitate partnerships and shared responsibility approaches.

## 4.7 Food loss and waste related criteria

Reducing Food Loss and Waste across Food Value Chains is a key measure to mitigate both upstream emissions from production, storage, transport and refrigeration of feed that it not consumed, and downstream emissions from waste management in landfill. A mitigation hierarchy applied to Food Loss and Waste set out in the Brief on food waste in the European Union, was used to structure eligible assets and UoPs.

There was considerable discussion in both the TWG and the IWG about whether to refer to the United Nations' Sustainable Development Goal (SDG) of halving food loss and waste by 2030 (from a 2015 baseline), which many nations and organizations have adopted, as it is the most widely used target available. Although in principle it is important to have a target it was agreed that the SDG target is not a useful reference because 2030 is very close and would not offer a realistic target nor a forward looking trajectory for progress for criteria published in 2025. TWG members also highlighted that this target is unlikely to be feasible to achieve in emerging economies where significant investment in post harvest infrastructure is needed. Many national strategies aligned with the SDGs are still in the early stages, particularly in emerging economies. This delay in implementation makes the 2030 goal even more challenging. The IWG also commented that even in developed countries measuring against this target has been difficult, eg in the UK a Roadmap was developed in 2018, which aimed for a 50% reduction in Food Loss and Waste by 2030 but lacked robust baselines and measurement consistency.

### 4.7.1 *Prevent Food Loss and Waste*: improved handling and storage, optimising products and production processes, improving packaging to extend product life and consumer engagement

Assets and UoPs to improve handling and storage to reduce food loss and waste are eligible. These are particularly relevant in emerging economies where the greatest losses occur during handling and storage and there is a

[48] Collacott, Laura, Where compostable packaging fits in a circular economy , Ellen MacArthur Foundation, 26 May 2022
[49] Beyond Plastics, The False Promise Of Bioplastics and Compostable Plastics, 2019-2024

pressing need to improve post-harvest infrastructure50. TWG members highlighted the need for investment in improving post-harvest management including warehousing, cold storage, transport infrastructure, logistics planning and better handling practices are crucial for reducing losses in the immediate post- production stage.

Given the diversity of food value chains and operating contexts it is not possible to set a threshold that would be globally applicable. However the TWG felt strongly that a condition of any bond should be mandatory measurement and reporting of food waste with standardized methods to ensure consistency and transparency. This is because measurement and reporting raises internal awareness and supports data collection to target mitigation actions where they will be most impactful. A requirement for measurement and reporting of food loss and waste and related emissions using an accepted methodology, demonstrating reduction against a verified baseline is included. Examples of accepted methodologies for measuring Food loss and waste and calculating related emissions are also provided.

Actions to optimise products and production processes are also eligible. This is particularly relevant at processing and manufacturing level the vast majority of food loss and waste comes from byproducts and production line waste[51]. This also includes actions to amend product standards and date labelling to minimise waste, especially in developed economies from product standards based on aesthetic criteria particularly for fruit and vegetables[52].

Improving packaging to extend product life is eligible. The TWG noted again the tradeoffs that issuers face in mitigating emissions from food loss and waste and emissions related to packaging. While improved packaging can play a key role in reducing food loss and waste the packaging solution adopted must not contribute to raising emissions, nor to increasing problems of increasing pollution from packaging, particularly plastics. For this reason, Assets and use of proceeds in this category must comply with the Packaging related criteria. An additional requirement was also included that issuers must demonstrate that expected food waste avoided emissions are higher than packaging related emissions.

Actions to support consumer engagement to reduce food loss and waste at household level are also eligible. These are particularly relevant in developed economies the majority of food loss and waste occurs at consumer level. The TWG acknowledged the importance of consumer education and behaviour change, highlighting that implementing awareness campaigns and clear labelling could help reduce waste at the consumption level. The IWG also highlighted that retail and consumer-level interventions such as elimination of "best-before" dates and consumer education campaigns to address over-purchasing and wasteful behaviors are likely to be a priority in developed countries. However, they also commented that it could be difficult for issuers to pinpoint where money goes in supporting consumer engagement and effective reporting mechanisms are required.

### 4.7.2 *Reuse to reduce Food Loss and Waste*: Reuse for human consumption and for non-food uses.

Actions that support the Reuse of unused food for new food products or consumers such as reprocessing or repackaging, developing secondary markets or supporting donation are eligible. The TWG suggested that establishing secondary markets for imperfect or surplus produce could be a viable investment opportunity. Donation and redistribution systems may also require investment to store and transport donated food and support distribution networks. The IWG mentioned a project in partnership with the Global Food Banking Network, linking food redistribution with carbon credits through the Gold Standard through methodologies tied to avoided emissions. This approach could help Climate Bonds identify eligible assets and UoPs and provide a methodology for measuring progress in this area. As with all activates in this topic area measurement and reporting of food loss and waste and related emissions reduction is required.

Actions that support the reuse of unused food products for non-food uses is also eligible. In line with the waste mitigation hierarchy these must use unavoidable and worthless by-products and residues of agricultural and agro-food industries with no potential value for food. The TWG in particular highlighted the opportunities for the use of food waste products for animal feed, which avoids primary production of inputs for this purpose that compete with food production.

---

[50] World Resources Institute, Reducing Food Loss And Waste Setting a Global Action Agenda 2019.

[51] ReFED's Roadmap to 2030: Reducing US Food Waste, 2023

[52] See Bond, M., Meacham, T., Bhunnoo, R. and Benton, T.G. (2013) Food waste within global food systems. A Global Food Security report (www.foodsecurity.ac.uk) and Stephen D. Porter, David S. Reay, Elizabeth Bomberg, Peter Higgins, Avoidable food losses and associated production-phase greenhouse gas emissions arising from application of cosmetic standards to fresh fruit and vegetables in Europe and the UK, Journal of Cleaner Production, Volume 201, 2018, Pages 869-878

TWG also emphasised the opportunities for investments in value addition, including complete commodity processing, where every part of the produce is used. eg using orange peels for extracting alkaloids or supplying byproducts to the cosmetic industry. These solutions are also well adapted to reduce food loss and waste from surpluses that occur during seasonal production that can be processed into long-shelf-life products. However, it was noted that this approach also needs to include a market creation component to be financially viable. These solutions are particularly well adapted to emerging economies and would require investment to incentivize small and medium-sized processing units that can manage the entire cycle of value addition. If reuse solutions are used for the production of Bio-plastics or bio-based packaging they must meet the requirements in the FVC packaging criteria.

### 4.7.3 *Recycle*: Recycle food waste for nutrient recovery and energy use

Waste management solutions that recycle food waste for nutrient recovery through composting and anaerobic digestion are eligible. Composting and Anaerobic digestion facilities must meet the criteria for these processes set out in the Climate Bonds Waste Management Criteria. The emissions factors for composting and anaerobic digestion in the current Waste Management Criteria are now out of date. The Food Value Chain criteria will require compliance with the thresholds set in Waste Management Criteria when it is updated next year.

Similarly solution to recycle food waste for energy generation are eligible provided they use only unavoidable and worthless by-products and residues of agricultural and agro-food industries with no potential value for food and that the bio-energy produced complies with the Climate Bonds Bioenergy criteria .

## 4.8 Sourcing related criteria

All Assets and Use of Proceeds that involve actions directly related to the sourcing of agricultural products or ingredients must meet the Precondition for deforestation and conversion free sourcing to ensure they are not linked to increasing emissions from land use change. .

### 4.8.1 Sustainable Sourcing

Investment in systems to support increasing sourcing of sustainably certified products is therefore eligible. Investments for actions at farm level are not eligible as these will be certified under the agriculture production Criteria. Several large food brands have made commitments or set targets to increase the proportion of sustainably sourced ingredients or to support the use of regenerative agriculture practices that improve soil health and increase carbon sequestration in agricultural production. Many voluntary sustainability standards are available to guide and measure a wide range of other environmental and social impacts beyond deforestation and carbon emissions in Food Value Chains[53].

The TWG agreed that it is too complex to set a single target for an increase in sustainable sourcing because the availability of appropriate certifications and the potential for measurement and verification vary hugely across different commodities and production systems. The TWG recommended requiring a clear plan from issuers that allows them to adapt actions to their circumstances and stage of their sustainability journeys. They also indicated useful investment opportunities to support increasing sustainable sourcing including traceability systems, data systems and digital monitoring systems that can track supplier compliance with sustainability criteria. They also stressed the importance of investments in supplier engagement, training and support to achieve sustainability certification, including long-term contracting to incentivize suppliers to adopt sustainable practices and investing in formalising and strengthening producer organisations and cooperatives.

The IWG suggested that Climate Bonds should provide a clear definition of acceptable sustainability certifications or production systems that are deemed to be climate friendly, particularly given that few sustainability certifications covering food production currently include measurement of GHG emissions. To maintain alignment with the Climate Bonds Agriculture Production criteria the requirement was included that

Certification covering agricultural production must Comply with section 3.1.1 in the in the Agriculture Production Criteria which defines qualitative proxies that can be used for UoP or Asset Certification at production level. These cover the following production systems under certain conditions:

- Organic farming (certified, plant-based or mixed production system).

[53] See International Trade Centre Standards Map

- Agroecology principles and practices (plant-based or mixed production system) applied in production unit(s). and
- Improved production systems for vulnerable contexts to increase productivity and efficiency sustainably (i.e., for small-scale producers including investments for capacity building in climate mitigation practices)

### 4.8.2 Demand management and optimised sourcing processes

Activities to optimise demand management and sourcing processes are eligible because they play a key role in reducing emissions from unnecessary food production, transport and storage. As it is not possible to define a threshold for progress that would be applicable across all food value chains, issuers are required to set measurable targets for emissions reduction from optimised sourcing practices and measure progress against a verified baseline. The TWG also highlighted the need to ensure that emissions mitigation through sourcing practices, such as increasing local and seasonal sourcing, does not inadvertently lead to increasing emissions from other processes, such as food loss and waste. A requirement was therefore included that assets and UoPs in this area must not increase food loss and waste, and that Food Loss and waste and related emissions must be measured and reported using an accepted methodology as defined in the Food Loss and Waste criteria.

## 4.9 Shifting consumption patterns related criteria

### 4.9.1 Optimise product offering to reduce consumption of high emissions foods

Reducing consumption of high emissions foods, particularly animal-based proteins, is the most effective mitigation strategy to reduce consumption emissions, given that demand for animal-sourced diets accounts for almost 60% of total agrifood emissions across all emissions categories[54]. Actions to support diversification of product offerings to shift consumption from high emissions food particularly animal- based protein are eligible. The IWG endorsed the importance of dietary shifts that could have a huge impact on emissions reduction. They particularly emphasised that the major barrier to consumer shifts lies in the difficulties for alternatives to reach sufficient scale to achieve pricing that is competitive with high emissions foods. There is therefore a need to unlock capital to bring alternatives to scale to lower cost for consumers and target growth markets. No target or threshold has been set for this. Issuers must set measurable targets for emissions reduction and measure progress against a verified baseline.

Alternative Proteins products and production will be Certifiable under the Alternative Proteins Criteria which is currently under development. However Issuers can certify other actions to support diversification of their product range to include more plant based-options as part of broader efforts to reduce the consumption of high emissions food, or ultra-processed foods and incentivise changes in consumer behaviour.

Both the TWG and the IWG identified the risk that increasing the availability of low- emissions food options is not yet leading to a significant reduction in the consumption of high emissions foods. This raises the risk that product diversification simply creates additional food production, leading to increasing food loss and waste and related emissions. For this reason a requirement was included that Assets and UoPs used for this purpose must also demonstrate that they do not increase food loss and waste. Food Loss and waste and related emissions must be measured and reported using an accepted methodology as defined in the Food Loss and Waste-related criteria .

### 4.9.2 Optimise product offering to reduce consumption of high emissions foods

Actions supporting Consumer engagement to reduce consumption of high -emissions foods and overconsumption are eligible. This is particularly relevant for developed countries where the impact of these consumption patterns is highest, and which is driving emissions from over production, transportation, storage and refrigeration across global supply chains. The TWG considered whether the requirements should secify the need to target specific food types or consumer groups to ensure these measures maximise their intended impacts. However it was considered to be complex to include such a requirement as it is not clear that all relevant actors in the food chain would be able to accurately identify target groups effectively. The IWG also commented that it could be difficult for issuers to pinpoint where money goes in supporting consumer engagement. Issuers are required to set measurable targets for emissions reduction and measure progress against a verified baseline.

[54] Xu, X., P. Sharma, S. Shu, T.-S. Lin, P. Ciais, F. N. Tubiello, P. Smith, N. Campbell, and A. K. Jain. 2021. "Global Greenhouse Gas Emissions from Animal-Based Foods Are Twice Those of Plant-Based Foods." *Nature Food* 2: 724–32.

Issuers must also demonstrate that consumer engagement efforts to shift consumption patterns do not lead to an increase in food loss and waste. Food Loss and waste and related emissions must be measured and reported using an accepted methodology as defined in the Food Loss and Waste-related criteria .

# 5. Definition of Adaptation & Resilience requirements

## 5.1 Overview of the Adaptation & Resilience Component of the Criteria

Climate adaptation and resilience mitigation criteria are designed to ensure that funded assets and use of proceeds are resilient to climate change over their operational lifetime, and that they do not negatively impact the resilience of ecosystem in which they operate. The development of the requirements for the Adaption and Resilience component is based on Climate Bonds' "Climate resilience principles" document[55] . A checklist is provided based on the four key steps set out in the Climate Resilience principles: boundary setting, risk assessment, action and M&E Environmental Safeguard (See figure 8 Below).

*Figure 9: Key steps for Adaptation and Resilience Requirements*

| | Steps for A&R Requirement | Demonstration of Compliance |
|---|---|---|
| 1. | Identify boundaries and interdependencies. | The applicant must define<br>• the boundaries of the investment and associated assets and activities,<br>• internal and external interdependencies between the broader system affected by those assets and activities. |
| 2. | Assessment of the physical climate hazards. | The applicant must<br>• demonstrate that a risk assessment has been undertaken of the physical climate hazards to which the assets and activities will be exposed over its operating life<br>• follow best-practice standards or similar schemes to carry on the risk |
| 3. | Measures taken:<br>a) Address and mitigate hazards<br>b) Ensure no harm to the resilience of system. | The applicant must also demonstrate that measures have or will be taken to:<br>i. address and mitigate those identified physical climate hazards to a level so that the assets and activities are resilient to 'climate change over the operational life; and<br>ii. ensure that the assets and activities do no harm to the resilience of the defined system it operates within, considering the boundaries and critical interdependencies identified in 1. |
| 4. | Ongoing monitoring and evaluation to adjust measures as necessary. | The applicant is required to demonstrate that there will be ongoing monitoring and evaluation of the relevance of the risks and resilience measures, and related project adjustments as needed. |

Defining resilience can be challenging. However, many topics which have been a part of environmental and social risk assessments for a number of years, and are currently included in double materiality assessments, overlap significantly with the resilience of affected populations and ecosystems and their ability to adapt to climate change. The A&R Component therefore takes a broad interpretation of climate resilience. This includes both the resilience of the specific asset or project to physical climate risks and the potential environmental and social risks arising from physical climate risks that may impact the resilience of affected ecosystems and populations.

## 5.2 Practical requirements for this Component

The A&R Component needs to leverage existing tools and guidance which is robust and has widespread recognition amongst a diverse set of stakeholders. Existing risk assessment tools and standards do not always fully

[55] Climate Bonds (2019). Climate Resilience Principles. A framework for assessing climate resilience investments. www.climatebonds.net/climate-resilienceprinciples

or explicitly cover the additional, often interrelated impacts connected to climate adaptation and resilience. Where possible Issuers should leverage existing climate risk assessment and wider environmental and social impact assessments before conducting new assessments.

## 5.3 Existing tools and guidelines considered

The following tools and guidelines have been leveraged to support issuers to demonstrate compliance with the Food Value Chain Criteria

*General guidelines for emissions reduction accross food value chain*

- Transition Plan Taskforce (TPT) *Food & Beverage Sector Guidance*, April 2024.
- The Taskforce on Climate-related Financial Disclosures (TCFD) Recommendations
- The Taskforce on Nature-related Financial Disclosures (TNFD), Draft sector guidance – Food and agriculture, 2023
- Climate Action 100+, *Recommended Investor Expectations for Food and Beverage: Guide for investor engagement with entities in the global food and beverage sector*, 2021
- Ceres, *Investor Guide to Climate Transition Plans in the US Food Sector: Guidance for food entities on creating and implementing sector-specific climate transition plans*.

*Standards and guidelines for reducing refrigeration emissions and safe handling of refrigerants*

- EU Regulation on fluorinated greenhouse gases (EU) 2024/573
- international standards for safe handling of refrigerants : ASHRAE/, ANSI Standard 34-2019, Standard 15-2019 , ISO, ISO 817:2014
- Canadian Government Federal Offset protocol.
- Recovery and recycling equipment must meet accepted safety standards set out in the AHRI standard 740

*Sustainable packaging frameworks*

- WBCSD SPHERE The Packaging sustainability framework,
- Consumer Goods Forum, Global Protocol on Packaging Sustainability 2.0;
- Sustainable Packaging Coalition. Definition of Sustainable Packaging; Sustainable Packaging Coalition,
- Walmart. Sustainable Packaging Playbook: A Guidebook for Suppliers to Improve Packaging Sustainability,
- Australian Packaging Covenant. Sustainable Packaging Guidelines; Australian Packaging Covenant
- EU Packaging and Packaging Waste Regulation (PPWR) 2024
- Compostability Label by European Bioplastics
- OK Compost certification label

*Food Loss and Waste (FLW) and FLW emissions measurement frameworks and guidelines*

- EU Common Methodology for measuring food waste
- Food Loss + Waste Protocol: Food Loss and Waste Accounting and Reporting Standard
- Food Loss + Waste protocol. Connecting Food Loss and Waste to Greenhouse Gas Emissions: Guidance for Companies.
- GAFSP food loss climate impact tool focused on emerging markets

# 6. Definition of Environmental and Social Safeguards

The criteria include the definition of safeguards required for eligible food value chain Assets and Use of Proceeds to ensure that they are resilient to the impacts of climate change and that they identify and minimise potential negative environmental and social impacts. The definition of safeguards supports the implementation of the Adaptation and Resilience Criteria by defining in greater detail the focus of the risk assessment process and the expected content of the mitigation actions related to the impacts of funded activities on the environment and surrounding communities.

The Social and Environmental safeguards also complement the Adaptation and Resilience Criteria by extending the risk assessment and identification of mitigation actions to cover the full range of potential environmental and social impacts of funded assets and use of proceeds beyond those specifically related to climate change.

The specific risks included in the safeguards checklists were identified during the discussions with the TWG and the IWG regarding the potential negative impacts that could arise from the implementation of assets and use of proceeds under each of the topics covered by the Food Value Chain criteria.

The mitigation measures stress the importance of ensuring compliance with existing laws, regulations and safety standards which issuers would be expected to be able to document without undue effort. In addition they set out other measures which issuers will likely already have in pace as part of their normal risk management and due diligence systems.

In a small number of areas where regulation and corporate risk management systems do not yet provide adequate safeguards a written commitment or policy is suggested to ensure that funded assets and use of proceeds avoid creating negative social and environmental outcomes, for example a commitment and strategy to promote healthy nutrition and reduce food inequality, or to support a just transition when changing sourcing strategies to support emissions reduction efforts.

# Definitions

**Adaptation and Resilience Criteria**: Rules or principles for evaluating and preventing physical climate risk, as well as assessing and reducing the vulnerability of an asset or entities to the effects of climate changes. These rules generally guarantee that the activities do not do any significant harm to other assets within their system boundaries covering the area affected by the activity.

**Applicant**: The term or name for any potential bond issuer, or non-financial corporate entity that might seek Certification under the Agriculture Production Criteria.

**Certified entity**: The entity or part thereof which is being certified under the Climate Bonds Standard. Currently, Entity Certification is limited to non-financial entities or segregated segments thereof, for which the Climate Bonds has Climate Bonds Standard Sector Criteria for Entity Certification. Entities are not eligible for certification under the Food Value Chain Criteria

**Circular CO2**: Carbon dioxide that has been captured or removed from the atmosphere and made available for new uses.

**Climate Bond Certification**: allows the applicant to use the Climate Bond Certification mark in relation to that bond. Climate Bond Certification is provided once the independent CBSB is satisfied the bond complies with the CBS.

**Climate Bonds Initiative (Climate Bonds):** An investor-focused not-for-profit organisation, promoting large-scale investments that will deliver a global low-carbon and climate resilient economy. Climate Bonds seeks to develop mechanisms to better align the interests of investors, industry, and government to catalyse investments at a speed and scale sufficient to avoid dangerous climate change.

**Climate Bonds Standard (CBS):** A screening tool for investors and governments that allows them to identify green bonds, the proceeds of which are being used to deliver climate change solutions. This may be through climate mitigation impact and/or climate adaptation or resilience. The CBS is made up of two parts: the parent standard (CBS v4.2) and a suite of sector specific eligibility Criteria. The parent standard covers the Certification process and pre-and post-issuance requirements for all Certified bonds, regardless of the nature of the capital projects. The Sector Criteria detail specific requirements for assets identified as falling under that specific sector. The latest version of the CBS is published on the Climate Bonds website.

**Climate Bonds Standard Board (CBSB):** A board of independent members that collectively represents $34 trillion of assets under management. The CBSB is responsible for authorising (i) revisions to the CBS, including the adoption of additional Sector Criteria; (ii) approved verifiers; and (iii) applications for Certification of a bond under the CBS. The CBSB is constituted, appointed, and supported in line with the governance arrangements and processes as published on the Climate Bonds website.

**Climate change**: A change in global or regional climate patterns attributed to the increased levels of CO2 in the atmosphere, produced mainly by the combustion of fossil fuels.

**Climate goals**: Objectives that aim to reduce GHG emissions to limit the global temperature increase to 1.5°C above pre-industrial levels.

**Climate mitigation performance targets**: The performance targets that define the measurable climate mitigation performance to be achieved.

**Climate adaptation and resilience**: Measures or assessments related to protecting communities or ecosystems from the effects of climate change. Adaptation refers to protection, while resilience is the ability to adapt and recover from the impacts of climate change.

**Climate targets**: Limits established by scientists and policymakers in plans to combat climate change.

**CO2 equivalent**: A unit to measure the effect of all greenhouse gases according to their global warming potential that expresses the warming effect of each greenhouse gas over a set period of time (usually 100 years) in comparison to CO2. Thus, an amount of a GHG can be expressed by the quantity of CO2 that will have the equivalent warming effect over 100 years.

**Critical interdependencies**: The asset or activity's boundaries and interdependencies with surrounding infrastructure systems. Interdependencies are specific to local context but are often connected to wider systems through complex relationships that depend on factors 'outside the asset fence' that could cause cascading failures or contribute to collateral system benefits.

**Decarbonisation pathways:** Transformation processes, strategies, or indications to be implemented in the energy sector aiming to reduce emissions and the use of fossil fuels. They involve measures such as shifting the energy mix, increasing energy efficiency, utilising the circular economy, or managing demand for energy.

**Decarbonise**: Move away from energy systems that produce carbon dioxide and other greenhouse gas emissions and remove the amount of carbon gaseous compounds in the atmosphere.

**Developing countries/emerging economies**: As defined by the UN, where Developing countries are characterized by a low level of income, structural impediments to growth, and a need for special measures to address these problems.[56]

**Emission intensity:** Volume of emissions per unit of a representative factor in the assessed sector, which for example for food freight transport is measured as ton per Kilometer tkm, representing the transport of 1t of goods by a given transport mode over a distance of 1 km. So so the emissions intensity is the grams of CO2 eq per ton of food transported over one kilometer : (g CO2eq per t-km).

**Food Value Chain:** Activities that occur at post-production level (beyond the farm gate) to bring food and beverage products to consumers and to dispose of the related waste. This includes activities such as transport, processing, packaging, storage and distribution, retail, food preparation by hospitality and food service providers and waste disposal. It also includes actions taken by actors in the food value chain to influence household level consumption patterns which are one of the main drivers of rising emissions, provided the emissions reductions can be credibly measured

**Global Warming Potential**: An index measuring how much infrared thermal radiation a ton of a greenhouse gas would absorb over a given time frame after it has been emitted to the atmosphere, compared to a ton CO2 (which has the reference value 1).

**Green bond**: A bond where the proceeds are allocated to environmental projects or expenditures. The term generally refers to bonds that have been marketed as green. In theory, green bonds proceeds could be used for a wide variety of environmental projects or expenditures, but in practice they have generally been earmarked for climate change projects.

**IWG (IWG):** A group of key organisations that are potential applicants, verifiers and investors convened by Climate Bonds. The IWG provides feedback on the draft Sector Criteria developed by the TWG (TWG) before they are released for public consultation

**Investment period**: The interval between the bond's issuance and its maturity date; otherwise known as the bond tenor

**Life-cycle analysis/ Life-cycle assessment (LCA):** A methodology for assessing or accounting for environmental emissions associated with all the stages of the life cycle of a product or process, from the initial design phase to disposal or recycling.

**Low-carbon fuels**: Fuels made without the use of fossil fuels such as hydrogen, green ammonia and biomass.

**Low-carbon technologies**: Technologies referred to as innovative technical solutions that are characterised by a low-emission intensity, compared to state-of-the-art alternatives. Considered best-in-class technologies with a focus on environmental impact, examples of electricity utility low-carbon technologies would be solar, wind, marine, bioenergy, hydropower, geothermal, and nuclear.

**Mitigation Criteria**: Rules and principles containing thresholds, benchmarks, and milestones for sector activities whose objective is the reduction of the harmful effects of greenhouse gases emissions.

**Net-zero emissions**: A situation where global greenhouse gas emissions from human activity are in balance with emissions reductions. To achieve this situation, human-caused emissions should be reduced as close to zero as possible.

**Paris Agreement**: A legally binding international treaty on climate change adopted by 196 parties. Its overarching goal is to hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels.

[56] 2014wesp_country_classification.pdf

**Pathways**: Science-based trajectories for different sectors indicating the way to achieve targets related to relevant indicators.

**Scope of emissions**: Scope 1, 2 and 3 are terms devised by the GHG Protocol to categorise the different sources of carbon emissions an organisation creates in its own operations, and in its wider value chain.

**Standards Criteria**: Established principles to evaluate processes, assets, or entities aiming to achieve benchmarks, targets, or goals.

**Sustainability-linked debt (SLD):** Any debt instrument for which the financial and structural characteristics can vary depending on whether the issuer achieves predefined sustainability/ESG objectives. Such objectives are measured through predefined key performance indicators (KPIs) and assessed against predefined performance targets. Proceeds of SLD are intended to be used for general purposes.

**TWG (TWG):** A group of recognised experts from academia, international agencies, industry, and NGOs convened by Climate Bonds. The TWG develops the Sector Criteria, which are detailed technical criteria for the eligibility of projects and assets as well as guidance on the tracking of eligibility status during the term of the bond. Their draft recommendations are refined through engagement with finance industry experts in convened IWGs (IWG) and through public consultation. Final approval of Sector Criteria is given by the CBSB.

**Use-of-Proceed (UoP) Bond**: a bond the proceeds of which are ringfenced for specific assets and activities. Green bonds, blue bonds, and transition bonds are examples of UoP bonds.

**Whole Life Carbon Assessment**: See *Life Cycle Assessment* (above)

# Bibliography

Adekomaya et al. Sustaining the shelf life of fresh food in cold chain - a burden for the environment. Environment, 2016

Anderson, CM., Bicalho, T., Wallace, E., Letts, T., and Stevenson, M. Forest, Land and Agriculture Science-Based Target-Setting Guidance. World Wildlife Fund, Washington, DC. 2022

ASHRAE, ANSI/ASHRAE Standard 34-2019, Designation and Safety Classification of Refrigerants. 2019, American Society of Heating, Refrigerating and Air-Conditioning Engineers: Atlanta, GA. 2019

Beyond Plastics, The False Promise Of Bioplastics and Compostable Plastics, 2019-2024

BNP Paribas, Carrefour issues sustainability-linked bond to drive the food transition, 11 April 2022

Bond, M., Meacham, T., Bhunnoo, R. and Benton, T.G, Food waste within global food systems. A Global Food Security report (www.foodsecurity.ac.uk) 2013

Burrows, David., Packaging: the carbon dilemma for food companies, *Just Food*, November 11, 2022

Chiriac, Daniela., Harsha Vishnumolakala, Paul Rosane,. Landscape of Climate Finance for Agrifood Systems. Climate Policy Initiative. 2023

Clark, Michael A., Nina G. G. Domingo, Kimberly Colgan, Sumil K. Thakrar, David Tilman, John Lynch, Inés L. Azevedo, and Jason D. Hill. "Global Food System Emissions Could Preclude Achieving the 1.5° and 2°C Climate Change Targets." Science 370: 705–08, 2020

Climate Bonds Sustainability-Linked Bonds, Building a High Quality Market , 2024

Climate Bonds Sustainable Debt: Global State of the Market *2023,* 2024

Climate Bonds, Agri-food Transition Principles, Discussion Paper, 07 December 2022

Cole, M.B., Augustin, M.A., Robertson, M.J. *et al.* The science of food security. *npj Sci Food* **2**, 14, 2018

Collacott, Laura, Where compostable packaging fits in a circular economy, Ellen MacArthur Foundation, 26 May 2022

Coronas A. High-temperature heat pumps for industrial applications, 45th Informatory Note on Refrigeration Technologies. International Institute of Refrigeration, 2021.

Costa Jr., C., E. Wollenberg, M. Benitez, R. Newman, N. Gardner, and F. Bellone. "Roadmap for Achieving Net-Zero Emissions in Global Food Systems by 2050." Scientific Reports 12 (1): 15064, 2022

Coyne, Andy, The road to net zero – Big Food's emissions pledges Our guide to the net-zero emission commitments of the world's largest food manufacturers. Just Food, June 21, 2024

Crippa, M., Solazzo, E., Guizzardi, D. *et al.* Food systems are responsible for a third of global anthropogenic GHG emissions. *Nat Food* **2**, 198–209, 2021.

Domanski P. A., Brignoli R., Brown J. S., et al, Low-GWP refrigerants: performance assessment and selection tradeoffs. International Institute of Refrigeration, 2022.

Ecoplus, BOKU, denkstatt, OFI, Food Packaging Sustainability: A guide for packaging manufacturers, food processors, retailers, political institutions & NGOs. Vienna, 2020

Environment and Climate Change Canada, Federal Offset Protocol: Reducing Greenhouse Gas Emissions from Refrigeration Systems Version 1.1 December 2023.

Eunomia, Assessing Climate Impact: Reusable Systems vs. Single-use Takeaway Packaging September 2023

European Commission: Directorate-General for Health and Food Safety, *Reducing food loss and waste – Examples of voluntary agreements and other forms of collaborations across Europe* 2024

European Commission Joint Research Centre, Brief on food waste in the European Union, 2020

FAO (Food and Agriculture Organization of the United Nations). The Future of Food and Agriculture: Trends and Challenges. Rome.2017

FAO, IFAD, UNICEF, WFP and WHO,. The State of Food Security and Nutrition in the World 2022: Every Country Can Harness Priority Opportunities to Achieve Net Zero Agrifood Emissions139 Repurposing Food and Agricultural Policies to Make Healthy Diets More Affordable. Rome: FAO. 2022

Ferreira, Ana, Manuel Duarte Pinheiro, Jorge de Brito, Ricardo Mateus, Decarbonizing strategies of the retail sector following the Paris Agreement, Energy Policy, Volume 135, 2019.

Food & Drink Federation (FDF), Achieving Net Zero: A Handbook For The Food And Drink Sector Practical guidance for food and drink manufacturers to achieve Net Zero emissions, 2021.

Food and Land Use Coalition, Future Fit Food and Agriculture: The financial implications of mitigating agriculture and land use change emissions for businesses March 2024,

Food Loss and Waste protocol. Connecting Food Loss and Waste to Greenhouse Gas Emissions: Guidance for Companies.

Food Loss and Waste protocol FLW calculator

Heard, B. & Miller, S. Potential changes in greenhouse gas emissions from refrigerated supply chain introduction in a developing food system. 2019

International Civil Aviation Organisation (ICAO), Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) Sustainability Criteria for CORSIA eligible fuels, November 2022,

International Institute of Refrigeration, The Carbon Footprint of the Cold Chain, 7th Informatory Note on Refrigeration and Food. April, 2021

International Renewable Energy Agency (IRENA) and The Energy Technology Systems Analysis Programme (ETSAP) of the International Energy Agency (IEA) Technology Brief on Solar heat for industrial processes, 2015

IPCC, 2022 *Climate Change Mitigation of Climate Change*, Working Group III contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change , 2022

ISO, ISO 817:2014 Refrigerants - Designation and Safety Classification. 2014, International Organization for Standarization., 2014

Just Rural Transition, Principles for Just Food System Transitions Envisioning a more equitable and sustainable future – and an inclusive path to achieving it. April 2023

Li, M., Jia, N., Lenzen, M. *et al.* Global food-miles account for nearly 20% of total food-systems emissions. *Nat Food* **3**, 445–453, 2022.

Li X., WANG B, Air source heat pumps for space heating and cooling. 41st Informatory Note on Refrigeration Technologies. *International Institute of Refrigeration, 2021*.

Li, Y., He, P., Shan, Y., Li, Y., Hang, Y.,Shao, S., Ruzzenenti, F. & Hubacek, K. Reducing climate change impacts from the global food system through diet shifts. *Nature Climate Change* 14, 943–953, 2024.

McKInsey, True packaging sustainability: Understanding the performance trade-offs, July 2021

Meyers, Steven.,Bastian Schmitt, Mae Chester-Jones, Barbara Sturm, "Energy efficiency, carbon emissions, and measures towards their improvement in the food and beverage sector for six European countries", *Energy,* Volume 104, 2016, Pages 266-283, ISSN 0360-5442, 2016

Miklautsch, Philip., Manuel Woschank, A framework of measures to mitigate greenhouse gas emissions in freight transport: Systematic literature review from a Manufacturer's perspective, *Journal of Cleaner Production*, Volume 366, 2022, 132883, ISSN 0959-6526, 2022

Minderoo, Plastic Waste Makers Index 2023.

Pauer E, Wohner B, Heinrich V, Tacker M. Assessing the Environmental Sustainability of Food Packaging: An Extended Life Cycle Assessment including Packaging-Related Food Losses and Waste and Circularity Assessment. *Sustainability*. 2019; 11(3):925. 2019

Planet tracker, Financial Markets Roadmap For Transforming The Global Food System, A Guide for the Financial Sector. March 2023

Plastics Europe, The Plastics Transition, Our industry's roadmap for plastics in Europe to be circular and have net-zero emissions by 2050, 2024

Poore, Joseph. and Thomas Nemecek, Reducing food's environmental impacts through producers and consumers, June 2018, Science 360(6392):987-992, 2018.

Porter, Stephen D., David S. Reay, Elizabeth Bomberg, Peter Higgins, Avoidable food losses and associated production-phase greenhouse gas emissions arising from application of cosmetic standards to fresh fruit and vegetables in Europe and the UK, Journal of Cleaner Production, Volume 201, 2018, Pages 869-878, 2018.

Ravishankar, Manu., Sophie Bordat, David Aitken , *Net Zero Cold Chains for Food, A discussion document on the case for philanthropic action,* The Carbon Trust 2020.

RE100 technical criteria https://www.there100.org/technical-guidance

ReFED Roadmap to 2030: Reducing US Food Waste, 2023

Roe, S. et al. Contribution of the land sector to a 1.5 °C world. Nature Climate Change vol. 9, 2019.

Rosenzweig, C., Mbow, C., Barioni, L.G. *et al.* Climate change responses benefit from a global food system approach. *Nat Food* **1**, 94–97, 2020.

Sarr J., Dupont J. L., Guilpart J., The carbon footprint of the cold chain, 7th Informatory Note on Refrigeration and Food, International Institute Of Refrigeration, 2021

SBTI, Forest, Land And Agriculture Science based Target-Setting Guidance, Version 1.1, December 2023.

Searchinger, T. et al. (2018). *Creating a Sustainable Food Future—A Menu of Solutions to Feed Nearly 10 Billion People by 2050*. World Resources Institute

Sovacool, Benjamin K., Morgan Bazilian, Steve Griffiths, Jinsoo Kim, Aoife Foley, David Rooney,"Decarbonizing the food and beverages industry: A critical and systematic review of developments, sociotechnical systems and policy options"', Renewable and Sustainable Energy Reviews, Volume 143, 2021, 110856, ISSN 1364-0321, 2021

Sutton, William R., Alexander Lotsch, and Ashesh Prasann. 2024. Recipe for a Liveable Planet: Achieving Net Zero Emissions in the Agrifood System. Agriculture and Food Series. Conference Edition. World Bank, Washington, DC. License: Creative Commons Attribution CC BY 3.0 IGO

Teske, Sven (Editor), *Achieving the Paris Climate Agreement Goals Part 2: Science-based Target Setting for the Finance industry — Net-Zero Sectoral 1.5˚C Pathways for Real Economy Sectors*, Springer, 2022,

Thapliyal, D.; Karale, M.; Diwan, V.; Kumra, S.; Arya, R.K.; Verros, G.D. Current Status of Sustainable Food Packaging Regulations: Global Perspective. *Sustainability* 2024, 16, 5554.

Thi NB, Kumar G, Lin CY. An overview of food waste management in developing countries: Current status and future perspective. J Environ Manage. 2015 Jul 1;157:220-9. doi: 10.1016/j.jenvman.2015.04.022. Epub 2015 Apr 21. PMID: 25910976. https://pubmed.nClimate Bonds.nlm.nih.gov/25910976/

Tinnes, Elliott., Fernando Perez, and Matthew Kandel with Tanner Probst, Decarbonizing logistics: Charting the path ahead, McKinsey and Company, June 2024,

Tribaldos, Theresa., Teea Kortetmäki, Just transition principles and criteria for food systems and beyond, *Environmental Innovation and Societal Transitions*, Volume 43, 2022, Pages 244-256.

Tubiello et al.: GHG emissions from pre- and post-production processes increasingly dominate greenhouse gas emissions from agri-food systems, Earth Syst. Sci. Data, 14, 1795–1809, 2022

UNEP and FAO. Sustainable Food Cold Chains: Opportunities, Challenges and the Way Forward. Nairobi, UNEP and Rome, FAO. 2022.

van Dijk, M., Morley, T., Rau, M.L. *et al.* A meta-analysis of projected global food demand and population at risk of hunger for the period 2010–2050. *Nat Food* **2**, 494–501, 2021.

Willett, Walter et al. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems *The Lancet*, Volume 393, Issue 10170, 447 – 492. February 02, 2019

World Bank.. Addressing Food Loss and Waste: A Global Problem with Local Solutions. Washington, DC: World Bank, 2020.

World Resources Institute, Creating A Sustainable Food Future A Menu Of Solutions To Feed Nearly 10 Billion People By 2050 Final Report, July 2019

World Resources Institute, Reducing Food Loss And Waste Setting a Global Action Agenda 2019.

WRAP, Scope 3 GHG Measurement & Reporting Protocols: Sector Guidance for Food & Drink Businesses 1 May 2022.

WRAP, Unpackaged, Reusable Packaging Roundtables Report, August 2023.

Xu, X., P. Sharma, S. Shu, T.-S. Lin, P. Ciais, F. N. Tubiello, P. Smith, N. Campbell, and A. K. Jain. "Global Greenhouse Gas Emissions from Animal-Based Foods Are Twice Those of Plant-Based Foods." *Nature Food* 2: 724–32. 2021

Zhu, J., Luo, Z., Sun, T. *et al.* Cradle-to-grave emissions from food loss and waste represent half of total greenhouse gas emissions from food systems. *Nat Food* **4**, 247–256, 2023.

# Appendix A: TWG and IWG members

| | | | |
|---|---|---|---|
| **Climate Bonds Coordinator** | | | |
| **Aishwarya Sankar**<br>Sustainability Analyst | Climate Bonds Initiative | | |
| **External Technical Lead Advisor:** | | | |
| **Ruth Rennie**<br>Founder | Rennie Sustainability Consulting | | |
| **TWG Members** | | | |
| **Dr. Prajal Pradhan**<br>Agricultural Engineering and Environmental Management | University of Groningen | **Francesca Nugnes**<br>International Fund for Agricultural Development | PARM |
| **Isabel Nepstad**<br>CEO | Bella Terra | **Liyuan Wei**<br>School of Physics | University of Sydney |
| **Joe Robertson**<br>Executive Director | Citizens' Climate International | **Dr. Christopher Martius**<br>Team leader, Climate change, energy and low-carbon development | University Centre for International Forestry Research (CIFOR) |
| **Saloni Shah**<br>Green Economy specialist, Agribusiness | European Bank for Reconstruction and development | **DING Shanshan (Helen)**<br>Green Supply Chain and Finance Director | Institute of Public and Environmental Affairs (IPE) |
| **Matthew Unerman**<br>Food sustainability manager | Independent consultant | **Liuba Marchionne**<br>Sustainable Food Systems Advisor | Independent consultant |
| **Dr. Jan Broeze**<br>Researcher, Data and Informatics and Supply chain design | Wageningen University and research | **Brijpal Singh Choudhary**<br>Food systems specialist | Independent consultant |
| **Claire McConnell (she/her/hers)**<br>Policy Advisor, Food and Agriculture | International Institute for Sustainable Development (IISD) | **Steffany Bermudez**<br>Policy Advisor, Food and Agriculture | International Institute for Sustainable Development (IISD) |

| IWG Members | |
|---|---|
| Laurence Bahk | EBRD |
| Taciano Custodio | Rabobank, South America |
| Nicolas Diaz | Global methane hub |

| | |
|---|---|
| Jasper Dix | Agri 3 |
| Marjolein Hanssen | Rabobank, Europe |
| Julie Loyson | Agri 3 |
| Daisy Nicholls | Impact Arc |
| David Shaw | Artemis eco |
| Andrew Van Haght | OFI (Olam Food Ingredients) |