



การจัดการคาร์บอนสำหรับอุตสาหกรรม
การผลิตอาหาร
Carbon management for the food
production industry

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Introduction – Carbon Management for Food Industry

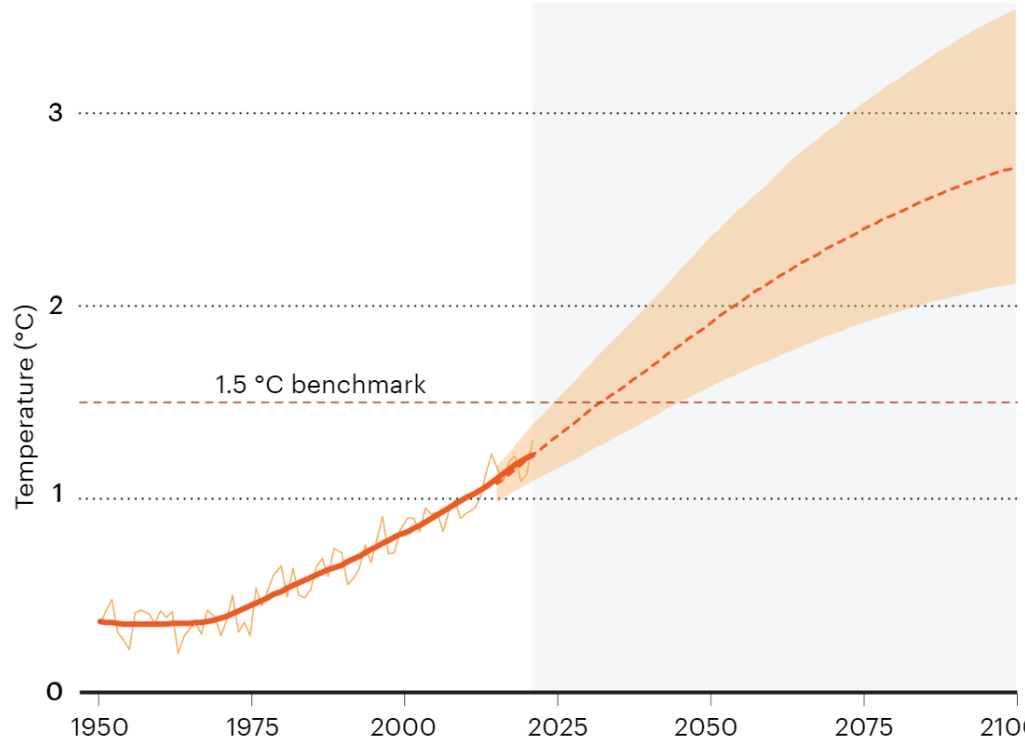
World Net Zero Target : 2050

Thailand Net Zero Target : 2065

What is the impact of Net Zero?

RISING TEMPERATURES

Average global temperatures hit nearly 1.3 °C above preindustrial levels in 2022 and are expected to reach even higher this year. At current trends, the world could surpass 1.5 °C of warming within a decade, if not sooner. Assuming moderate emissions into the future, climate models assessed by the Intergovernmental Panel on Climate Change project a range of warming (orange) by 2100 that is well above 2 °C.



Source: Berkeley Earth

Source: <https://www.nature.com/immersive/d41586-023-03601-6/index.html>

Definition and importance

Carbon Management

Carbon Neutrality Management Plan (CNMP)

Carbon Budget



BSI Flex 3030

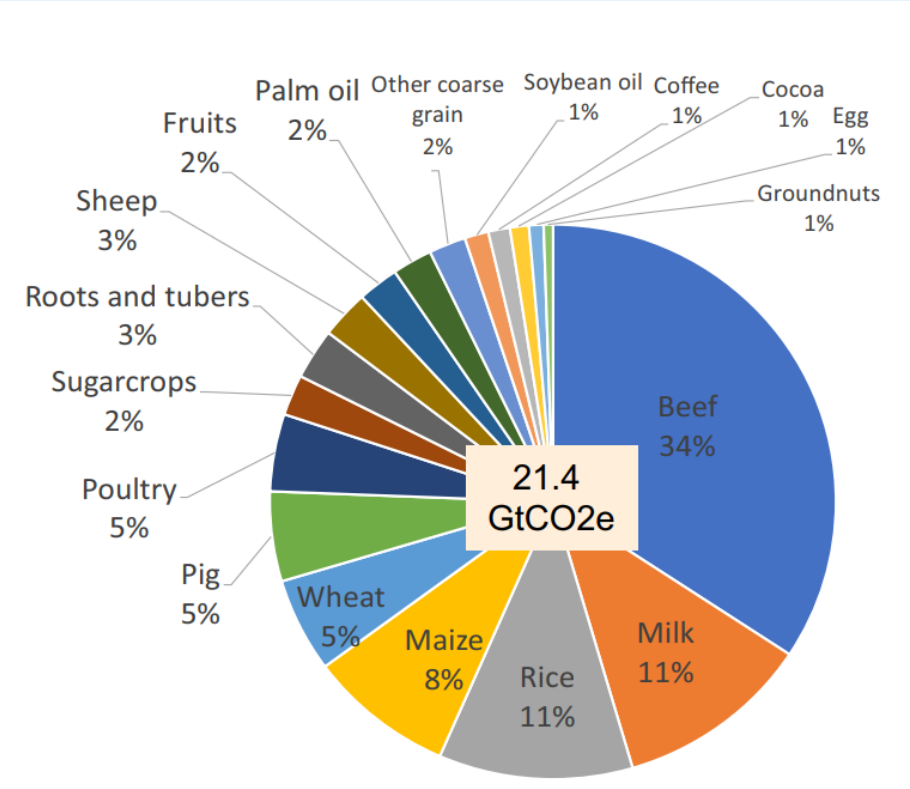
Net Zero
Transition Plans.
Code of Practice

[Download now](#)

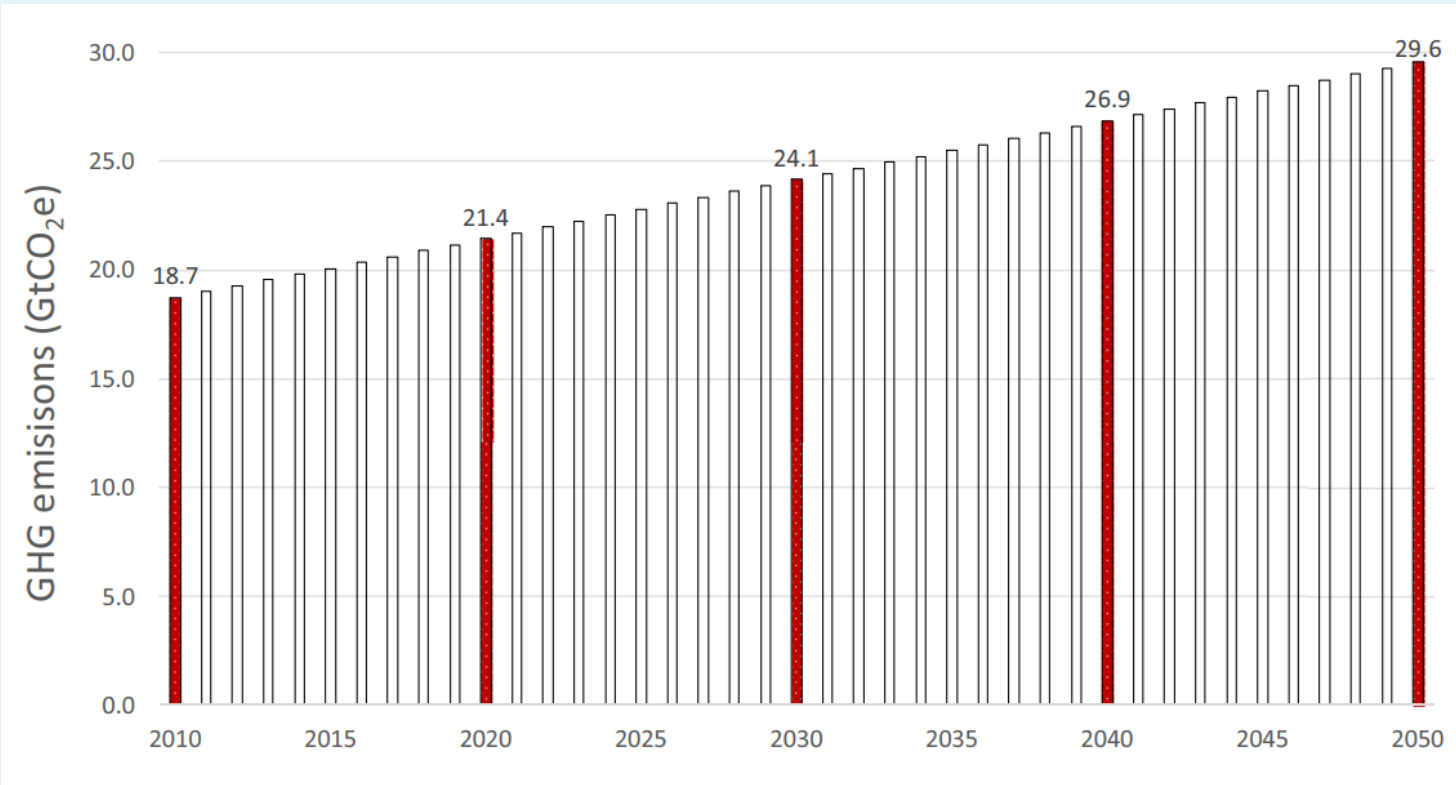


Carbon management to the food production industry

Global food systems emissions in 2020



Estimated global food systems emissions 2010–2050

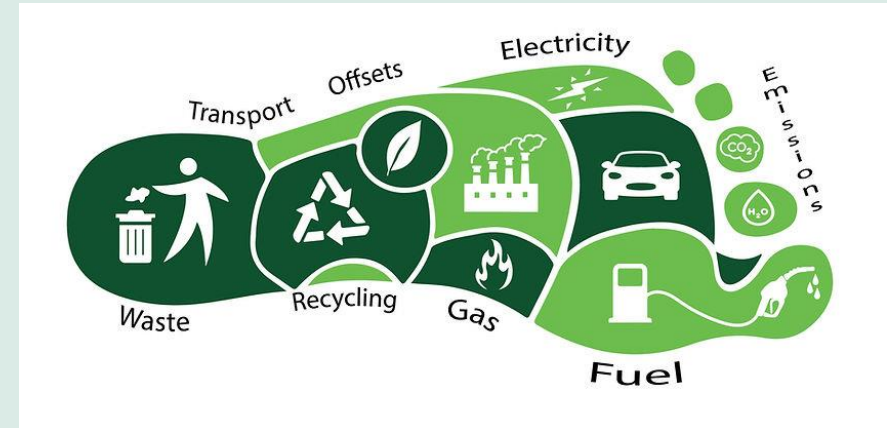


Source: Costa, C., Wollenberg, E., Benitez, M. *et al.* Roadmap for achieving net-zero emissions in global food systems by 2050. *Sci Rep* 12, 15064 (2022). <https://doi.org/10.1038/s41598-022-18601-1>

Understanding Carbon Footprint

What is carbon footprint?

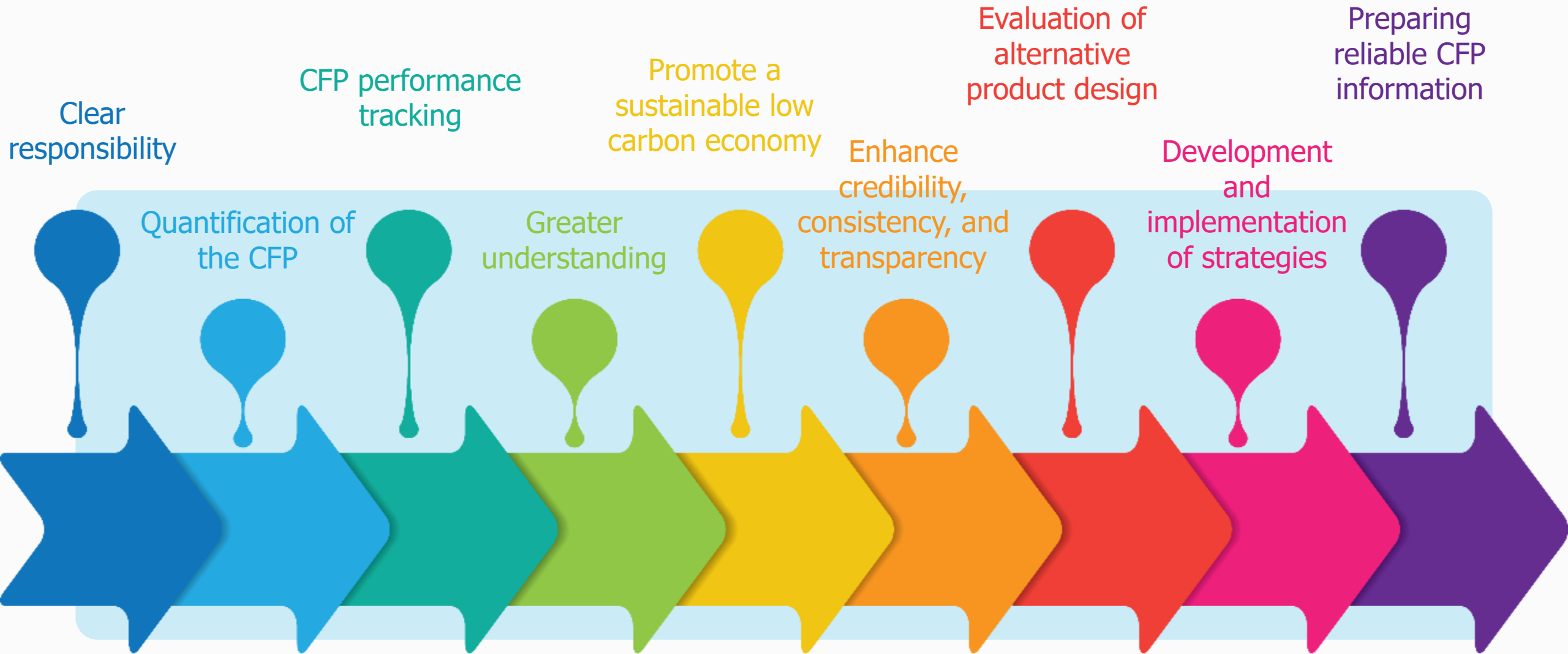
คาร์บอนฟุตพริ้นต์ คือ ผลรวม ปริมาณการปล่อยก๊าซเรือนกระจก ทั้งหมดที่กิจกรรม ผลิตภัณฑ์ องค์กร ปล่อยสู่ชั้นบรรยากาศ



[What Is A Carbon Footprint? \(plugitinsolar.com\)](http://plugitinsolar.com)


What is the important of carbon footprint ?

Understanding Carbon Footprint




Calculating the Carbon Footprint

ISO 14064-1




BSI Standards
Publication

Greenhouse gases
Part 1:
Specification with
guidance at the
organization level for
quantification and
reporting of greenhouse
gas emissions and
removals




ISO 14067



BSI Standards
Publication

Greenhouse gases
Carbon footprint of
products –
Requirements and
guidelines for
quantification



Examples specific to food production

ประโยชน์

Environmental Impact Reduction:

Identify hotspot – Create strategy to mitigation – Related to agricultural practices, transportation, processing, and packaging

Resource Efficiency:

Reducing the carbon footprint often goes hand-in-hand with improving resource efficiency - leading to cost savings and more sustainable practices.

Consumer Awareness:

Environmental impact of their food choices - Carbon footprint of products can help consumers make more informed decisions



Examples specific to food production

ประโยชน์

Regulatory Compliance:

Understanding and managing the carbon footprint can help companies comply with current and future regulations, avoiding potential fines and penalties.

Market Advantage:

Enhance brand reputation, attract eco-conscious consumers, and potentially command higher prices for sustainable products.

Supply Chain Improvements:

Can create more streamlined and sustainable supply chains, which can lead to better overall performance and reduced costs.



Examples specific to food production

ประโยชน์

Innovation and Development:

The development of new technologies, sustainable farming practices, and alternative packaging solutions that are better for the environment

Corporate Social Responsibility (CSR):

Improving stakeholder relationships, enhance company reputation, and contribute positively to the community and the planet.

Long-term Sustainability:

Companies that proactively reduce their emissions will be better positioned to adapt and thrive in a changing environment.





Sources of Carbon Emissions in Food Production

Sources of Carbon Emissions in Food Production

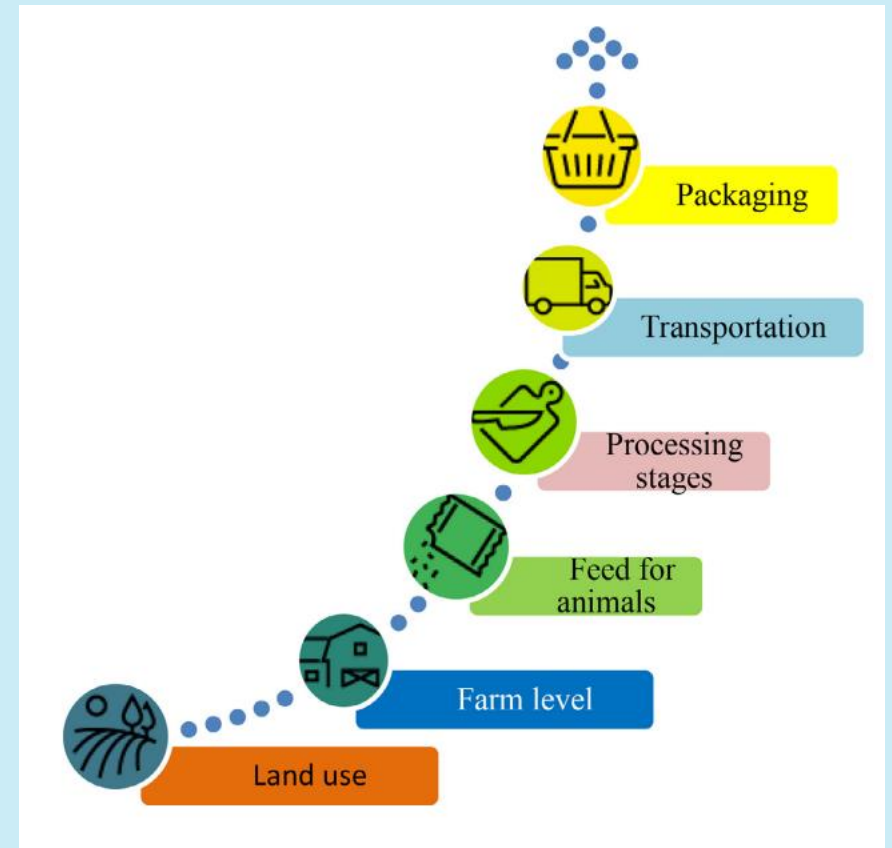
Greenhouse gases emission throughout supply chain

Agricultural Practices

- Land use and deforestation
- Use of fertilizers and pesticides

Food processing stages and its GHG emissions

Raw material	The agriculture sector produced about 8% of all GHG emissions.	Gan et al., 2021
Processing the food	Carbon footprint was 14.21% and 25.51% occurred during distilling operations	Ritchie et al., 2019
Livestock & fisheries	31% of food emissions	Ritchie et al., 2019
Crop production	27% of food emissions	
Land use accounts	24% of food emissions	
Supply chains account	18% of food emissions	

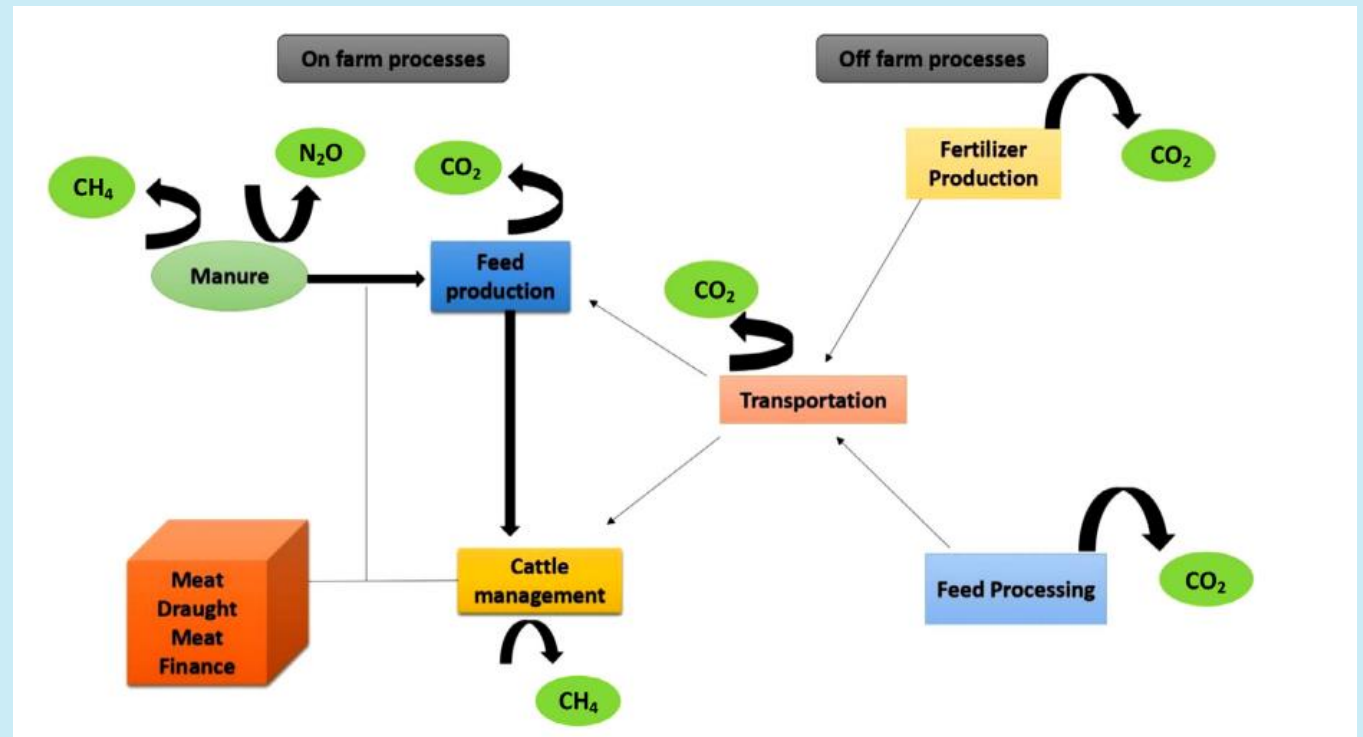


Source: Shabir, I., Dash, K. K., Dar, A. H., Pandey, V. K., Fayaz, U., Srivastava, S., & Nisha, R. (2023). Carbon footprints evaluation for sustainable food processing system development: A comprehensive review. *Future Foods*, 7, 100215.

Sources of Carbon Emissions in Food Production

Livestock and Animal Farming

- Methane emissions
- Manure management



Source: Shabir, I., Dash, K. K., Dar, A. H., Pandey, V. K., Fayaz, U., Srivastava, S., & Nisha, R. (2023). Carbon footprints evaluation for sustainable food processing system development: A comprehensive review. *Future Foods*, 7, 100215.

Sources of Carbon Emissions in Food Production

Food Processing and Manufacturing

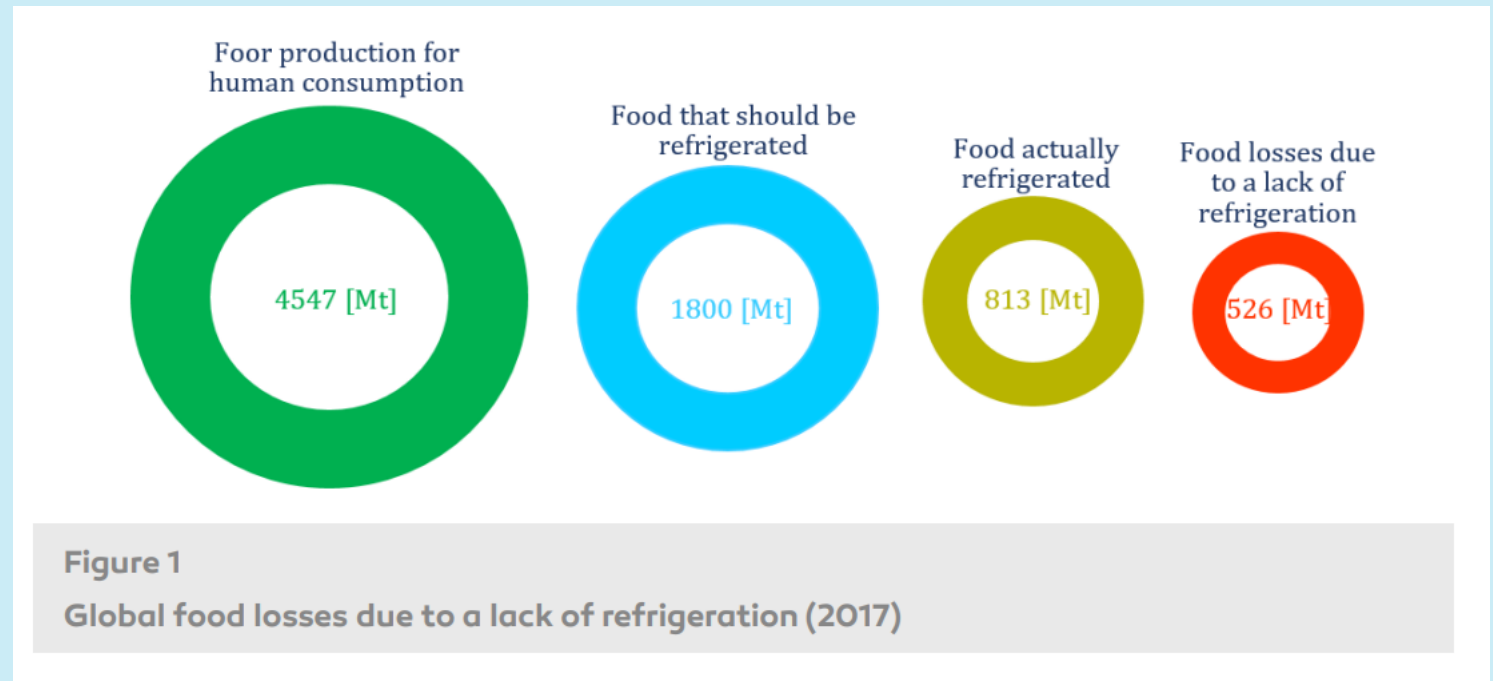
- Energy consumption
- Waste management

Energy consumption of meat and poultry industry				
Industry	Electricity / Activity	Percentage	Fuel Activity	Percentage
Cattle slaughtering	Slaughtering	26	Cleaning & disinfecting	80-90
	Evisceration	3		
	Cooling	45-70		
Poultry & slaughtering	Compressed air, lightening and machines	30	Space heating	10-20
	Cooling	52-60	Singeing	60
	Machines & compressed air	30	Cleaning & disinfecting	30
Meat processing	Lightening & ventilation	4	Space heating	10
	Cutting & mixing	40	Cleaning & disinfecting	25
	Cooling	40	Space heating	15
Rendering	Packing	10		
	Lightening	10		
	Compressed air, lightening & machines	12	Vacuum evaporation	2
Meal processing	Grinding & pressing	17	Drying	61
	Drying	23	Grinding & pressing	17
	Vacuum evaporation	6	Space heating	1
Meal sterilisation	Milling plant	8	Fat treatment	3
	Meal sterilisation	2	Meal sterilisation	8

Sources of Carbon Emissions in Food Production

Transportation and Distribution

- Fuel use
- Cold chain logistics



Sources of Carbon Emissions in Food Production

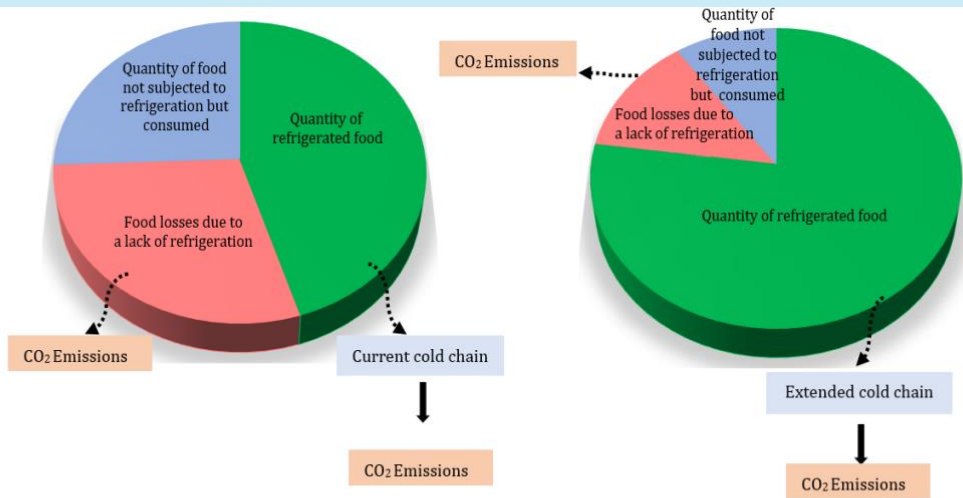
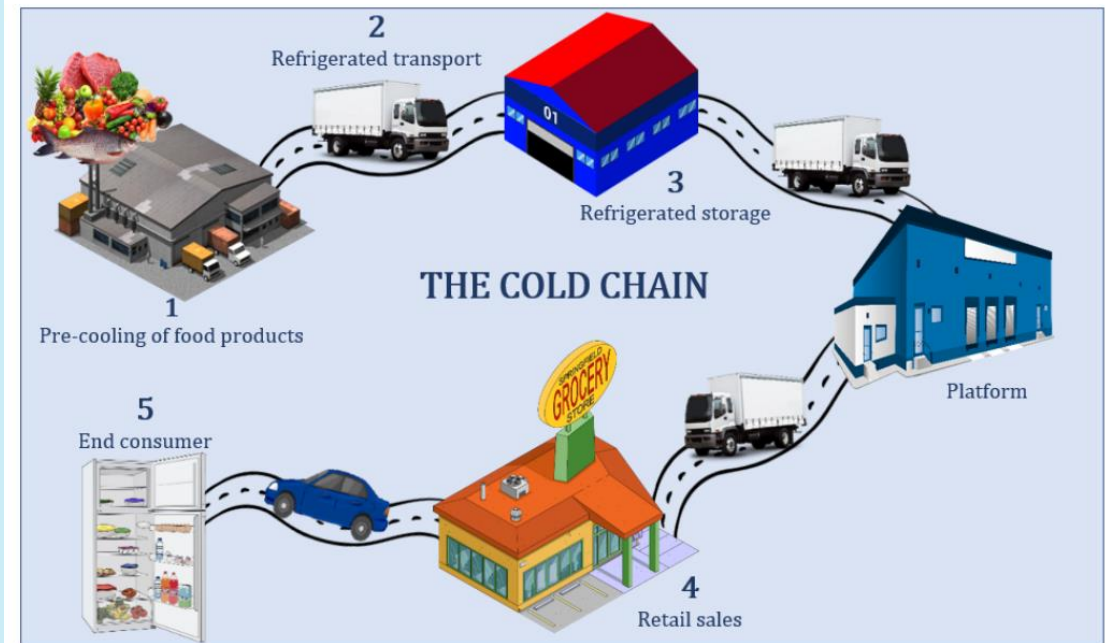


Figure 2a: Current cold chain

Figure 2b: Extended cold chain

Figure 2
Origin of CO₂ emissions from the current cold chain and from an extended cold chain



Strategies for Reducing Carbon Emissions

LED and C-sequestration practices priorities by cost	2020-2030	2030-2040	2040-2050	Mitigation potential/cost	
				Up to 100 US\$/tCO ₂ e	> 100 US\$/tCO ₂ e
Existing practices and technologies				47%	53%
Rice paddies	Improved water management in rice paddies			70%	30%
Crop	Nutrient management (e.g., balance nitrogen application)			87%	13%
	Biochar			77%	23%
	No-till and residue management			90%	10%
Livestock	Grazing management; animal feeding, health and breeding and feed additives			61%	39%
	Manure management			78%	22%
Cross-cutting (crop-livestock)	Agroforestry			20%	80%
Off-farm/demand side/other	Avoided forest conversion			59%	41%
	Reduce food loss and waste			52%	48%
	Shift diet demands from livestock- to plant-based protein			63%	37%
	Renewable energy and improved fuel efficiency			-	-
New horizon technologies					
Rice paddies	Plant and soil microbiome technology; perennial row crops			-	-
Crop	Enteric methane direct capture, new inhibitors and novel feed additives			-	-
Livestock	Gene editing for enhanced carbon sequestration			-	-
Cross-cutting (crop-livestock)	New technologies— not yet present but could increase mitigation from GHG-efficient food production practices			-	-
Off-farm/demand side/other				-	-
Development	Affordable and available				



Source: Costa, C., Wollenberg, E., Benitez, M. *et al.* Roadmap for achieving net-zero emissions in global food systems by 2050. *Sci Rep* **12**, 15064 (2022). <https://doi.org/10.1038/s41598-022-18601-1>

Table 2 mitigation potential of food systems practices

Sustainable Agricultural Practices

1. Crop rotation and diversification
2. Organic farming
3. Conservation tillage
4. Agroforestry
5. Sustainable livestock farming
6. Cover cropping
7. Biological pest control
8. No-till farming
9. Permaculture
10. Aquaponics



Improving Livestock Management

Good animal health = lower emissions

Changing the nutrition mix

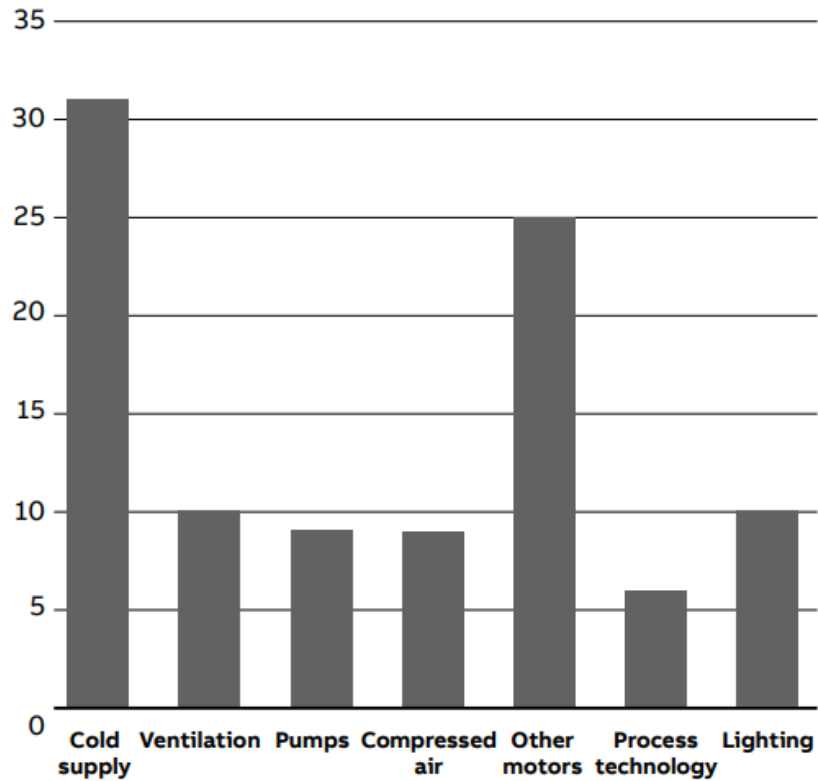
New products to target methane reduction



Energy Efficiency in Processing

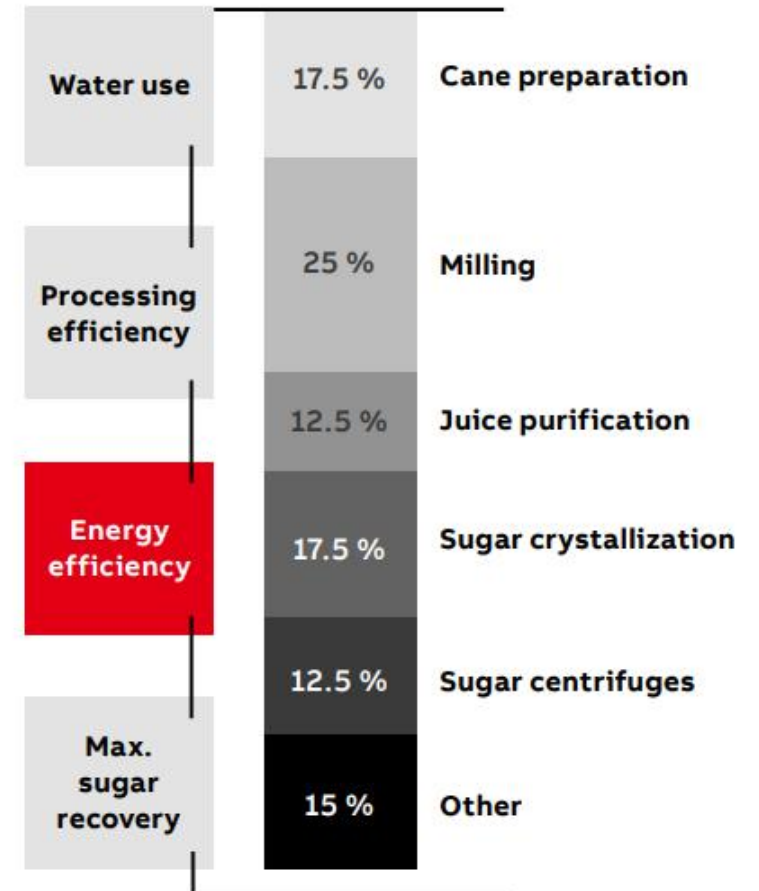
The processes that consume the most electricity in the food industry rely on motors.⁶

Percentage of energy consumption



Main cost drivers

Relative energy consumption (calculated for the whole plant)



Optimizing Transportation

Before we can implement effective strategies, it's essential to understand the array of challenges that threaten food quality during transportation. These include, but are not limited to:

- **Temperature fluctuations:** Most perishable foods have specific temperature requirements. Variations can lead to spoilage, decreased shelf life, and possibly the growth of harmful microorganisms.
- **Packaging and handling:** How food is packaged and handled can have critical implications on its quality. Damaged containers, exposure to air, and poor handling can lead to contamination, spills, and altered flavor.
- **Time spent in transit:** The longer the food is in transit, the greater the likelihood of quality degradation. Efficient routes and speedy delivery are crucial.
- **Hygiene and sanitation:** Ensuring that the vehicles and equipment used for transportation are clean and regularly sanitized is a prerequisite for food safety.
- **Regulatory compliance:** Each stage of food production and distribution is governed by a complex web of laws and regulations. Adhering to these is mandatory and contributes to maintaining quality.



Best Practices for Food Transportation

Packaging Strategies for Different Types of Foods.

Proper packaging is key for preventing spoilage, damage, and contamination. The type of food being transported influences the type of packaging you need to use. For example:

- **Perishable goods:** Insulated packaging designed to maintain the required temperature, even if there are unforeseen delays, is critical.
- **Frozen foods:** Packaging should be durable and moisture-resistant to prevent the formation of condensation and ice crystals, which can damage the quality of the food.
- **Bulk items:** Sturdy packaging that can handle the weight is necessary, and it should be airtight to prevent exposure and contamination.

Best Practices for Food Transportation

Temperature Control Throughout the Supply Chain.

Maintaining the right temperature is non-negotiable when it comes to transporting food. Here's how you can do it effectively:

- **Advanced planning:** Determine the optimal temperature for each type of food and strategize how to maintain it.
- **Regular checks:** Equip vehicles with temperature control devices that provide real-time data, and ensure they are regularly calibrated.
- **Emergency procedures:** Have a clear plan for dealing with temperature excursions, with contingencies like backup refrigeration units or rerouting to a closer destination.

Safe and Secure Handling of Food.

Proper handling from loading to unloading is vital for food quality. Some key handling practices include:

- **Employee training:** Provide comprehensive training to staff on proper handling techniques and the importance of following procedures.
- **Loading and unloading:** These are critical phases; ensure there is a system in place for organized, safe movement of goods.
- **Travel shocks:** Take measures to minimize sudden jerks and movements during transit to prevent damage to the cargo.

Waste Reduction and Management

1. Practice waste segregation:
2. Practice using designated waste storage area:
3. Practice regular or scheduled waste removal:
4. Train employees on proper waste handling methods:



Carbon Offset Programs

What are Carbon Offsets?

- Definition and types

How to Implement Carbon Offset Programs

- Selection of projects
- Verification and certification



Monitoring and Reporting

Establishing Baselines and Targets

- Initial assessments
- Setting realistic goals

Data Collection and Analysis

- Monitoring tools and software
- Reporting standards (e.g., GHG Protocol)

Regular Audits and Reviews

- Continuous improvement
- Transparency and accountability



Case Studies and Best Practices

Successful Examples from the Industry

- Company-specific initiatives
- Results and benefits

Lessons Learned

- Challenges faced
- Solutions and innovations



Policy and Regulatory Framework

International Agreements and Standards

- Paris Agreement
- ISO 14001

National and Regional Regulations

- Compliance requirements
- Incentives and support programs



Future Trends and Innovations

Emerging Technologies

- Precision agriculture
- Biotechnology

Market and Consumer Trends

- Demand for sustainable products
- Impact on branding and sales



Conclusion

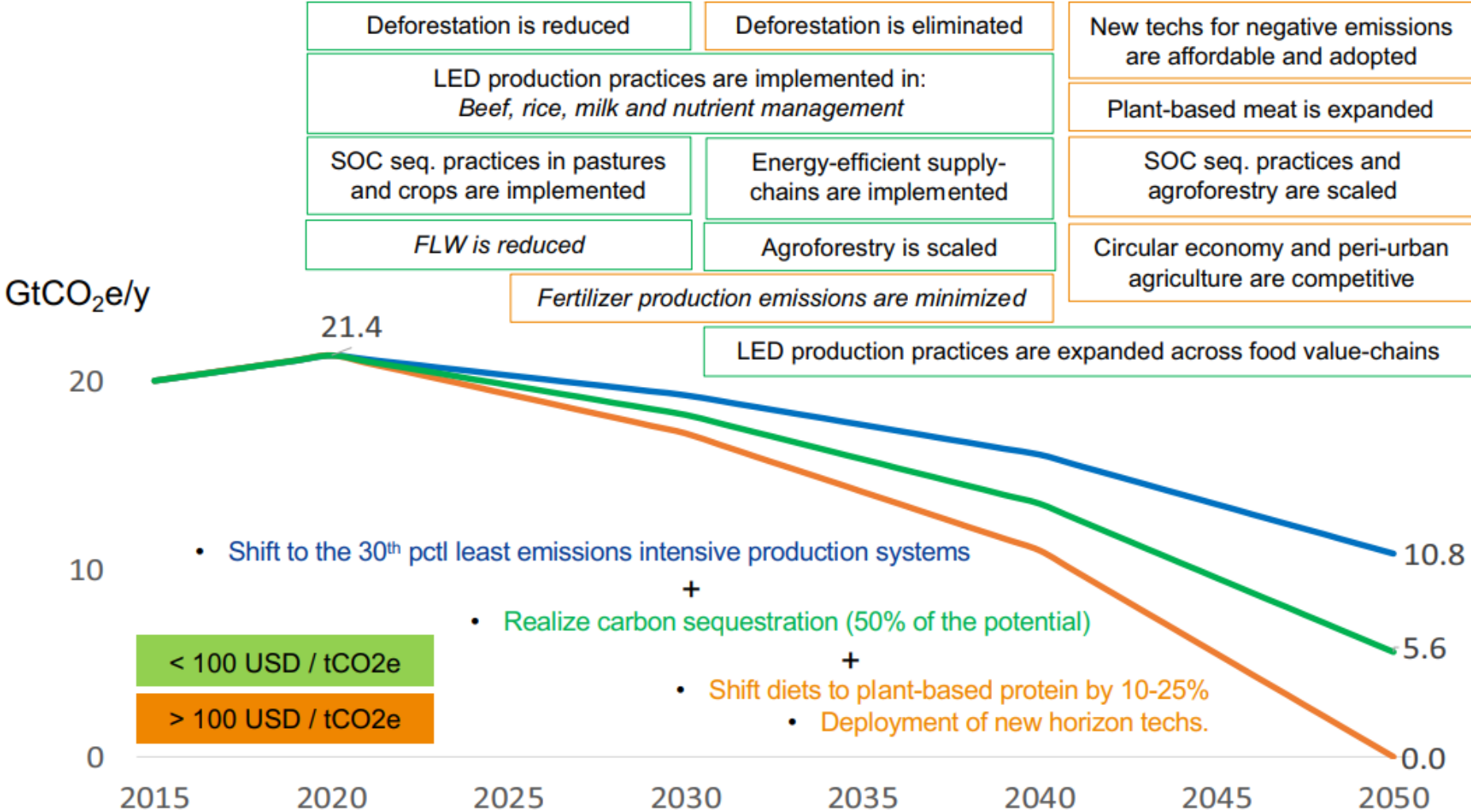


Figure 4. Roadmap for food systems net zero emissions by 2050.



“ Q&A Time



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