The Concept & Methodology

Cold Chain Database

A GFCCC - UNEP OzonAction Initiative towards a

Sustainable Cold Chain

GLOBAL FOOD COLD CHAIN COUNCIL

UN environment programme

OzonAction COMPLIANCE ASSISTANCE PROGRAMME

In cooperation with

Gluckman Consulting specialists in refrigeration and climate change

EXPERTGROUP

Executive Summary

The world's food systems[1] are responsible for more than one-third of global anthropogenic greenhouse gas emissions, according to a pioneering new study published in Nature Food. Spanning from land-use change and agricultural production to packaging and waste management, food system emissions were estimated at 18 billion tonnes of carbon dioxide equivalent in 2015. (FAO, March 2021 http://www.fao.org/news/story/en/item/1379373/icode)

The Cold Chain sector is playing a crucial role in managing the world's food systems from production to consumption or "from Farm to Fork". Absent or inefficient cold chain processes immediately contribute to food loss in different segments of cold chain operations. The Cold Chain can be best defined as "The series of actions and equipment applied to maintain a product within a specified low-temperature range from harvest/production to consumption, including farming/fishing, food processing, cold storage, transportation, food services, and domestic uses, as well as specialized products like medicinal products and vaccines."

Meanwhile, the world 2030 Agenda known as "Sustainable Development Goals (SDGs)" pays special attention to the topics of food security and safety through many goals such as End of Hunger (SDG-2), Good Health (SDG-3), and Responsible Consumption and Production (SDG-12). This is in addition to the connection to other SDGs directly or indirectly.

UNEP OzonAction and the Global Food Cold Chain Council (GFCCC) teamed up to tackle the needs of the cold chain sector in developing countries. UNEP OzonAction, an implementing agency to the Multilateral Fund of the Montreal Protocol, supports developing countries in meeting their compliance targets towards the Protocol, including eliminating the use of ozone depleting and high global warming potential refrigerants and technologies. The GFCCC, as an industry association, seeks to simultaneously reduce food loss and related greenhouse gas emissions in the processing, transportation, storage, and display of the chilled/frozen food products by expanding and improving access to energy-efficient low-global warming potential technology.

In addressing the needs of the cold chain sector in a country, it is important to establish a thorough analysis of local cold chain capacities and operations. UNEP OzonAction and GFCCC cooperate to offer an overarching methodology to quantify stocks and to understand gaps and project scenarios of food loss and GHG emissions. A comprehensive assessment methodology captures information about technologies, refrigerants, food loss, energy, economics, and operation practices.

Understanding the importance and urgency of the topic and while the database is currently being piloted in 6 countries, GFCCC and UNEP OzonAction are expanding their line of service through offering the Cold Chain Database Methodology to interested governments and local institutions. This document offers an overview about the concept and methodology of the database and what is needed to pursue it vis-a-vis interact with both GFCCC and UNEP OzonAction. The ongoing pilot stage is successfully progressing and demonstrates that the exercise is an eye-opening to governments to see the sector holistically and in conjunction with SDGs.

---

[1] **Food System** encompass the entire range of actors and their interlinked value-adding activities involved in the production, aggregation, processing, distribution, consumption and disposal of food products that originate from agriculture, forestry or fisheries, and parts of the broader economic, societal and natural environments in which they are embedded. **Sustainable Food System** is a food system that delivers food security and nutrition for all in such a way that the economic, social, and environmental bases to generate food security and nutrition for future generations are not compromised (*FAO 2018, Sustainable Food Systems*)

THE BACKGROUND

Cold Chain can be simply defined as:

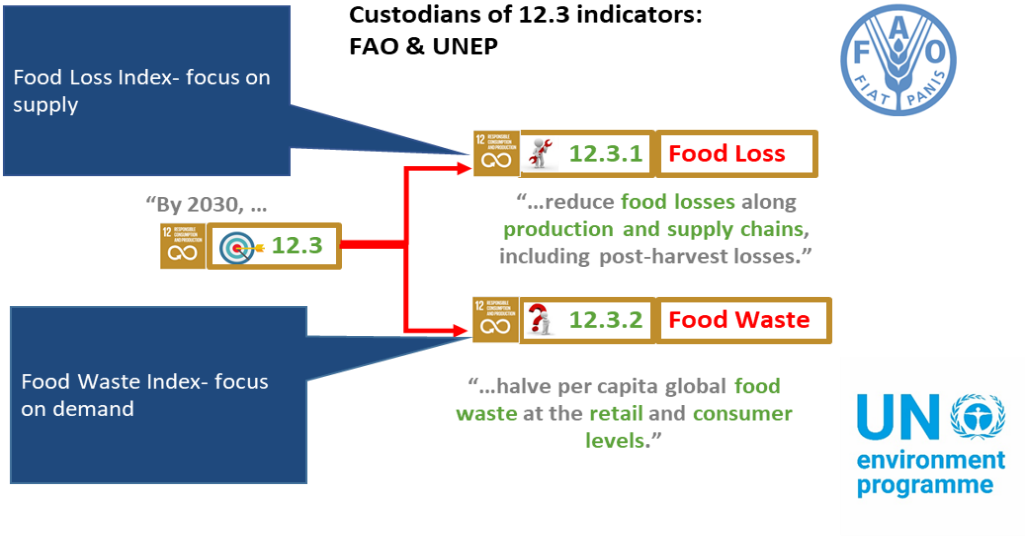
The series of actions and equipment applied to maintain a product within a specified low-temperature range from harvest/ production to consumption, including farming/fishing, food processing, cold storage, transportation, food services, display, and domestic uses, as well as special products like medicinal products and vaccines.

Sustainable Development Goals (SDGs)

Agenda 2030 for Sustainable Development consists of 17 goals aimed at improving livelihoods and achieving sustainable development with regards to environmental, social, and economic global equity. The 17 goals (and associated targets) cover areas of concern such as poverty and poor health outcomes, as well as implementation groundwork like partnerships and financing.

SDG	2030 Targets	Connection to the cold chain
	2.1 End hunger and ensure access for all people to sufficient nutritious food	Attaining zero hunger requires identifying vulnerabilities within the food supply system to ensure that loss is minimised.
	2.2 End all forms of malnutrition, including targets on stunting and wasting in children under 5	
	2.3 Double agricultural productivity and incomes of small-scale farmers	
	3.9 Reduce the number of death and illnesses from contamination amongst other things	Food-borne diseases caused roughly 600 million illnesses and 420,000 deaths in 2010 according to WHO. Efficient cold chain operations can significantly minimize food contamination.
	9.2 Promotion of inclusive and sustainable industrialisation	Cold chain and associated industries are expected to expand as global population and demand for food grow. Furthermore, a greater understanding of the weak links in cold chains, improved resource efficiency, and responsible use of refrigerants will contribute to the sustainability of and lowered emissions of the sector
	9.4 Upgrading and retrofitting of industries to increase resource efficiency, and clean environmentally friendly technologies	
	9.a Facilitation developing of sustainable infrastructure in countries requiring assistance	
	12.2 Sustainable management and use of natural resources	Halving per capita food wastage requires behavioural changes in consumers as well systemic changes in cold chains and the global food system in general. Currently food loss from failures in cold chains and associated industries contributes to unsustainable management and use of natural resources in terms of soil, water, etc.
	12.3 Halve per capita food wastage at all stages of the supply chain and consumer level	
	12.4 Achieve environmentally sound management of chemicals and significantly reduce their release into air, water, and soil	
	12.a Support less developed countries to strengthen their scientific and technological capacities to move towards more sustainable patterns of consumption and production	
	13.b Promote mechanisms that increase capacity for less developed countries for effective climate-change related planning and management	The production of food that is wasted and lost generates more GHGs than all GHGs emitted by India.

Tracking SDG 12.3 (Food Loss and Waste)



The Kigali Amendment

The Kigali Amendment, of the Montreal Protocol, addresses the need to phase-down the production and consumption of hydrofluorocarbons (HFCs) that were initially used as alternatives to ozone depleting substances (ODSs). Yet, HFCs have a long atmospheric lifetime, and some have high global warming potential (GWP) values. The Kigali Amendment is a contributory effort, by the Montreal Protocol, in mitigating climate change.

Several high-GWP HFCs are widely used for cold chain applications, making the sector one of the key contributors to meet commitments of the Kigali Amendment in many developing countries. In order to reduce the dependency on high-GWP refrigerants and advance the use of lower-GWP technologies, countries should have detailed analysis about different segment and associated technologies, including types of refrigerants being used in the cold chain. Parties to the Montreal Protocol adopted the Rome Declaration (Nov 2019) on the Contribution of the Montreal Protocol to Food Loss Reduction through Sustainable Cold Chain Development, which demonstrates that the protocol is keen in contributing actively to the global food loss reduction efforts.

UN Environment Assembly (UNEA) Related Resolutions

UN Environment Assembly meets every two years to set international priorities for global environmental policy and law; the Assembly is the governing body of UNEP and has universal membership of all 193 states.

Resolution 3/9 (2016-UNEA-2) recognizes that national governments and international institutions play a central role in contributing to solving global food loss and waste problems; organisations should:

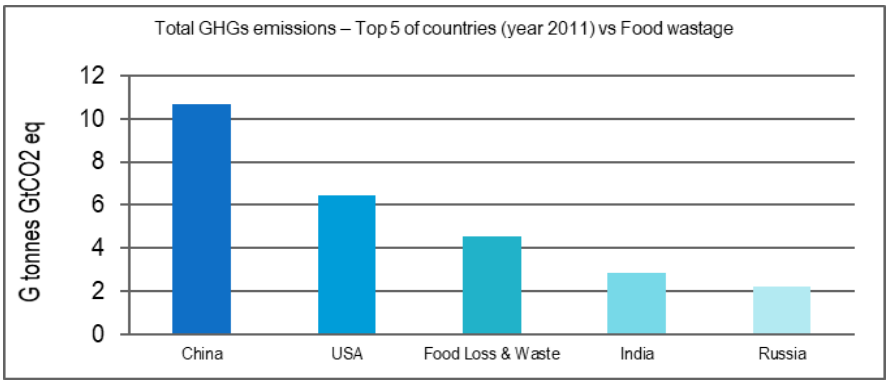
a) Promote market-based incentives, co-operation with stakeholders in cold chain sustainability, and improving measurement of food loss and waste
b) Implement programmes that reduce food wastage and reuse of edible food that might otherwise be wasted

While *Resolution 4/2 (2019-UNEA-4)* is more linked to cold chain where it urges organisations and institutions:

a) Contribute towards solving food loss and waste with an orientation towards addressing environmental, socio-economic, and public-health problems
b) Engage with stakeholders in food systems and participate in international efforts

Contribution to Climate Action

If Food Loss and Waste were a country, it would be the third biggest emitter of Greenhouse Gases (GHGs), therefore all efforts to minimize loss/waste of food will positively and notably contribute to Climate Actions.



Interventions and Players

There is a long list of international and regional entities and associations, as well as initiatives, that directly or indirectly address the cold chain sectors taking into consideration the above-mentioned food, environment, climate, health and energy aspects. Below are examples of key players and programs:

- **Food and Agriculture Organisation (FAO)** with its central objectives being: achieving food security and eliminating hunger and malnutrition through promoting awareness and developing policies; facilitating coordination amongst food supply chain actors; and educating consumers on safe food handling, food storage, and identifying spoiled foods to prevent food waste.

- **United Nations Environment Program (UNEP)** is the leading global authority on environmental issues and sustainability. UNEP established and engaged in several relevant initiatives including Cool Coalition initiative, OzonAction program of the Montreal Protocol, Sustainable Food Systems Programme, *Think.Eat.Save* initiative, and others.

- **GFCCC (Global Food Cold Chain Council)** was formed as one of four lines of action organized under the United Nations Environment Programme's Climate and Clean Air Coalition (CCAC) HFC Initiative that were unveiled at the 2014 United Nations Secretary-General's Climate Summit. The Council seeks to simultaneously reduce food loss/waste and related greenhouse gas emissions in the processing, transportation, storage and retail display of cold food by expanding and improving access to energy-efficient low-global warming potential technology.

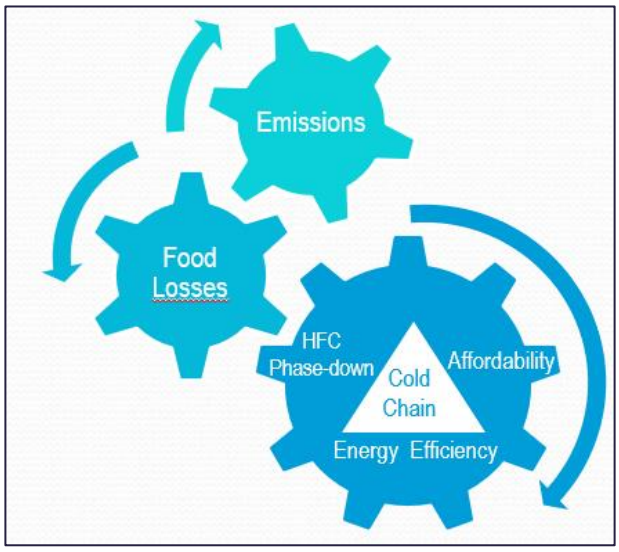
- **Champions 12.3** is a coalition of bottom-up, top-down, expert, and commercial groups committed to addressing SDG 12.3. The Coalition does this through a range of projects that include knowledge and best practices information sharing, publicizing food wastage and promoting sustainability, and identifying opportunities to enhance and encourage food sustainability.

- **Industry and specialized associations** which represent refrigeration professionals and industry around the globe offering a wide range of products and services related to cold chain applications and operation including standards, studies, guidelines, training, conferences, and events. Some of the key players, that have a global perspective in terms of their services, are the International Institute of Refrigeration (IIR), International Energy Agency (IEA), ASHRAE, Global Cold Chain Alliance (GCCA), European Partnership for Energy and the Environment (EPEE), and many others that are mainly active at regional or local levels.

THE CONCEPT

The Need for a Cold Chain Database

To quantify the contribution of the cold chain to food loss/waste, refrigerants & energy consumption, and economies; there is a need to better understand the complexity of the sector. In terms of applications, majority of non-standalone units are tailored/designed for a specific application or facility and not an off-shelf products. From the institutional perspective, it is also not an easy task to find detailed information, logs or statistics about cold chain capacities in most countries where several authorities are responsible for different segments of the sector, such as Agriculture, Industry, Economy, Environment, and other local entities.



Hence, understanding the cold chain challenges and gaps would facilitate the introduction of overarching strategies or policies to advance the wise selection of lower-GWP technologies, minimize food loss/waste, and eliminate unnecessary emissions at different operations and practices of cold chain. The database will be the cornerstone for building a sustainable path for the cold chain, in a country, using robust and validated detailed information about all sub-sectors vis-a-vis different economic segments.

Business as Usual (BAU)	Sustainable path
• The food production will continue to grow because of increased demand • Increased food loss/waste • Increased carbon dioxide emissions • Significant increase in required farmland area • Significant increase in water consumption	• Food loss/waste reduction • Deployment of Sustainable technologies • Less use of high-GWP refrigerants • Reduced carbon dioxide emissions • More responsible use of farmland areas • More responsible management of water use

What is the Cold Chain Database?

A model to quantify stocks, understand gaps and project scenarios of the cold chain applications at different cold chain processes through a comprehensive assessment methodology and a thorough data collection approach that captures information about technologies, refrigerants, food loss, energy, economics, and operation practices.

THE METHODOLOGY

Scope of Coverage

The cold chain database will cover analysis of data and information of 7 main sectors:

1) Primary production
2) Food and drink processing
3) Bulk cold storage
4) Refrigerated transport
5) Food and drink retail
6) Food service
7) Residential

Types of products handled by the food cold chain sector are grouped as follows:

A. Meat and poultry
B. Seafood
C. Dairy and eggs
D. Fruit
E. Vegetables
F. Beverages
G. Other processed products

Noting that pharmaceutical and vaccines applications are currently being part of food services classification but most likely will become a separate section with specific questionnaire.

1. Primary Cooling on farm / boat

2. Processing in factories

3. Bulk Storage

4. Refrigerated Transport

5. Food Retail

6. Food Service

7. Residential Storage

Outputs

Initial Output: understand current status, with assessment of:

- stock of cooling equipment in different parts of cold chain sectors
- energy usage and related CO2 emissions
- refrigerants usage and related CO2 equivalent
- levels of food loss linked to a lack of refrigerated food cold chain (RFCC)

Longer Term Output: assess future scenarios

- with different levels of improvement to RFCC, e.g. minimum, mid, maximum
- make assessment of:
  - investment required for each scenario
  - potential benefits (e.g. GHG reduction; financial value of food saved)
  - potential impacts (e.g. extra energy use / CO2 emissions)

Data Collection Stages

- **Stage 1:** Country Questionnaire, high level; using national data sources
  - host country to complete questionnaire
  - structured to collect available statistics on production, number of relevant food chain facilities, levels of food loss
- **Stage 2:** Country Research, detailed data e.g. via sample of site surveys
  - based on Questionnaire, develop a customised investigation plan
  - host country to collect detailed data based on this plan

Structure of the Data

The model is designed to capture the details and specifics of each sub-sector; therefore, the classification and categorization of sectors and sub-sectors was critical to ensure the comprehensiveness and inclusiveness of the model. In addition to the main 7 sectors that are identified, 20+ sub-sectors and 50+ sub-sub-sectors are being classified within the scope of work of the cold chain database model.

A detailed set of questionnaires have been developed to facilitate the stage-I and Stage-II data collection process. All questionnaires are also available in three languages (English, French and Spanish). As a sample, **Annex-1** represents an outline of the sectors/sub-sectors classifications vis-a-vis the International Standard Industrial Classification (ISIC). The data to be collected in each sub-sector includes 5 main topics:

1. Population and types of applications in each sub-sub-sector
2. Type, quantities, and service practices of refrigerants used for each type of application
3. Basic energy consumption data
4. Information about food loss estimates and causes
5. Basic capital and operating expenditures (CAPEX/OPEX) of different types of facilities

Piloting the Database

With the launch of the Cold Chain Database model concept in 2019, GFCCC and UNEP OzonAction cooperated to mobilize champion countries for piloting the model using thorough data collection methodology and cooperation with GFCCC-UNEP teams in validating their national data against the model. Currently, there are 6 countries from 5 regions piloting the model:

1. Bahrain (West Asia)
2. Bosnia and Herzegovina (East Europe)
3. Maldives (South Asia)
4. North Macedonia (East Europe)
5. Paraguay (Latin America)
6. Senegal (Africa)

Extending the Service

While the database is currently being piloted, GFCCC and UNEP OzonAction are expanding their line of service through offering the *Cold Chain Database Methodology* to interested governments and local institutions that are implementing relevant programs. The line of services includes several levels such as access to the complete methodology and data collection questionnaires, access to use the database interface platform, technical support to assist interested countries to review/validate their data as well as advance design of scenario modeling for analyzing possible benefits and impacts.

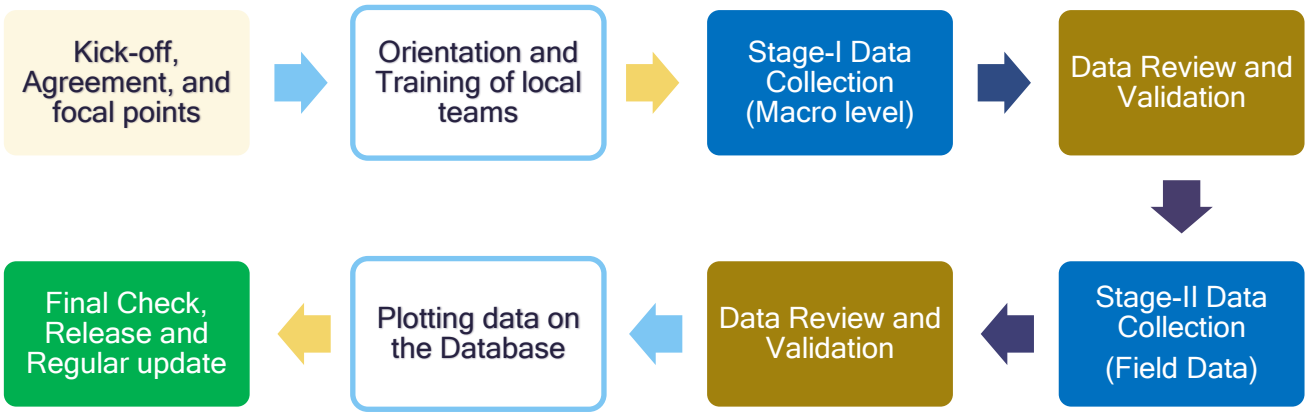
Local Stakeholders

The National Ozone Units (NOUs) are currently the main focal points for leading the work under this model in the 6 pilot countries. However, other entities might also be taking the lead at the national level depending on the local context, the connection with relevant programs, and the resources required to conduct the data collection. In principle, there are key local players that need to provide input (feed-in or validate data) to the model, regardless of the lead entity, which are:

- Agriculture and food authorities
- Statistics authorities
- Environment authorities
- Industry and trade authorities
- Energy authorities
- Technology providers
- Cold Chain associations & experts' groups

Suggested Timeline

The time required to plan each stage, gather field data, and review collected information will vary among countries; overall, countries should allocate 12-18 months to conduct the exercise. This timeline can be extended to 24 months for very large countries, taking into consideration logistical and intuitional aspects. **Annex-2** includes the timeline with steps and roles to be followed in piloting the database, while below show the different steps to be followed by the model (if the full service is requested).



Data management and Confidentiality

At different levels of this program, there are certain non-disclosure and confidentiality arrangements to be followed by all parties. These general principles can be summarized as follows:

- NOUs, or the local leading entity, as well as other cooperating local stakeholders, shall use the technical documentation, questionnaires and the final database platform only for data collection and presenting purposes and shall not share any of those documents outside this cycle without the consent of GFCCC & UNEP OzonAction.
- GFCCC and UNEP OzonAction, teams/experts, shall treat any country data shared for the purpose of piloting or providing technical support in a confidential meaner and shall not disclose any of its content to any third party.
- GFCCC and UNEP OzonAction shall not publish any country data, in full or partially, in any of their publications. However, an overall anonymous trend analysis for sample groups of countries and regions can be used for demonstrating value of the model and mobilize interest of other countries.

How to obtain the Cold Chain Database Model

If you need more information or wish to benefit from the model, please contact:

Kevin Fay
Executive Director
Global Food Cold Chain Council (GFCCC)
fay@foodcoldchain.org

James S. Curlin
Head
OzonAction – Law division
UN Environment Programme (UNEP)
jim.curlin@un.org

Annex-1

Classification of Sectors and Sub-Sectors Vs. ISIC

Sectors and Sub-Sectors				International Standard Industrial Classification (ISIC)				
Main Sectors	**Sub-sectors**	**Sub-sub-sectors**	**Key Cooling Requirements**	**Section**	**Division**	**Group**	**Class**	**ISIC Description** (Group or Class Level)
Primary production	**Farming**	On-farm milk cooling	Milk coolers; chilled tanks	**A**	01	014	0141 to 0149	Animal production
		On-farm product cooling	Product chilling			011 012	0111; 0113; 0119 0121 to 0129	Growing of non-perennial crops Growing of perennial crops
		On-farm cold storage	Chilled storage					
	Fishing	Land-based Ice production	Ice production plants and ice storage	**A**	03	031 032	0311, 0312 0321, 0322	Marine Fishing; Freshwater Fishing Marine Aquaculture; Freshwater Aquaculture
		On-boat fish cooling	Fish chillers and freezers; chilled / frozen storage					
Processing	**Dairy**	Liquid milk	Pasteurisation; chilled tanks; chilled store	**C**	10	105	1050	Manufacture of dairy products
		Cheese	Pasteurisation; cheese maturing warehouse					
		Butter	Pasteurisation; butter cooling; chilled butter storage					
		Ice cream	Pasteurisation; product freezing, hardening and storage					
		Yoghurts / desserts	Pasteurisation, product chilling; chilled product storage					
	Meat and fish	Abbatoirs	Carcass chilling / freezing; chilled / frozen storage	**C**	10	101 102	1010 1020	Processing and preserving of meat Processing and preserving of fish, crustaceans and molluscs
		Frozen / chilled raw products	Cutting room cooling; product chilling / freezing and storage					
		Cooked meat products	Cooked product chilling / freezing and storage					
	Fruit and vegetables	Frozen / chilled raw products	Fruit / vegetable chilling / freezing and storage	**C**	10	103	1030	Processing and preserving of fruit and vegetables
		Cooked fruit / vegetable products	Cooked product chilling / freezing and storage					

Sectors and Sub-Sectors				International Standard Industrial Classification (ISIC)				
Main Sectors	**Sub-sectors**	**Sub-sub-sectors**	**Key Cooling Requirements**	**Section**	**Division**	**Group**	**Class**	**ISIC Description** (Group or Class Level)
	Confectionery	Chocolate products	Chocolate tempering; product cooling tunnels	**C**	10	107	1073	Manufacture of cocoa, chocolate and sugar confectionery
	Bakery	Chilled / frozen baked products	Baked product chilling / freezing and storage	**C**	10	107	1071	Manufacture of bakery products
	Edible oils and fats	Margarines and spreads	Product cooling / solidification; chilled storage	**C**	10	104	1040	Manufacture of vegetable and animal oils and fats
	Prepared meals	Chilled meals	Raw material storage. Cooked product chilling. Cooked product freezing	**C**	10	107	1075	Manufacture of prepared meals and dishes
		Frozen meals						
	Other food products	Other food products	Various	**C**	10	107	1079	Manufacture of other food products
	Soft drinks	Carbonated and bottled waters	Water chilling	**C**	11	110	1104	Manufacture of soft drinks; production of mineral waters and other bottled waters
		Fruit Juice	Juice cooling; concentrate freezing; chilled /frozen storage	**C**	10	103	1030	Fruit juice is included in fruit and vegetable processing
	Alcoholic drinks	Beer, cider and wine	Wort cooling; fermenter cooling; beer cooling; chilled maturation; pasteurisation; yeast cooling and storage	**C**	11	110	1103 1102	Manufacture of malt liquors and malt Manufacture of wines
Bulk Storage	**Stand-alone warehouses**	Chilled storage	Air cooling in 0 to 10 ^{oC} range	**H**	52	521	5210	Warehousing and storage
		Frozen storage	Air cooling in -18 to -25 ^{oC} range					
		Pharmaceutical storage	Special storage requirements e.g. at very low temperature					

Sectors and Sub-Sectors				International Standard Industrial Classification (ISIC)				
Main Sectors	**Sub-sectors**	**Sub-sub-sectors**	**Key Cooling Requirements**	**Section**	**Division**	**Group**	**Class**	**ISIC Description** (Group or Class Level)
Transport	**Refrigerated transport systems**	Intermodal containers (reefers)	Chilled or frozen product storage during transport	**H**				
		Trucks and trailers		**H**	49	492	4923	Freight transport by road
		Vans						
		Rail waggons		**H**	49	491	4912	Freight rail transport
		Cargo ships		**H**	50	501 502	5012 5022	Sea and coastal freight water transport Inland freight water transport
		Air freight		**H**	51	512	5120	Freight transport by air
Retail	**Supermarkets**	Small (200 - 500 m2)	Chilled product retail display cases Frozen product retail display cases Bulk frozen / chill storage rooms	**G**	47	471 472	4711 4721 4722 4730	Retail sale in non-specialized stores with food, beverages or tobacco predominating Retail sale of food in specialized stores; Retail sale of beverages in specialized stores Retail sale of fuel in combination with food, beverages etc., with fuel sales dominating,
		Medium (500 - 2000 m2)						
		Large (2000 to 5,000 m2)						
		Hypermarkets (>5,000 m2)						
	Shops	Grocery	Chilled product retail display cases Frozen product retail display cases Bulk frozen / chill storage appliances					
		Butchers						
		Bakery						
	Vending machines	Drinks	Chilled storage (cans / bottle); in-line cooling (dispensed)					
		Snack food	Chilled product storage					
Food Service	**Restaurants**	Fast food	Chilled and frozen food storage cabinets, in-line drinks coolers, ice cream dispensers	**I**	56	551 559 561 562 563	5510 5590 5610 5621 5629 5630	Short term accommodation activities Other accommodation Restaurants and mobile food service activities Event catering Other food service activities Beverage serving activities
		Coffee shops						
		Other restaurants						
	Hotels	Small	Chilled and frozen food storage cabinets, walk-in chill/frozen storage, in-line drinks coolers, ice cream dispensers					
		Medium						
		Large						
	Pubs	Drinks only	Cellar cooling; in-line chillers; bottle coolers					
		With restaurant	As above + chilled and frozen food storage cabinets					
	Catering	Office canteens	Chilled and frozen food storage cabinets, walk-in chill/frozen storage, in-line drinks coolers, chilled display cases					
		Hospital catering						
		School catering						

Annex-2

Sample Timeframe and Roles for the Cold Chain Database (Example from Pilot Stage)

Cold Chain Database

About the Partners

Global Food Cold Chain Council (GFCCC)

An coalition of major HVACR companies and associations from around the world launched at the New York Climate Summit 2014. GFCCC Objective is to promote a sustainable food cold chain to feed an increasing world population by reducing food loss while addressing associated greenhouse gas emissions and advance sustainable technologies.

http://www.foodcoldchain.org/

UN Environment Programme - OzonAction

The United Nations Environment Programme (UNEP) is the leading global environmental authority that sets the global environmental agenda, promotes the coherent implementation of the environmental dimension of sustainable development.

UNEP is an Implementing Agency of the Multilateral Fund of the Montreal Protocol on Substances that Deplete the Ozone Layer. OzonAction strengthens the capacity of governments - particularly the operational focal points known as National Ozone Units - and industry in developing countries to elaborate and enforce the policies required to implement the Protocol and to make informed decisions about alternative technologies.

https://www.unep.org/ozonaction/

In cooperation with

Gluckman Consulting

Gluckman Consulting is a specialist technical consultancy providing expertise related to climate change mitigation and refrigeration. The firm provides services related to climate change mitigation are designed to help both policy makers and organisations that emit greenhouse gases to develop practical and cost effective initiatives to reduce emissions

http://www.gluckmanconsulting.com/

Expert Group

The Expert Group is an independent consulting firm with extensive experience working with government and private enterprise, in the development of climate change, energy efficiency and renewable energy policies and programs, as well as delivering innovative, practical and cost-effective solutions that help businesses to thrive in a highly competitive, carbon-constrained world.

http://www.expertgroup.com.au/index.htm