**SIDS Cold Chain Survey**

This document presents the main aspects that must be followed for the development of national surveys that must serve as a basis for the study on cold chain

**1. Introduction**

Basically, the food cold chain is composed of a set of equipment and logistical processes to control the temperature of food from production to the final consumer. The basic refrigeration equipment used is:

* Cold chamber
* Refrigerated truck and vessel
* Commercial refrigeration equipment
  + Stand alone units (ice cream freezers, bottle coolers, displays, …)
  + Condensing units
  + Supermarket central systems (compressor racks )
* Domestic refrigerator



Figure 1 The Food Cold Chain

Source: *IIR Informatory Note “The carbon footprint of the cold chain”, April 2021*

The vaccine and pharmaceutical cold chain is similar to the food cold chain involving:

* Cold rooms
* Freezers, refrigerators
* Cold boxes
* Carriers

that are fundamental for keeping vaccines and medicines at the right temperature during the journey from the manufacturing line to clinics and health centres.

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*Figure 2 The Vaccine Cold Chain*

*Source: https://www.paho.org/en/immunization/cold-chain*

Using refrigeration equipment and systems and logistical operations, the main objective of the cold chain is to control and monitor the temperature of different food, vaccines and pharmaceutical products throughout their life cycle, to guarantee their quality and preservation, based on temperature standards. The absence of an adequate cold chain is the main cause of food, and vaccines and pharmaceutical products losses, especially in developing countries.

The cold chain environmental impact is due to ODS and GHG refrigerant direct emissions and CO2eq indirect emissions (electricity consumption by stationary refrigeration equipment), and the CO2 emissions from the fuel consumption by refrigerated transport.

To understand the state of the cold chain in Small Island Developing States (SIDS) and estimate the present and future impact on the ozone layer and climate, and the food and vaccine/medicine losses caused by a deficient cold chain, a survey to obtaining and estimating basic information will be carried out. To assess future scenarios, the data obtained can/will be used in a modeling-based methodology. Modeling can be as simple as a curve fitting approach based on historical market data, or it can use more sophisticated methods depending on the data available and the schedule constraints adopted for the work.

**2. Objectives**

Develop a survey to collect cold chain data, which will allow UNDP to develop a study to assess the current situation of the cold chain in each SIDS and develop future projections related to climate impacts and food and vaccine/medicine losses, and identify the need to actions/projects to improve the cold chain and reduce these impacts.

Identify and categorize potential projects and investment plans on the cold chain from the private sector investors, evaluate the impact of considered technology v/s the gold standard in terms of food/ vaccine medicine losses and energy savings (TEWI).

**3. Activities**

National consultants should gather information on the main characteristics of the cold chain. The following tables with actual data or estimates should be completed where applicable. While it is understood that there could be data collection challenges, the consultants should exercise flexibility of providing more detailed data and information, especially on the sectors which are important for the country.

**Table 1 Food Cold Chain equipment and systems stocks and imports**

|  | **Stock (number of units)** | | | | | **Imported and/or installed (number of units)** | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Application** | **2017** | **2018** | **2019** | **2020** | **2021** | **2017** | **2018** | **2019** | **2020** | **2021** |
| Domestic refrigeration |  |  |  |  |  |  |  |  |  |  |
| * HFC-134a |  |  |  |  |  |  |  |  |  |  |
| * HC-600a |  |  |  |  |  |  |  |  |  |  |
| blowing agent used in equipment foam (please indicate the type of blowing agent used, for example cyclopentane or HCFC-141b). If possible, provide percentage of each blowing agent in the stock of refrigerators |  |  |  |  |  |  |  |  |  |  |
| Commercial refrigeration |  |  |  |  |  |  |  |  |  |  |
| * *Stand-alone units (ice cream freezers, bottle coolers, displays, …)* |  |  |  |  |  |  |  |  |  |  |
| * + R-404A |  |  |  |  |  |  |  |  |  |  |
| * + HFC-134a |  |  |  |  |  |  |  |  |  |  |
| * + HCFC-22 |  |  |  |  |  |  |  |  |  |  |
| * + Others (please specify) |  |  |  |  |  |  |  |  |  |  |
| blowing agent used in equipment foam. (Please indicate the type of blowing agent used, for example cyclopentane or HCFC-141b). If possible, provide percentage of each blowing agent in the stock of refrigerators |  |  |  |  |  |  |  |  |  |  |
| * *Condensing units* |  |  |  |  |  |  |  |  |  |  |
| * + R-404A |  |  |  |  |  |  |  |  |  |  |
| * + HFC-134a |  |  |  |  |  |  |  |  |  |  |
| * + HCFC-22 |  |  |  |  |  |  |  |  |  |  |
| * + Others (please specify) |  |  |  |  |  |  |  |  |  |  |
| * *Supermarket central systems (compressor racks)* |  |  |  |  |  |  |  |  |  |  |
| * + R-404A |  |  |  |  |  |  |  |  |  |  |
| * + HFC-134a |  |  |  |  |  |  |  |  |  |  |
| * + HCFC-22 |  |  |  |  |  |  |  |  |  |  |
| * + R-744 |  |  |  |  |  |  |  |  |  |  |
| * + Others (please specify) |  |  |  |  |  |  |  |  |  |  |
| Industrial refrigeration |  |  |  |  |  |  |  |  |  |  |
| * + R-717 |  |  |  |  |  |  |  |  |  |  |
| * + HFC-134a |  |  |  |  |  |  |  |  |  |  |
| * + HCFC-22 |  |  |  |  |  |  |  |  |  |  |
| * + Others (please specify) |  |  |  |  |  |  |  |  |  |  |
| Refrigerated transport |  |  |  |  |  |  |  |  |  |  |
| * + R-404A |  |  |  |  |  |  |  |  |  |  |
| * + HFC-134a |  |  |  |  |  |  |  |  |  |  |
| * + HCFC-22 |  |  |  |  |  |  |  |  |  |  |
| * + Others (please specify) |  |  |  |  |  |  |  |  |  |  |
| blowing agent used in refrigerated truck body foam |  |  |  |  |  |  |  |  |  |  |
| Cold Chambers[[1]](#footnote-1) |  |  |  |  |  |  |  |  |  |  |
| blowing agent used in cold chamber foam (please indicate the type of blowing agent used, for example cyclopentane or HCFC-141b). If possible, provide percentage of each blowing agent in the stock of refrigerators |  |  |  |  |  |  |  |  |  |  |

**Table 2 Food Cold Chain equipment and systems characteristics**

| **Application** | **Average refrigerant charge (kg)** | **Average emission factor**  **(% initial charge)** | **Average lifetime**  **(years)** | **Average cooling capacity**  **(kW)** | **Average coefficient of performance (COP)** | **Average runtime hours**  **(h/day)** |
| --- | --- | --- | --- | --- | --- | --- |
| Domestic refrigeration |  |  |  |  |  |  |
| * HFC-134a |  |  |  |  |  |  |
| * HC-600a |  |  |  |  |  |  |
| Commercial refrigeration |  |  |  |  |  |  |
| * Stand-alone units (ice cream freezers, bottle coolers, displays, …) |  |  |  |  |  |  |
| * + R-404A |  |  |  |  |  |  |
| * + HFC-134a |  |  |  |  |  |  |
| * + HCFC-22 |  |  |  |  |  |  |
| * + Others (please specify) |  |  |  |  |  |  |
| * Condensing units |  |  |  |  |  |  |
| * + R-404A |  |  |  |  |  |  |
| * + HFC-134a |  |  |  |  |  |  |
| * + HCFC-22 |  |  |  |  |  |  |
| * + Others (please specify) |  |  |  |  |  |  |
| * Supermarket central systems (compressor racks) |  |  |  |  |  |  |
| * + R-404A |  |  |  |  |  |  |
| * + HFC-134a |  |  |  |  |  |  |
| * + HCFC-22 |  |  |  |  |  |  |
| * + R-744 |  |  |  |  |  |  |
| * + Others (please specify) |  |  |  |  |  |  |
| Industrial refrigeration |  |  |  |  |  |  |
| * + R-717 |  |  |  |  |  |  |
| * + HFC-134a |  |  |  |  |  |  |
| * + HCFC-22 |  |  |  |  |  |  |
| * + Others (please specify) |  |  |  |  |  |  |
| Refrigerated transport |  |  |  |  |  |  |
| * + R-404A |  |  |  |  |  |  |
| * + HFC-134a |  |  |  |  |  |  |
| * + HCFC-22 |  |  |  |  |  |  |
| * + Others (please specify) |  |  |  |  |  |  |
| Cold Chambers |  |  |  |  |  |  |

**Table 3 Food Cold Chain - Refrigerated transport Fuel Consumption**

|  |  |  |  |
| --- | --- | --- | --- |
| Estimate number of refrigerated trucks | Estimate of average travel distance of refrigerated trucks  (km/day) | Estimate of average refrigerated truck cooling capacity  (kW) | Estimate of average diesel consumption  (l/km) |
|  |  |  |  |
|  |  |  |  |

**Table 4 Vaccines and pharmaceutical products cold chain equipment and systems stocks and imports**

|  | **Stock (number of units)** | | | | | **Imported and/or installed (number of units)** | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Application** | **2017** | **2018** | **2019** | **2020** | **2021** | **2017** | **2018** | **2019** | **2020** | **2021** |
| Refrigerators |  |  |  |  |  |  |  |  |  |  |
| * + R-404A |  |  |  |  |  |  |  |  |  |  |
| * + HFC-134a |  |  |  |  |  |  |  |  |  |  |
| * + HCFC-22 |  |  |  |  |  |  |  |  |  |  |
| * + Others (please specify) |  |  |  |  |  |  |  |  |  |  |
| blowing agent used in equipment foam |  |  |  |  |  |  |  |  |  |  |
| Refrigerated transport |  |  |  |  |  |  |  |  |  |  |
| * + R-404A |  |  |  |  |  |  |  |  |  |  |
| * + HFC-134a |  |  |  |  |  |  |  |  |  |  |
| * + HCFC-22 |  |  |  |  |  |  |  |  |  |  |
| * + Others (please specify) |  |  |  |  |  |  |  |  |  |  |
| blowing agent used in refrigerated truck body foam (please indicate the type of blowing agent used, for example cyclopentane or HCFC-141b). If possible, provide percentage of each blowing agent in the stock of refrigerators |  |  |  |  |  |  |  |  |  |  |
| Cold Chambers |  |  |  |  |  |  |  |  |  |  |
| blowing agent used in cold chamber foam (please indicate the type of blowing agent used, for example cyclopentane or HCFC-141b). If possible, provide percentage of each blowing agent in the stock of refrigerators |  |  |  |  |  |  |  |  |  |  |

**Table 5 Vaccines and pharmaceutical products cold chain equipment and systems characteristics**

| **Application** | **Average refrigerant charge (kg)** | **Average emission factor**  **(% initial charge)** | **Average lifetime**  **(years)** | **Average cooling capacity**  **(kW)** | **Average coefficient of performance (COP)** | **Average runtime hours**  **(h/day)** |
| --- | --- | --- | --- | --- | --- | --- |
| Refrigerators |  |  |  |  |  |  |
| * + R-404A |  |  |  |  |  |  |
| * + HFC-134a |  |  |  |  |  |  |
| * + HCFC-22 |  |  |  |  |  |  |
| * + Others (please specify) |  |  |  |  |  |  |
| Refrigerated transport |  |  |  |  |  |  |
| * + R-404A |  |  |  |  |  |  |
| * + HFC-134a |  |  |  |  |  |  |
| * + HCFC-22 |  |  |  |  |  |  |
| * + Others (please specify) |  |  |  |  |  |  |
| Cold Chambers |  |  |  |  |  |  |

**Table 6 Vaccines and pharmaceutical products cold chain - Refrigerated transport Fuel Consumption**

|  |  |  |  |
| --- | --- | --- | --- |
| Estimate number of refrigerated trucks | Estimate of average travel distance of refrigerated trucks  (km/day) | Estimate of average refrigerated truck cooling capacity  (kW) | Estimate of average diesel consumption  (l/km) |
|  |  |  |  |
|  |  |  |  |

**Table 7 Refrigerant imports (2017-2021, in kg)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **2017** | **2018** | **2019** | **2020** | **2021** |
| HCFC-22 |  |  |  |  |  |
| HFC-134a |  |  |  |  |  |
| R-404A |  |  |  |  |  |
| R-407C |  |  |  |  |  |
| R-410A |  |  |  |  |  |
| R-507A |  |  |  |  |  |
| HC-600a |  |  |  |  |  |
| HC-290 |  |  |  |  |  |
| R-717 |  |  |  |  |  |
| R-744 |  |  |  |  |  |
| HFO-1234yf |  |  |  |  |  |
| Others refrigerants  Please specify |  |  |  |  |  |

**Table 8 Food Cold Chain Frozen food imports (2017-2021, in kg)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Product** | **2017** | **2018** | **2019** | **2020** | **2021** |
| Dairy |  |  |  |  |  |
| Meat |  |  |  |  |  |
| Fish |  |  |  |  |  |
| Other (please add more as necessary) |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

**Table 9 Food Cold Chain Refrigerated food imports (2017-2021, in kg)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Product** | **2017** | **2018** | **2019** | **2020** | **2021** |
| Dairy |  |  |  |  |  |
| Meat |  |  |  |  |  |
| Fish |  |  |  |  |  |
| Other (please add more as necessary) |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

**Table 10 Vaccines and pharmaceutical refrigerated products imports (2017-2021)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Product** | **Quantity, number of units** | **2017** | **2018** | **2019** | **2020** | **2021** |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

**4. Other data/questions**

General

* What is the expected cold chain (equipment, business) growth rate?
* What is the estimate number of cold chain technicians?
* What is the estimate number of super-markets, retailors and numbers of employees?
* What is the estimate number of clinics and health centers using refrigerated vaccines and pharmaceutical products?
* Describe the importance of the fishery sector in the sector

Fishery sector

* Provide information about the companies involved with this sector
  + Name of the companies
  + Number of and capacity of boats
  + Number and capacity of cold storages
  + Number of people working in the sector
  + Number of independent fishers working in the sector
* Do fishing companies use ice or have refrigeration equipment in the vessels? If both options are use, could you please provide the distribution.
* Does your country have a fish processing industry?
* Does the country have an estimate of the amount of fish which isn’t processed and goes to waste?

Energy

* What is the country-specific emission factor for electricity production (kg CO2eq/kwh) and expected changes (e.g. due to the increasing importance of renewable energy)?
* Does the country have MEPS and labelling system for cold chain equipment? Please describe them
* What are government plans for MEPS and labelling?

Temperature Management

* What are, if existing, the regulations that manage and control the temperature of the frozen and refrigerated food cold chain? and refrigerated vaccines and pharmaceutical products?
* What are the temperature standards for the frozen and refrigerated food products? and for refrigerated vaccines and pharmaceutical products?
* How are the temperature standards monitored and controlled?
* What are the main gaps in the cold chain? and what could be done for increase the sustainability and reduce the losses?
* Is there any equipment in your country which has electronic components for temperature control? Is it trackable remotely by an app?

Business/companies

* For supermarkets, and cold storage companies, beer producer, ice producers, food export companies, fresh and frozen food production companies, central municipal market for fresh food (vegetables, meat, fish, dairy) the following data is requested:
  + Name of the company
  + Number and capacity of cold storages
  + Number of employees.
  + number of new or retrofit projects on 2022 and 2023, type of refrigeration technology being considered, estimated refrigeration Kw considered and investment main features
  + number of refrigerated containers that are being used as refers or cold rooms, type of refrigerant they use.

1. Please, indicate if it is a refrigerated container or a standard cold chamber. [↑](#footnote-ref-1)