Decommissioning and safe disposal of cold chain equipment

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World Health Organization

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Abbreviations and Acronyms

ADC	Authorized Decommissioning Committee
CCE	Cold Chain Equipment
CFC	Chlorofluorocarbon
CHAI	Clinton Health Access Initiative
EEE	Electric and Electronic Equipment
EMP	Essential Medicines and Health Products
EPI	Expanded Programme On Immunization
GAVI	Global Alliance for Vaccines and Immunization
GHG	Greenhouse Gas
HSS	Health System Strengthening
ICC	Inter-agency Coordinating Committee
IO	International Organization
LTA	Long Term Agreement
NGO	Non-Governmental Organization
NLWG	National Logistics Working Group
ODS	Ozone Depleting Substances
PIS	Product Information Sheet
PQS	Performance, Quality and Safety
PQT	Prequalification Team
SOP	Standard Operating Procedure
ToR	Terms of Reference
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
WEEE	Waste Electric and Electronic Equipment
WHO	World Health Organization

1. Introduction and overview

1.1. Welcome to users

Thank you for your interest in this document, entitled "DECOMMISSIONING AND SAFE DISPOSAL OF COLD CHAIN EQUIPMENT". This summary contains an overview of the guideline contents, its target audience, specific objectives, and structure. Let's get started!

1.2. Importance of Government involvement

When done incorrectly, the decommissioning and disposal of Cold Chain Equipment (CCE) can be detrimental to the environment and human health. Furthermore, the impact can place significant legal and financial burdens on the operators once CCE utilization ends. Obsolete CCE is often stored at the health facility because there is no provision made for decommissioning (including funding) and/or safe disposal of equipment. These are all reasons why governments – along with their private and public sector counterparts – must understand and proactively manage the environmental, social, and economic issues associated with the end of a CCE's life cycle as early as possible.

1.3. Guideline purpose and objectives

This guidance is not meant to supersede local, regional or national laws regarding CCE decommissioning and disposal practices but to provide assistance where there is insufficient guidance or none at all. There is no attempt to cover the management of other waste generated by CCE.

Specifically, the overall guidance objectives are to:

- **Raise the level of awareness and contribute to capacity building** on issues associated with decommissioning and disposal by providing an overview of CCE decommissioning and disposal challenges and issues, as well as background information on safe and proper practices.
- **Share key resources** related to decommissioning and safe disposal, including references and tools on policy and regulatory requirements, technical practices, and financial surety mechanisms designed to guarantee the implementation of decommissioning and disposal obligations.
- **Disseminate a generic CCE decommissioning and safe disposal guideline and process roadmap**, promoting a proactive approach of "thinking with the end in mind," that may be of interest to government authorities seeking to strengthen CCE decommissioning and disposal strategies, as well as to CCE manufacturers.

1.4. Who will find the guideline useful?

This guidance document can be used by all relevant health authorities, mandated to authorize the procurement, use, decommissioning or disposal of CCE. In many countries CCE decommissioning and disposal will also involve environmental and regulatory authorities, and experts at ministerial, regional and local level. Depending on the situation in the country, the appropriate authority may be a department responsible for CCE management within the ministry of health, the regulatory authority (if different from the former), a regional or local health authority or the ministry of environment, etc.

1.5. Key components of the guideline

This guideline hinges on five core components designed to facilitate a practical, effective, and flexible approach that governments may adopt or adapt in the process of identifying and managing their CCE decommissioning and disposal needs. The components are: (1) health and environmental considerations, (2) reasons for decommissioning and possible alternatives, (3) required framework, (4) decommissioning plan, and (5) technical and safety considerations.

2. Terms and definitions

Cold chain	The cold chain is the system used for storing vaccines in good condition. A cold chain system requires different types of equipment for transporting and storing vaccines and diluents within the required temperature range, including: walk-in cold or freezer rooms, freezers, refrigerators, cold boxes and vaccine carriers, coolant packs, voltage regulators and stabilizers, temperature monitoring devices, and refrigerated vehicles.
Commission	The process by which Cold Chain Equipment is distributed and installed in health facilities and is tested to verify it functions according to its design objectives or specifications.
Condemnation	Cold chain equipment is condemned when it has become out of order and can never be repaired or the repair is not cost effective. This equipment unnecessarily occupies space at the health facility and may be decommissioned and disposed after completing necessary formalities.
Decommission	A formal process which facilitates the planned removal of cold chain equipment from an active status in accounting records, and its storage in a secure and safe place until disposal.
Decontamination	All re-usable CCE to be disposed of should undergo decontamination. This is necessary to ensure that they are in a condition that makes them safe to be handled by all personnel who may come into contact with them during transit and subsequent handling. Processes to ensure that CCE are safe to handle can include cleaning, cleaning followed by disinfection and cleaning followed by sterilization. Decontamination should always be carried out in accordance with the equipment manufacturer's instructions.
Disposal	The process of remove cold chain equipment from the health facility or storage location includes different actions such as donation for other use than vaccines, sale, or destruction.
E-waste	E-waste is a term used to cover items of all types of electrical and electronic equipment (EEE) and its parts that have been discarded by the owner as waste without the intention of re-use. It is also referred to as WEEE (Waste Electrical and Electronic Equipment), electronic waste or E-scrap in different regions. E-waste includes a wide range of products, almost any household or business item with circuitry or electrical components with power or battery supply.
Inventory of CCE	The compiling of national Cold Chain Equipment data. The inventory captures and provides a record of the number, operational status, and age of all cold chain equipment in the country and identifies them by location, type, energy use, and model based on the following criteria: • The functional status of the Cold Chain Equipment. • Quality of cold chain equipment in the system (WHO PIS/PQS qualified and non-qualified). • Operational age and functionality of the Cold Chain Equipment. • Record of major maintenance interventions and spare parts requirements – to facilitate the procurement planning and to calculate the total cost of ownership including when to replace
Lifespan	The number of years a Cold Chain Equipment is expected to remain functional and in service.
WHO PIS (Product Information Sheet) & PQS (Performance, Quality, and Safety)	The Product Information Sheets (PIS), produced by WHO and UNICEF (published prior to 2001), provides as specific technical and purchasing data for individual selected items. The WHO Department of Essential Medicines and Health Products (EMP), Prequalification Team (PQT) sets standards and prequalifies vaccines and related products, including a range of Cold Chain Equipment. These standards are documented in the WHO PQS (Performance, Quality, and Safety) catalogue, which is being updated on a continual basis. The general information has been updated in PQS catalogue. The WHO PQS Catalogue is accessible online.
Procurement planning	The procurement of Cold Chain Equipment should not be an *ad hoc* undertaking, but rather the outcome of a proper planning process. Equipment is either purchased to expand cold chain capacity including new facilities, or to replace obsolete equipment. For budgeting purposes, it is important not only to consider the initial purchase cost of CCE, but also the running cost and cost of spare parts and consumables.
Refrigerants and foaming agents	Concerns over the depletion of the stratospheric ozone layer as a result of refrigerants and foaming agents have spurred a global effort to phase out the production and consumption of chlorofluorocarbons (CFC) and many others (i.e. HCFCs). Subsequent concerns over global warming have reinforced the need to eliminate these substances because they are also potent greenhouse gases. Montreal and Kyoto protocols provide more information and progress made in different countries
Thermal insulation	Insulation materials, which may take the form of fibers or foams, are used to reduce the rate of heat transfer and seal air leaks. There are some concerns surrounding the potential negative environmental and health impacts of insulation products. These concerns range from detrimental health effects for the individual installer to depletion of the earth's ozone layer.
Obsolete CCE	The performance of cold chains has been hampered by large quantities of outdated equipment which does not offer the same protective benefits as more recent designs. These previous-generation units often have poor temperature control and shorter holdover times. They often lack freeze protection, putting vaccines at risk and limiting the efficiency of cold chains. The identification of obsolete equipment that has surpassed its life span, either for economic or technical reasons, is crucial for replacement planning.

3. Full life cycle for Cold Chain Equipment

The cold chain equipment life cycle is divided in four phases:

- **First phase - "PLANNING"**: it consists in planning and assessment of the CCE needs in the healthcare facility based on its health workforce capability, target population to cover, and financing, in which the appropriate budgets are established for purchase and the total cost of ownership.
- **Second phase - "PROCUREMENT"**: this contains assessment and selection, covering how to decide which equipment meets the needs and specifications are written and a donation is agreed upon or a tender is developed.
- **Third phase - "LIFETIME"**: this phase starts with installation and commissioning of CCE, training of users and maintainers, the daily operation and safety for and by users, as well as maintenance and repairs.
- **Fourth phase - "DECOMMISSIONING AND DISPOSAL"**: this is the end of life of the CCE and disposal channels are defined and environment is considered, with clear regulations on e-waste disposal and CCE decommissioning, and technicians/health workers are skilled to do it.

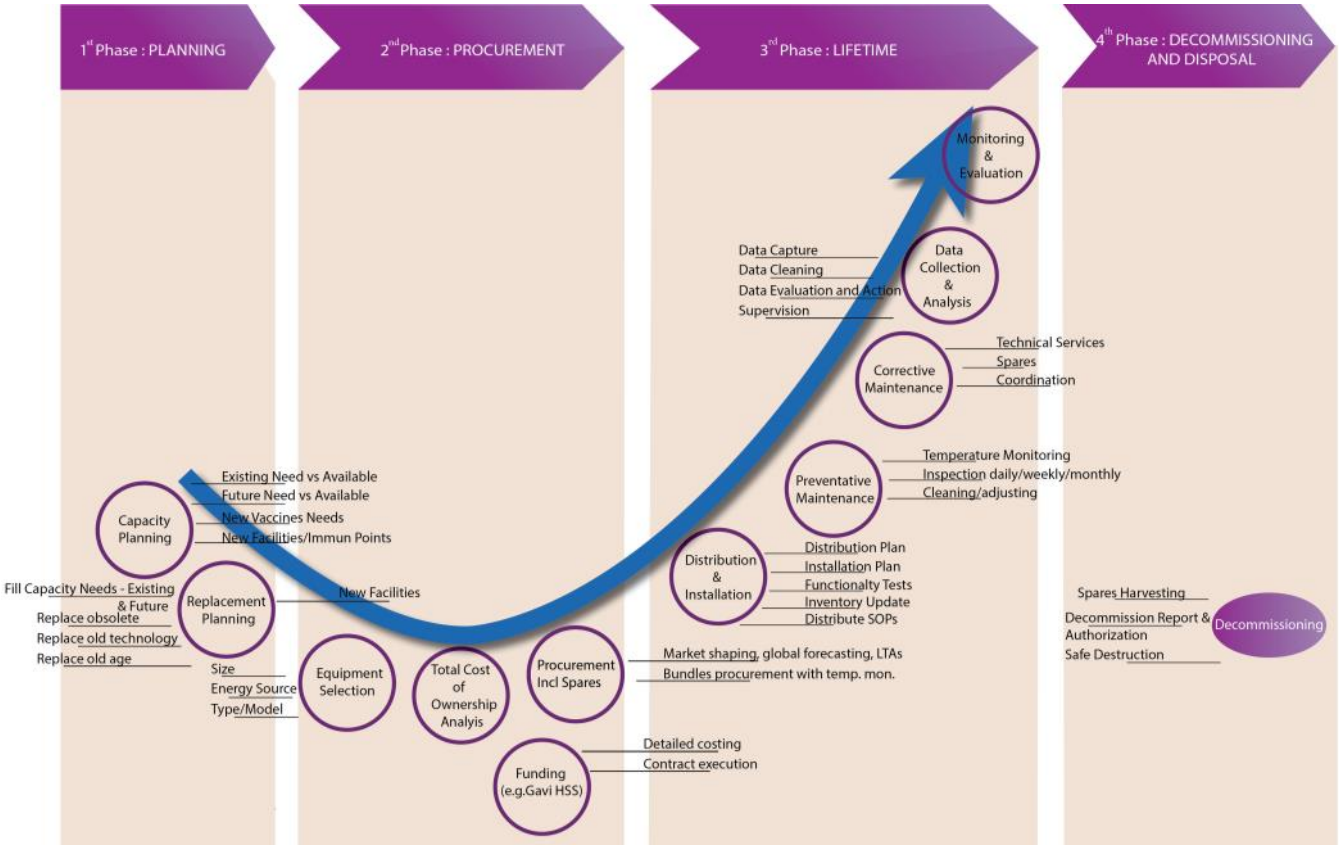


Figure 1: Life cycle of Cold Chain Equipment (adapted from T. Raubenheimer)

4. CCE disposal: Health and environmental considerations

Box 1. Why shouldn't countries just dump non-functioning CCE at health facility?

It's harmful to the environment and human health.

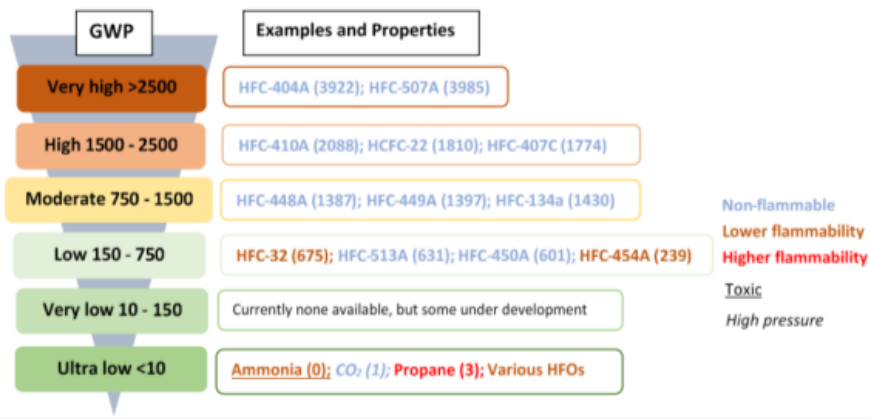
It is not aligned with Environment protection Law

Health facility can earn money by selling recovered refrigerant to a certified reclaimer.

Today many countries are facing the challenge of how to decommission and safely dispose of CCE in many health facilities. Refrigeration equipment has historically used oils, chemical refrigerants and/or insulating foam, all of which deplete the stratospheric ozone layer and contribute to global climate change; some products may also be toxic or flammable. In addition to accumulating in the atmosphere, these products, when released into the immediate environment, can affect occupants of health facility or become a fire hazard. For these reasons, it is crucial to prevent Ozone-Depleting Substance (ODS) refrigerants and ODS substitutes from being vented into the atmosphere while disposing of refrigeration equipment. Until 1995, the CFCs R11 and R12 were commonly used as refrigerant gases in compression refrigeration and as foaming agents for the insulation of refrigerators and insulated containers (cold boxes and vaccines carriers). Under the terms of the Montreal Protocol[1] and Kyoto Protocol[2] , the international community has committed itself to the elimination of these gases. CFCs have now been phased out worldwide, and HCFCs are now following. Therefore, immunization program managers should ensure that remaining CCE using CFC gases are responsibly managed by:

1. Keeping an inventory of CFC equipment and where it is installed.
2. CFC phasing out was supposed to be completed by 2010 – all such equipment should be decommissioned as a priority. But, making sure there is replacement equipment ready to prevent reducing vaccine cold chain capacity.
3. Making sure that CFC equipment is decommissioned in a responsible manner at the end of its lifespan and that the refrigerant is recovered and destroyed.

Box 2. Common refrigerants categorized by Global Warning Potential



[1] http://ozone.unep.org/en/treaties-and-decisions/montreal-protocol-substances-deplete-ozone-layer
[2] https://unfccc.int/resource/docs/publications/08_unfccc_kp_ref_manual.pdf

Consequently, there are environmental and safety challenges that countries must consider:

- Safety: Rapid evaporation of the liquid may cause frostbite. Vapor is heavier than air and can cause suffocation, and direct contact with CFC can cause breathing and heart problems, leading to possible death.
- Environment: The principal focuses of the environmental impact are the refrigeration source, but the thermal performance of cold room and refrigerator insulation[3] and the insulation of the bodies of refrigerated vehicles also have an impact. Leakage of these agents into the atmosphere during the service life of the equipment and during end-of-life disposal can therefore have an adverse environmental impact. Dumping non-functioning CCE in open sites is both an environmental and safety hazard. Governments are responsible for ensuring the appropriate decommissioning and disposal of non-functioning CCE, in accordance with its *e-waste*[4] *management* (Box 3) and hazardous waste management regulations.
- Requirements for appropriate decommissioning: At the end of its economic life, fixed refrigeration equipment and refrigerated vehicles shall be properly decommissioned. Indeed, refrigerants and associated materials – refrigerant recovery machines, refrigerant recovery bottles, and leak detectors – should be removed from the cooling equipment by a trained technician. It should be incinerated in an approved plant or recycled by a refrigerant manufacturer at an appropriate facility.

Box 3. What is e-waste or WEEE?

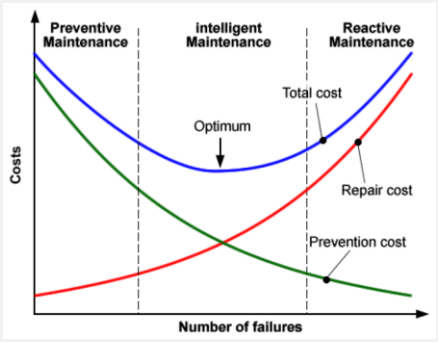
As the consumption and obsolescence of electronic commodities have intensified during the digital era, waste streams have grown more complex with massive quantities of globally generated electronic waste (**e-waste** or **Waste Electrical and Electronic Equipment** [WEEE]) changing the material nature, toxicity and value of the common urban waste stream.

The significant human health and environmental degradation associated with improper handling and treatment of waste electronics has become a priority concern on the contemporary sustainable development agenda.

5. Reasons for decommissioning and possible alternatives

The lifespan of refrigeration equipment depends largely on the operational cost of its utilization and its maintenance. Actual cost of maintenance may be different for each country and each model of CCE. Consequently, assets should be estimated based on a cost-benefit criterion. In most countries, equipment is valued on the basis of historical cost. Asset and financial management should be reassessed from the initial expected life that was assigned when the assets were acquired, even though actual lifespan might have exceeded the initial expected lifespan. Indeed, at the end of its economic life, CCE needs to be decommissioned and removed from the health facility. There are different reasons for CCE decommissioning and it will depend on its condition and operational cost.

Box 4. Optimum maintenance cost



5.1. CCE operational conditions

- Unserviceable or beyond economic repair: Damaged beyond economical repair, damaged by contamination, absence of manufacturer/supplier technical support, or non-availability of spare parts and consumables.
- Obsolete: Passed its life span, clinically or technically obsolete, or change in policies for device use.
- Unsafe or standards not met: Does not comply with safety requirements from manufacturer or international protocols.
- Costly: Not economical to use versus market value.

[3] Insulation limits heat exchange transmission. This reduces the size and refrigerant charge needed for the cooling machinery, reduces energy consumption, and hence limits CO2 emissions from the refrigeration plant.

[44] http://web.unep.org/ietc/what-we-do/e-waste

- Surplus to requirements
- Replace
- Lost/stolen: Lost, stolen assets must be reported on the 'CCE disposal form" (tool 4) following which the Fixed Asset Register will be updated. In the case of stolen CCE, the custodian/budget holder is also responsible for reporting to the Police. When recording the stolen CCE, the police report number should be included in the CCE disposal form.

When assets are approved for decommissioning, then there are several disposal methods as described in table 1.

Box 5. How to assess CCE re-use pathway?

Answer the following questions:

- Is the equipment to be traded-in?
- Is the asset of value to the original site?
- Does the equipment have possible value for other health facilities? Or other services?
- Does the CCE have possible value for external buyers or for donation?

If "No" to all questions above, then CCE should be recycled or disposed safely

Table 1: Decommissioning reasons and disposal methods

Conditions	Disposal Metho				
	Donation	Trade-in	Sale or public auction	Transfer to other services or facility	Recycled or spare part harvesting
Unserviceable					x
Obsolete	x	x	x	x	x
Unsafe					x
Ineffective for vaccines	x		x	x	x
Costly	x		x		x
Surplus	x		x	x	x

5.2. Disposal methods

1) Donation: equipment is not needed, in good technical condition, and meets safe refrigerant requirements. Donations to other health facilities must follow national guidelines for health equipment donations.
2) Sale: equipment is not needed and has a market value. The auction or sale will follow government law determining the procedure for disposal of state assets.
3) Transfer to another procurement entity or health programme:
4) Destroyed or cannibalized: Allowed authority to identify a public or private institution with capacity to properly destroy the CCE according to manufacturer instructions and international standards.

6. CCE decommissioning and disposal framework

The assets in the public sector are procured, operated, maintained, and efficiently decommissioned to provide optimum economic and social benefits to society. This is why the Cold Chain Equipment decommissioning framework shall be decided in accordance with the government's principles and policy for the disposal of assets and obsolete equipment. In February-March 2018, a desk review and a rapid survey conducted in 44 UNICEF and WHO supported countries revealed the absence of clear directions and guidance on the National Immunization Programme's CCE decommissioning and disposal.

Box 6. What are key components of Sustainable Decommissioning?

- Clear identification of CCE **ownership**
- A **robust policy, legal and regulatory** framework that specifically addresses CCE decommissioning and disposal.
- A set of accepted **good practice guidelines** on aspects related to CCE decommissioning.
- Sufficient and reliable **financial assurance** to enable implementation.
- **Monitoring** of established requirements.
- **Stakeholders'** consultation and engagement.

6.1. Formal CCE ownership by government

The question of asset ownership must be clearly addressed, as CCE can be procured by governments and also donated by development partners. In the event of donation, the CCE's ownership must be properly transferred by donors (multilateral,

bilateral cooperation, and NGOs) to the government for maintenance and legal compliance. This is a critical starting point for equipment commissioning and decommissioning. Indeed, the transfer of formal ownership will enable CCE to become an asset, owned and controlled by government agencies.

6.2. Policy, legal and regulatory framework

The purpose of policy is to lay out the requirements for disposing of Cold Chain Equipment assets under a holistic framework that allows the government to obtain the best value and to be consistent with the general policy for the control of assets. Linking disposals with the government's environmental strategy will ensure that the portfolio of assets remains efficient and safe. A critical requirement at the country level is to develop a CCE decommissioning system and outline practical procedures that enable the government to effectively manage the performance of CCE throughout its lifespan. This is essential to achieve the lowest-cost solution for the acquisition, use, maintenance, and disposal of assets in a manner that is consistent with national policies, priorities, and objectives. It is then strongly recommended that existing healthcare and biomedical equipment guidelines include sufficient and clear procedures on CCE decommissioning and disposal. In some countries, the healthcare equipment decommissioning procedure refers to regulations on national e-waste[5] management and hazardous waste management (Rwanda), and to the Public Procurement Act (Ghana).

Box 7. Why an Authorized Decommissioning Committee?

- Inspection and decision for CCE decommissioning should be clearly assigned to an Authorized Decommissioning Committee
- Best practices demonstrated added value of such entities: National Logistics Working Group (NLWG), Health Facility Asset Disposal Valuation Committee in Rwanda, National Advisory Committee on Medical Equipment in Uganda, and Board of Survey in Ghana

6.3. Authorities to decommission

In accordance with government regulations, healthcare decommissioning and disposal should be decided by an *Authorized Decommissioning Committee* responsible for CCE inspection, decommissioning approval, and necessary steps for disposal. When making decisions on assets for disposal, a designated disposal/decommissioning group should at the very least be composed of representatives from the following legal authorities: Public Procurement, Ministry of Finance, Health and Infrastructure Division, National Immunization Program, Ministry of Environment Affairs, and a qualified technician or engineer, or a member with technical knowledge of the asset. In some countries this may be prescribed by the Auditor General or whoever is in charge of the auditing of assets.

6.4. Multi-sectorial approach to engage relevant stakeholders in CCE decommissioning

One of the key challenges of CCE decommissioning and disposal is the need to engage all stakeholders in the national strategy to safely remove, transfer, and dispose of CCE. It is strongly recommended not to restrict CCE decommissioning dialogue to the health sector, but preferably to broaden this question to other sectors in the country such as:

- Public procurement: Ministry of finance. As soon as CCE ownership is transferred, the Ministry of Finance becomes directly involved in the control of assets. Therefore in Figure 2 they will move to the center for high involvement
- Environment Protection: Ministry of Environment.
- Private business: CCE manufacturers (equipment return to vendor or representatives of the vendor in the country), Waste of Electrical and Electronic Equipment Recycling firms, Refrigerant Reclaimers.
- NGOs: Health and environmental nonprofit organizations.
- International Organizations: UNICEF, WHO, and UNEP.

[5] E-waste and Waste Electric and Electronic Equipment (WEEE) are terms used to cover all types of equipment with circuitry or electrical components with a power or battery supply. E-waste is discarded as waste with out the intention of re-use.

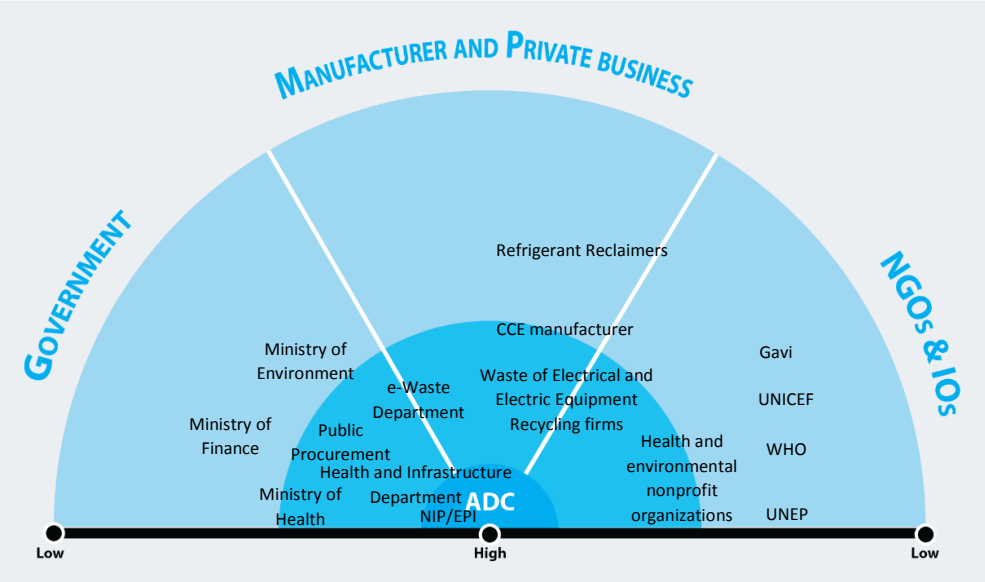


Figure 2: Degree of stakeholders' involvement

Countries shall adopt a multi-sectorial approach to coordinate efforts for the safe and sustainable disposal of hazardous equipment, aligned with existing environmental laws and in partnership with local recycling firms.

Stakeholder mapping is a key strategy to develop a CCE decommissioning policy or update existing ones.

7. Decommissioning process and planning

Figure 3: Decommissioning process

Decommissioning of any assets shall be undertaken in accordance with the designated public laws, regulations, and accounting practices in that country. Specifically, the Cold Chain Equipment disposal procedure shall align with the government procedure on e-waste and any law on Environment Protection. The equipment must be correctly decommissioned and decontaminated prior to transfer or disposal. The recommended process to properly decommission CCE is outlined in Figure 3.

7.1. Process for CCE decommissioning

STEP 1: NOTIFICATION

Responsible: CCE users, technicians

Users or technicians who identify that CCE has reached the point where it should be decommissioned shall notify health facility management, utilizing a specific notification form (Tool 2). Based on the notification, a qualified engineer will conduct a technical assessment of the CCE and update the incident form, which will then be transferred to the Authorized Decommissioning Committee[6] (ADC). In some countries, the Health and Infrastructure Department or other services in charge of maintaining biomedical equipment within MoH, will conduct the assessment.

STEP 2: CONDEMNATION

Responsible: ADC, Cold Chain Manager

The Notification form is sent to the ADC to inspect, approve condemnation, and remove CCE from the health facility. The committee can request additional expertise to verify criteria:

- CCE details: Description, serial number, location, date of commissioning, installation date, manufacturer, funding source, product code, and property code.
- Depreciated value: this will depend on countries' practices and asset management regulation.
- Condition:

1-	Excellent	2-	Good	3-	Fair	4-	Poor	5-	Not functional

- Reason for removal/transfer/disposal:

B	Beyond Economic Repair	S	Surplus to requirements
O	Obsolete	R	Replace
L	Lost/Stolen	SN	Standards not met

The ADC decides on removal-transfer-disposal or re-use. Considerations should be given to the principles of salvage and disposal:

- Obtaining value for money in the expenditure of public finance.
- Ensuring accountability, compliance with processes and procedures, and transparency in procurement operations.

When CCE is condemned, the ADC completes the Condemnation Form Tool 3 for the health facility. The equipment should immediately be removed from the health facility. The ADC might instruct Public Procurement and/or the Cold Chain Manager to develop a dedicated condemned CCE database for monitoring and evaluation.

STEP 3: DECONTAMINATION

Refrigerated Equipment Decontamination: Processes to ensure that equipment and medical devices are safe to handle can include cleaning, cleaning followed by disinfection and cleaning followed by sterilization. A trained technician should decontaminate the CCE before disposing of it or transferring it to a third party. He/she should provide a certificate of decontamination (Tool 6).

STEP 4: REMOVAL

Responsible: Cold Chain Manager/Assets Manager, Technicians

The following operations are recommended for CCE removal:

[6] Members should, at the very least, comprise representatives from Public Procurement, Ministry of Finance, Control of state assets, Health and Infrastructure Division, National Immunization Program, Ministry of Environment Affairs, and a qualified technician or engineer – or a member with technical knowledge of the property

1. Communication to users: The technician/engineer and health facility management are responsible for informing users that the CCE has been condemned and must immediately be removed from the service.
2. Safe removal from service: The technician is responsible for disconnecting electrical and water connections and any other accessories from the CCE.
3. Transfer to safe and secure storage: The technician/engineer appropriately packages, labels, and transfers it to storage.
4. Special storage: Storage must be secured, well organized, and environmentally safe (well ventilated and dry). The time unwanted CCE is kept in storage should not exceed 3 months to reduce risks and holding costs.
5. Update ECF transfer-disposal database: Date condemned, equipment references, quantity, and current value).

STEP 5: TRANSFER

Responsible: Cold Chain Manager/Assets Manager, Technicians

The transfer of CCE depends on the initial method of disposal and re-use of assets:

R	**Recycled**	**IT**	**Internal Transfer**
T	**Trade-in**	**Do**	**Donated**
SP	**Spare Parts**	**ES**	**External Sale**
D	**Dumped**	**NA**	**Not Applicable**

Once the CCE has been assessed and deemed of value to another health service or health facility and/or to an ***external sale/donation/trade-in***, it is available for transfer. A CCE transfer/disposal form should be utilized (Tool 4).

STEP 6: REUSE CCE AND DISPOSAL

Responsible: Cold Chain Manager/Assets Manager, Technicians

Ineffective CCE for vaccines and surplus equipment that are not in use but in good working condition can be transferred to another health service within the same district and if no need, to other facilities beyond the district. If this is not possible, or if the equipment is beyond its useful life, then it must be disposed. Indeed, when CCE doesn't meet criteria for re-use, it is designated to be disposed of or recycled. A health facility is responsible for the safe and appropriate recycling/dumping of CCE, and for ensuring its electrical and mechanical parts are disabled and unable to be re-used in accordance with the manufacturers' instructions and national regulations:

- Refrigerant component recovery/removal: Trained staff involved in the disposal of refrigeration equipment must use approved recovery equipment. If no in-house qualified or certified technicians are available to perform refrigerant recovery from CCE at the time of disposal, a company with certified technicians should be hired.
- Solar CCE, solar panels and batteries which could have a longer lifespan and can be re-utilized. Solar equipment should be handled separately with its own assessment and disposal procedure. It may be appropriate to combine it with spare parts to be harvested which also requires an assessment for re-usability of its own (Figure 4).

MONITORING AND REPORTING

Responsible: Cold Chain Manager/Assets Manager, Technicians

- Updating CCE inventory: The CCE manager is responsible for withdrawing assets from the CCE register and inventory. As per financial and procurement regulations, condemned CCE shall be recorded in the Asset Register.
- Updating the transferred and disposed CCE database: The CCE manager is responsible for updating the dedicated database of condemned equipment to accurately reflect which CCE has been decommissioned, including the disposal method. Likewise, it is crucial to monitor the storage duration of unwanted CCE and make decisions before deadlines are reached.
- Reporting: At the end of the fiscal year, health facilities should submit a report to ADC detailing the quantity and value of CCE that has been condemned and disposed of.

7.2. Decommissioning plan

Considering planning for CCE decommissioning requires countries to be well aware of key challenges in decommissioning. The following concerns shall be addressed when developing CCE decommissioning plan:

- Unclear national regulations and SOP on CCE disposal.
- Disposal channels are unavailable when equipment reaches the end of its life.
- When disposing CCE, environment is not considered.
- Companies that buy old CCE don't exist or are unknown.
- Technicians and staff are not trained to properly decommission condemned CCE.
- There is no agreement between government/donor and manufacturer to take responsibility for the equipment that is being disposed.

Consequently, country CCE decommissioning plan should integrate mitigation actions to make sure equipment will be properly decommissioned and disposed. CCE decommissioning plan's key components are suggested as Tool 1.

7.3. Budgeting CCE decommissioning costs

Expenses for the removal, transfer, and disposal of CCE should be part of the maintenance budget. These costs could be recouped from the recipient if re-used: new owners, external buyers, and recipient. Budgets should take into account the following costs:

- Storage overheads (indirect costs)
- Direct transactional costs (labor overheads)
- Operation costs (repair/replace parts, manual consumables)
- Logistics (packaging, freight, transport)
- Decontamination, salvage and disposal, recycling

8. Refrigerant disposal procedure: Technical and safety considerations

In regard to refrigerator recycling, harmful chemicals should be properly disposed of and any reusable materials such as metal should be recycled. This is done to prevent unnecessary harm to humans, animals, and plant life.

8.1. Refrigerant Recovery Equipment requirements

Technicians, engineers and other personnel involved in the disposal of refrigeration equipment must properly use refrigerant recovery equipment. It is mandatory to check with ministry of health, ministry of environment and other relevant ministries if any regulation defines national standards or certification requirements to approve certified staff or organizations to perform refrigerant recovery.

Specifically, the final staff in the disposal chain is responsible for performing the following operations:

- If recovering is done by Government agencies (Infrastructure and equipment Department/MoH or Ministry of Environment): A trained/certified technician recovers any remaining refrigerant from the CCE in accordance with the national regulation.
- If recovering is performed by a third party: Staff notifies the third party that the refrigerant must be properly removed before delivery to the destruction/recycling facility. Staff shall verify that refrigerants have been removed from the equipment first. The notification shall be the form specified in the national regulation.

Box 8. What are harmful chemicals?

CCE may contain hazardous components, including used oil, polychlorinated biphenyls (PCBs), and mercury.
Some refrigerators and freezers manufactured prior to 2000 have mercury-containing components (i.e., switches and relays). Equipment manufactured prior to 1979 may contain PCB capacitors. For this reason, CCE should be recycled by facilities that safely remove these components prior to shredding and recycling.

8.2. Storage, destruction and reclamation of recovered refrigerant

Once the refrigerant is recovered, it may be destroyed, reclaimed for sale, or stored safely to prevent emissions.

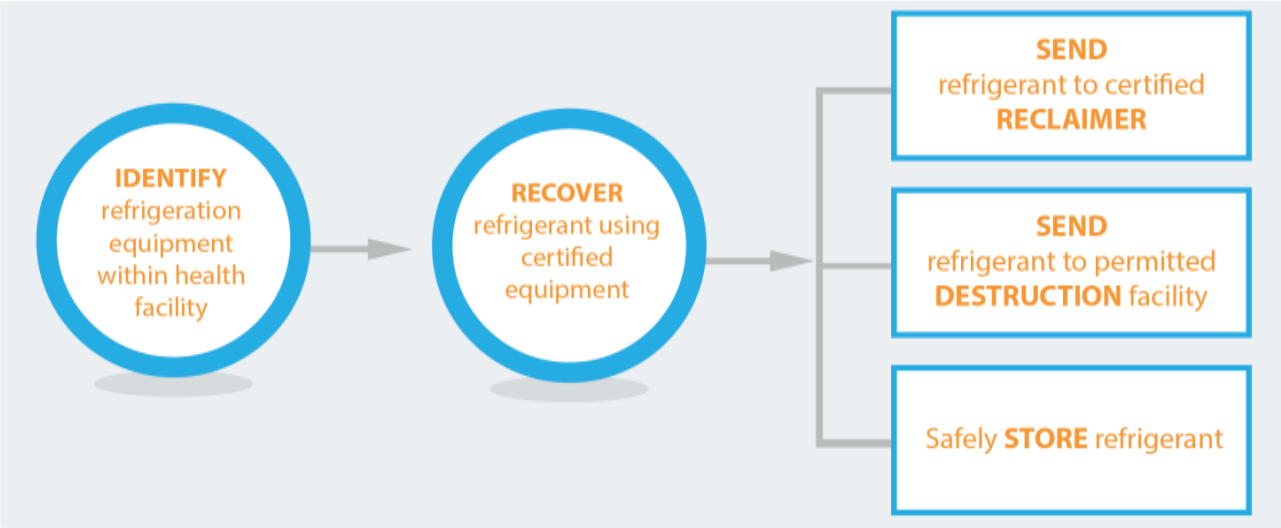


Figure 4: Steps to dispose refrigerants

1) Storage: It must be stored in specific refrigerant cylinders, as illustrated in Figure 5.
2) Destruction: The recovered refrigerant must be sent to a destruction facility which uses one of the following destruction technologies: liquid injection incineration, reactor cracking, gaseous/fume oxidation, rotary kiln incineration, cement kiln, or radio frequency plasma. It is recommended to verify National Regulations.

Figure 5: Refrigerant Cylinders

3) Reclamation: The refrigerant shipment must be sent to a certified refrigerant reclaimer. A list may be available at the Ministry of Environment.

9. Toolkit

Tool 1: CCE Decommissioning plan

POLICY, REGULATION, GUIDELINE
– Create awareness and develop/revise CCE policy and practical guideline & tools, aligned with existing Public Procurement, Finance, and Environment Protection Laws. – Explain the environment impact to decision makers. – Conduct in-country stakeholders mapping: ministry of health, ministry of finance, ministry of environment, UN agencies (WHO, UNICEF, UNCEP), WEEE recycling companies, Refrigerant reclaimer, NGOs. – Establish or use existing Authorized Decommissioning Committee to inspect, approve, and decide for disposal method. Specify ToR and disposal channels.
BUDGETING
1- As part of the maintenance strategy, costs for decommissioning should be estimated: – Storage overheads (indirect costs) – Direct transactional costs (labor overheads) – Operation costs (repair/replace parts, manual consumables) – Logistics (packaging, freight, transport) – Decontamination, salvage and disposal, recycling 2- Value for re-used CCE shall be estimated (*)
OPERATIONS AT HEALTH FACILITY
Training of users, technicians, engineers, asset managers on decommissioning procedure and tools to be able to: – Notify – Execute safe removal of condemned CCE – Store properly condemned CCE – Monitor and report on effective disposal: re-used, recycled, and destroyed.

***(*)**The approach will depend on Countries' practices and regulations. For example in some countries, estimation of value can use sales comparison cost approach which takes all forms of depreciation into account: physical, functional, and economic.*

Tool 2: CCE Notification form

Request for CCE Condemnation Assessment	
Health Facility Details	
Health Facility Name:	
Department:	
Equipment Details	
Name:	
Model No:	
Serial No:	
Inventory No:	
Manufacturer:	
Reason for Notification:	
Department User	
Name:	
Position:	
Signature and Date:	
Received By (Authorized Decommissioning Committee)	
Name:	
Position:	
Signature and Date:	

Tool 3: CCE Condemnation form

CCE Condemnation form			
Health Facility Details			
Health Facility:			
Department:			
Equipment Details			
Name:		Model No:	
Serial No:		Inventory No:	
Manufacturer:		Purchase Date:	
Purchase Price:		Accumulated Depreciation:	
Current Value:		Estimated Remaining Life Span:	
Equipment Assessment			
Clinical Testing Results:			
Technical Testing Results:			
Assessment Conclusion:	□ Condemned □ Not condemned		
Reason for Condemnation	□ Beyond economical repair □ Technically obsolete □ Other (Specify)	□ Beyond life span □ Clinically obsolete □ Damaged by contamination	
Engineer/Technician Details			
Name:			
Position:			
Signature and Date:			
Approved By (Authorized Decommissioning Committee)			
Name:			
Position:			
Signature and Date:			

Tool 4: CCE disposal form

CCE Disposal Form			
Health Facility Details			
Health Facility:			
Department:			
Equipment Details			
Name:		Model No:	
Serial No:		Inventory No:	
Manufacturer:		Purchase Date:	
Purchase Price:		Accumulated depreciation:	
Current Value:		Estimated Remaining Life Span:	
Disposal Details			
Method	□ Donation □ Sale □ Transfer □ Destruction/cannibalized □ Other □ Lost/stolen - specify Police report number: _____		
Estimated Disposal Cost			
Comments:			
Engineer/Technician Details			
Name:			
Position:			
Signature and Date:			
Approved By (Authorized Decommissioning Committee)			
Name:			
Position:			
Signature and Date:			

Tool 5: Certificate of equipment decommissioning

CERTIFICATE OF EQUIPMENT DECOMMISSIONING

Please note that no one should be exposed to hazardous products whenever equipment is decommissioned or disposed of. Therefore decontamination must be done by a technician or skilled personnel **before** any repair, transfer or disposal.

Complete and sign this form **before** sending health or biomedical furniture, apparatus or equipment for repair, relocation or disposal, and before on-site servicing. Attach the certificate to the item and keep a copy for your records.

Description of equipment	_____
Manufacturer	_____
Model/Type	_____
Serial Number	_____

Type of Hazard	YES	NO
Chemicals: Has this equipment been in contact with HAZARDOUS MATERIALS (for example: sensitizers, toxics, carcinogens, mutagens, teratogens)?	☐	☐
Biohazards / Biological materials: Has this equipment been in contact with any: • Biological material? • Blood? • Body fluid? • Excreta?	 ☐ ☐ ☐ ☐	 ☐ ☐ ☐ ☐
Is there any electrical connection remaining?	☐	☐
Is there any remaining connection to compressed air or compressed gas?	☐	☐
Is there any residual part under pressure or any residual energy left in the equipment?	☐	☐
Is there any moving parts? Have you performed the appropriate lock-out procedure?	☐	☐
Other hazards (please specify in *Decontamination procedure description*). _____ _____	☐	☐

Decontamination procedure description:

For each of the hazard category specified in page one, please describe the decontamination procedure completed.

_____
_____
_____
_____
_____

Decontamination performed by:

_____

Name Signature Date

Owner's statement:

I certify that the equipment has been decontaminated as described above and that I am not aware of any other items or special circumstances that are not listed on this form.

_____ _____
Name Signature

_____ _____
Department, Building, Room number Telephone

Tool 6: Decontamination certificate

DECONTAMINATION STATUS

IMPORTANT – HAS THIS EQUIPMENT BEEN CONTAMINATED BY ANY BIOLOGICAL MATETIAL, BLOOD, AND BODY FLUID OR EXCRETA? **YES □** **NO □**

HAS IT BEEN CLEANED? **YES □** **NO □**

Signature ……

Name (print) ……

Ward/Department ……Date……

(This label must be completed prior to equipment being transferred)

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