Measuring and reducing the environmental impact of UNFPA's humanitarian supply chain

Analysis and recommendations

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Executive summary

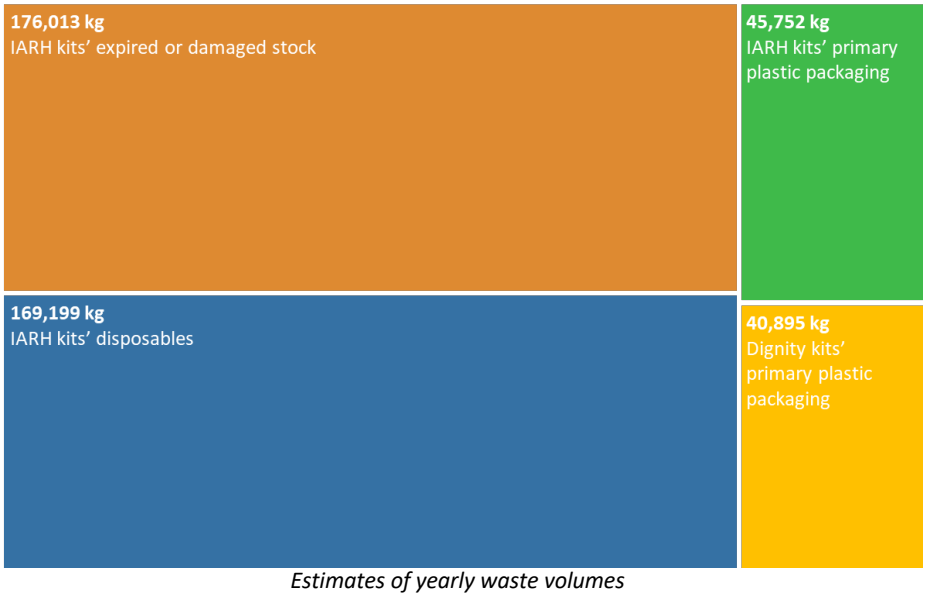
Humanitarian operations present a significant environmental footprint, with an impact at both local and global level. In face of today's climate and environmental crises, and following the "do no harm" principle, understanding and reducing aid's humanitarian footprint is as an urgent task. This report evaluates how UNFPA's humanitarian supply chain is impacting the environment, considering waste and greenhouse gas (GHG) emissions, and for kits specifically. Operational and structural recommendations are then proposed to further help UNFPA reduce its environmental footprint.

Analysis: approach

To understand how UNFPA's humanitarian supply chain is impacting the environment a zoom out – zoom in approach was followed. The zoom out step was fully qualitative, aside from some analysis of pre-existing quantitative data. Through key informant interviews with internal and external actors and a thorough desk review, UNFPA's supply chain was mapped (considering physical flows and processes), environmental pain points were identified, together with ongoing mitigation measures and further potential leverages. The zoom in step was mostly quantitative. To evaluate the volumes of waste, the analysis zoomed in on the waste types perceived as the most critical to UNFPA: (i) expired and damaged stock for IARH kits, (ii) disposables for IARH kits, (iii) primary plastic packaging materials for IARH kits as well as for (iv) dignity kits. For each of these waste types, their yearly volume was estimated based on procurement data and a large set of assumptions. To evaluate the volumes of GHG emitted throughout UNFPA's humanitarian supply, the analysis zoomed in on one kit (IARH kit 6B) and performed a life cycle assessment considering three international distribution scenarios: distribution of the kit from a supplier in the Netherlands (Supplier A) to a given country (Country X) by air (Scenario 1), and by sea (Scenario 2), as well as distribution to that same country from pre-positioned stock in Dubai by sea (Scenario 3).

Analysis: waste results

The below graph illustrates the results of the waste analysis. The size of the rectangles reflects the corresponding waste volume.



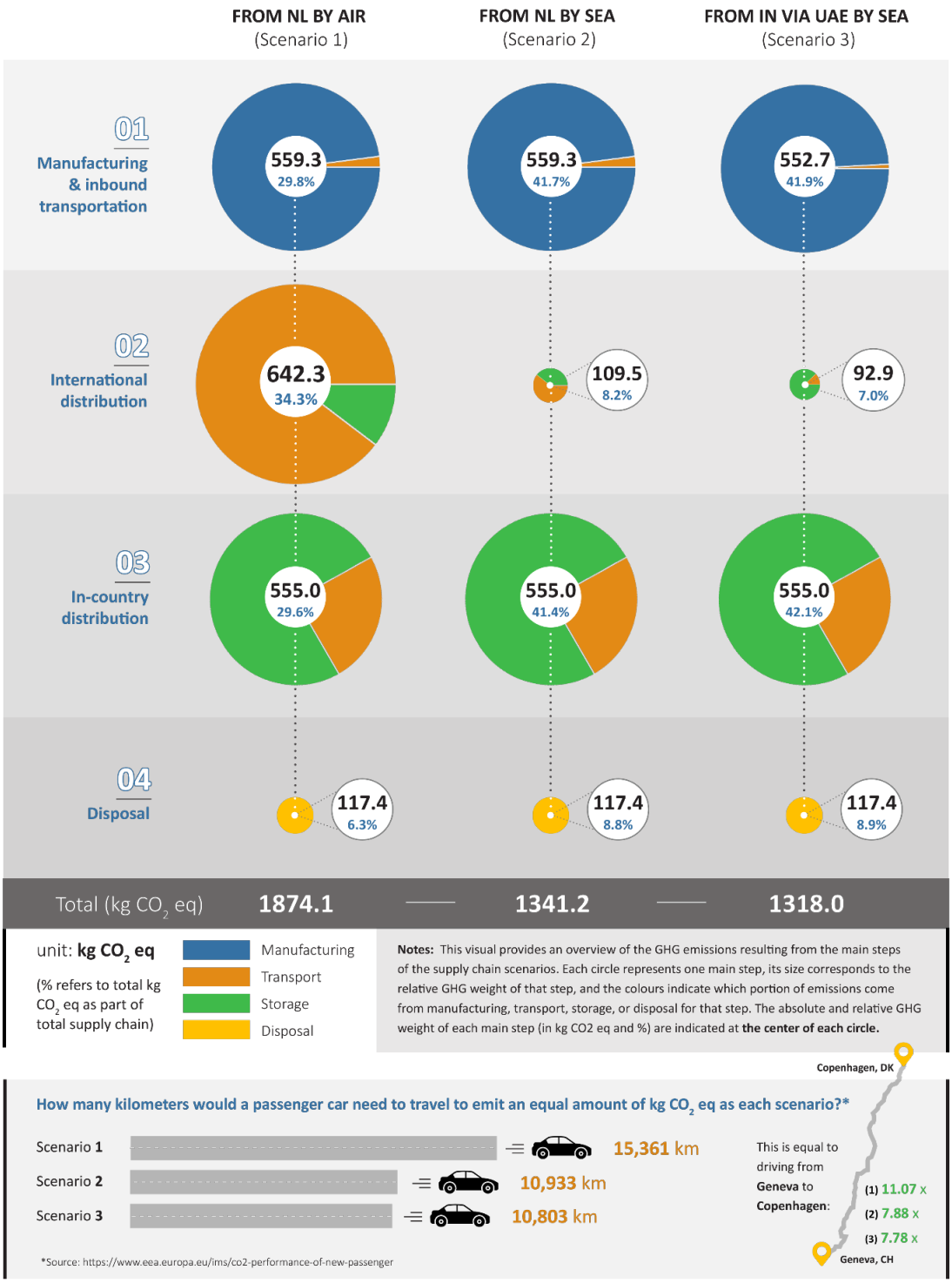
Estimates of yearly waste volumes

As shown in the visual, the most important waste type in terms of weight is IARH kits' expired and damaged stock, roughly estimated at 176 tons yearly. This is then followed by IARH kits' disposables

(169 tons yearly), IARH kits' primary plastic packaging (46 tons yearly), and dignity kits' primary plastic packaging (41 tons yearly). The most important waste type (IARH kits' expired and damaged stock) is avoidable – and should be avoided with help of a more efficient supply chain and stronger in-country logistics infrastructure. Where waste cannot be avoided, it should be disposed of following WHO and in-country guidelines. Today however UNFPA has no visibility on whether this is done properly.

Analysis: GHG results

The below graph illustrates the results of the GHG analysis.



GHG emissions coming from the different main steps of IARH kit 6B's supply chain

Manufacturing and inbound transportation of the kits' items and the in-country distribution steps contribute the most to the kits' carbon footprint, between 30% and 40% depending on the scenario. While it was expected that manufacturing would contribute to a significant proportion of the kit's carbon footprint, the similar importance of in-country distribution came as a surprise. It is mainly due to lack of proper in-country infrastructure and operational constraints specific to the humanitarian context. The fact that in-country inefficiencies can sum up to a relatively large GHG impact is an important conclusion. The international distribution step also presents a significant proportion of the kit's carbon footprint (30%) but only when the kit is distributed by air (Scenario 1). When it is distributed by sea, this step only weights 10% of the kit's carbon footprint. This illustrates how painful air transportation is. Finally, the waste disposal step represents around 6 to 8% of the kit's carbon footprint. Most of it (more than 80%) is coming from waste incineration.

Recommendations

In line with the above zoom in observations and also considering the zoom out overview, a total of 29 recommendations were identified to help UNFPA further decrease its environmental footprint, some of these further building on initiatives already ongoing at UNFPA. To help UNFPA build its roadmap, the recommendations were classified based on their change level (structural / operational), action type (continue / scale up / advocate / analyse / implement), and priority (high / medium / low). The recommendations were also grouped across five thematic area: supply chain network design and planning, procurement, logistics, collaboration, as well as reporting and monitoring. The below bullet points describe the most important recommendations for each category. The breadth of the recommendations shows how important it is to consider supply chains end-to-end; mitigation actions are necessary throughout at both operational and structural level.

- Supply chain network design and planning. Country offices (COs) should use data and insights to forecast their kits demand which will serve as input to procurement planning and placing of orders. This requires specific technical capacity in country.
- Procurement. The Supply Chain Management Unit (SCMU) should continue enacting their Green Procurement Strategy and train COs to apply it for local procurement. In parallel, UNFPA should include environmental sustainability in their *best for value* definition to make environmental considerations part of every sourcing decision. Additionally, UNFPA should scale up its transition from kits to bulk procurement across all COs working in a post-acute context.
- Logistics. UNFPA should invest in in-country capacity building for humanitarian medical logistics and wider supply chain management as well as invest in adequate storage infrastructure.
- Collaboration. UNFPA should continue the collaboration with the Sexual and Reproductive Health (SRH) and Importation and Customs Clearance Together (IMPACCT) working groups to improve the distribution plans and actual delivery of kits. It should further increase its utilization of common logistics services offered through the Logistics Cluster where possible in sudden-onset emergencies (or other UN agencies and NGOs where common services are not implemented).
- Reporting and monitoring. UNFPA should include supply chain emissions in their carbon reports and set targets to reduce these. Additionally, it should break waste stigma, increase the capacity of implementation partners (IPs) and health facilities to manage waste, and improve application of Last Mile Assurance (LMA) to kits.

The need for increased supply chain management and logistics capacity (ie, the need to hire additional staff) and capability (ie, the need to train current staff) at UNFPA transcends all recommendations. Supply chain management has increasingly been recognized as a critical topic at UNFPA, but its importance is not yet fully reflected in HR decisions.

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IARH kits	During acute response, reproductive health commodities are mainly distributed in Interagency Emergency Reproductive Health (IARH) kits. UNFPA, in coordination with the Inter-Agency Working Group on Reproductive Health in Crises (IAWG) designs and manages these kits on behalf of the interagency community. There are currently 24 IARH kits (13 main kits and 11 complementary ones) which health facilities can use to fulfil the service objectives of the Minimum Initial Service Package for Reproductive Health in Crisis Settings (MISP). In other words, these IARH kits ensure that health facilities can carry out minimum lifesaving reproductive health services during emergencies.
Dignity kits	Dignity kits are the main type of NFI kits provided by UNFPA and contain items like toothbrushes and toothpaste, underwear, menstrual pads, and many other items mostly related to female personal hygiene and protection. For UNFPA, dignity kits distribution is directly linked to achieving objectives of gender-based violence and sexual and reproductive health programmes, usually linked to information sharing on service availability, risks and good practices, or to incentivize service seeking behaviour.
Humanitarian context	With humanitarian context, we refer to acute and post-acute crises, which due to demand and supply uncertainty present barriers to lean supply chain flows and appropriate infrastructure.
Humanitarian Office (HO)	UNFPA's Humanitarian Office (HO) is based in Geneva. It provides guidance (together with UNFPA's Regional Offices) to UNFPA's Country Offices with regards to humanitarian supplies and harmonizes guidelines, processes, and tools. In case of large sudden-onset emergencies, HO takes a larger and more active role to support Country Offices in ensuring a fast and coordinated emergency response, always in close collaboration with the Regional and Country Office of the affected country. It also works together with UNFPA's Supply Chain Management Unit to ensure continuous improvement of the procurement and international distribution of humanitarian supplies.
Supply Chain Management Unit (SCMU)	UNFPA's Supply Chain Management Unit (SCMU) is based in Copenhagen. It organises the procurement and international distribution of reproductive health commodities – and can also facilitate the procurement of NFIs and operational commodities when required – for UNFPA COs as well as for third party actors.
Suppliers A, B, C	Suppliers A, B, and C are the three IARH kits suppliers for UNFPA. Both Supplier A and Supplier C assemble IARH kits for UNFPA at facilities in the Netherland; Supplier B does so from India. The name of these suppliers was kept anonymous to maintain a level of objectivity.

Waste	There are four main types of waste which can result from UNFPA humanitarian operations: • Expired stock (avoidable) • Damaged stock (avoidable) • Packaging materials (avoidable up to a certain extent) • Disposables (non-avoidable)
Greenhouse gas emissions	Greenhouse gasses (GHG) are a direct contributor to global warming and climate change. Different GHG have different effects on global warming because of the way they absorb energy as well as how long they stay in the atmosphere. Global Warming Potential (GWP) is a measurement developed to compare the impacts of different GHG in the atmosphere and standardize these impacts in a common unit of measurement (kg CO_2 equivalent, as CO_2 is used as the reference gas) to quantify the impact of different activities and compare reduction opportunities.
Life cycle assessment (LCA)	LCA is a methodology used to quantify and measure the environmental performance of products from a sustainability perspective considering their complete life cycle – from raw materials extraction to the use and disposal of the product itself. Organisations perform LCAs to (i) identify and prioritize improvement opportunities and/or (ii) compare similar products/flows with each other.
Country X	For the LCA, Country X is indicated as the recipient country for IARH kit 6B. It was selected mainly because it is representative of large-scale complex humanitarian emergencies (conflict, disaster, and outbreak) and because foreground data for the LCA was accessible. This country remains anonymous to avoid stigma.
Scenarios 1, 2, 3	The LCA considered three international distribution flows: • Scenario 1: the kit is transported by air from a supplier in the Netherlands (Supplier A) to Country X • Scenario 2: the kit is transported by sea from a supplier in the Netherlands (Supplier A) to Country X • Scenario 3: the kit is transported by sea from a supplier in India (Supplier B) to Dubai's regional warehouse (UNHRD) where it is pre-positioned and then from Dubai's regional warehouse, the kit is transported by sea to Country X

List of abbreviations

APRO	(UNFPA) Asia Pacific Regional Office
BEmONC	Basic Emergency Obstetric and Newborn Care (health facility)
CF	Characterization Factor
CO	(UNFPA) Country Office
CO_2 eq.	CO_2 equivalent
FEFO	First Expired First Out
FTE	Full Time Employee
GBV	Gender-Based Violence
GSP/GDP	Good Storage Practice / Good Distribution Practice
GWP	Global Warming Potential
HO	(UNFPA) Humanitarian Office
IARH	Inter-Agency Reproductive Health (kit)
IPCC	Intergovernmental Panel on Climate Change
IAWG	Inter-Agency Working Group on Reproductive Health in Crises
IP	Implementation Partner
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
LET	Logistics Emergency Teams
LTA	Long-Term Agreement
LMA	Last Mile Assurance
NFI	Non-Food Item
NGO	Non-Governmental Organisation
MISP	Minimal Initial Services Package for Reproductive Health in Crisis Settings
MoH	Ministry of Health

MOQ	Minimum Order Quantity
OCHA	(UN) Office for the Coordination of Humanitarian Affairs
PO	Purchase Order
PoE	Port of Entry
QA	Quality Assurance
RH	Reproductive Health
RO	(UNFPA) Regional Office
SDG	Sustainable Development Goals
SPOC	Single Point of Contact
SRH	Sexual and Reproductive Health
SCMU	(UNFPA) Supply Chain Management Unit
UN	United Nations
UNFPA	United Nations Population Fund
UNHAS	United Nations Humanitarian Air Service
UNHRD	United Nations Humanitarian Response Depot
WHO	(UN) World Health Organisation
3PL	Third Party Logistics Provider

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1. Introduction

In March 2019, António Guterres, Secretary-General of the United Nations, reiterated the warning from the Intergovernmental Panel on Climate Change's 2018 special report: *humankind has less than 12 years to avoid potentially irreversible climate disruption*. *We must address this global emergency with ambition and urgency*, he said. (UN Press, 2019)

Humanitarian response often requires large-scale procurement and fast logistics solutions based on a push supply chain and no-regrets-approach to avoid morbidity and mortality among affected populations. These interventions typically present a large environmental footprint – in terms of greenhouse gas emissions and waste. With 60 to 80 per cent of humanitarian funding utilised by the supply chain, the lion share of the environmental impact of humanitarian response can be attributed to supply and logistics systems.

On the other hand, one of the key drivers of displacement and destruction requiring humanitarian intervention is climate disaster. Following the do-no-harm principle, humanitarian organisations have an inherent obligation to structurally measure, and where possible, reduce the impact of their operations on the environment – both as an obligation to achieve the Sustainable Development Goals (SDGs), but also as a measure to reduce future humanitarian need.

In response to the climate and environmental crises, many humanitarian organisations have defined measures and targets to mitigate the impact that their operations have on the environment. The United Nations Population Fund (UNFPA) has been working in that direction as well through various initiatives – their early adoption of carbon accounting and the Green Procurement Strategy, which they apply since several years already, are two notable examples. UNFPA wants to further build on these existing initiatives and mitigate the environmental impact of UNFPA's humanitarian supply chain specifically.

Humanitarian supplies make up a significant proportion of the total supplies procured and managed by UNFPA and are an essential life-saving component of UNFPA's humanitarian action. Given the pivotal role of supply availability in achieving UNFPA's strategic goals and the magnitude of investments made by the organisation, the Humanitarian Supplies Strategy (HSS) for the period 2021-2025 aims to ensure a strategic approach to strengthening the supply chain system to greatly improve the overall institutional performance, and to achieve health and protection outcomes for affected populations before, during, and after humanitarian crises. One of the key objectives of the HSS aims to reduce the impact of UNFPA's humanitarian supply chain and logistics interventions on the local and global environment.

While efforts have been made in different parts of UNFPA to address components of carbon output there has yet to be an organisation-wide systematic analysis and theory of change to ensure UNFPA can reduce its environmental footprint for supply chain and logistics from the start of the process to the last mile delivery and waste management. The breadth of ways UNFPA can mitigate its own environmental footprint and inform others in the humanitarian community to follow is significant.

There are six sections in this report. The first one introduces UNFPA and the scope of the analysis. The second section outlines the functioning of UNFPA's humanitarian supply chain. The third and fourth sections investigate the environmental impact of UNFPA's humanitarian supply chain, in terms of waste and greenhouse gas emissions respectively. The fifth section presents recommendations for UNFPA to mitigate the environmental impact of its humanitarian supply chain. The sixth section presents a conclusion to this report.

1.1 UNFPA and humanitarian response

1.1.1 UNFPA's mission and objectives

UNFPA is the United Nations (UN) agency for sexual and reproductive health (SRH). Its mission is to *deliver a world where every pregnancy is wanted, every childbirth is safe, and every young person's potential is fulfilled* – which translates into three clear objectives: *zero unmet need for family planning, zero preventable maternal deaths, and zero gender-based violence* (GBV) *and harmful practices* (UNPFA, 2018).

UNFPA works on realizing these three objectives in development as well as humanitarian contexts. This report focuses on the humanitarian context specifically. In that context, UNFPA works on both SRH and GBV programmes – throughout all three phases of the humanitarian programme cycle, namely preparedness, acute response, and post-acute response (including protracted response in case of protracted situations as well as recovery)[1] (see Figure 1) – and distributes the necessary supplies to fulfil these.

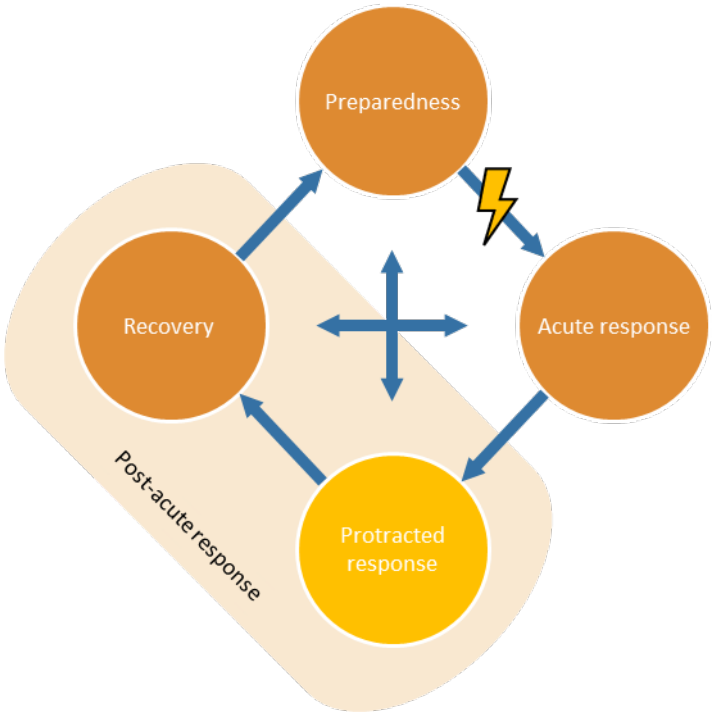

Figure 1: UNFPA supply interventions as a component of the humanitarian programme cycle[2]

1.1.2 UNFPA's humanitarian product portfolio

UNFPA distributes different types of humanitarian supplies to fulfil its SRH and GBV programmes as a component of a coordinated humanitarian response. These can be grouped into three large categories for the sake of this analysis.

[1]A typical humanitarian intervention would not follow these three phases chronologically; these three phases tend to overlap, especially in complex and protracted situations.
[2]Source: *UNFPA Humanitarian Supplies Strategy, 2021-2025* (see UNFPA, 2020)

Category 1: Medical commodities (medical kits and bulk commodities). Medical commodities for UNFPA include contraceptives, pharmaceuticals, diagnostics tests, medical equipment, and medical devices. Medical commodities are distributed to health facilities, either in bulk or as part of kits depending on the context. During acute response, medical commodities are mainly distributed in Interagency Emergency Reproductive Health (IARH) kits. UNFPA, in coordination with the Inter-Agency Working Group on Reproductive Health in Crises (IAWG) designs and manages these kits on behalf of the interagency community. There are currently 24 IARH kits (13 main kits and 11 complementary ones) which health facilities can use to fulfil the service objectives of Minimum Initial Service Package for Reproductive Health in Crisis Settings (MISP). In other words, these IARH kits ensure that health facilities can carry out minimum lifesaving SRH services during emergencies. Each IARH kit contains a defined set of items to fulfil different clinical interventions across three levels of health care, for a certain population size over a period of three months. In post-acute situations, medical commodities should be distributed to health facilities as bulk items rather than kits, although reliance on kits over long periods of time is a challenge (for all actors providing humanitarian medical kits), which UNFPA Humanitarian Office (HO) is working to support country offices to address.

Category 2: Non-Food Items (NFIs). For UNFPA, NFI distribution is directly linked to achieving objectives of SRH or GBV programmes, usually linked to information sharing on service availability, risks and good practices, or to incentivize service seeking behaviour. NFIs often include items like toothbrushes, toothpaste, underwear, menstrual pads, and many other items mostly related to female personal hygiene and protection based on the context and needs of local communities. NFIs are predominantly distributed directly to beneficiaries as part of dignity kits but can also be provided through other NFI kits or as individual items.

Category 3: Operational Commodities. The last category of supplies provided by UNFPA are those items linked to the successful operational delivery of the programme. It can include infrastructure (eg, mobile clinics, tents, prefabs), ambulances, office and security equipment, IT equipment, and more.

1.1.3 UNFPA's organisational structure for humanitarian response

UNFPA operates in more than 150 countries and in 2021, it delivered humanitarian aid to more than 60 of these. In-country humanitarian activities are managed by UNFPA's country offices (COs) with the guidance and support from UNFPA's regional offices (ROs)[3] as well as from UNFPA's Humanitarian Office (HO), based in Geneva. In case of large sudden-onset emergencies, HO takes a larger and more active role to support COs in ensuring a fast and coordinated emergency response, in collaboration with the RO and CO of the affected country. HO also defines and harmonizes guidelines, operational tools, and approaches for country level operations – with regards to programmes and supply chain practices – conducts capacity building, deploys surge staff and supports the COs in *transformational change for effective humanitarian action* (UNFPA, 2022). When looking at humanitarian supplies, HO has a larger accountable role, in relation to design of the IARH kits, supporting SCMU in oversight of the IARH kit stocks, approving IARH kit requests, reviewing and approving specifications for local dignity kit procurement, designing operational tools and guidelines in coordination with SCMU, and providing support to COs in quantification, logistics management, and oversight and monitoring for rational and effective use of humanitarian supplies.

As the lead UN agency for SRH, UNFPA naturally became the lead UN agency for the procurement of SRH commodities. The procurement and international logistics of SRH commodities is organised by UNFPA's Supply Chain Management Unit (SCMU), which is based in Copenhagen. SCMU facilitates the procurement of the majority of SRH commodities – and can also facilitate the procurement of NFIs

[3]UNFPA has a RO for each of the six following regions: Arab States, Asia & the Pacific, East & Southern Africa, Eastern Europe & Central Asia, Latin America & the Caribbean, and West & Central Africa.

and operational commodities when required – for UNFPA COs as well as for third party actors. SCMU is responsible for quality assurance (QA) and contracting with the suppliers, packing and storing of IARH and dignity kits (including global stockpiles), and international freight. It also manages QA for any in-kind contribution of medical supplies, supports COs in procurement (also with regards to importation rules), and provides tools and guidance to facilitate emergency procurement, distribution, and last mile assurance in coordination with HO. COs mostly source medical commodities via SCMU (referred to as international procurement) because of the high-quality standards and the sourcing intelligence they require. For NFIs and operational commodities, COs can either source these directly from local or regional suppliers (referred to as local procurement) or via SCMU if no sourcing options exists locally either due to the crisis impacting local markets or a lack of availability. COs can obtain authorisation for local procurement of pharmaceuticals and medical supplies from SCMU within strict QA requirements under procurement rules and regulations.

1.2 Context, objective, and scope

1.2.1 Context and objective

As part of its 2022-2025 strategic plan, UNFPA aims to further *transform itself into a more agile, more flexible, and more innovative organisation*. A lot of smaller objectives derive from this statement. One of these relates to environmental (and social) sustainability. In short, UNFPA commits to reduce its carbon footprint and actively ensure that its programmes do not harm local environments and communities.

> *UNFPA is committed to mainstreaming social and environmental sustainability in programming, preventing pollution, reducing the environmental footprint of its programmes and operations, and pursuing climate neutrality (…). Accordingly, UNFPA will continue to implement (a) its environmental efficiency strategy to reduce its environmental footprint; and (b) its social and environmental standards to ensure that there is no inadvertent harm to people and the environment caused by its programming.*
>
> From *UNFPA's 2022-2025 strategic plan* (see UNFPA, 2021a)

This vision is also depicted in the UNFPA Humanitarian Supplies Strategy (2021-2025). UNFPA aims to limit the negative impact that UNFPA's humanitarian supply chain has on the environment. It organised this objective in three subsequent steps: (i) evaluate the existing impact, (ii) define strategic and operational measures to reduce the impact, and most importantly, (iii) implement these measures (see Figure 2).

Figure 2: UNFPA's plan towards an environmentally sustainable humanitarian supply chain

This report focuses on the first two of these three steps, aiming to measure and understand the impact that UNFPA's humanitarian supply chain has on the environment, and based on that understanding define strategic and operational recommendations to mitigate that impact.

1.2.2 Scope

Supply chain activities can negatively impact the environment in many ways. Heavy manufacturing contributes to the depletion of natural resources. Freight transport is responsible for close to 10% of global CO_2 emissions, and it often also results in fine particulate matter endangering human health. Storing goods costs energy, and when it relies on unclean energy sources, further increases the carbon footprint of logistics activities. Waste can be generated all along the supply chain, as well as after supplied items are consumed, and when not managed well, it pollutes land and / or water and can be dangerous for humans and animals. Waste can be avoidable: expired or damaged medical supplies can result from overprovision of commodities, inefficient logistics processes, and poor-quality assurance along the logistics network up to the last mile. Waste can also be inevitable: inevitable waste includes items that are natural biproducts of medical interventions (eg, sharp, used gauze, etc.) which while it cannot be prevented, must be disposed of properly to avoid harm to the environment. More examples on how supply chain activities can negatively impact the environment could be added to this list.

UNFPA is primarily concerned with the volumes of greenhouse gases emitted by the end-to-end components of the humanitarian supply chain activities as well as with the level of wastage resulting from quantification to last mile logistics management. The scope of this analysis focused on two environmental dimensions: greenhouse gas emissions and waste. Focusing on these two dimensions is in line with what has become standard for humanitarian organisations across the sector[4].

UNFPA delivers approximately 400-500 products around the world, including SRH commodities in bulk and kits, NFIs, and operational commodities. UNFPA's humanitarian supply chain does vary across all of these. This analysis focuses on IARH and dignity kits specifically because UNFPA still very much relies on kits in humanitarian settings and because kits are complex and comprehensive. Note that many of the conclusions drawn can relate to different items provided within the context of a humanitarian operation.

[4]These two dimensions are behind several commitments of *The Climate and Environment Charter for Humanitarian Organisations* (see ICRC / IFRC, 2021). The Charter was published online in May 2021 and has now been signed by more than 200 humanitarian organisations.

1.3 Approach

The analysis was implemented using a mixed quantitative and qualitative approach. The qualitative analysis was used to outline the main components that influence UNFPAs humanitarian supply chain, process flows and ongoing work and challenges. Quantitative analysis was used to calculate overall volumes of waste and greenhouse gas emissions.

1.3.1 Qualitative Analysis

The qualitative analysis aimed to comprehensively capture the full scale of UNFPA's humanitarian supply chain, its functioning, constraints, and challenges. The analysis also helped in understanding UNFPA's maturity with regards to environmental sustainability, ongoing initiatives, and potential leverage points for change. Qualitative analysis included data from:

- Key informant interviews with internal actors (from HO and SCMU)
- Key informant interviews with external actors (from suppliers)
- An internal UNFPA literature review (policies, procedures, mission reports, strategies, tools)

It also included the outcomes of a recent supply chain mapping exercise performed by HO in a country (Country X) representative of UNFPA operations in humanitarian context.

1.3.2 Quantitative Analysis

The quantitative analysis weighs the environmental impact of UNFPA's humanitarian supply chain activities in terms of greenhouse gas emissions and waste and for kits specifically. To measure levels of waste, the types of waste resulting from UNFPAs operations were outlined and the most critical ones were defined. Total volumes of these most critical waste types for the year 2021 were evaluated based on assumptions and observations specific to each waste type and based on the procurement volumes. To measure greenhouse gas emissions, a life cycle assessment (LCA) was performed for one kit (IARH kit 6B) which is the most representative of common needs, size, complexity, and procurement volumes. Based on these aspects the analysis highlighted which supply chain's steps have the largest carbon footprints and overall scale of impact. Quantitative analysis included data from:

- UNFPA procurement volumes
- UNFPA last mile assurance reports
- UNFPA procurement catalogue
- Suppliers
- LCA databases

While most data got collected at macro level (ie, data applicable to all UNFPA humanitarian operations), the LCA required some specific in-country data. Distribution data (incl. transportation and storage data) to a representative country (Country X) and within that country was thus collected from suppliers and from the country's office (facilitated by a recent supply chain mapping exercise performed by HO).

2. Mapping of UNFPA's humanitarian supply chain

This section explains how UNFPA's humanitarian supply chain functions, considering kits specifically. The two sub-sections zoom in on IARH kits and dignity kits respectively and describe their physical flow as well as their forecasting and ordering processes.

2.1 Supply chain for IARH kits

2.1.1 Physical flow of IARH kits

Each IARH kit contains a predefined list of items. These items typically belong to one of the following product families: contraceptives, pharmaceuticals, medical devices, and diagnostic tests. Appendix 1 and the following paragraphs describe the physical flow of IARH kits from the moment the items are manufactured up until their usage at health facilities.

Upstream

Items are manufactured at suppliers located in China, India, and Europe (1). They are then transported from these suppliers (tier 2) to UNFPA's suppliers for IARH kits (tier 1) (2). UNFPA has three suppliers for IARH kits[5]: Supplier A, Supplier B, and Supplier C. Both Supplier A and Supplier C assemble IARH kits for UNFPA at facilities in the Netherlands; Supplier B does so from India. After arriving at the suppliers, the items remain in stock (3) before being assembled into kits (4). Note that the extent to which an item is kept in stock depends on the supplier's replenishment strategy for that item: for items in high demand and with a long shelf-life (or with no shelf-life constraints at all), the risks associated with keeping these on stock is relatively low and the supplier might thus decide to pile up a significant amount of stock; this might not be the case for items with a short shelf-life and inconsistent demand. The item's minimum order quantity (MOQ) may also play a role here: the stock volume of an item with a high MOQ is generally larger than that of an item with a lower MOQ. Once the kits are assembled, they are inspected and if no quality issues are identified, they become the property of UNFPA and are either kept in stock to fulfil orders as they come (for Suppliers A and C) or are shipped immediately to UNHRD (for Supplier B) (5). Once SCMU receives an HO-approved order from a CO or third party, kits can be transported to the requesting country in different ways:

- For Suppliers A and C, kits are directly shipped from the supplier's location to the requesting country (6). Transport is by default organised by SCMU and their international freight forwarders but can also sometimes be arranged by the suppliers. In the case of sudden-onset disasters, SCMU might collaborate with other UN agencies for chartering; or rely on humanitarian flights (eg, EU Humanitarian Air Bridge) or flights donated by national governments. Relying on freight forwarders is also an option for sudden-onset disasters. All kits in stock at the suppliers' warehouses are owned and managed by SCMU.
- For Supplier B, kits are shipped to UNHRD Dubai warehouse. Transport from Dubai is organised by either SCMU or by the UNHRD logistics team. In the case of sudden-onset disasters, SCMU might collaborate with other UN agencies for chartering; or rely on humanitarian flights (eg, EU Humanitarian Air Bridge) or flights donated by national governments (including the International Humanitarian City of Dubai). Relying on freight forwarders is also an option for sudden-onset disasters. All kits in stock at the UNHRD warehouse are owned and managed by SCMU.
- Kits can be pre-positioned in regional hubs (7). UNFPA strategically holds stock in Brisbane (in the Palladium warehouse funded by the Australian government) to respond to emergencies.

[5]The three suppliers are referred to as supplier A, B, and C to maintain a level of objectivity in the analysis and subsequent recommendations.

The Brisbane stock can be replenished by any of the suppliers. All kits pre-positioned in Brisbane are owned and managed by UNFPA's Asia Pacific Regional Office (APRO)[6]. For the transport of the kits from Brisbane to the requesting country, APRO either relies on freight forwarders, humanitarian charters, or flights donated from a national government (8).

Through this international transportation segment, kits are generally transported by sea or air (and road for a few countries in Europe/Middle East). They do not always directly arrive at the requesting country's port of entry. Sometimes, SCMU must organise transit via a third country (or multiple other countries) before the kits can reach their destination[7] (9). For these shorter segments, kits are generally transported by road.

Downstream

When the kits arrive in country (10), they generally need to be cleared before they can be transported to a warehouse[8]. In sudden onset emergencies national authorities often put in place expedited customs procedures for humanitarian cargo, one-stop shops, or humanitarian staging areas simplifying and fast-tracking clearance. The first in-country transportation segment (from the port of entry to a warehouse) is by default organised by the CO and their local freight forwarders, but the CO also sometimes relies on transportation services offered by the Logistics Cluster or other UN agencies (11). The first in-country warehouse is either managed by the CO through subcontractors or by the country's MoH – and again, the CO also sometimes uses storage space from warehouses managed by the Logistics Cluster or other UN agencies (12). Note that in larger countries or in countries with a complex geographical or political context, the CO typically organises transportation and storage over multiple forward logistics hubs within the country.

In most cases, the distribution of the kits up to the health facilities is done by the CO's implementation partners (IPs). IPs indeed take care of further transportation (13) and optionally store the kits (14) across the country on the way to the health facilities. IPs are not only responsible for the logistics aspect, but they also need to ensure that the health facilities can properly deliver the RH services that are in their scope. IPs can be local or international NGOs, but can also be the country's Ministry of Health (MoH)[9]. When the kits are received at health facility level, the items are unpacked and placed in a dedicated storeroom or directly moved to the units that require them (15) before being consumed (16).

In some cases, UNFPA hands over IARH kits to non-IP partners. In these cases, the distribution of kits is done by the partner. Additionally in some large scale or sudden onset crisis, UNFPA does direct distribution to the health facility level utilizing subcontractors, IPs, the Logistics Cluster, or other UN agencies for forward transportation, transit warehouse and last mile distribution.

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[6]This pre-positioning initiative is part of a larger preparedness project led by APRO. The project is currently in its third phase and includes four main components: (i) capacity building (for supply chain management as well as RH and GBB programming), (ii) stock pre-positioning (in Brisbane but also in different countries in the region), (iii) advocacy, and (iv) project management.

[7]One example of this is the 2015 sea blockade on Yemen. This meant that UNFPA (along with other humanitarian organisations) could no longer directly forward their supplies to Yemen by sea or air. There are now two alternative options: (i) kits could be brought first to Dubai and then from there sent to Yemen by road through Oman or (ii) kits could be brought first to Djibouti and then from there sent to Yemen by sea.

[8]Exception to this is with bonded warehouses: kits can directly be moved to bonded warehouses and cleared there rather than at the country's port of entry.

[9]IPs' work is managed through IP agreements. UNFPA defines a list of requirements, IPs then propose a budget to fulfil these requirements, and the deal is then formalized in an IP agreement. UNFPA typically monitors IP activities – mostly to identify and share improvement points.

The various actors (suppliers, SCMU, ROs, COs, IPs, health facilities) also need to manage kits' waste as it occurs. The section *3. Waste resulting from humanitarian supply chain activities* further describes the different types of waste and how these are managed.

2.1.2 Forecasting and ordering process of IARH kits

At the end of every calendar year, SCMU creates procurement plans for the upcoming year[10]. These plans include demand forecasts for bulk items and (IARH and NFI) kits[11] and are prepared mainly based on input from the COs procurement plans (what the COs think they will need in the future – non-binding) and ad-hoc on historical demand (what was actually needed in the past). The CO procurement plans are rather modest when it comes to kits. In theory, kits should only be used to respond to humanitarian emergencies, which are relatively difficult to forecast. However, many COs which are considered humanitarian (ie, have a humanitarian response plan and predominantly one-year funding cycles) either work on protracted crises or have cyclical natural disasters increasing the predictability of kits (or bulk) supply needs. Despite this, only few COs share demand forecasts for kits leaving SCMU to mostly rely on historical demand and ad-hoc guidance from HO to build up the kits' procurement plans.

Global stock levels

Once the procurement plans for the IARH kits are ready, SCMU shares these with their kit suppliers. Whether they then act upon the plans – by securing sourcing or by already building up low-risk items stock – is left to their entire discretion. The suppliers are only required to produce the kits' stock once SCMU places a purchase order (PO) with them. In a typical year, SCMU would do so every six months[12]. These POs – referred to as blanket POs – detail the stock quantity required for every kit. SCMU prepares these based on their procurement plans, remaining stock on-hand and available financial resources. The blanket POs and their associated IARH kits' stock are financed through dedicated revolving funds managed by SCMU. The limited amount of funding for the revolving fund often limits the amount of kits SCMU is able to raise a PO with, as the revolving fund is only replenished when the supplies are dispatched to the country. This – combined with the increased cost of kits, increased demand for kits, and increasing production lead time for kits – results in a "rubber-banding effect" or large stocks for a period of time and then no stocks for a period of time. SCMU and HO then are often forced to evaluate and prioritise order distribution.

Order dispatch[13]

Most IARH kit requests come from UNFPA COs. The CO places its order based on assumptions within the IARH kits calculator, demand forecasts (if any) or actual needs – once budget is confirmed[14]. The order is first reviewed by HO who ensures that the requested quantities are technically correct based on the objectives of the CO and local context. Once the order is approved by HO, SCMU can start the work to fulfil it. In rare cases, exclusively sudden-onset or scale up emergencies, HO may place an

[10]The procurement plans are released in December and cover the full upcoming year (eg, in December 2021, SCMU released the procurement plans for 2022).

[11]The procurement plan is structured as follows: requesting CO, requested item or kit, requested quantity, probability that the forecast materializes (<50%, intention only, funds not secured; 50-80%, fund secured, quantity may be adjusted; >80%, funds and quantity are both confirmed) and requested delivery date (month).

[12]It can happen that SCMU places a smaller and more targeted blanket PO in case of insufficient stock for high-demand kits.

[13]The process is illustrated in Appendix 2.

[14]In the case of CERF and EF the budget confirmation will come only later. COs are required to obtain HO approval prior to submission of CERF and EF proposals, as well as an estimate of freight costs from SCMU.

order on behalf of, and in consultation with, COs to expedite the immediate dispatch of an initial quantity of kits. Additionally, third party actors may place requests for IARH kits directly to SCMU.

SCMU then allocates the order to existing (or work-in-progress) stock at the suppliers' locations. After allocating the stock, SCMU reaches out to UNFPA's long term agreement (LTA) freight forwarders and requests a quotation for the transport of the kits to the requesting country. This process step has always been challenging as there are typically limited commercial lines running to countries needing humanitarian intervention. It is even more challenging now because of the global air freight and global maritime crisis resulting from the COVID pandemic. SCMU reported that for some countries it can take up to one month to secure a spot on a sea vessel and two weeks to get space on a plane. Once SCMU obtained a freight quotation, they then evaluate the total cost of the order and communicate this back to the CO. If in-budget, the CO would approve SCMU's proposal; if not in-budget, they would have to re-adjust the order quantities to bring costs down. Once the order is approved, the CO reaches out to the competent national authorities and requests their approval to bring the kits in the country. The time it takes to get their green light depends on the national authorities and their processes, as well as on the preparedness activities that would have been run upfront by the CO. Generally, this process step is quite painful, and, in some countries, it can take up to three months to get the green light. In sudden-onset humanitarian crisis, HO works to advise SCMU based on discussions with the CO and humanitarian importation exemptions to ship without the green light. The kits are dispatched to the requesting country once the CO has received the green light and communicated it down to SCMU. The CO then pays SCMU, which refills the IARH kits' revolving fund making it possible for SCMU to later submit another blanket PO and rebuild the stock levels.

In case a CO would forecast a very high demand for IARH kits, then SCMU with advice from HO would encourage the CO to rely on fresh production rather than on SCMU's stock to avoid draining all of the in-stock resources, particularly if the kits are destined for a preparedness or post-acute emergency response. Fresh production means that the suppliers would fulfil the incoming order based on a make-to-order rather than make-to-stock approach (ie, the suppliers would procure the items and assemble the kits once the order is received and for that order specifically). This would avoid too much pressure on the SCMU's stock which's quantity is constrained by the revolving funds' total value. While many countries requesting kits do so on a regular basis, and have longer visibility on needs, few countries which could procure from fresh production decide to do so.

2.2 Supply chain for dignity kits

2.2.1 Physical flow of dignity kits

Dignity kits are generally locally procured, and exceptionally they can be internationally procured from SCMU in the same way as IARH kits. Appendix 3 illustrates the physical flow of dignity kits in case of international procurement. The only differences between the physical flow of dignity kits in case of international procurement and that of IARH kits are the facts that (i) beneficiaries collect the dignity kits at service delivery points for their own usage while IARH kits are used by medical staff at health facilities and (ii) the distribution of dignity kits by IPs might include less echelons than that of IARH kits and might also be co-organised in collaboration with other UN agencies or NGOs[15]. Appendix 4 illustrates the physical flow of dignity kits in case of local procurement. In this case, the COs have full

[15]For example, this is the case in Yemen with the Rapid Response Mechanism (RRM). The RRM brings together WFP, UNICEF, and UNFPA, who leads the initiative. Its purpose is to distribute emergency supplies to displaced families. The RRM supplies include food rations from WFP, hygiene kits from UNICEF, and female dignity kits from UNFPA. (UNFPA Yemen, 2021)

control over the procurement of the kits. They either order these from a supplier in-country or from another country utilizing a local procurement process.

2.2.2 Forecasting and ordering process of dignity kits

Dignity kits are distributed as part of a wider GBV programmes. By distributing these kits, UNFPA works to share information on GBV referrals, share information on risks for GBV and SRH as well as develop connections with local communities and can then later rely on these pre-established networks to organise sessions to address GBV issues or to raise awareness about SRH topics. The mindset in forecasting dignity kits is thus different than with IARH kits, as UNFPA does not do blanket distribution of hygiene items. Dignity kits' forecasts reflect GBV programming targets rather than estimated needs; they are supply- rather than demand-driven.

Unlike IARH kits, dignity kits can include a mix of different items, which depend on the context of the kits' distribution, the exact function the kit needs to fulfil, and cultural preferences of the beneficiaries. When ordering from SCMU, COs can either choose one basic dignity kit, which contains ten predefined items, or customize their own kit (customized dignity kit) by choosing from a predefined list of items (some are kept in stock at the suppliers' warehouses). When purchasing the kits locally, the COs designs the content of the kits based on the needs of affected communities and develops specifications for those items. COs need to validate the specifications of the kits' items with HO.

In case of international procurement, the COs share their forecasts (if any) with SCMU who then uses these as an input for their procurement plans. Just like with IARH kits, SCMU then shares these plans with their two NFI suppliers, but the suppliers would only start procuring the NFI items and assembling these into dignity kits once SCMU places a blanket PO with them. The resulting stock is financed by a separate NFI revolving fund and is used to fulfil CO orders as they come in the same fashion as with IARH kits. In case of local procurement, the COs align with their suppliers and invest in stock in a way that works for them.

3. Waste resulting from humanitarian supply chain activities

This section investigates the volume of waste generated throughout UNFPA's humanitarian supply chain, considering kits specifically. There are many different types of waste and this analysis focuses on the four most important ones (as perceived): (i) IARH kits' expired or damaged stock, (ii) IARH kits' disposables, (iii) IARH kits' packaging, and (iv) dignity kits' packaging. The approach to estimate waste volumes is specific to each of these four types of waste.

This section starts by describing the different types of waste that can result from UNFPA's operations and how these are managed. The approach to estimate the waste volumes is then explained and the results are shared in the last sub-section.

3.1 Waste types

There are four main types of waste which can result from UNFPA operations[16]:

- Expired stock (avoidable)
- Damaged stock (avoidable)
- Packaging materials (avoidable up to a certain extent)
- Disposables (non-avoidable)

The below paragraphs define each of these four types of waste and explain how UNFPA and its partners manage it.

3.1.1 Expired stock

Causes

Most items in IARH kits have a limited shelf life, ranging between 12 and 60 months upon production (and decreasing as items move down the supply chain). The expiry date of an entire kit is set to the expiry date of the first of its items to expire. A kit is thus considered to be expired if that one item has reached its expiry date (same principle as with all other humanitarian health kits). Dignity kits, just like IARH kits, could also expire but this rarely happens because most NFIs have very long shelf life and present relatively short distribution lead times. Expired stock is mostly an IARH kits' issue, and the below paragraphs thus consider IARH kits specifically.

Pre-packaged humanitarian health kits – like IARH kits – are inherently wasteful. They are designed based on global demographics averages and standard medical treatment protocols. When ordering kits, COs are aware of these global averages and ideally adapt their ordering volume considering their country's specificities in comparison with these global averages. Still, kits follow a "push" methodology based on demographic data; they are pushed to countries to meet assumed rather than measured demand. Health facilities might consequently receive items they do not need, or they might end up with too many/few of certain items. Overstocked items may then expire before they can be consumed. This push approach combined with poor inventory management practices related to kits and misunderstandings on expiry of kits across many health facilities can lead to high volumes of expired stocks.

The risk of waste resulting from expired stock exists at each point along UNFPA's humanitarian supply chain. It increases as kits move down the supply chain and lead times shorten their remaining shelf

[16]Biowaste resulting from medical interventions at health facilities (with the use of UNFPA's RH items) represents another type of waste. It is however not considered in this report.

life. Most of the waste resulting from expired IARH kits is thus incurred at health facilities. Key causes can include:

- In humanitarian crisis, increased complexities in last mile distribution often lead to inconsistent lead times for in-country distribution.
- Blockades or embargos imposed may cause unexpected delays shortening the shelf life of items.
- Remote, hard to reach areas or areas with active armed conflict make maintaining a predictable distribution network challenging.
- Constantly changing national regulations or multiple state and non-state authorities in countries impact customs and transit times and more generally the ability to distribute humanitarian commodities.
- A lack of availability of fuel or third party transport providers may increase lead times.

These unpredictable – typically longer – last mile lead times further shorten the kits' remaining shelf life and increase expiry risks at health facility level. HO and ROs work to support COs receiving kits to ensure that IPs understand the IARH kits, have strong inventory management capacity, and that proper pharmacy management practices are implemented and overseen at health facilities for the kits. Despite that, many IPs and health facilities not used to receive IARH kits have challenges managing the inventory of kits and individual items within the kits to track and avoid expiry.

Prevention, disposal, and reporting

UNFPA defines different processes to limit volumes of expired stock. To start with, IARH suppliers are only allowed to assemble items into kits if these items have a remaining shelf life of 75% or more[17]. SCMU should then organise the kits' stock and its distribution in a such a way that, when kits arrive at the requesting country's port of entry, they still have at least 6-12 months of remaining shelf life. As IARH kits are designed to support a health facility for three months, in acute crisis, the remaining shelf life can be less than 6 months when the IP is confident the supplies can be consumed. If the kits with a remaining shelf life of less than six months cannot be handed over to IPs, then the CO should either request HO approval to remove the short expiry items, or to donate the kits to the national system or humanitarian partners that can absorb them, clearly indicating the expiry date of all items within the kit.

In case a kit expires, the expired items should be taken out of the kit. COs are required to get HO approval to ensure this does not compromise the integrity of the kit, then the kit can still be distributed as such. Else, the CO (or the IP with the consent of the CO) should seek to donate the remaining items which have not yet expired to the national system or another humanitarian partner. UNFPA has an obligation to ensure that all expired stock is physically disposed of in line with national medical waste management regulations and WHO guidelines[18]. Also note that to minimize the volumes of expired

[17]This seems to be a struggle with some items that are coming from far away. Let us take the example of an item that has a shelf-life of 24 months and that is shipped from a supplier in China to a supplier in the Netherlands. Let us assume shipping takes four months all-in-all. This means that the item arrives at the supplier location with only 20 months of remaining shelf-life, which amounts to 83% of its total shelf-life. The 75% shelf-life threshold would be respected if the supplier can directly start to assemble the item into a kit. But that is not always the case; it could happen that the other items required to assemble the kit have not yet arrived at the supplier location, and so the item's shelf-life might get close to the 75% threshold or even go below it when the kit's assembly is finally starting.

[18]For IARH kits, it is the responsibility of the IPs (and COs) to ensure that health facilities can safely dispose of medical waste. If a health facility does not have that possibility, the IP together with the CO should organise the transport of the waste to a location that has the necessary disposal capability and capacity, and of course also respects safe disposal standards.

stock, UNFPA and their partners (incl. medical staff at health facilities) should manage the kits' stock following the FEFO (first expired first out) rule: the kits (items) that expire first should be distributed (consumed) first.

SCMU keeps track of the stock volumes that expired under their custody. These volumes are marginal. UNFPA's Finance Branch centralizes in one report the stock volumes that expired under the custody of IPs. This report does however not include donations of soon to be expired stock and should therefore be carefully interpreted. Additionally, it is unclear to what extent IPs systematically report back (or even track) their volumes of expired stock. UNFPA's Finance Branch also receives information regarding the stock volumes that expired under the custody of COs, but again it is unclear how systematically this information is shared. UNFPA has no global visibility of the stock volumes that expire after handover to IPs (eg, at IP warehouse or health facility level), while this is where the risk of expiry is the highest for IARH kits. Considering all of this, UNFPA is unable to report the total volume of its supplies which expire before being consumed. This is due to both a lack of structural data collection and structural oversight by UNFPA COs which lack capacity in supply chain management and medical logistics, but is also a result of potential reporting bias of health facilities who fear that if they report expired stock they may not receive future allocations.

There is a big stigma around expired stock in humanitarian crisis. Expired stock is indeed the result of supply chain inefficiencies, something practitioners might feel guilty about (even when not responsible). It represents a financial loss, a missed opportunity to help beneficiaries with available funds; and its disposal comes at an extra cost. Most large-scale humanitarian crises have weak or non-existent national medical waste management practices, meaning that the risk of expired stock being mismanaged is high. Reporting expired stock often triggers highly bureaucratic investigation processes and takes much of practitioners' precious time and energy and can create significant animosity with affected populations. Practitioners might also fear to receive less resources or funds in the future as a consequence. All in all, practitioners – at all levels – might be reluctant to proactively track and report back expired stock volumes. This lack of transparency makes it difficult for UNFPA to help them manage expired stock, and most importantly, to prevent it in the first place.

3.1.2 Damaged stock

Causes

A kit is considered damaged if one or several of its items (or the entire kit) have been physically altered, meaning the kit's item(s) quality and/or quantity are affected. Kits can be directly damaged (or fully destructed or stolen) by natural hazards like floods and storms or by human hazards like bombings and lootings. More importantly, damaged kits are often the regretful consequence of inappropriate storage conditions and poor stock handling practices – which is, despite all effort, not uncommon in the humanitarian context. Key causes can include:

- In the case of sudden-onset disasters, stock may remain blocked at ports of entries congested due to high and immediate volumes of relief items being pushed to the affected country. The impact of a lack of infrastructure at ports of entry can lead to sun and heat exposure of medical commodities waiting to be cleared on an airport tarmac.
- Natural hazards or armed actors may not only destroy or damage goods but may also impede delivery and affect the quality of the distributed commodities. Think for example of a truck having to wait (up to several days) at a frontline in a war zone. Fragile commodities may suffer from extended storage inside the truck.
- Due to large amounts of humanitarian cargo moving and potential impact on the national supply chain, there may be a lack of available third party logistics providers (3PLs) with

infrastructure or staff able to properly offload/onload, transport and monitor medical supplies.

- Cargo optimisation across partners or by 3PLs, due to limited availability of infrastructure, can cause damage to medical stocks due to over stacking or co-transporting with items that can be damaging to medicines. Products may also be incorrectly palettized or stacked.
- Natural hazards and armed actors may damage stocking facilities (warehouses, pharmacies) and consequently affect storage conditions there, or may impact other essential infrastructure (eg, roads and bridges) increasing risk of damage.
- The quality of stocking facilities (warehouses, pharmacies) in many humanitarian operations is often not GSP/GDP compliant (especially in remote settings) and may also lead to damage or reduced shelf life of commodities. Handling equipment may also be missing.
- IPs and health facilities may not have adequate pharmacy management capacity.
- In many disaster areas, energy sources (electricity, fuel) may be inconsistent or unavailable leading to unstable temperature control systems in stocking facilities, which is a threat especially for keep-cool commodities.
- Time pressure and overworked staff further increases the risk for accidents when supplies are handled.

A lack of capacity for medical logistics or pharmacy management in UNFPA COs makes it challenging to reduce the risks for damaged stock. In fact, it might further increase the risks because of non-compliance to quality assurance rules with regards to storage and transport conditions.

Prevention, disposal, and reporting

In humanitarian crises, avoiding (or limiting) damaged stock is increasingly difficult compared to more stable settings and requires time and attention of trained humanitarian logisticians to address in coordination with external and internal actors. The mitigation measures required may require creative solutions, linked to the wider humanitarian logistics sector, different procurement needs, or partnerships required.

Internally, strong logistics management capacity is critical and includes well-trained human resources and effective leadership, clear processes and robust information systems. Moreover, close oversight on quality assurance for handling, storage and transport, investment in proper storage and transportation infrastructure and transparent and effective information management and reporting processes are recommended. Externally, collaboration with customs authorities and other humanitarian actors (eg, Logistics Cluster in one stop shops or OCHA in civil military coordination), requesting minimum standards from freight forwarders and warehousing subcontractors are just a few other examples. UNFPA is aware of these internal and external measures but has been working on these on a very ad-hoc rather than systematic basis.

The reporting and disposal of damaged stock follow similar processes as with expired stock.

3.1.3 Packaging materials

Causes

Most IARH kits' items have a primary and sometimes secondary packaging for sanitary reasons. There are much fewer packaging requirements when it comes to NFIs, but they often end up being unnecessarily packaged by local suppliers. All kits' items are then packed in an exterior packaging which is put on pallets. For example (see Figure 3), syringes are packaged in a plastic box – this is the primary packaging – and the plastic boxes are packaged in a carton box – this is the secondary

packaging. The carton boxes are then placed in cardboard – this is the exterior packaging – and the cardboards are placed on a pallet.

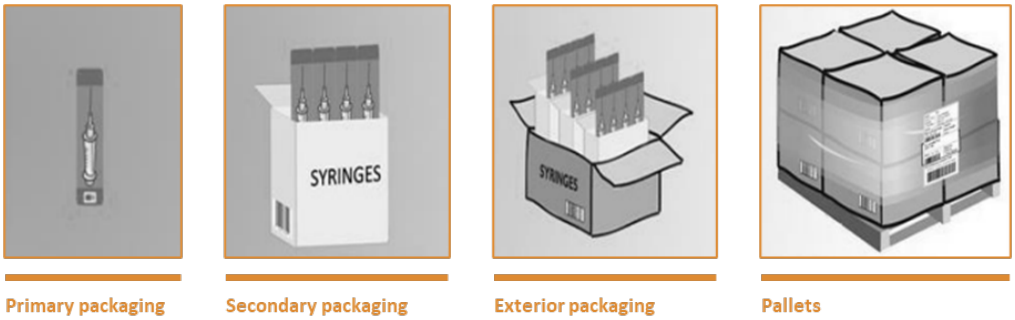


Figure 3: Primary, secondary, and exterior packaging[19]

Prevention, disposal, and reporting

Most of the packaging materials end up at health facilities for IARH kits or with beneficiaries for dignity kits. UNFPA does not manage or monitor this type of waste, though they do work on limiting its volumes by collaborating with their suppliers (this is explained further in the section *5. Recommendations to reduce waste and GHG*).

3.1.4 Disposables

Causes

Disposables are items that are meant for single-use and need to be disposed of after that. Most IARH kits contain disposables – some much more than others. Figure 4 lists out the disposables that one can find in an IARH kit and must be managed at health facility level. Dignity kits also contain disposables, but to a much lesser extent than IARH kits. Typical NFI disposables are disposable menstrual pads[20] and diapers.

[19]Source: *Policy and Procedures on Management of Programme Supplies* (see UNFPA, 2021b)
[20]The basic dignity kit from SCMU contains both reusable and disposable menstrual pads.

Figure 4: Disposables in IARH kits[21]

Prevention, disposal, and reporting

Just like packaging materials, disposables end up at health facilities for IARH kits or with beneficiaries for dignity kits. UNFPA does not structurally manage nor monitor this type of waste. As this type of waste is governed by national government regulation, it is the obligation of all actors, including UNFPA, to ensure it is managed in line with medical waste management practices and WHO guidelines.

3.2 Approach to estimate waste volumes

The four aforementioned types of waste differ in their nature, but also in their volume and avoidability. Figure 5 roughly classifies these considering their volume and avoidability, for IARH and dignity kits separately. Note that as comprehensive volume data was unavailable, the volume here needs to be interpreted as perceived rather than measured.

The waste types estimated with the most significant volumes were weighted: (i) IARH kits' expired and damaged stock, (ii) IARH kits' disposables, (iii) IARH kits' packaging, and (iv) dignity kits' packaging. Some of these fall under unavoidable waste. Despite the difficulty to reduce unavoidable waste, it is still necessary to understand its volume and organise capacity to dispose it properly.

[21]The pictures were retrieved from Google Images.

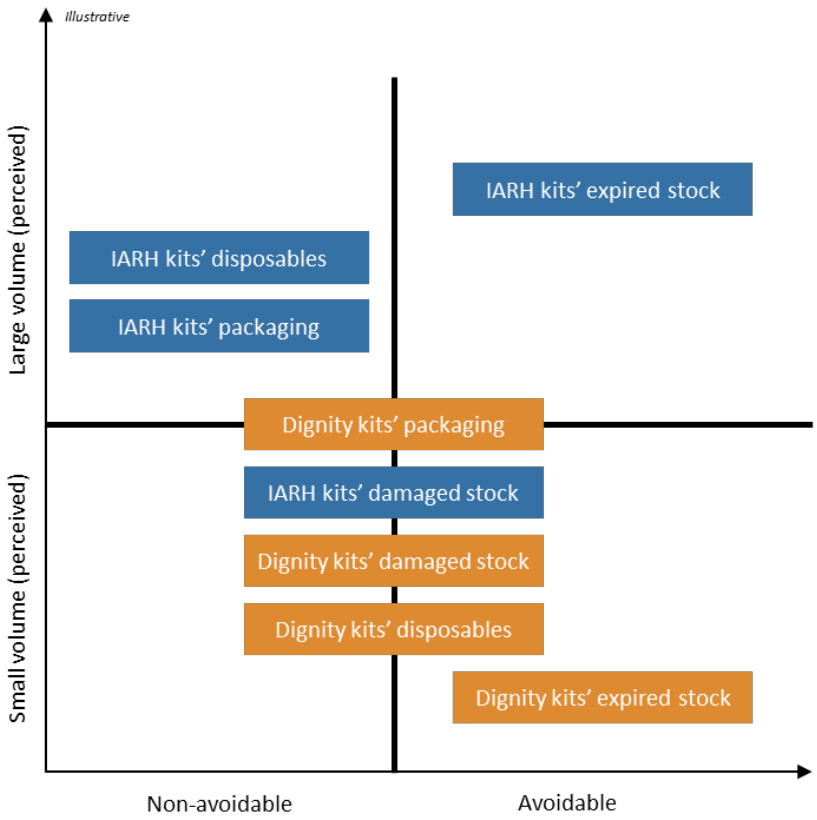


Figure 5: Classification of waste types

3.2.1 IARH kits' expired and damaged stock

As mentioned above, very little data exists regarding expired and damaged kits' stock and relying on existing reports would give an incomplete picture of total volumes. Based on experience and understanding of the IARH kits' design and observation across a significant number of humanitarian operations, HO has basic relative estimates of the proportion of kits that typically gets wasted for each of the 16 main IARH kits. Figure 6 lists out HO's assumptions regarding wastage percentages and the rationale that led to these assumptions. Please note that the assumptions are based on the 5th edition IARH kits which were the predominant kits available during the analysis.

IARH Kit	Proportion of waste assumed	Rational
1A	20%	Waste assumed as part of the kit's design
1B	20%	Same assumed as with kit 1A
2A	0%	Only gloves with expiry date; will be used by women in delivery or after
2B	0%	Only gloves with expiry date; will be used by women in delivery or after
3	30%	High rate of loss seen due to short expiry and lack of service seeking behaviour variable across settings; many IPs report too much per kit and many COs over procure

4	5%	Basic waste due to poor management or over-procurement
5	5%	Basic waste due to poor management or over-procurement
6A	0%	Equipment
6B	10%	Cold chain making additional complexities in management; many pharma items of which not all will be used in each setting
7	5%	Basic waste due to poor management or over-procurement
8	5%	Basic waste due to poor management or over-procurement
9	5%	Basic waste due to poor management or over-procurement
10	0%	Equipment
11A	0%	Equipment
11B	10%	Cold chain making additional complexities in management; many pharma items of which not all will be used in each setting
12	10%	Short expiry and cold chain making additional complexities in management; many pharma items of which not all will be used in each setting

Figure 6: Expired and damaged stock assumptions for IARH kits

The listed rationales can be classified in three overarching groups. First, the proportion of wastage can be assumed based on the kit's design:

- Kits 6A, 10, and 11A only contain medical equipment. Because medical equipment does not expire and are less fragile than other medical commodities, HO assumed 0% of wastage for these kits.
- Kits 2A and 2B are meant for individual deliveries at home without skilled birth attendants. The only items in these kits that do expire are gloves, but it can easily be assumed that these will be used before expiry because they have a relatively long shelf-life (60 months) and because the kits are only distributed to women who are already pregnant (and their birth attendants) and will thus effectively need the gloves when they deliver. HO thus assumed 0% of wastage for these kits.
- Kits 1A and 1B contain male and female condoms, respectively. Their quantities were calculated for a target population of 10.000 people over a period of three months – with the conservative assumption that 20% of the distributed condoms might not get used because some would fall on the ground or get broken before use and thus need replacement. In an ideal world, condoms would not fall on the ground or get broken, and 20% of the condoms would be a stock surplus at risk of expiry. Following the kit's design, HO – conservatively – assumed 20% of wastage for these kits.
- IARH kit 3 supports clinical management of rape. It contains medical items which must be available across health facilities in the event of a rape survivor but, depending on the context, have low utilization rates. In other words, this kit needs to be widely available but can have

low use in practice. These items might thus expire before being used and HO made a rough assumption of wastage based on observations.

- Kits 6B, 11B, and 12 support obstetric care. They contain many medical items with shorter expiry dates which may or may not be used for each delivery depending on national treatment protocols and practices. These kits include cold chain items which are at high risk of damage when not maintained at appropriate temperatures. Some of these items will have low consumption rate, and thus expire before being used, and some will not be used at all. HO made a rough assumption of wastage based on observations as well as based on work related to moving from IARH kits to bulk procurement.

Second, the proportion of wastage can be assumed based on procurement and stock mismanagement:

- Based on research conducted by HO and London School of Hygiene and Tropical Medicine in 2017[22], it appeared that COs tend to over-procure kits (UNFPA HO, 2017). This can be due to a lack of visibility on needs and stock on hand coupled with a positive forecast bias out of fear of not being able to fulfil critical RH needs (see quote below). It can be further explained by the long procurement lead times and COs preferring to place large but infrequent orders rather than smaller and more frequent ones. A third reason relates to funding mechanisms. COs sometimes order IARH kits based on the funds that are available (supply rather than demand-driven). As HO is now reviewing all IARH kits' orders coming in from COs to help guide COs on rational procurement, as well as supporting COs to move away from IARH kits to bulk procurement, the extent of over-procurement is likely lower today in comparison to when the interviews were conducted in 2017.

> *Countries don't often know how much they have left over; it is very difficult to track the kits on the ground during an emergency. Where it ends up, do the people still have enough… but what we don't want is not having enough. So we supply, we supply, we supply. Then when everyone leaves, that's when you find out how many tons of used or wasted stuff are sitting there (…).*
>
> From HO's key informant interviews on IARH kits (see UNFPA HO, 2017)

- While the development of emergency health kits (like the IARH kits) has revolutionized the way commodities reach affected populations in the immediate aftermath of crisis, there has also been a negative consequence related to prolonged long-term kit procurement. The kits are designed to be a short term, imperfect, solution to "push" supplies quickly to the last mile in a sudden onset emergency response. As mentioned previously the kits are designed based on global assumptions and standard treatment practices which is not designed for national treatment practice or based on the specific demographic makeup of the target populations in a specific country. However, as the kits are "easy" to procure, held in stock at the global level and require less supply chain and logistics investments from the side of COs and IPs, prolonged kit procurement over months and years (even beyond humanitarian operations) is a structural issue. From UNFPA's experience with the longer-term use of the IARH kits, while some of the items among the supplied IARH kits are rapidly used up, in some cases many items are not used at all leading to increased waste. HO has implemented three pilot projects in Cox's Bazar, Iraq and Yemen and is working to develop an operational toolkit to support COs in this transition away from kits. Additionally, as HO is reviewing all kit orders coming from country

[22]Interviews were conducted with people from various positions – decision-makers, policy officers and strategists, as well as people from the field – all working with IARH kits.

offices, HO has been supporting COs with alternative solutions for kits, particularly in countries without a largescale humanitarian programme.

It's already packaged and you know the cost and it's a good way to use money as well. It's also a good way to show the country that you are doing something. It's very visible. Especially if you are going to have issues with the importation of drugs, these kits are all already approved and you can bypass a lot of the customs issues.

From HO's key informant interviews on IARH kits (see UNFPA HO, 2017)

- While prepositioning at the national level can be an effective mechanism as part of wider preparedness and contingency planning exercises, prepositioning of kits requires significant logistics infrastructure, process, and human resource investments to avoid waste. Many country offices are "prepositioning" supplies for different reasons (some strategic and less strategic) without a holistic strategy related to stock management and stock rotation increasing the risk of waste or damage of products. Based on the HO survey 56% of respondents reported procuring for the purpose of prepositioning (UNFPA HO, 2017).

Third, the proportion of wastage can be assumed based on improper logistics and pharmacy management:

- Lack of structural human resource capacity related to medical logistics and pharmacy management within many COs and IPs contributes both to increased risk of damage or expiry and a lack of ability to adequately address the causes when they are identified. This also limits the capacity of the COs and IPs to oversee processes and track waste at service delivery points as well as address Last Mile Assurance (LMA) concerns.
- While significant work is being implemented across UNFPA through LMA to track and address causes of damage of products, the application of LMA in humanitarian contexts and relation to kits is still limited. The lack of structural oversight over the quality of storage and transport of kits after handover to IP and lack of structural oversight on storage at service delivery points – store rooms and pharmacies – can lead to a lack of visibility over the causes of damaged stocks and therefore an inability to address them. As programme staff are primarily responsible for oversight and monitoring of IPs, logistics staff (where they exist) are often not structurally part of the selection of IPs or regular monitoring activities. These challenges are compounded when delivering kits to hard-to-reach areas.
- Health facilities should all manage their stock based on FEFO, should add kits to inventory as "kits" and then track unpacked kits' individual items with stock cards. The extent to which this rule gets applied is however unclear in relation to the kits as often kits are not unpacked upon receipt or are tracked as a "kit" as opposed to individual items. Based on a survey conducted by HO in 2017[23], it appeared that only 53% of health facilities' staff did effectively unpack items out of their kits (UNFPA HO, 2017). Those that did not unpack these could not possibly have conscientiously applied the FEFO rule. Many health facilities receiving kits, especially those unfamiliar with kits and without trained store managers and pharmacists also face challenges with proper inventory management practices.

[23]The survey pool included mostly people from UNFPA COs, and to a smaller extent people from the Red Crescent and Red Cross Movement, as well as from international and local NGOs.

- Kits 6B, 11B and 12 all include keep-cold items. Cold chain requirement makes the distribution of these kits more complex due to many of the challenges highlighted in the previous section, which increases the risk of wastage.

For wastage resulting from procurement and stock mismanagement as well as from improper logistics and pharmacy management, HO assumed some rough wastage proportions based on their experience.

In order to approximately calculate the yearly volume of expired stock for each of the 16 main IARH kits, their wastage percentages were multiplied with an estimate of their yearly procurement volumes of 2021[24]. The results are detailed out in the next sub-section.

3.2.2 IARH kits' disposables

When it comes to IARH kits' disposables, the quantity of disposables were listed out (see Figure 4) in each kit based on the UNFPA procurement catalogue. Note that the following disposables were not considered:

- Condoms
- Drug bags
- Sutures
- Capillary tubes

Condoms, drug bags, and sutures were not considered as these are shared with or used on / by beneficiaries – which means the waste is not managed at health facilities. Capillary tubes were also not considered because their size and quantities are negligeable. The full analysis can be found in the Supplementary Material 1.

The quantities of disposables were multiplied by the estimated yearly procurement volumes of 2021 to approximately calculate the yearly volume of disposables for each of the 16 main IARH kits. This calculation assumes that all disposables in the distributed kits were used. The results are detailed out in the next sub-section.

3.2.3 IARH kits' packaging

As mentioned in the previous sub-section, items in kits can have a primary and secondary packaging and are then placed in an exterior packaging. The UNFPA procurement catalogue only stipulates the requirements for primary packaging (very rarely for secondary packaging) of kits' items. Exterior packaging is not mentioned at all. Therefore, it was only possible to estimate the total volume of primary packaging. More specifically, focusing solely on plastic primary packaging, as plastic appeared as the most used packaging material, enables on its own an impactful analysis as plastic waste mismanagement and pollution is a problem in many countries where UNFPA operates.

Based on the UNFPA procurement catalogue, it was possible to indicate which of the below primary plastic packaging types was used for each kits' item, and in what quantity.

- Small (individual) plastic bag
- Normal plastic bag
- Plastic tablet

[24]The most recent and accessible procurement volume data for IARH kits was for the year 2018. A yearly 5% growth was assumed to estimate the 2021 procurement volumes.

- Plastic tube
- Plastic ampoule

The weight for each of these packaging types were estimated. The quantities of each packaging type in each kit were multiplied by their weight to obtain an approximation of the total weight of primary plastic packaging in each kit. This analysis can be found in the Supplementary Material 1 and an overview of the main assumptions is given in Appendix 5.

In order to evaluate the yearly volume of primary plastic packaging for each of the 16 main IARH kits, the estimated total weight of primary plastic packaging per kit was multiplied with the estimated yearly procurement volumes of 2021. This calculation assumes that all packaged items in the distributed kits were used. The results are detailed out in the next sub-section.

The fact that only primary plastic packaging was considered means that it is not possible to fully estimate the yearly volume of IARH kits' packaging. Non-plastic primary packaging, secondary packaging, and exterior packaging do probably sum up to a significant weight of packaging which also needs to be disposed of. The results in this analysis can be viewed then as an under estimation.

3.2.4 Dignity kits' packaging

Just like IARH kits' items, dignity kits' items can also have a primary plastic packaging. Unlike with IARH kits' items though, that packaging is often not necessary. The amount of packaging used for dignity kits very much varies based on where the kits are supplied from. Typically, kits supplied from SCMU have less packaging material than kits supplied locally. HO and SCMU agreed in 2021 to request no non-essential single use plastic within the next dignity kit LTA which is now being implemented.

In order to estimate the dignity kits' packaging volume, a similar approach was followed as with IARH kits and focused only on primary plastic packaging to keep the approach consistent. For the internationally procured dignity kit, all of the items were listed out in one basic dignity kit based on UNFPA's procurement catalogue. Unlike with IARH items, the UNFPA procurement catalogue does not specify the packaging requirements for NFI items. Common sense assumptions were used (eg, disposable menstrual pads are packed in small plastic bags) and photos of the dignity kits to estimate what packaging type is used for each item. The estimated weight of the packaging type was then multiplied by their quantities and the estimated yearly procurement volumes of 2021[25].

When it comes to locally procured dignity kits, their content (and thus primary packaging) very much varies based on country, context, target population, and of course also based on the supplier. Dignity kit distributed in Country X was used as a reference. Based on a picture of that kit and all of its content (see Appendix 6), it was possible to list out all the items in that kit as well as their primary plastic packaging type. The estimated weight of the packaging type was multiplied by their quantities and then by the estimated yearly procurement volumes of 2021.

The full analysis – both for internationally and locally procured dignity kits – can be found in the Supplementary Material 2. The results are detailed out in the next sub-section.

[25]The most recent and accessible procurement volume data for dignity kits was for the year 2020. Because of COVID, 2019 rather than 2020 was chosen as a reference year. A yearly 5% growth was assumed to estimate the 2021 procurement volumes.

3.3 Waste volume estimation's results

3.3.1 IARH kits' expired and damaged stock

Based on the estimated IARH kits' procurement volumes of 2021 and expired and damaged stock assumptions, the total weight of expired and damaged stock for one year is estimated at 176,013 kg. Figure 7 lists out the weight for each kit separately. Expired and damaged stock for kit 11B represents by itself more than 70% of the total expired and damaged stock weight. This disproportionately high number needs to be interpreted considering kit 11B's weight which is almost ten times higher than the average IARH kit's weight. The next kit contributing the most to the total expired and damaged stock weight is kit 6B, which by itself represents close to 20% of the total expired and damaged stock. This does not come as a surprise considering the fact that this kit has the highest estimated 2021 procurement volume and comes with a relatively high expired and damaged stock assumptions (10%). All the other kits represent between 0.1% and 3% of the total expired stock volume. All the results and their calculation can be found in Supplementary Material 3.

IARH kit	Expired/damaged stock quantity (units)	Expired/damaged stock volume (kg)	Expired/damaged stock volume (%)	Expired/damaged stock value (USD)
1A	72	4,436	2.5%	39,351
1B	18	126	0.1%	5,505
3	729	5,105	2.9%	829,692
4	65	977	0.6%	33,118
5	86	3,021	1.7%	94,684
6B	314	31,877	18.1%	422,774
7	30	426	0.2%	6,682
8	57	2,065	1.2%	60,080
9	66	992	0.6%	57,563
11B	117	126,374	71.8%	518,932
12	41	615	0.3%	73,868

Figure 7: Estimated yearly volume of IARH kits' expired stock

In value, the estimated total expired and damaged stock volume for one year corresponds to a value of 2,142,249 USD. The LMA report from UNFPA's Finance Branch which centralizes the in-country expired stock volumes only account for around 394,252 USD of the kits' expired and damaged stock across the years 2019, 2020, and 2021 (detailed analysis in Supplementary Material 4). The big gap between these two numbers is not surprising in the sense that UNFPA's Finance Branch report does not consider stock at health facility level (while this estimate does) and spot checks do not fully or structurally capture IARH kits after handover to IPs.

In humanitarian settings, it is important to note that it is often difficult to access IPs' forward warehouses and health facilities' storerooms and ensuring QA in logistics management after handover

to IPs is thus challenging. Many COs do not structurally engage in conversations with their IPs on the quantities and variety of supplies they are receiving and distributing to health facilities, or on the volumes of waste and disposal processes at IP and health facility level. Even if they did, IPs may struggle to provide the necessary information because of poor stock management practices at some health facilities or challenges due to a conflict or disaster related consideration. Additionally, when it comes to waste reporting specifically, they may be biased out of fear of penalty by either UNFPA or by the national system in which they operate. Despite these constraints, HO is working with the Finance Branch to see how to include tracking and addressing kits waste at IP and health facility level in the LMA reports.

Because of the lack of visibility, it appears difficult for UNFPA to engage with its partners on the waste topic and make sure that they have the capability and capacity to dispose expired and damaged stock properly.

3.3.2 IARH kits' disposables

Figure 8 lists out estimated yearly volumes of disposables being distributed through IARH kits. The needles and syringes stand out with over 11 million and 8 million being distributed respectively. IARH kits containing disposables also come with disposal bags and/or boxes – in total 300,000. A rough estimation of how much each disposable category weights was made and based on that the disposables quantities in weight were calculated. In total, disposables were calculated to 169,199 kg yearly. All the results and their calculation can be found in Supplementary Material 1.

Disposable category	Disposable quantity	UoM	Total Weight (kg)
Blood and urine bags	228,307	Each	3,425
Cannulae	1,055,495	Each	5,277
Catheters and extractors	394,877	Each	1,974
Compresses and cotton wool	10,968	Kg	10,968
Gloves	6,024,292	Each	3,012
Needles	11,858,433	Each	1,186
Single-us scalpels	116,689	Each	1,750
Syringes	8,161,905	Each	122,429
Tape	579,860	Meter	5,799
Tests	1,911,702	Each	1,912
Tubes	108,540	Meter	3,256
Umbilical clamp	547,441	Each	8,212

Figure 8: Estimated yearly volume of IARH kits' disposables

It can be argued whether these numbers are big or not. This is not the point: these disposables do fit a certain purpose and are mostly unavoidable. More important is whether the health facilities

receiving UNFPA's IARH kits have the capacity to manage and dispose the disposables waste in line with WHO guidelines on medical waste management or national medical waste management protocols. The disposables, once used, can be classified as infectious waste because contaminated with blood and other bodily fluids. They therefore need to be handled with extra care and subsequently disposed of through incineration. UNFPA has little structural visibility on whether the health facilities receiving IARH kits have the capacity and capability to do so. Additionally, working to ensure that rational kit procurement is implemented (ie, being as accurate as possible on when and how many kits to procure) and moving away from IARH kits to bulk procurement in post-acute emergencies can ensure that any disposables distributed will actually be used before expiry.

3.3.3 IARH kits' packaging

Based on the estimates of IARH kits' procurement volumes in 2021 and of primary plastic packaging weight per IARH kit, the data showed that 45,752 kg of primary plastic packaging needs to be disposed of yearly after the usage of the IARH kits distributed by UNFPA. Figure 9 lists out the primary plastic packaging weight for each kit separately – per kit, and per kit and year. Kit 11B scores the highest in terms of primary plastic packaging weight at kit level. It indeed comes with more than 7 kg of primary plastic packaging. While this is a lot in absolute value, note that it only represents 1% of the kit's total weight. The kit that scores the highest at yearly level is kit 3; its distribution results in approximately 14,000 kg of primary plastic packaging per year. All the results and their calculation can be found in Supplementary Material 1.

IARH kit	Primary plastic packaging weight (kg) / kit	Primary plastic packaging weight (kg) / kit / year
2A	1.61	3,222
3	5.70	13,856
4	1.45	1,891
5	1.43	2,470
6A	0.13	161
6B	3.89	12,201
7	0.64	392
8	2.13	2,438
9	0.21	280
10	< 0.01	2
11A	0.19	106
11B	7.17	8,367
12	0.90	367

Figure 9: Estimated yearly volume of IARH kits' primary plastic packaging

Again, the question here is not whether these numbers are too high – most of the packaging is unavoidable due to sanitary reasons. What matters is whether the health facilities have the capacity and capability to dispose the IARH kits' packaging waste properly, if the kits are an appropriate solution for that setting and if the quantities are rational. Just like with the other waste types, UNFPA does not have such visibility.

3.3.4 Dignity kits' packaging

Based on the estimates of dignity kits' procurement volumes in 2021 and of primary plastic packaging weight per dignity kit, 40,895 kg of primary plastic packaging needs to be disposed of yearly after the usage of the dignity kits distributed by UNFPA. Figure 10 lists out the primary plastic packaging weight for each kit separately – per kit, and per kit and year. Unsurprisingly, most of the packaging weight comes from locally procured dignity kits – these contain on average more plastic packaging than the ones procured via SCMU and also represent a much higher procurement volume (more than 60% of the dignity kits are locally procured). All the results and their calculation can be found in Supplementary Material 2.

Procurement type	Primary plastic packaging weight (g) / kit	Primary plastic packaging weight (kg) / kit / year
International	65	9,735
Local	130	31,159

Figure 10: Estimated yearly volume of dignity kits' primary plastic packaging

Unlike the previously discussed types of waste, packaging of dignity kits needs to be disposed of by the beneficiaries (receiving the dignity kits) rather than by health facilities. UNFPA has close to no control over how beneficiaries dispose of the packaging material – though they do have control over how much packaging material is used in the first place, as most of the plastic packaging in dignity kits is avoidable.

4. GHG resulting from humanitarian supply chain activities

Greenhouse gases (GHG) are a direct contributor to global warming and climate change. Reducing GHG emissions has not only been an increasingly discussed topic relating to environmental sustainability in general but is also closely tied to supply chain activities – eg, manufacturing, transportation, storage, and waste disposal activities all carry GHG emissions (see Figure 11). Different GHG have different effects on global warming, specifically in the way they absorb energy (and thus slowing the rate it can escape into space), as well as how long they stay in the atmosphere. Global Warming Potential (GWP) is a measurement developed to compare the impacts of different GHG in the atmosphere and standardize these impacts in a common unit of measurement (kg CO_2 equivalent, as CO_2 is used as the reference gas) to quantify the impact of different activities and compare reduction opportunities.

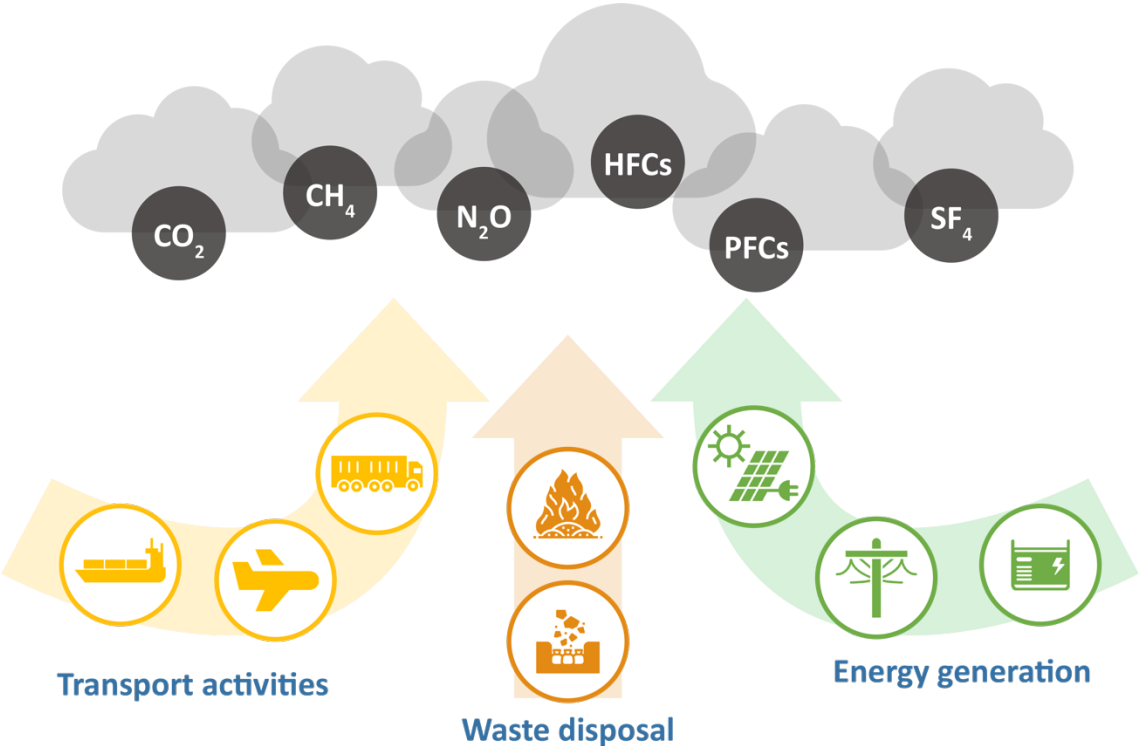


Figure 11: GHG emissions and associated source activities[26]

In this analysis the volume of GHG emissions emitted throughout UNFPA's humanitarian supply chain was evaluated, considering one IARH kit, kit 6B. Estimating the total volume of all kits was not possible due to the timeline and boundaries of the project. As an alternative, focus was put on just one kit (a commonly procured and relatively representative kit in terms of complexity and size) and performed a life cycle assessment (LCA) of various supply chain scenarios coming from two suppliers – one in the Netherlands (Supplier A) and one in India (Supplier B). The IPCC 2013 GWP 100a was used as a method (described more in detail in the below sub-section) to quantify GHG emissions, which was developed by the Intergovernmental Panel on Climate Change (IPCC) and expresses the emission of GHG generated, in kilograms of CO_2 equivalent, over a 100-year period (kg CO_2 eq). The results of the LCA

[26]Visual adapted from https://ghgprotocol.org/blog/you-too-can-master-value-chain-emission.

are specific to IARH kit 6B but they carry many important insights and lessons learnt for UNFPA and the sector more generally.

The next few sections introduce the LCA methodology generally and detail the application as part of the analysis. The model of the LCA for the supply chain of kit 6B is then outlined. In the last sub-section, the results of the LCA are presented.

4.1 Life cycle assessment's methodology

4.1.1 LCA methodology

LCA is a methodology used to quantify and measure the environmental performance of products from a sustainability perspective considering their complete life cycle – from raw materials extraction to the use and disposal of the product itself (see Figure 12). An LCA is used to (i) identify and prioritize improvement opportunities and/or (ii) compare similar products/flows with each other. LCA studies generally include multiple environmental dimensions like global warming, land use, land acidity, freshwater ecotoxicity, ionizing radiation and many others. (PRé, 2016)

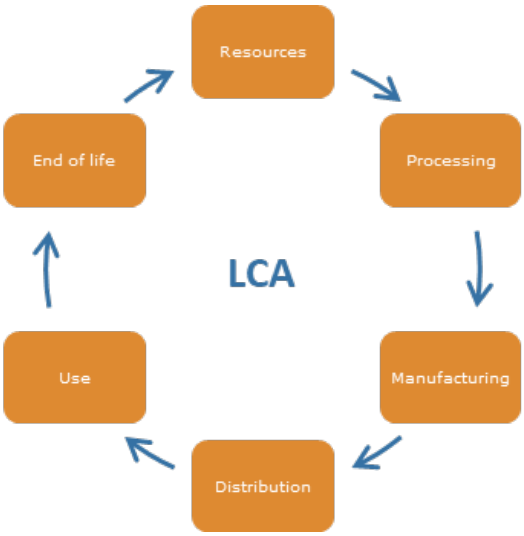


Figure 12: Life cycle steps considered in a typical LCA

An LCA study typically consists of three main steps: (i) goal and scope definition, (ii) life cycle inventory, and (iii) life cycle impact assessment.

4.1.2 Goal of the LCA

The objective of this LCA was to evaluate the overall GHG emissions (measured in kg CO_2 eq) associated with selected UNFPA humanitarian supply chain scenarios. Specifically, the results were used to measure the relative weight of the different steps of the supply chain to identify and target processes for emissions reduction activities.

The LCA in this analysis thus differs from more typical LCAs in two main respects: (i) it only considers one environmental dimension, global warming, while LCAs usually consider multiple ones[27]; and (ii) the objective is not necessarily to quantify the total GHG emissions through each step in absolute terms (although this may also provide valuable insights), but rather to use these values to assess the impact of each step relative to the other steps as a means of identifying high-impact activities within the supply chain (eg, air transport).

4.1.3 Scope of the LCA

An LCA is used to model a specific product, service, or system life cycle. However, this model is a simplification of a complex reality, and thus the model will have distortions (due to assumptions and limitations). The role of the LCA practitioner is to try to reduce distortions as much as possible and ensure the LCA is performed consistently. Clearly defining the scope of the LCA requires two steps: (i) identifying the functional unit and (ii) defining system boundaries. The functional unit is the comparison basis used to compare the products or scenarios. In this case, the functional unit is the supply chain process itself – the manufacturing, procurement, assembly, storage, distribution, use, and disposal of the IARH kit 6B based on multiple supply chain scenarios. The resultant GHG emissions is then used to compare scenarios. The system boundaries define the most important methodologies choices, assumptions, and limitations of the model (ie, what is included and what is not). As it is not possible to include all inputs and outputs in a product system, specific system boundaries were defined, presented in Figure 13.

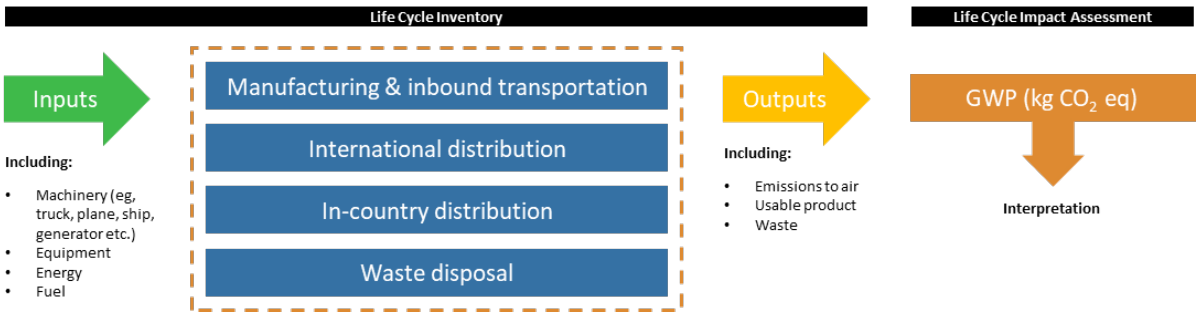


Figure 13: System boundaries of the LCA

Together with UNFPA's HO one IARH kit was selected for the LCA. IARH kit 6B is used for clinical delivery assistance at Basic Emergency Obstetric and Newborn Care (BEmONC) level health facilities. It contains a total of 68 items, a mix of pharmaceuticals and disposables (syringes, needles, gloves, …). This kit was chosen because (i) like all IARH kits, it is internationally procured, allowing us to evaluate the GHG volume resulting from international procurement and distribution, and (ii) it is one of the most important IARH kits in terms of delivery volumes. A cradle-to-grave approach was taken to consider the entire life cycle of the kit, from raw materials' extraction to the items' disposal, only excluding the usage of the items.

[27]Considering just one environmental dimension is referred to as single issue methods. Single issue methods are not in compliance with ISO 14044 (guidelines and requirements for LCAs) as this standard requires a deliberate assessment of all relevant impact categories for the study. There are two main standards for single issue methods: GHG Protocol Product Standard and the relatively new ISO 14067 (carbon footprint for products).

Three international distribution flows were analysed based on UNFPAs processes (see Figure 14)[28]:

- Scenario 1 (From NL by air): the kit is transported by air from a supplier in the Netherlands (Supplier A) to Country X
- Scenario 2 (From NL by sea): the kit is transported by sea from a supplier in the Netherlands (Supplier A) to Country X
- Scenario 3 (From IN via UAE by sea): the kit is transported by sea from a supplier in India (Supplier B) to Dubai's regional warehouse (UNHRD) where it is pre-positioned and then from Dubai's regional warehouse, the kit is transported by sea to Country X

The destination country, Country X, was kept anonymous to avoid any risk of stigma and finger pointing, as many of the challenges documented can be seen across all UNFPA humanitarian country operations. Country X was selected as the distribution point in all scenario analyses for a few reasons: (i) Country X is a large scale complex humanitarian emergency (conflict, disasters and outbreaks are persistent and ongoing), (ii) a recent in-depth supply chain and logistics mapping was implemented by HO of Country X's operations, which allowed for data collection and validation of the operational reality as much as possible, and (iii) like many humanitarian supply chains, in-country distribution of products in Country X is highly complex and significantly affected by the current situation, which provides unique insights on how the uncertainty of the humanitarian context can further influence the carbon footprint of supply chains. The distribution of kit 6B to one given BEmONC health facility in an area under a hard to reach and conflict affected region of the country was used as a mechanism for measurement.

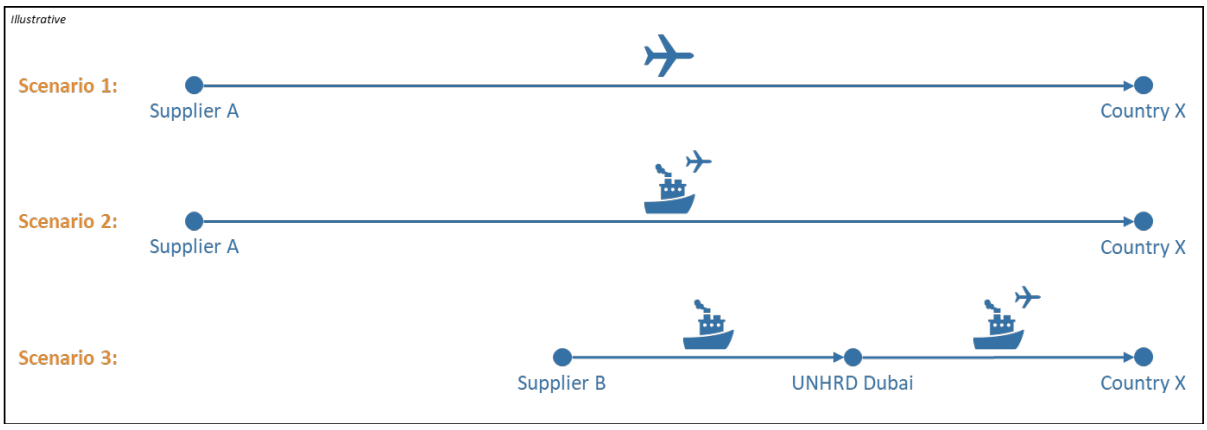


Figure 14: LCA scenarios for the international transportation of RH kit 6B to Country X

4.1.4 Life cycle inventory

The next step after defining the goal and scope of the LCA was to collect data for the LCA inventory (ie, all of the inputs of the different processes included within the system boundaries). As there can be thousands of inputs included within even simple processes, an LCA software was used to do the analysis. The LCA software SimaPro was used to calculate the results of the impacts of the supply chain, including disposal. This also included several databases (eg, EcoInvent and AgriFootprint) with

[28]These scenarios include both the regular temperature items, as well as the keep cold item, oxytocin. Separate supply chain scenarios were modelled for the cold chain, as it in some cases requires air transport. The main modes of transport are indicated in the description of the scenario, and the exact break down of transport modes can be found in the Supplementary Material 5.

pre-screened datasets referring to thousands of products and processes. Data is classified as two types: foreground and background. Foreground data refers to specific data needed for the study (typically done via questionnaire with a specific company or organisation). Background data refers to the data included within the databases, describing generic materials, energy, transport, and waste management.

For this study, a mix of foreground and background data was used (commonly done in practice). This includes information gathered directly from the suppliers on procurement location of items, transport distances, energy use, storage, and distribution steps (to be described in more detail in the next sub-section). The insights from suppliers were combined with the background data from the tool to quantify the inputs and outputs of the different processes. For example, the supplier indicates an item travels 10,000 km by ship to reach their location for assembly. Therefore, the appropriate process within the tool was selected to model shipping an item (by weight) 10,000 km (this will also be described more in the next sub-section).

4.1.5 Life cycle impact assessment

The last step of an LCA is the Life Cycle Impact Assessment (LCIA). Each input into the process (eg, transporting an item 10,000 km by sea) will typically also have outputs (eg, emissions to air). These are called "elementary flows", and in this case represent the GHG emissions to the environment coming from each process. Using this input data from the previous step, the LCA tool produces a table called the "Life Cycle Inventory" (LCI) result. This table includes all of the elementary flows included in the model. This value (eg, 1 kg CO_2 or 10 g CH_4) is then multiplied by a characterization factor (CF) to standardize to a common unit of measurement (kg CO_2 eq), using the IPCC 2013 GWP 100a method as mentioned in the earlier section (see Figure 15).

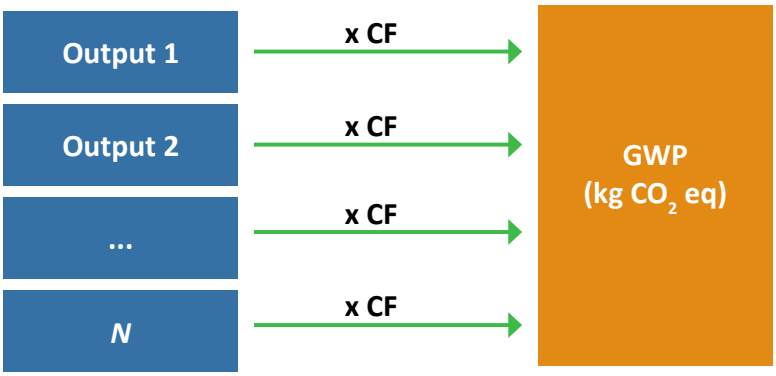


Figure 15: LCA impact assessment steps

4.2 Modelling the supply chain

In general, there are four main processes that were modelled in the IARH kit 6B's supply chain: manufacturing (of items and packaging), transportation, storage, and disposal. Due to the complexity of calculating the emissions from the manufacturing step (this required interviews directly with all manufacturers on the inputs for each of the 68 products) a different approach was used to measure manufacturing than the other three processes. Manufacturing of items is modelled using global emissions factors[29], which is described in the next sub-section. Manufacturing of primary and exterior

[29]The emission factors are coming from the CEDA 5.0 database (environmental input-output database).

packaging, transport activities, energy use for storage, and disposal of waste items are estimated using data gathered at the supplier and the background data in the tool.

Packaging was broken down into three sections: primary and secondary packaging (included with the item before it arrives at the supplier), and exterior packaging (applied by the supplier following the assembly step). Here, the main material of the packaging was identified (based on UNFPA catalogue), the weight (based on supplier data and results from an external consultant) and inputs and impacts of producing this raw material were modelled, as well as disposing of it using the database and tool. For more details on how this is broken down see Supplementary Material 5.1-5.3.

To model any transport activity the first steps were to select the mode, load capacity, and emissions factor (when possible). Mode refers to not only sea, air, or road, but specifically to the type of vehicle, ship, or plane, such as a 20-ton truck or a Boeing 747-200F. Load capacity refers to how full the transport mode is, as well as if it has an empty return or it can be assumed that there are also some new goods being picked up on the return trip. It was possible to customize load capacity for road and sea in the tool. Emissions factor refers to the European emissions standards EURO 1 to EURO 6 for vehicles, with EURO 1 having the highest emissions, and EURO 6 the lowest. Transport activities are measured in the unit "tkm" or tonne-kilometre, which refers to the amount of weight traveling a specific distance. The outputs (GHG emissions) associated with the specific value of tkm (by mode) is then used to calculate the GWP (measured as kg CO_2 eq) associated with the activity.

Storage was modelled based on the temperature requirement for quality control, number of days in storage, cargo details of the kit, estimated energy use per day, and type of energy used (eg, diesel generator, photovoltaics, or the grid). Depending on the source, the unit of input is either kWh (to represent the amount of energy required from the grid of photovoltaics) or as MJ (to represent the amount of diesel used to meet energy demand). As with transport, the GHG emissions is then multiplied with the CF to standardize to the kg CO_2 eq. For more details on how this was calculated see Supplementary Material 5.1, 5.2 and 5.5. Disposal refers to the energy required for either incineration or landfill of the waste items (expired stock, disposables, as well as packaging materials). This is described in more detail under the "disposal" step below.

As well, the IARH kit 6B contains one keep-cool item: Oxytocin. For international transportation, Oxytocin is either sent by plane or it can also be placed in a refrigerated container and shipped by boat (when the option is available). In the three scenarios, oxytocin is always transported by either plane (assumed in a cold box), by sea (in a refrigerated container/reefer), or by road in a refrigerated truck. It is always stored based on the required conditions (2-8 degrees Celsius). The cold chain is modelled separately in the Excel sheet (Supplementary Material 5 and 6) and the tool but combined together in the results section of this document for completeness.

4.2.1 Supply chain steps

Figure 16 lists out all the main steps considered in the LCA for the three scenarios. In some cases, there are sub-steps within these main steps, which will be described in the sections below. Notice that the items' manufacturing steps as well as the steps following the kit's arrival in Country X are common for all three scenarios. The following paragraphs provide more details around the different steps and how the volume of GHG that they generate was assessed. For further details on the classifications used in the tool for the different processes, as well as calculations described please see the Supplementary Material 5 and 6. As well, in the Supplementary Material there are six supply chains modelled for Supplier A, which represents the three with mainly air transport and three with mainly sea to represent their typical supply chains, which can vary depending on the demand. The average scenarios were used for both transportation modes (Scenarios 2 and 5 in the Supplementary Material 5 and 6) for simplicity purposes, which are referred to as Scenarios 1 and 2 in this document. For Supplier B, it

was assumed the supply chain process does not change significantly as they offer a decentralized stock flow.

All assumptions (on top of input data) used for the LCA are listed in Supplementary Material 5. On overview of the most important assumptions are also listed in Appendix 7.

<table>
<tr><th>Scenario 1</th><th>Scenario 2</th><th>Scenario 3</th></tr>
<tr><td colspan="3">Manufacturing of the IARH kit 6B's items</td></tr>
<tr><td colspan="2">Transport of the IARH kit 6B's items to Supplier A</td><td>Transport of the IARH kit 6B's items to Supplier B</td></tr>
<tr><td colspan="2">Assembly and storage of IARH kit 6B at Supplier A</td><td>Assembly and storage of IARH kit 6B at Supplier B</td></tr>
<tr><td>Transportation of IARH kit 6B from Supplier A to Country X by air</td><td>Transportation of IARH kit 6B from Supplier A to Country X by sea</td><td>Transportation of IARH kit 6B from Supplier B to UNHRD and then Country X</td></tr>
<tr><td colspan="3">In-country storage and transportation of IARH kit 6B up to the health facility</td></tr>
<tr><td colspan="3">Storage of IARH kit 6B at the health facility</td></tr>
<tr><td colspan="3">Disposal of waste resulting from IARH kit 6B</td></tr>
</table>

Figure 16: LCA scenarios and steps

4.2.2 Manufacturing of the IARH kit 6B's items

The 68 items of IARH kit 6B are manufactured at different suppliers located mainly in China, India, and Europe. Supplier A and C each have their own suppliers, and these can change over time[30].

This step was measured by relying on global emission factors which translate, for many different product categories, purchasing price into kg CO_2 eq. The factors take a cradle-to-gate approach, meaning that they consider all the GHG emissions from the moment the raw materials are extracted from the ground (cradle) up to the moment the finished product is manufactured and ready to leave the factory (gate). The 68 items of IARH kit 6B were mapped to their respective product categories (11 in total), the total value of each product category was then calculated (based on the prices indicated in UNFPA's procurement catalogue) and multiplied by the emission factors. Because the scope of the LCA is one kit, this calculation considers the quantities of items required for one kit. The full analysis can be found in the Supplementary Material 7.

4.2.3 Transportation of the IARH kit 6B's items to Supplier A/C

Once the items have been manufactured, they are transported from the manufacturers to the suppliers' plants. The transportation was considered for each of the 68 items of IARH kit 6B – and for each supplier (Suppliers A and C) – separately. Data was collected directly from the suppliers and includes information on the source country, transport mode, fuel type, kilometres travelled, and weight of each item as part of the total kit. The total weight of the item was multiplied by the kilometres travelled to calculate the tkm associated with the procurement of each item. For Scenarios 1 and 2 (Supplier A) procurement includes air, sea, and road transport. For Scenario 3 (Supplier B) this

[30]UNFPA defines the items' technical requirements, and the suppliers can propose any vendor respecting these requirements. The suppliers have the possibility to change vendors – for example if a vendor discontinued the required item, if it becomes uncompetitive or uncompliant, etc.

includes only road and sea transport. Note that the storage of the kit's individual items before assembly at the supplier's plant was not considered. Some items are stored before being assembled, but the stock levels are limited because of inventory costs and risks (see *2.1 Supply chain for IARH* kits).

4.2.4 Assembly and storage of IARH kit 6B at Supplier A/C

The supplier is responsible for two main activities: assembly of the kits and storage of the assembled kits until they are ready to be sent out. In Scenario 1 and 2, there is little automation during the assembly of the kit. For Scenario 3, more automated processes are included. As it was difficult to estimate the energy required for these specific activities, estimates on the average energy demand per day for warehouse and storage activities together were used based on industry expertise (Lewczuk, et al., 2021). This includes energy required for space heating, cooling, ventilation, lighting, IT & equipment, as well as other distributional warehouse activities. Cold storage was calculated using the methodology from industry experts (Evans, 2017), which considers the transmission load, internal load, equipment load, and infiltration load of the cold storage, especially considering the local climate (Netherlands vs. India). For both calculations, the result is a value of kWh per m^2 per day. This is then multiplied by the amount of space one kit requires (2 m^2 for the regular temperature goods and 0.5 m^2 for the cold chain) and the number of days in storage.

4.2.5 Transportation of IARH kit 6B to Country X

Once ordered, the kit is transported to Country X. Country X has two main port of entries – one in the south and one in the north – but when it comes to IARH kits, UNFPA predominantly sends these to the entry point in the south for several logistical and political reasons. There are several sub-steps included in the transportation of the kit from the supplier to Country X.

For Scenario 1 and 2 with Supplier A, the kit is either transported by sea or air to Country X. The following sub-steps were considered:

- The transportation of the kit by truck from the Supplier A plant to its closest airport / seaport in the Netherlands
- The storage of the kit at the airport / seaport in the Netherlands
- The transportation of the kit by plane / boat from the airport / seaport in the Netherlands to Country X

For Scenario 3 with Supplier B, the kit is transported in multiple steps mainly by sea to Country X. The following sub-steps were considered:

- The transportation of the kit by truck from the Supplier B plant to its closest seaport in India
- The storage of the kit at the seaport in India
- The transportation of the kit by boat from the seaport in India to Dubai
- The transportation of the kit by truck from the seaport in Dubai to the UNHRD warehouse in Dubai
- The storage of the kit at the UNHRD warehouse in Dubai
- The transportation of the kit by truck from the UNHRD warehouse in Dubai to the seaport / airport in Dubai
- The transportation of the kit by boat / plane from the seaport / airport in Dubai to Country X

From this point in the supply chain on, the tkm is calculated as the weight of the kit (or weight of oxytocin in the cold chain) plus primary and exterior packaging, multiplied by the kilometres travelled.

Energy required for storage is based on the same value for kWh per m^2 per day based on the method in the previous step, considering the local temperature.

4.2.6 In-country storage and transportation of IARH kit 6B up to the health facility

Once the kit arrives in Country X (via sea or air), it follows a series of steps before it reaches the health facility. All of the steps were considered within the LCA:

- The transportation of the kit by truck from Country X airport / seaport in the south to UNFPA's warehouse in the south[31]
- The storage of the kit at UNFPA's warehouse in the south
- The transportation of the kit by truck from UNFPA's warehouse in the south to the MoH's warehouse in the north
    - To reach the north, the truck needs to pass a frontline, which requires a green light from the actors in control there and with that, waiting time
- The storage of the kit at the MoH's warehouse in the north
- The transportation by truck of the kit from the MoH's warehouse in the north to a health facility in another region in the north

The processes in this step are the same for all three scenarios – for both regular temperature goods and the cold chain. The energy source in Country X for storage is assumed to be a diesel generator (according to the supply chain mapping implemented by HO and the CO). For the cold chain, a refrigerated truck is used for storage at the UNFPA warehouse in the south and it must also stay idling during the entire time waiting at the frontline to ensure no break in temperature. In the north, the warehouse has a compliant cold room.

4.2.7 Storage of IARH kit 6B at the health facility

When the kit arrives at the health facility, it is opened, and the kit's items are moved to a storage room. The oxytocin is stored in a small fridge. Here a storage time of 45 days is used based on the linear use of the kit, considering that the kit should be used over a target period of three months (90 days).

4.2.8 Disposal of waste resulting from IARH kit 6B

The final step of the kit's life cycle is disposal of packaging, expired/damaged stock, and disposables such as syringes, gloves, or needles (assumed to be used, and thus hazardous waste). An assumption that 10% of the kit 6B will expire or get damaged before it can be used (see Figure 6) is used and thus needs to be disposed of. It was assumed that no waste is separated before disposal, and two disposal methods were analysed: landfill for primary, secondary, and exterior packaging; and incineration for used disposables and expired stock based on the supply chain mapping implemented by HO and the CO.

4.3 Life cycle assessment's results

The results of the LCA indicate the Scenario 2 (NL by sea) and 3 (IN via UAE by sea) have the lowest comparative GWP compared to Scenario 1 (NL by air). Including manufacturing (assumed the same for all three scenarios) and the respective cold chains, the GWP of the three scenarios are as follows:

- Scenario 1 (From NL by air): 1,874 kg CO_2 eq

[31]This warehouse has a bonded area so customs clearance can happen there.

- Scenario 2 (From NL by sea): 1,341 kg CO_2 eq
- Scenario 3 (From IN via UAE by sea): 1,318 kg CO_2 eq

Looking more closely at which parts of the supply chain contribute the most provides interesting insights (Figure 17). Manufacturing and international distribution are different for the three scenarios, but in-country distribution and disposal are the same.

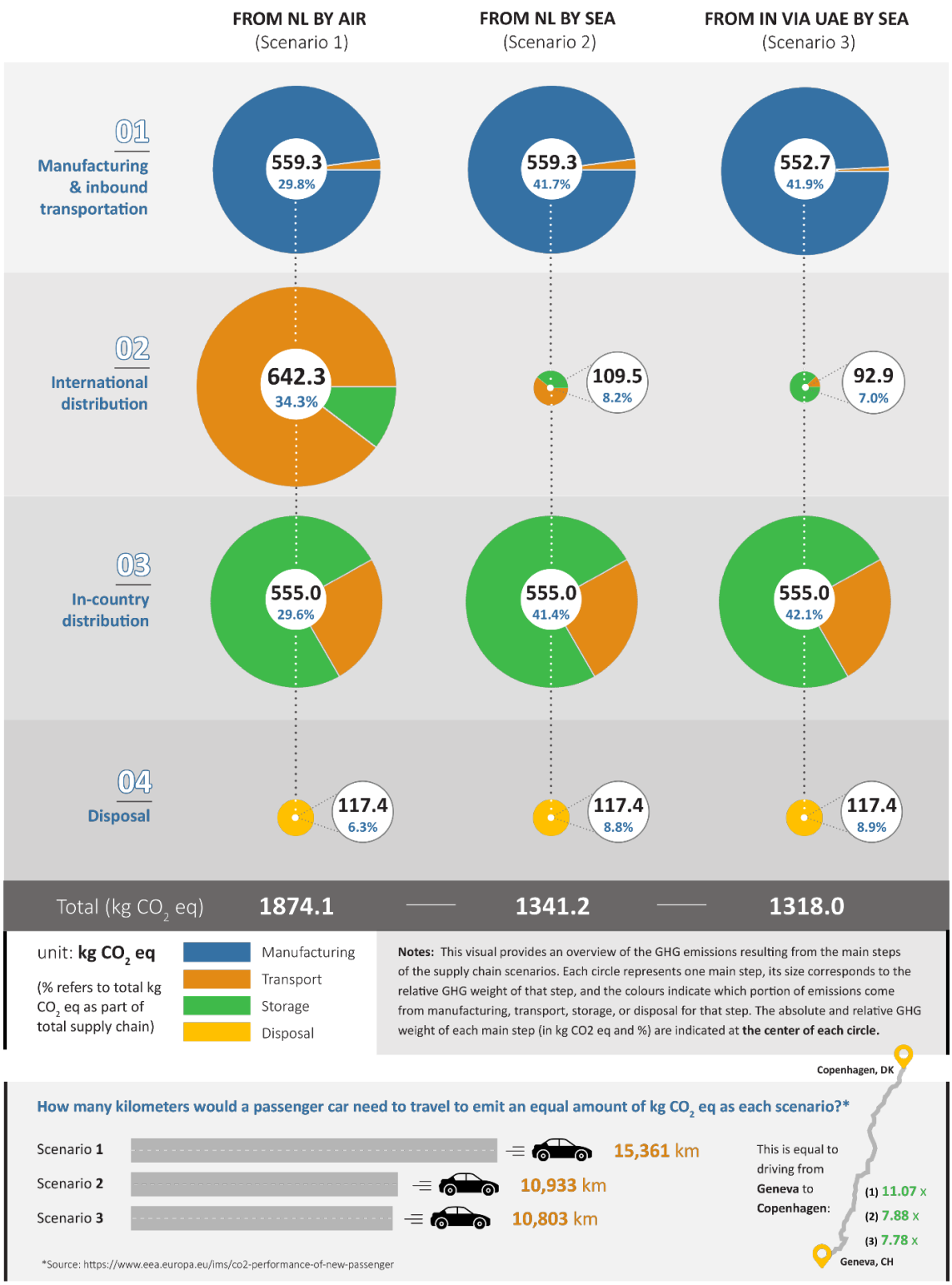


Figure 17: GHG emissions coming from the different main steps of one IARH kit 6B supply chain (for all three scenarios)

Looking at the results from the process perspective, it is clear that international distribution differs the most between the three scenarios. Within international distribution, Scenario 1 has significantly more GHG than the other two scenarios. This is due to the air transportation, which accounts for the vast majority of all GHG emissions in this step. In Scenario 2, while transport is still a larger part of the overall emissions than storage, the values are very low comparatively. This is because the regular temperature items are sent by ship (cold chain in this step are always sent via air for Supplier A, but the weight of the oxytocin compared to the rest of the kit is very low, and thus the impact is much smaller). In Scenario 3, although the overall emissions are also low (compared to Scenario 1), the majority can be attributed to storage in the UNHRD warehouse (for three months). These results not only corroborate the assumption that transporting by plane implies greater carbon emissions, but also illustrates that storing the kit for such long periods of time has a large impact. Storing the kit longer also increases the risk that products will expire and thus need to be disposed of (also a waste of the inputs and resources required to produce and transport it).

Going more detailed into each process, the major pain points were identified. For Scenario 1 (Figure 18), the largest contributor of the process is transporting the kit by plane (including intermediary storage at the airport) from the supplier's location to Country X (Step 4), which account for over 31% of total emissions from the entire supply chain. The second largest contributor is manufacturing (Step 1) (which is assumed to be the same among all scenarios), and the third is storing the kit at the UNFPA's warehouse in Country X (Step 6) (also assumed to be the same for all scenarios). The bulk of the emissions for this step, however, come from the cold chain. Here, the oxytocin stays inside the refrigerated truck (which must remain idling to ensure power for cooling) the entire duration (assumed to be 45 days based on the supply chain mapping done by HO and the CO).

In Scenarios 2 (Figure 19) and 3 (Figure 20), the largest contributors to GHG (besides manufacturing) come from storing the kit at the UNFPA Warehouse in Country X (included within in-country distribution, as mentioned previously). The step with the next highest emissions is the transport of the kit from UNFPA's warehouse in the south to MoH's warehouse in the north (step 7), which is also part of in-country distribution. This is due to the waiting time at the front line, in which the truck for the cold chain must remain on for an average of 21 days. For Scenario 3, storage at the UNHRD warehouse in Dubai also implies a larger portion of GHG emissions, due to the long-assumed storage time (for three months).

In all three scenarios, the in-country disposal of waste represents between 6% and 9% of the kit's total carbon footprint. Incineration is responsible for more than 80% of this load, the rest is landfill. Waste thus also has a non-neglectable carbon footprint. Note that reverse logistics that could be associated with waste disposal was not included; the assumption was that waste could be disposed of at local level. In reality, this is often not the case, which implies that the GHG impact of waste could be higher than 6-9% of one kit's carbon footprint.

Supplier A by air (Scenario 1)

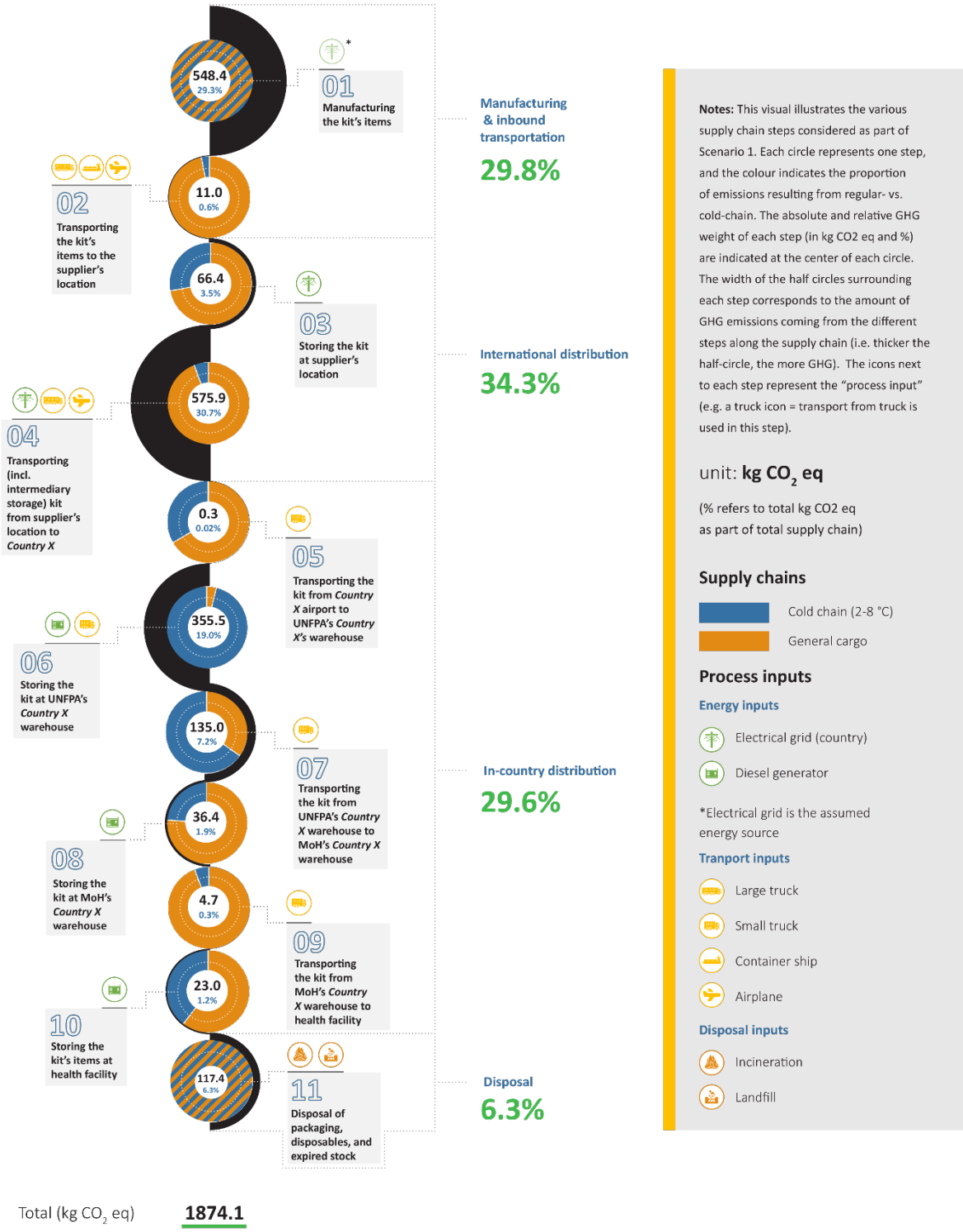


Figure 18: Scenario 1 (from Supplier A by air) breakdown of contribution to GWP (expressed as a percentage kg CO_2 eq) per step

Supplier A by sea (Scenario 2)

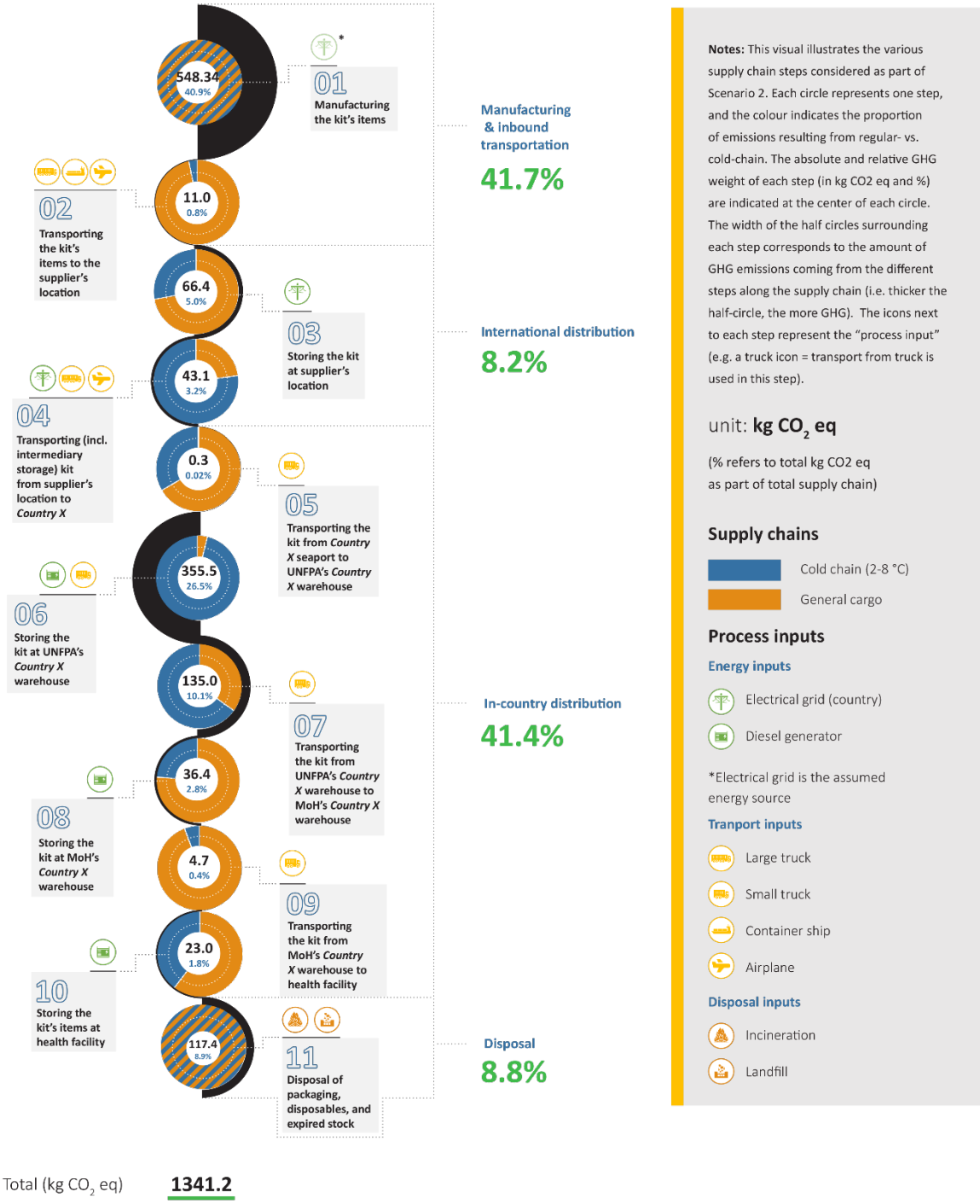


Figure 19: Scenario 2 (from Supplier A by sea) breakdown of contribution to GWP (expressed as a percentage kg CO_2 eq) per step

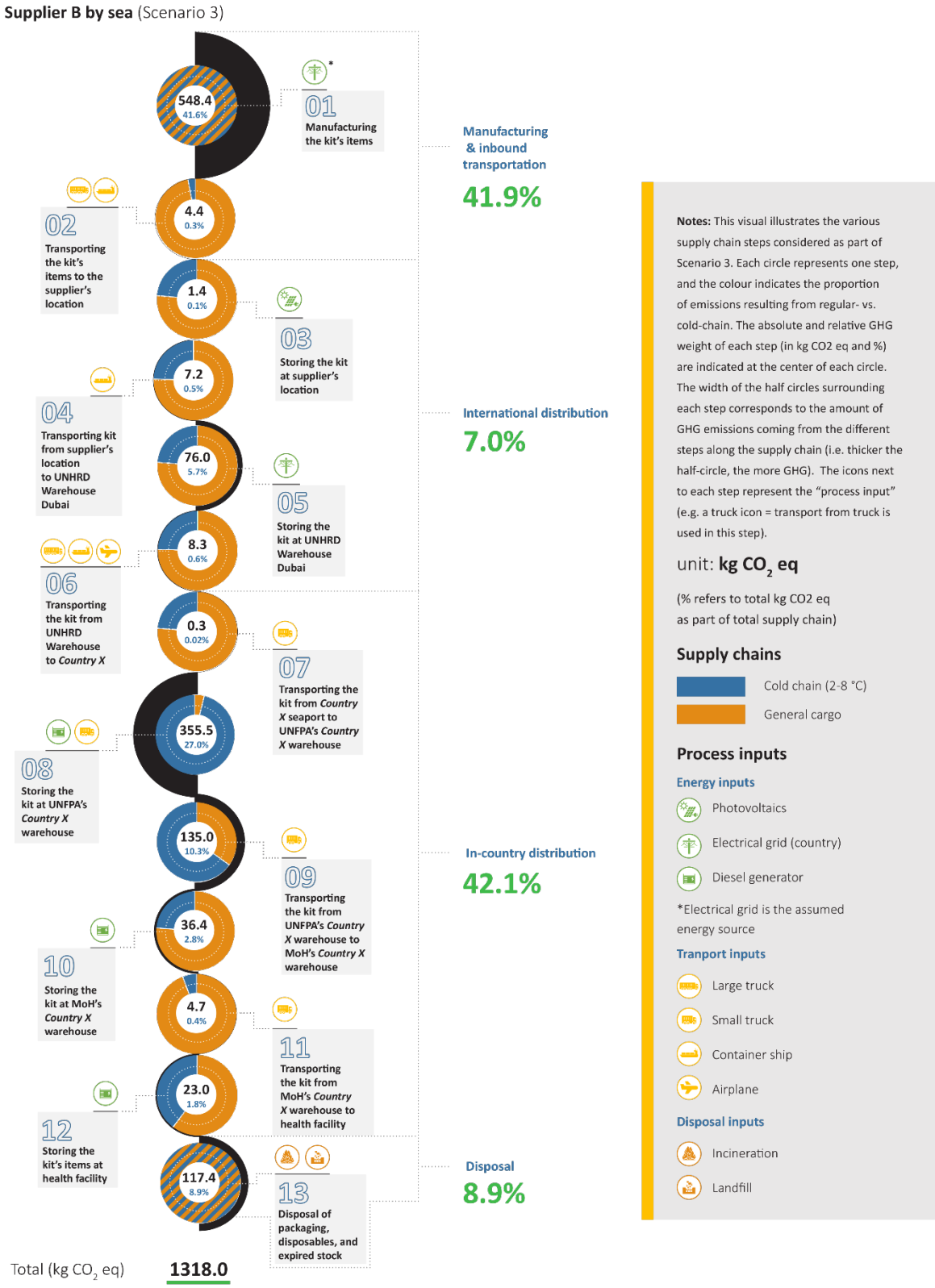


Figure 20: Scenario 3 (from Supplier B by sea) breakdown of contribution to GWP (expressed as a percentage kg CO_2 eq) per step

5. Recommendations to reduce waste and GHG

Environmental sustainability is not a new concept to UNFPA. Over the last years, UNFPA has been working on several initiatives where the primary goal was to reduce the environmental load of its activities. **UNFPA has also been seeking to improve its operational efficiency, and several initiatives in that area do not just present the potential to increase UNFPA's humanitarian supply chain performance, but also to decrease its environmental impact.** Efficiency and environmental sustainability do indeed often overlap.

This section describes recommendations for UNFPA to further reduce its environmental footprint. The recommendations are defined in light of previous analysis work and also considered ongoing initiatives. **Appendix 8 provides a summary of all recommendations (29 in total).** The recommendations are classified based on change level, action type, and priority.

The change level defines whether following the recommendation would lead to structural or operational (or both) change:

- Structural: the initiative (behind the recommendation) would alter UNFPA's supply chain dynamics and/or foundational processes
- Operational: the initiative (behind the recommendation) would impact UNFPA's operations without altering UNFPA's supply chain dynamics and/or foundational processes

The action type defines what sort of action(s) is (are) required for UNFPA to follow the recommendation:

- Continue: the initiative (behind the recommendation) is already ongoing and UNFPA should continue with it
- Scale up: the initiative (behind the recommendation) is already ongoing and UNFPA should scale it up to amplify its impact
- Advocate: the initiative (behind the recommendation) requires commitment from external or internal stakeholders and UNFPA should advocate for it before it can be enacted
- Analyse: the initiative (behind the recommendation) requires preliminary analysis work before it can be enacted
- Implement: the initiative (behind the recommendation) should be implemented

The priority defines the importance of the recommendation:

- High: the initiative (behind the recommendation) has a relatively high potential to reduce UNFPA's environmental footprint (either because it can significantly reduce waste or GHG volumes, or because it can reduce both) or it has a medium potential but is easy to implement
- Medium: the initiative (behind the recommendation) has a medium potential to reduce UNFPA's environmental footprint (and is not easy to implement)
- Low: the initiative (behind the recommendation) has a relatively low potential to reduce UNFPA's environmental footprint

For each recommendation, it is also specified whether the recommendation would mitigate UNFPA's waste and/or GHG footprint. For waste, a differentiation was made between impact on the waste volumes and impact on the disposal processes. Supplementary Material 8 is a more detailed Excel version of Appendix 8. It specifies which waste type would be impacted by the recommendation and also defines whether the recommendation would have a positive impact on supply chain efficiency.

On top of the three aforementioned classification groups (change level, action type, and priority), which should help UNFPA outline its mitigation roadmap, the recommendations are also classified based on five thematic areas:

- Supply chain network design and planning
- Procurement
- Logistics
- Collaboration
- Reporting and monitoring.

The need for increased supply chain management and logistics capacity (ie, the need to hire additional staff) and capability (ie, the need to train current staff) at UNFPA is part of recommendations 15 and 16, but it in fact transcends all 29 recommendations. Staff is indeed UNFPA's most important asset and impactful supply chain changes – over time – can only be achieved if UNFPA's staff has the appropriate skills and availability to enact and support these changes. Supply chain management and logistics has increasingly been recognized as a critical topic within the humanitarian sector and also at UNFPA, but while things are improving (namely with the creation of SCMU and capacity building at COs), the importance of supply chain management and logistics is not yet fully reflected in HR decisions.

The following sub-sections address each of recommendation in turn. To conclude, the last sub-section weights the carbon footprint of IARH kit 6B in case of an "ideal" supply chain.

5.1 Supply chain network design and planning

5.1.1 Supply chain planning (recommendation 1)

As mentioned in the section *2. Mapping of UNFPA's humanitarian supply* chain, few COs accurately forecast their kits' demand. Their rationale is that kits should only be used for emergencies, and these are difficult to predict. However, many countries experience cyclical natural disasters, which are relatively predicable. As well, many conflict affected or high-risk countries often have an advanced warning period where risks of deterioration are clear. In addition, as explained previously, kits are also used in post-acute emergency situations, which present a relatively stable and thus predictable demand (while kits procurement in post-acute emergency situations should not be encouraged generally, it is sometimes justified given logistics and financing bottlenecks).

UNFPA kits demand is thus to a large extent forecastable and UNFPA should improve the quality of its kits demand forecast. On top of improving UNFPA's supply chain's efficiency, demand planning presents the potential of making UNFPA's supply chain more environmentally sustainable: demand planning feeds supply planning and supply planning could lead to less reliance on air transportation (products can be shipped upfront) as well as less waste at country and global levels (only the products that are needed are produced and distributed).

This is in line with UNFPA's Strategic Plan, which states that UNFPA will improve its supply chain management and specifically mentions forecasting – as part of it overarching goal to optimize the management of its resources as well as UNFPAs Humanitarian Supplies Strategy which highlights potential impact on improved forecasting and supply planning. This is illustrated in below excerpt.

UNFPA will adapt its processes and procedures to attain operational agility with accountability for results and resources. (…) UNFPA will (a) improve its supply chain management, forecasting and prepositioning; (…) (d) build stronger data systems for more responsive programming; (…).
From UNFPA's Strategic Plan (see UNFPA, 2021a)

How can UNFPA improve its demand planning processes? COs should utilize historical demand and early warning and risk analysis to start forecasting kits demand and further improve the forecasting for bulk commodities. Advanced demand (and supply) planning skills at CO level are however often lacking and COs would need to either train their logisticians and programme staff or hire new resources with the required skillset (see recommendations in *5.3.1 In-country capacity building for supply chain management and logistics*). The forecasts should then feed into the yearly procurements plans as well as the biyearly (or more) orders (see Figure 21).

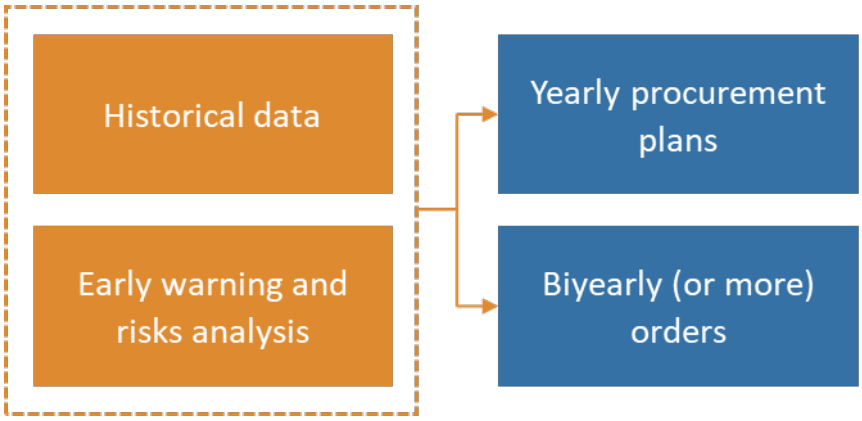


Figure 21: Historical data and present insights feeding procurement plans and subsequent orders

5.1.2 Alignment of SCMU's stock volumes (recommendation 2)

SCMU holds IARH kits' stock at the suppliers' warehouses as well as in Dubai UNHRD. Holding stock makes it possible to keep delivery lead times relatively short. The stock of IARH kits is financed by a separate revolving fund of 5m USD. This amount is not sufficient to meet IARH kits' demand as SCMU often faces stock outs and backlogs. SCMU and HO are now advocating for increasing the value of the revolving funds. They are hoping to double the funds but might realistically land in the middle (around 7-8m USD).

Stock outs and backlogs can be an environmental concern (i) COs over-order to compensate for future expected backlogs, which increases the risk of waste, and (ii) backlogs are delivered via plane rather than boat to compensate for the longer lead times. Therefore, UNFPA seeking to increasing the value of the IARH kits' revolving funds could both improve operational efficiency and environmental sustainability. Note that for this to be true, the target stock volumes should be calculated carefully to avoid overstock (and the risk of waste). UNFPA should continue its advocacy work and further supplement it with a detailed stock turnover and min/max target setting analysis and a business case.

5.1.3 Partial relocation of kits' assembly to Dubai (recommendation 3)

Inbound transportation of Scenario 1/2 and Scenario 3 represents 11 kg and 4 kg CO_2 eq respectively. While the absolute difference is relatively small at kit level, inbound transportation of Scenario 1/2 is more than double in comparison with Scenario 3. The distance and used transport modes between Suppliers A, B, and C and their own suppliers thus matters from an environmental perspective.

Supplier A is located in the Netherlands (this is where the IARH kits are assembled and stored today) but it also has a kitting plant in Dubai, which so far has only been used for WHO, Supplier A's largest customer. Relocating – partially – the IARH kits' assembly to Dubai is likely to decrease the greenhouse gas emissions resulting from the transportation of the kits' items to the kitting plant (and from the kitting plant to the requesting countries). Most of the RH items manufacturers are located in China and India, which is geographically closer from Dubai than from the Netherlands (and a large share of UNFPA demand is in the Middle East or East Africa).

UNFPA briefly discussed the possibility with Supplier A to rely on their Dubai plant, but no formal due diligence process has been triggered so far. UNFPA should consider this option more carefully and build a business case, which should analyse feasibility, costs, as well as benefits in terms of operational efficiency and of course environmental sustainability (ie, GHG "savings").

5.1.3 Institutionalise supply chain preparedness through roll out of supply preparedness operational guide: (recommendation 4)

HO has been working on the creation of a humanitarian supply preparedness operational guide together with HELP Logistics. The objective of this initiative is to gather preparedness best practices from UNFPA and other UN agencies and INGOs and to institutionalize a preparedness framework for supplies across all UNFPA entities, linked with UNFPAs minimum preparedness actions. This preparedness operational guide should include all preparedness-related recommendations which are part of this report and be rolled out across country offices upon completion.

5.2 Procurement

5.2.1 Decrease reliance on air freight (recommendation 5)

The LCA study showed that international distribution represents around 35% of IARH kit 6B's total carbon footprint in case of air transportation and around 10% for sea transportation. It is clear that air transportation should be avoided whenever possible. Sea transportation should be used instead as the impact per unit is much lower (up to 50 times lower).

In 2018, 41% of IARH kits were transported by air. UNFPA should do a detailed analysis of when air transportation was used and for what reasons. Based on that analysis, supply chain processes could subsequently be updated to ensure air transportation is only used when needed, particularly in sudden onset acute emergency response. Better demand and supply planning processes, linked with comprehensive preparedness plans, will help decrease reliance on air transportation.

5.2.2 Green procurement (recommendation 6, 7, 8, and 9)

The LCA shows that manufacturing represents around 30-40% of IARH kit 6B's total carbon footprint. UNFPA should thus collaborate with its suppliers (and the manufacturers of its suppliers) to reduce the volumes of GHG emissions coming out of their processes (eg, by increasing the efficiency of manufacturing processes or switching to clean energy sources or by redesigning the supplied product altogether).

At the end of 2013, SCMU (PSB at the time) released their Green Procurement Strategy. This strategy describes a framework which SCMU is to follow to mitigate the environmental impact of their

procurement activities. In very short, the Green Procurement Strategy proposes a collaborative and step-by-step approach in which SCMU would (i) engage with their suppliers and investigate on environmental pain points in the suppliers' operations (and these of upstream suppliers) as well as in the design of their products, (ii) set up targets to mitigate these pain points and support the suppliers in their effort to meet these, and finally (iii) increase expectations over time and translate the targets into firm requirements (UNFPA SCMU and Deloitte, 2013) (see Figure 22).

Figure 22: SCMU's Green Procurement Strategy[32]

Let us consider a couple of examples resulting from the Green Procurement Strategy. One of the first products for which SCMU followed their Green Procurement Strategy was the male latex condom. SCMU indeed identified the male latex condom as the heaviest product from their catalogue in terms of environmental impact – and also one which they had significant leverage over thanks to large procurement volumes. SCMU thus decided to engage with their condom suppliers and together they agreed on an action plan to mitigate the environmental load of condom manufacturing. In 2016, the suppliers' efforts accounted for a total of 3.600 tons of non-emitted CO_2 eq. emissions, 210.000 m^3 of water saved, and 1.500 tons of solid waste avoided (UNFPA SCMU, 2019). These improvements were then translated into supplier eligibility requirements. The following example considers the design of dignity kits. SCMU sat with their two dignity kit suppliers and looked at how they could improve the environmental sustainability of their basic dignity kit. Several solutions came out of these discussions: plastic packaging was replaced by more environmentally friendly packaging or fully eliminated where not actually required, plastic toothbrushes were replaced by bamboo ones, traditional flashlights were replaced by self-powered ones, and disposable menstrual pads were (partially) replaced by reusable ones where possible. These changes not only decreased the environmental load of the basic dignity kit, but it also made the kit lighter and 20% cheaper. This example thus very well illustrates the overlap between environmental sustainability and (cost-)efficiency. SCMU, after discussions with HO, is now

[32]Source: *UNFPA Green Procurement Strategy* (see UNFPA SCMU and Deloitte, 2013)

entering a second round of discussions with their NFI kit supplier to further improve the environmental sustainability of their dignity kits.

In the two above examples, SCMU defined new suppliers' eligibility criteria – either related to the environmental impact of the suppliers' manufacturing processes or that of the manufactured products. Luckily, this did not result in increased prices. But what if it would have? Would UNFPA agree to pay for green premiums? The answer to this question is not straightforward. On the one hand, UNFPA's procurement procedures do highlight the importance of sustainable procurement. This is illustrated by the following excerpt.

> *Through the increased promotion of environmental sustainability, and by integrating the application of environmental performance considerations in its procurement process, UNFPA is in a position to influence the demand for environmentally preferable goods and services and the ability of the industry to respond to the escalating use of environmental standards in the global market.*
> From UNFPA's Procurement Procedures (see UNFPA, 2019)

Additionally, UNFPA's strategic plan mentions that UFNPA *will continue to invest in green procurement practices* (UNFPA, 2021a). On the other hand, one of UNFPA's core procurement principles is to seek *best value for money* (UNFPA, 2019). Value is defined based on a set of different financial and non-financial criteria. As financial criteria, UNFPA's procurement procedures include price, transaction cost, and life cycle cost (usage, maintenance, and disposal costs of the good or service). As non-financial criteria, they include fitness for purpose, quality, services, and support. The procedures remain vague in terms of environmental criteria, only stating that *environmental objectives defined in the legal agreement with the client may also need to be taken into account* (UNFPA, 2019). This means that if the needs identifier does not include environmental criteria in its purchasing request, then SCMU cannot compare alternative sourcing options based on environmental criteria. When it comes to the suppliers' selection, the only environmental criterion mentioned in the bidding documents of the previous contracting cycles was for the suppliers (and their suppliers) to be ISO 14001 certified (ie, the organisation should have an environmental management system in place). This criterion did not however result in any sort of scoring points, it was pure bonus.

In conclusion, SCMU is clearly working on improving the environmental performance of their procurement activities and they should continue doing so by further engaging with their suppliers on environmental matters and by seeking sustainable alternatives for UNFPA's products (and packaging). Nonetheless, it remains unclear whether UNFPA would pay a higher price for more environmentally sustainable procurement sources, and if so, to what extent. UNFPA should address this question and include environmental sustainability in its best value for money definition. This should then translate in the systematic inclusion of green criteria – as requirements or awards – in the vendor selection process. The green criteria should be specific to the product or service (and their upstream activities) and their definition will require groundwork and market knowledge. In case the criteria are set as awards (ie, points), they must also be weighted, as illustrated in Figure 23. Weighting green criteria basically means agreeing on how much UNFPA is willing to compromise on traditional non-financial and financial criteria for the purpose of environmental sustainability. This will require internal alignment and support from leadership.

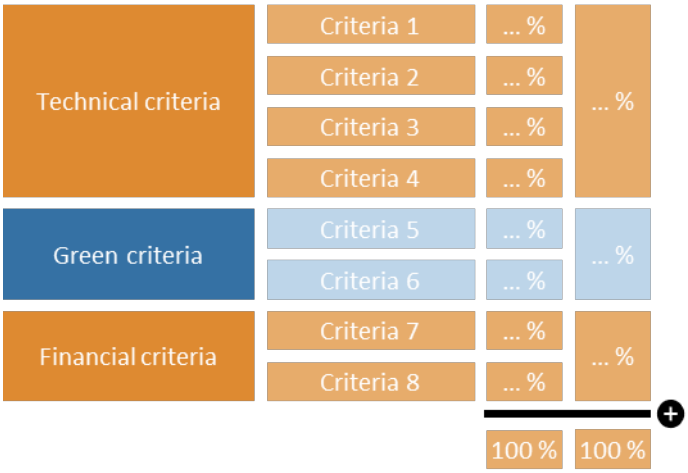


Figure 23: Weighting green criteria for vendor selection

SCMU's drive to environmental sustainability has yet to translate – systematically – at CO level; there seems to be an important gap between international and local procurement on that regard. SCMU should increase work to train COs on their Green Procurement Strategy. Additionally, because the Green Procurement Strategy is close to 10 years old, it is recommended that UNFPA updates it considering gained experience and maturity as well as today's environmental and climate context.

5.2.3 Primary packaging for dignity kits (recommendation 10)

Out of the four waste types analysed, dignity kits' primary plastic packaging has the lowest volumes. However, it is probably the one that can be the most easily avoided. Qualitative interviews revealed that the primary packaging of dignity kits which are procured internationally was reduced to the strict necessary, but that does not seem to be the case for kits procured locally. For these, there is still significant space for improvement. To make matters clear, UNFPA should fully ban primary plastic packaging (and in fact any sort of packaging) for dignity kits except if required for quality reasons. Before implementing the ban, UNFPA should give some time to COs to pass on the message with their suppliers (and for them to further pass it on upstream) and collaborate with them to remove all unnecessary packaging in due time.

5.2.4 Transition from kits to bulk procurement (recommendation 11)

While IARH Kits (and other similar humanitarian health kits) have revolutionised humanitarian health response, they are inherently wasteful. They follow a "push" methodology based on demographic data; they are pushed to countries to meet assumed rather than measured needs and will therefore always result in a certain amount of waste (expired stock). This compares to the pull (ie, demand-driven) approach in which items' stock would be replenished based on consumption data. The below quote, taken from an interview with a representative from one of UNFPA's IARH kits suppliers, illustrates the risks of pushing down kits based on high-level demographic assumptions.

We shoot with a big canon on a specific problem. (...) Send in the troops, send in the kits.

Based on interview with IARH kit Supplier in January 2022

The usage of kits should therefore be limited to situations that specifically require them. In theory, kits should only be used in acute crises, where speed of delivery is crucial and where urgency, chaos, and dynamic changes to supply availability and service seeking behaviour at local level do not allow for careful needs assessments or add to the complexities in last mile distribution. The situation is different with post-acute crises (protracted crises or recovery phase of emergencies). For these, understanding and mid-term view of context and needs allow for careful planning. Yet, in realty, COs tend to default to kits and kits end up being used in post-acute crises for years (see below quote).

> *The people that are ordering the kits need to have an understanding of what the kits are for, how many they are supposed to serve. Because when anything happens, the first thing people do is order the kits. That's not really acceptable. There needs to be better justification for ordering a kit, more than just that something happened.*
>
> From HO's key informant interviews on IARH kits (see UNFPA HO, 2017)

Based on a survey conducted by HO in 2017[33], only half of the respondents said that they were using IARH kits for emergency response (UNFPA HO, 2017). There are multiple reasons COs tends to default to kits in non-emergency situations. First, bulk comes with operational complexities. SCMU does not hold stock of bulk items, which means that the lead times to fulfil a bulk order are longer than with kits. This combined with predominantly one-year humanitarian funding cycles leads to issues. Moreover, quantifying bulk needs is more complex than with kits: bulk SKUs are obviously more numerous than kits SKUs to start with, but more importantly quantifying bulk needs typically requires facility level data, tools, and processes as well as quantification skills which are often missing at CO level. COs sometimes also prefer kits over bulk because of legal constraints (see below quote) or challenges in physical distribution. In some countries, controversial commodities like controlled drugs or misoprostol are indeed easier to import via kits. While it might be difficult to work around these legal challenges, operational complexities related to bulk can certainly be overcome.

> *What about Misoprostol? What about emergency contraceptives? What about the PEP? When you say Kit number three, they notice that it's a UNFPA or Inter-Agency RH kit and they let it go on. But then if you order as a bulk it has to go through a long process to be approved and this is a process that can take even six months or even more. And these kinds of things also are very important.*
>
> From HO's key informant interviews on IARH kits (see UNFPA HO, 2017)

HO is aware of this general kits' inertia and has been helping COs to transition from kits to bulk where possible. They supported three pilots and are currently working on generalizing the approach in a toolkit for COs. This is great because UNFPA should indeed scale up the transition, but it is not sufficient. To effectively transition from kits to bulk procurement, COs would generally require CO and HQ investments on top of guidance. Bulk procurement follows a demand-driven (ie, pull) approach and thus requires increased efforts in demand and supply planning compared with the kits' status-quo. Advanced demand and supply planning skills at CO level are however often lacking and COs would need to either train their logisticians or hire new resources with the required skillset. Demand planning for bulk items also requires data on top of skills. COs would need to set in place processes and tools to collect historical demand (or historical consumption as a proxy) at health facility level, which is the

[33]The survey pool included practitioners working with IARH kits, mostly from UNFPA COs, and to a smaller extent from the Red Crescent and Red Cross Movement, as well as from international and local NGOs.

main input to demand planning. In addition to these in-country investments, the transition from kits to bulk procurement – at appropriate scale – would also require investments at global level. Currently, SCMU does not maintain any bulk stock for RH items, instead these are directly delivered from the manufacturers to the COs, which usually implies long lead times. COs are often reluctant to order RH items in bulk rather than IARH kits specifically because of these long lead times – which is a challenge for funding (most COs are limited to a one-year budget) and flexibility. UNFPA should work to maintain stock for critical RH items. The exact mix of items and their quantities would require a separate analysis and business case.

5.2.5 Lead times compression, ordering frequency increase, and orders reviews (recommendations 12, 13, and 14)

Moving away from kits to bulk will help reduce expiry risks. But what about all the kits that cannot be replaced by bulk, how can UNFPA reduce expiry risks for these? The importance of demand planning has already been addressed (see *5.1.1 Supply chain planning*). Next to planning (and closely related to it), stock expiry risks would be reduced if UNFPA would increase ordering frequency rules (eg, to every four months). Today, COs (not including sudden onset emergencies) order IARH kits approximately twice a year, which means that as they place their order, they forecast their kits' demand over a period of six to twelve months. As a general rule, the shorter the forecasting horizon, the easier it is to forecast demand, and thus the lesser the risk to end up with unwanted/expired stock. Of course, increasing ordering frequency does not just happen overnight; it requires alignment work with both suppliers and COs, also taking into consideration logistics practicalities and operational objectives.

Increased demand planning efforts and ordering frequency will help COs end up with a more suitable mix and quantities of kits at in-country level which reduces stock expiry risks. To further reduce these risks, UNFPA should work on its international distribution lead times and compress these where possible. The shorter the lead times, the longer the remaining shelf life of the kits when they arrive in country, and the less probable they are to expire before being used. A detailed lead time analysis would be required to understand which steps are contributing the most to the total international distribution lead times, and for which of these lead times can be reduced. This is already a midterm Humanitarian Supplies Strategy result for UNFPA. Based on interviews, the customs green light and route selection processes appeared as two painful steps which present potential for lead time compression. The ideas developed are illustrated in Figure 24.

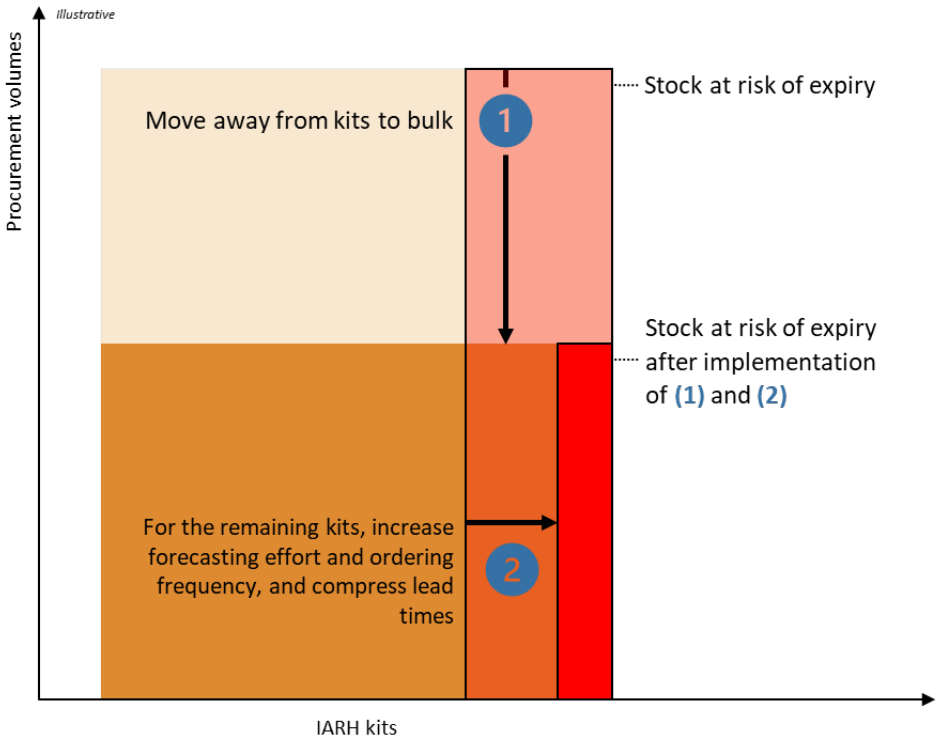


Figure 24: Recommendations to reduce IARH kits' expired stock

Sub-section *2.1 Supply chain for IARH kits* explains that HO is reviewing each IARH kits order made by COs to SCMU. This process step is a good safeguard to avoid over procurement and also plays a role in reducing expiry risks.

5.3 Logistics

5.3.1 In-country capacity building for supply chain management and logistics (recommendations 15 and 16)

UNFPA should further build supply chain management and logistics capacity at in-country level to reduce both its carbon and waste footprint. It should do so by training existing staff and hire new staff as needed. Professionalizing the staff would serve UNFPA's environmental purpose in different ways. First, it would enable COs to be better prepared to emergencies and with this decrease its reliance on air freight. It would further help avoid expired and damaged stock through better inventory management practices in logistics distribution while in UNFPA custody, as well as enable quality oversight and support while supplies are in IP custody or at health facilities. Lastly, skilled supply chain management and logistics professionals would also be able to tackle reverse logistics for waste disposal processes and implement more sustainable solutions.

UNFPA could consider defining a certain financial threshold (reflecting volume of operations) that would define which CO would have the right to hire additional supply chain management and logistics experts (ie, each CO whose annual spend exceeds that threshold would have the possibility to hire additional technical staff). Countries with low volumes of operations may not require technical staff, while bigger ones might desperately need the expertise.

5.3.2 Support for in-country supply chain management and logistics (recommendations 17 and 18)

HO has been working with COs to help them improve their skills, processes, and tools linked to forecasting and supply planning, quality assurance in logistics distribution, monitoring and oversight, preparedness, and risk analysis. Too often though, support of country leadership is missing, and HO ends up doing supply chain advocacy and problem solving rather than capacity building. Additionally, the effort appears more ad-hoc than systematic based on the limited human capacity at HO and lack of humanitarian experts with SCM capacities structurally within the organisation.

UNFPA should further enable HO as well as ROs and SCMU to train in-country staff and improve their supply chain processes and tools. HO is developing currently in collaboration with SCMU and other business units an operational humanitarian supplies training targeting operations and programme staff. Once completed UNFPA should aim to ensure every CO has both sent relevant staff to participate, and committed to follow up on action plans developed within yearly country programme documents and funding. Again, this would support the professionalization of the staff which serves both efficiency and environmental sustainability purposes.

5.3.3 Storage facilities (recommendations 19, 20, and 21)

The LCA showed that in-country constraints can result in a significantly large volume of GHG emissions. Most importantly is the storage of keep cool items in "band-aid" inefficient solutions rather than compliant cold warehousing rooms. UNFPA should address these local challenges and refurbish its subcontracted warehouses: these should be properly insulated and should have cold rooms as needed. Additionally, the majority of items in IARH kits require storage under 30 degrees Celsius. In warm climates, lack of temperature control for all time-temperature-sensitive medicines including these items can cause excess waste due to damage. Refurbishment or investment in warehouses and storerooms to ensure proper temperature maintenance can also reduce risk of damage. Where warehouse refurbishment is not possible – because of time or cost constraints – UNFPA should rely on mobile refrigerators running on solar energy or should consider alternative energy options for climate control (eg, inflatable or container based cold rooms with solar adaptations). As a second priority, UNFPA should connect its subcontracted warehouses to decentralized renewable energy sources (like solar panels) where not already done. Decentralized renewable energy sources are obviously beneficial from an environmental point of view but are also helpful in places where electricity from the grid is unreliable, not available, or fuel availability limited as is often the case in humanitarian crisis. UNFPA should advocate for the same to happen with warehouses managed by its IPs or by interagency partners (including the Logistics Cluster or Logistics Sector), and with health facilities. These investments will not only reduce waste and GHG emissions of UNFPAs supplies but are also structural investments in the national supply chain which will remain beneficial to the national system even once the humanitarian crisis has passed.

The LCA shows that prepositioning RH kit 6B over several months (which is the case at the UNHRD Dubai warehouse) also represents a significant footprint when storage energy is sourced from the grid. The impact of storage at international level can, just like at national level, be avoided with decentralized renewable energy sources. UNFPA should work to increase advocacy not just at in-country level but also at international level, with UNHRD as well as with any other partners (including kit suppliers) that store kits on UNFPA's behalf.

5.3.4 Procurement of logistics services (recommendations 22 and 23)

To further reduce the footprint of international distribution – after having decreased its reliance on air transportation to the minimum – UNFPA should consider going one step further and engage with

their freight forwarders or together with the Logistics Cluster engage the LET[34] to utilize more energy-efficient planes, vessels, and trucks. The same approach should be followed at in-country level: UNFPA should ask their local freight forwarders for more energy-efficient transport modes (eg, from EURO5 to EURO3 trucks), integrating requirements into procurement contracts for 3PLs. It should also request that all truck drivers be trained on eco-driving where possible in preparedness and post-acute emergency operations. Also the subcontracting process of warehousing activities at in-country level should include environmental criteria (eg, energy-efficient warehouse, renewable energy source). These different transportation and storage requests may most often than not be left unmet. The markets where UNFPA operates may indeed lack the required maturity and resources to meet these. The requests should thus not be set as hard requirements for vendor selection, but rather should provide bonus points to vendors that manage to meet these, increasing their chance to be selected by the procurement team in charge. The objective of the recommendation is thus to push local markets to adopt more sustainable alternatives over time without being overly restrictive in the short term.

In addition, when UNFPA needs to procure infrastructure (eg, vehicles, refrigerators) because lack of availability at in-country level, it should always do so in collaboration with other UN agencies and procure the greenest alternatives (eg, EURO 6 trucks, solar-enabled refrigerators). These items should become the default for UNFPA procurement and should be added to the UNFPA catalogue if not available from other UN partner LTAs.

5.4 Collaboration

5.4.1 SRH working group (recommendation 24)

In countries with Humanitarian Response Plans, SRH actors collaborate through SRH working groups within the health cluster, usually coordinated by UNFPA. At the global level SRH actors coordinate through the IAWG, where UNFPA coordinates the Supplies sub-working group. When it comes to the distribution of IARH kits or items at in-country level, SRH actors generally collaborate – to an extent that differs from one country to another – on demand and supply planning through the working group. More specifically, they aim to align on what is needed and where; and who distributes what and where to avoid overlap and gaps[35]. UNFPA COs also use this channel to communicate excess stock availability and seek partners willing to absorb the stock surplus.

Collaboration through SRH working groups is essential in many regards, and again enables UNFPA to be more operationally efficient and environmentally sustainable. Aligning on needs and plans indeed allows UNFPA COs and other SRH organisations to match demand and supply as well as to avoid and manage overstock situations to limit expired stock volumes. Structurally including a standing agenda item on coordinated distributions and stock status in all SRH working group meetings at country level can support all UNFPA operations to leverage this coordination to improve environmental sustainability.

5.4.2 Logistics Cluster common services (recommendation 25)

For in-country transportation, UNFPA should utilize the common services offered by the Logistics Cluster as much as possible to limit the carbon footprint of its in-country kits distribution. Optimization of trucks (eg, using one full truck from two agencies going to the same location, as opposed to two

[34]The Logistics Emergency Teams (LET) is a group of four global logistics companies (Agility, UPS, Maersk, and DP World). These companies partnered up and propose pro-bono services in case of emergency response. Their services can be requested via the Global Logistics Cluster.
[35]In case of funding gaps, SRH actors might also unite and advocate with donors.

half empty trucks to the same location) is one way partners can reduce the impact of in-country GHG emissions. The Logistics Cluster/Sector can also be an avenue for collaboration in common requirements for contracts of 3PLs as well as a space to pool resources for logistics infrastructure investments. Next to the Logistics Cluster, UNFPA should also seek collaboration with other UN agencies or NGOs again with the idea of pooled logistics services both at an upstream (international freight) and downstream (last mile distribution) level.

5.4.3 IMPACCT working group (recommendation 26)

In some countries, the customs green light and clearance processes take several months, bringing kits closer to their expiry date at the time they are effectively being distributed in the requesting countries and increasing the risk for expired stock waste. Some COs have been working on preparedness activities to increase the efficiency of these processes during the response.

HO is also part of the IMPACCT (Importation and Customs Clearance Together) working group. This global working group led by OCHA focuses on importation and customs clearance processes, specifically in the context of humanitarian response. Its objective is to help humanitarian organisations understand the actions that they should take before and during a response and to enable them to run the importation and customs clearance processes, which are often cumbersome, as efficiently as possible. IMPACCT also works with national customs agencies and the international customs administrative bodies to reduce delays and bottlenecks in customs clearance for humanitarian response.

Activities at country or global level that help reduce the lead times of the customs green light and clearance processes should be encouraged for efficiency and environmental reasons. In some countries, these processes represent a significant proportion of total distribution lead time; they hinder UNFPA's response agility and increase the risk of expired stock. Additionally, through the IMPACCT working group, UNFPA can address whether the port of entry has the appropriate infrastructure and processes (and bandwidth) to maintain the quality of the imported commodities. UNFPA should increase its investment effort to the IMPACCT working group across multiple levels of the organisation (including at national level where IMPACCT is engaged with the Logistics Cluster) with these objectives in mind.

5.6 Reporting and monitoring

5.6.1 GHG reporting (recommendation 27)

UNFPA has been doing carbon accounting since 2008 and declares itself carbon neutral since 2014 (by offsetting "unavoidable" emissions). UNFPA's carbon accounting scope includes the mandatory scope 1 and scope 2 emissions. When it comes to scope 3 emissions, which includes all indirect emissions except the purchase of energy (part of scope 2 emissions), it only measures business travel (air and taxi travel) (UNFPA Environmental Sustainability Team, 2021). This means that the volume of greenhouse gases emitted throughout UNFPA's humanitarian supply is not being considered – at all. UNFPA should include these supply chain activities in its carbon reports in a two-step approach: first, include all upstream activities (ie, manufacturing, inbound transportation, and international distribution) and second, include all downstream activities (ie, in-country distribution). By doing so, UNFPA's carbon reports would provide a complete picture of where GHG emissions are embedded in UNFPA's activities and would further guide UNFPA on where to focus its carbon reduction efforts.

Carbon reporting only makes sense when complemented with carbon targets. UNFPA should set phased targets to decrease the carbon footprint of its supply chain activities. Lessons can be learned from private sector actors who have set similar targets. These targets should be shared externally and

progress towards these targets should be reported (also externally) on an annual basis. UNFPA could use its webpage *Corporate Environmental Responsibility in UNFPA* to publish its progress (this webpage already includes nice visuals on UNFPA's carbon footprint).

5.6.2 Last mile assurance for kits (recommendation 28)

The last mile assurance (LMA) processes aim to monitor and strengthen UNFPA's in-country supply chain. They include safeguarding activities as well as risks and gaps analysis routines. The processes however are not easily applicable for kits (they have not been designed for humanitarian supplies in the first place) and therefore are not consistently applied for kits. HO has been working together with the LMA team on how to practically utilize the LMA processes for kits without increasing the burden on partners operating in highly difficult settings. Integration of key basic data collection in the regular monitoring of facilities, as well as increasing the capacity of IPs to monitor supply consumption and waste could help enforce LMA for kits.

Applying the LMA processes for kits would decrease their environmental footprint through supply chain monitoring and strengthening because it would highlight inefficiencies like high volumes of expired and damaged stock or uncompliant stock disposal practices. Root cause analyses can follow and mitigation measures can be implemented.

5.6.3 "Engage-Improve" waste feedback loop (recommendation 29)

No one likes waste, even more so when clear waste disposal processes are lacking. In humanitarian settings waste stigma is even stronger among the national government and local communities due to the incredibly high demand compared to supply of lifesaving items. Because of this waste stigma, UNFPA (and many other UN agencies and NGOs) fails to engage with its partners on this topic, and opportunities to reduce waste or improve its disposal processes are missed. UNFPA can address this by implementing a positive "Engage-Improve" feedback loop (see Figure 25). This loop targets all kits' waste[36] occurring at in-country level and in the hands of UNFPA or its partners (ie, IARH or dignity kits' expired stock, and IARH or dignity kits' damaged stock at CO and IP level; IARH kits' expired stock, IARH kits' damaged stock, IARH kits' disposables and IARH kits' packaging materials at health facility level). It comprises four steps – described in the next paragraphs – mutually reinforcing each other in a positive feedback loop. The first two steps aim at engaging the conversation around waste and creating visibility. The outcome of these subsequently enable steps three and four which aim at improving waste management practices. Lessons learnt resulting from steps three and four should then trigger more engagement, and in turn more improvement, etc.

[36]The proposal is of course also applicable for items distributed in bulk rather than kits.

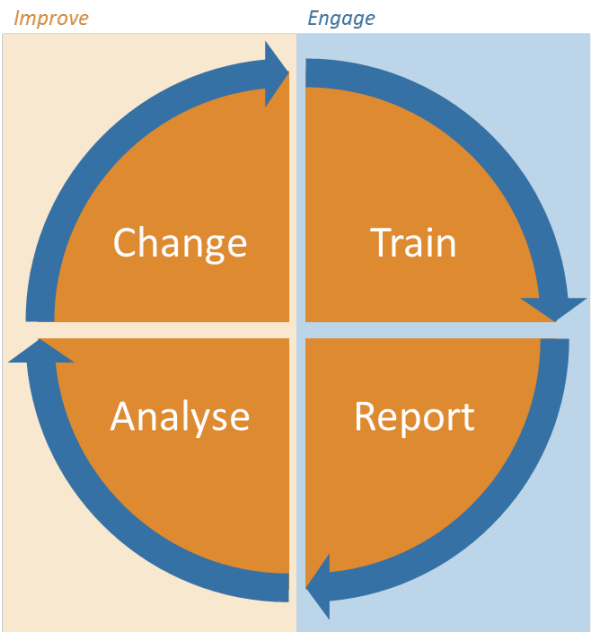


Figure 25: Positive "Engage-Improve" feedback loop

The first step of the positive "Engage-Improve" feedback loop is "train". As explained previously, there is a lot of stigma attached to waste. A better understanding of waste – what it is, where it comes from, and how it should be disposed of – can help reduce that stigma, and eventually eliminate it. UNFPA should start addressing in-country waste challenges by providing training to COs as well as to the IPs and the health facilities they support. The training itself should be adapted to the different audiences – the waste they face, the role they play in avoiding and/or disposing it, and their maturity with regards to this topic – and in line with WHO's medical waste management guidelines. These trainings can be implemented together with humanitarian health actors (eg, UNICEF, WHO, ICRC) to increase impact as many IPs and facilities are receiving supplies from multiple actors. Training is not just important for helping people understand waste and how to deal with it, but it is also a way to formalize waste problems and engage an open conversation on this topic.

The second step of the positive "Engage-Improve" feedback loop is "report". According to the estimates, IARH kits' expired and damaged stock is the (kits') waste type with the largest volume (in weight). Yet, the vast majority of it is goes off radar. Health facilities do not share their IARH kits' expired stock volumes (they are also not asked to), and it is unclear how consistently COs and IPs report on this. Where it is reported it is often related to full kits as opposed to the individual items of which kits are broken down to at health facility levels. Damaged stock volumes (for both IARH and dignity kits) seem to be better reported, but the quality of the data appears as relatively weak still. UNFPA should work to further strengthen their reporting requirements – in terms of format and frequency – for expired and damaged stock at CO and IP level, and start a similar process at health facility level of which the majority of risk takes place and where UNFPA has the least visibility [37]. All data should be centralized at CO level and the CO should then further share it to both HO and UNFPA's LMA team.

The second step is not just about the reporting of expired and damaged stock volumes. It also includes the reporting of waste disposal concerns and issues – for all four main waste types. For example, if a health facility does not have the capacity or capability to incinerate its disposables, it should report

[37]Ask for IPs to gather the data from the health facilities at periodic intervals using proxy products or through the development of basic and user-friendly tools.

this issue to its IP, who could then look at reverse logistics possibilities (eg, transport waste to another health facility that has the required capacity and capability). The reporting of waste disposal concerns and issues should follow a clear escalation path, as described below:

- Health facilities should escalate their waste disposal concerns and issues to their IPs.
- The IPs should address and solve these; if they cannot, or if they themselves face waste disposal concerns and issues, they should then escalate these to their COs.
- The COs should in turn address and solve the escalated concerns and issues. While they should be the ones bearing the final responsibility, they might not be able to solve the concerns and issues by themselves – or they might themselves face waste disposal concerns and issues. If so, they should engage and unite with COs of other in-country UN agencies, who might be facing similar challenges. If no sustainable solution can be found through that collaboration, the COs should further escalate the concerns and issues to their ROs and to HO.
- The ROs and HO should support the COs through the sharing of best practices and/or through advocacy work.

The third step of the positive "Engage-Improve" feedback loop is "analyse". The main purpose behind the reporting of waste volumes, concerns, and issues in step two is to understand the waste challenges and identify their root causes in step three (and then subsequently address these in step four). While this should happen at each in-country level – health facility, IP, CO – UNFPA should have a dedicated single point of contact (SPOC) for this topic at each of its ROs and at HO. The responsibility of these SPOCs[38] would be to analyse the collected data and disseminate conclusions and best practices. They would also be the ones creating the training content (for the first step) and define the reporting requirements (for the second step). Their work should be in line with WHO's medical waste management guidelines. All the SPOCs across ROs and HO should collaborate as a working group.

The fourth step of the positive "Engage-Improve" feedback loop is "change". The conclusions and best practices to avoid waste and improve its disposal processes should not just be disseminated; they should also be implemented and end up effectively changing the status quo. Each CO, IP, and health facility should take care of the change at their own level, but COs should quite naturally guide IPs and IPs should do so with health facilities. The waste SPOCs at ROs and HO should follow-up on progress and measure general improvements. They should also update the waste training materials with the lessons learnt.

To conclude SCMU, HO and Finance Branch may need to revise the components of waste included in the policies and procedures for the management of programme supplies to ensure that UNFPA is not unintentionally reinforcing waste stigma in a manner which creates increased reporting bias, or will discourage COs from improving measurement and addressing the causes of waste.

To conclude, SCMU, HO, and the Finance Branch may need to revise the components of waste included in the policies and procedures for the management of programme supplies to ensure that UNFPA is not unintentionally reinforcing waste stigma in a manner which creates increased reporting bias or will discourage COs from improving measurement and addressing the causes of waste.

5.7 Ideal GHG scenario

Based on the recommendations for reducing GHG emissions and waste, two more supply chain scenarios were developed to represent an "ideal" supply chain scenario compared to the current status quo. To do this, the supply chain steps as-is were modelled (including indicated storage times and in-country specific difficulties such as long waiting times at the front line) but replaced all

[38]Time effort requirements would need to be defined but there is certainly no need for an FTE.

transport modes (trucks) with the most efficient option (EURO5 or EURO6, depending on the truck load capacity, and what was available in the LCA tool). As well, all energy inputs were replaced with those of a renewable alternative (for the Netherlands this is wind power, for India and Country X photovoltaic panels). Finally, all waste that can be recycled was assumed to be separated, and the rest is then sent to incineration, with no expired or damaged stock. The results are indicated in **Error! Reference source not found.** and can be seen as an "upper bound" for what could potentially be achievable with a full intervention into sustainable transport, energy, and disposal. GHG emissions from each step in the process is also listed in Supplementary Material 6. A particularly interesting insight from this analysis is that opting for renewable energies has the potential to dramatically decrease in-country distribution, without expecting a deviation from the current process (ie, long wait times for storage, at the front line, etc.).

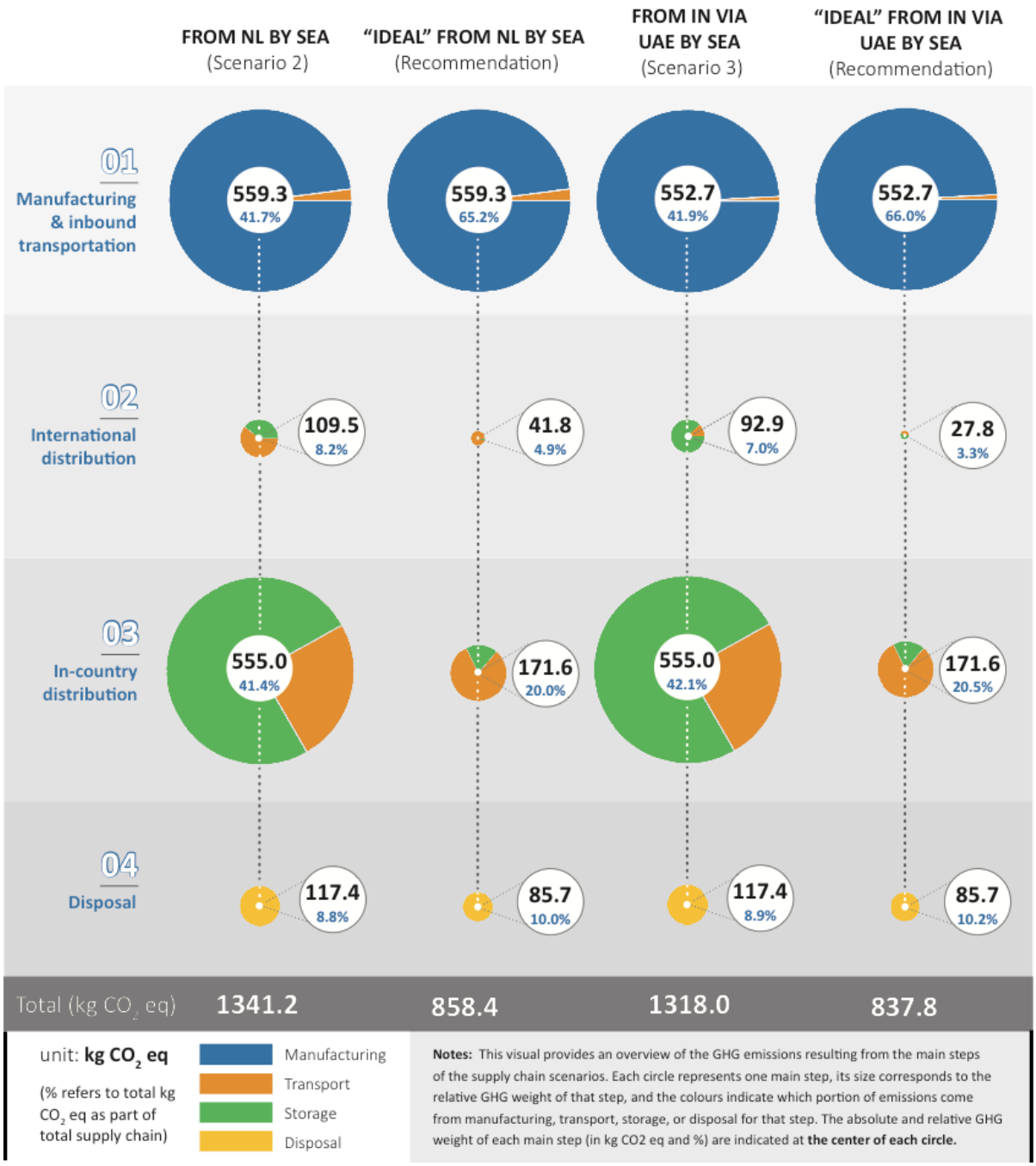


Figure 26:"Ideal" supply chain scenarios in comparison to status quo

6. Conclusions

Humanitarian operations present a significant environmental footprint, with an impact at both local and global level. In face of today's climate and environmental crises, and following the "do no harm" principle, understanding and reducing aid's humanitarian footprint is as an urgent task.

This analysis aimed to assess the impact that UNFPA's humanitarian supply chain has on the environment, considering waste and GHG, and for kits specifically. The report describes the kits' end-to-end supply chain, outlines the approach to weight the waste and GHG resulting from UNFPA's supply chain activities, and shares the results. Based on these, the report subsequently describes, classifies, and prioritizes recommendations to support UNFPA in building its environmental mitigation roadmap.

When it comes to waste, a focus was put on the four waste types which volumes were perceived by UNFPA as being the largest. UNFPA believed IARH's kits' expired/damaged stock to have the largest volume, following by IARH kits' disposables, IARH kits' primary packaging, and then dignity kits' primary plastic packaging. The results of the analysis match these perceptions: IARH's kits' expired/damaged stock indeed represents the largest annual volume (in kg), and is followed by IARH kits' disposables, IARH kits' primary packaging, and dignity kits' primary plastic packaging (see Figure 27). These numbers are limited to kits (items distributed in bulk were not considered) and certainly have limitations as they were calculated based on many assumptions.

IARH kits' expired/damaged stock (kg)	IARH kits' disposables (kg)	IARH kits' primary plastic packaging (kg)	Dignity kits' primary plastic packaging (kg)
176,013	169,199	45,752	40,895

Figure 27: Yearly waste volumes overview

Out of these four waste types, only IARH's kits' expired/damaged stock and dignity kits' primary plastic packaging are avoidable, however all the waste types need to be disposed of properly. This is especially important for IARH's kits' expired/damaged stock and IARH kits' disposables which can present a danger for local communities, animals and the environment. Today, UNFPA does not have much visibility on the capacity and capability of health facilities to dispose of these waste types properly.

When it comes to GHG, an LCA for the IARH kit 6B was done considering three scenarios: distribution from a supplier in the Netherlands by air (Scenario 1) and by sea (Scenario 2), as well as distribution from pre-positioned stock in Dubai by sea (Scenario 3). A cradle-to-grave approach was followed, meaning that all supply chain steps were considered from raw materials' extraction and items' manufacturing up to the items' disposal. The results are summarized in Figure 28.

Scenario 1: From NL by air (kg CO_2 eq)	Scenario 2: From NL by sea (kg CO_2 eq)	Scenario 3: From IN via UAE via sea (kg CO_2 eq)
1,874	1,341	1,318

Figure 28: GHG volumes overview

The main objective was to understand the relative GHG weight of each supply chain step to subsequently define and prioritize GHG reduction initiatives. The kit's supply chain was divided in four

main steps: (i) manufacturing and inbound transportation of the kits' items, (ii) international distribution, (iii) in-country distribution, and (iv) waste disposal. The results show that the (i) manufacturing and inbound transportation of the kits' items and the (iii) in-country distribution steps contribute the most to the kits' carbon footprint, between 30% and 40% depending on the scenario. While it was expected that manufacturing would contribute to a significant proportion of the kit's carbon footprint, the similar importance of in-country distribution (incl. storage and transportation) came as a surprise. The fact that in-country distribution represents such an unexpectedly large carbon footprint is due to the lack of proper storage (and to a lesser extent transport) infrastructure as well as to supply chain inefficiencies resulting from the humanitarian context. The (ii) international distribution (incl. storage and transportation) step also presents a significant proportion of the kit's carbon footprint (30%) but only when the kit is distributed by air (Scenario 1). When it is distributed by sea, this step only weights 10% of the kit's carbon footprint. Air transportation is a carbon bomb: the transportation of kit 6B from the Netherlands to Country X (Scenario 1) is more than 50 times higher in GHG emissions than with sea transportation over the same distance (Scenario 2). Finally, the (iv) waste disposal step represents around 6 to 8% of the kit's carbon footprint. Most of it (more than 80%) is coming from the waste incineration process and is likely an under-estimation.

UNFPA has been working towards reducing the waste and GHG emissions resulting from its operations, both through initiatives that directly target this objective and through initiatives that indirectly serve this objective by improving humanitarian medical logistics capacity and supply chain efficiency. In order to further reduce its waste and carbon footprint, this report describes a total of 29 recommendations which were identified in light of previous analysis work and also considering the initiatives already ongoing at UNFPA (which need to be either continued or scaled up). The recommendations were classified based on their change level (structural / operational), action type (continue / scale up / advocate / analyse / implement), and priority (high / medium / low) to support UNFPA in building up its mitigation roadmap. They were also grouped across five thematic area: supply chain network design and planning, procurement, logistics, collaboration, as well as reporting and monitoring. The below bullet points describe the most important recommendations for each category. The breadth of the recommendations shows how important it is to consider supply chains end-to-end; mitigation actions are necessary throughout at both operational and structural level.

- Supply chain network design and planning. Country offices (COs) should use data and insights to forecast their kits demand which will serve as input to procurement planning and placing of orders. This requires specific technical capacity in country.
- Procurement. The Supply Chain Management Unit (SCMU) should continue enacting their Green Procurement Strategy and train COs to apply it for local procurement. In parallel, UNFPA should include environmental sustainability in their *best for value* definition to make environmental considerations part of every sourcing decision. Additionally, UNFPA should scale up its transition from kits to bulk procurement across all COs working in a post-acute context.
- Logistics. UNFPA should invest in in-country capacity building for humanitarian medical logistics and wider supply chain management as well as invest in adequate storage infrastructure.
- Collaboration. UNFPA should continue the collaboration with the Sexual and Reproductive Health (SRH) and Importation and Customs Clearance Together (IMPACCT) working groups to improve the distribution plans and actual delivery of kits. It should further increase its utilization of common logistics services offered through the Logistics Cluster where possible in sudden-onset emergencies (or other UN agencies and NGOs where common services are not implemented).

- Reporting and monitoring. UNFPA should include supply chain emissions in their carbon reports and set targets to reduce these. Additionally, it should break waste stigma, increase the capacity of implementation partners (IPs) and health facilities to manage waste, and improve application of Last Mile Assurance (LMA) to kits.

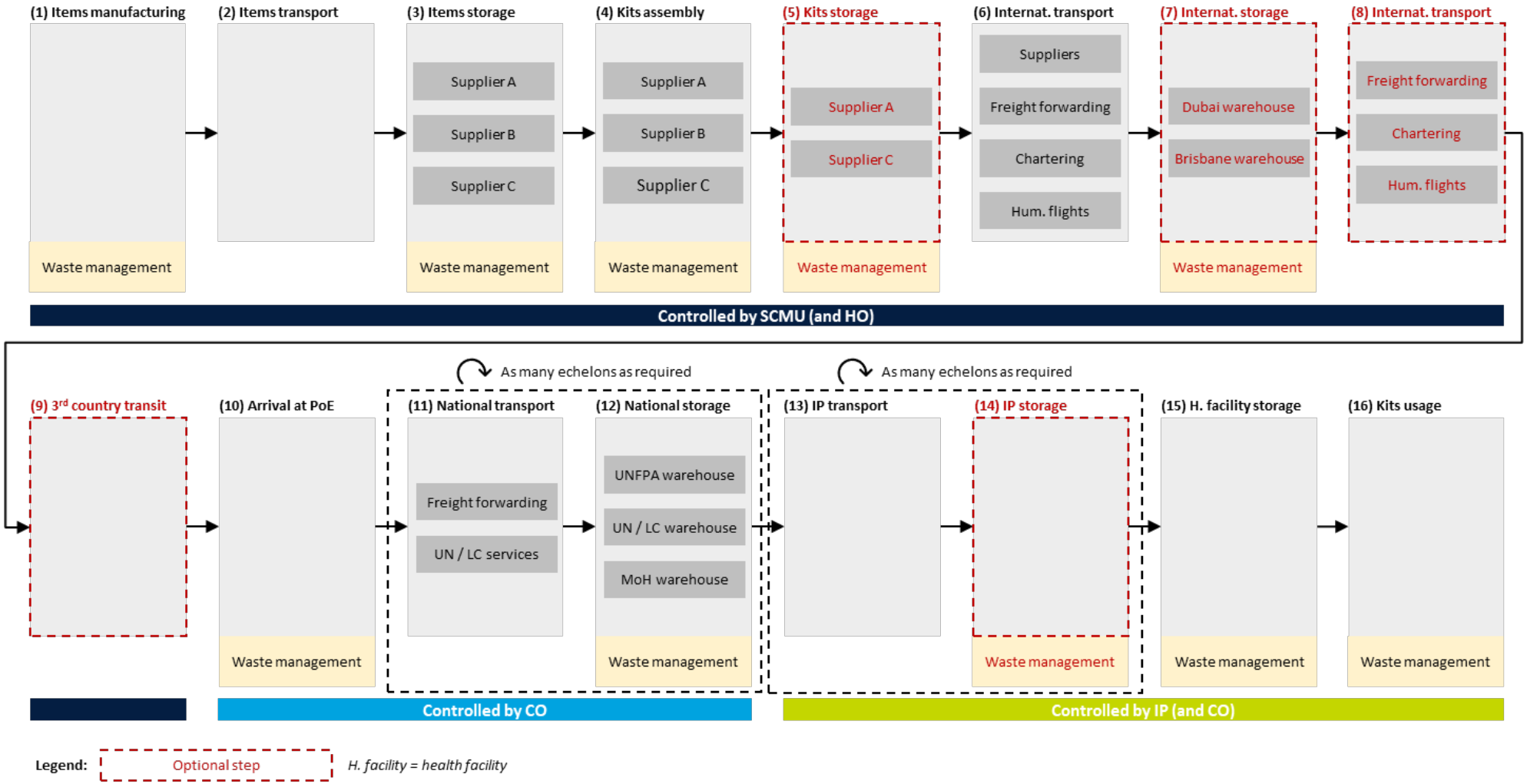
The need for increased supply chain management and logistics capacity (ie, the need to hire additional staff) and capability (ie, the need to train current staff) at UNFPA transcends all recommendations. Supply chain management has increasingly been recognized as a critical topic at UNFPA, but its importance is not yet fully reflected in HR decisions.

Before implementing any recommendation involving COs or SCMU, HO should engage with them, explain the objective and background of the recommendations relevant to them, and validate the recommendations with them. Recommendations can indeed only be successfully implemented if all involved parties are aligned and supportive. Additionally, the recommendations involving COs should only be implemented at COs in post-acute or preparedness situations. COs in acute situations should follow the humanitarian imperative and focus on response work.

While UNFPA has been making progress over the last years, there is still a lot that it can do to further mitigate the environmental impact of its humanitarian logistics network and wider supply chain management. The recommendations outlined in this report can help UNFPA achieve its goals to reduce its impact on the environment and can provide other humanitarian actors insights for wider green humanitarian supply chain management and logistics.

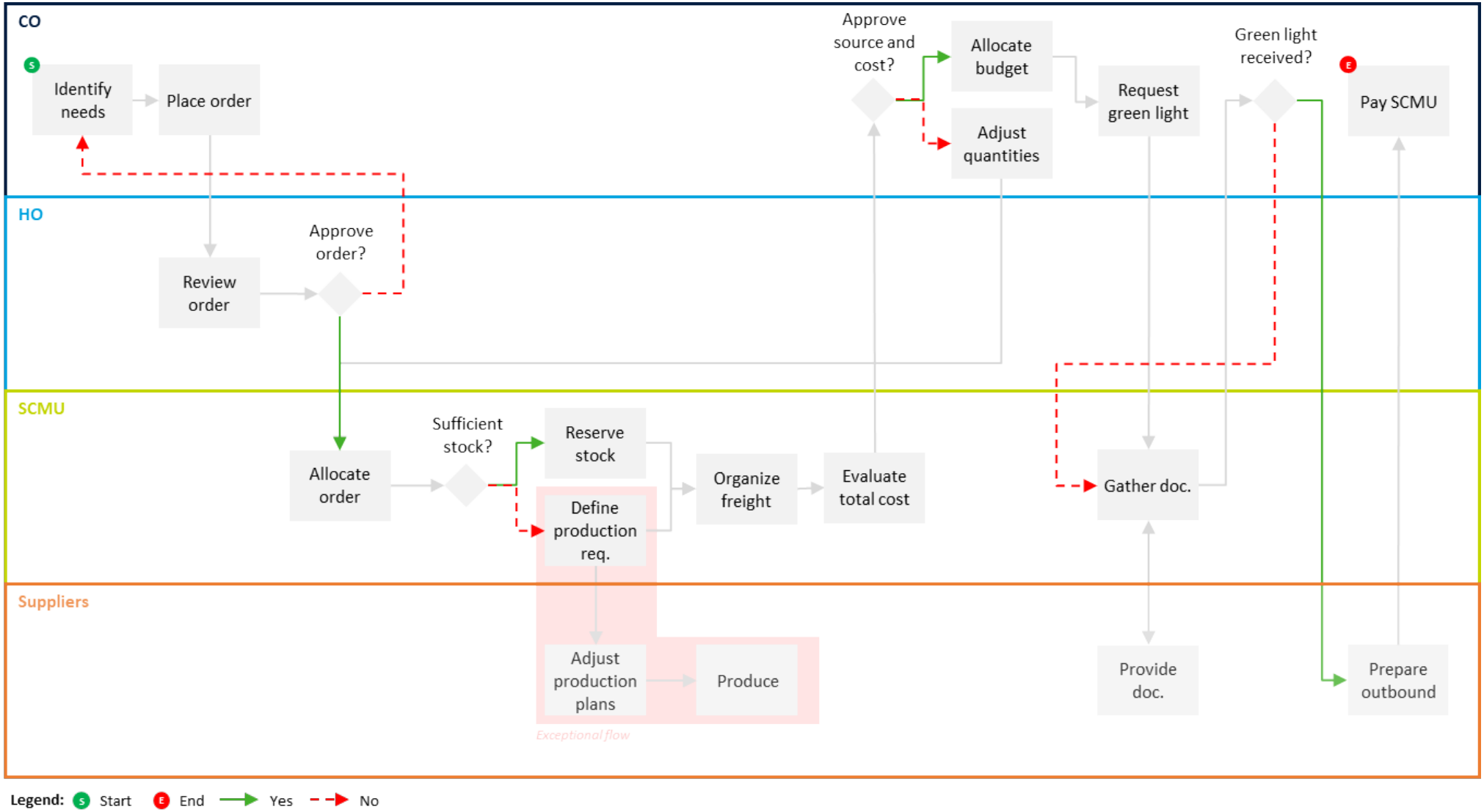
Appendix

Appendix 1: Physical flow of IARH kits

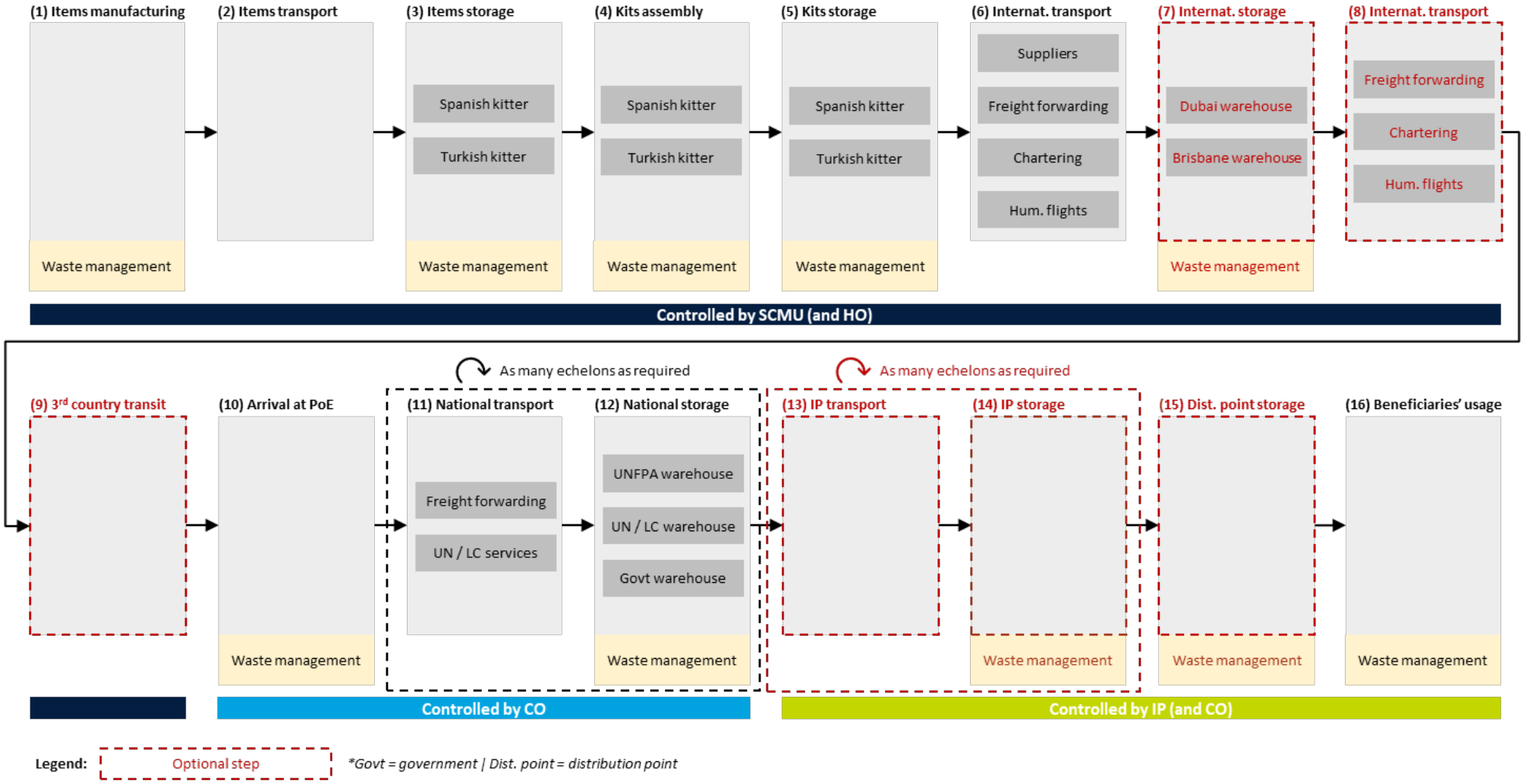


Legend: Optional step *H. facility = health facility*

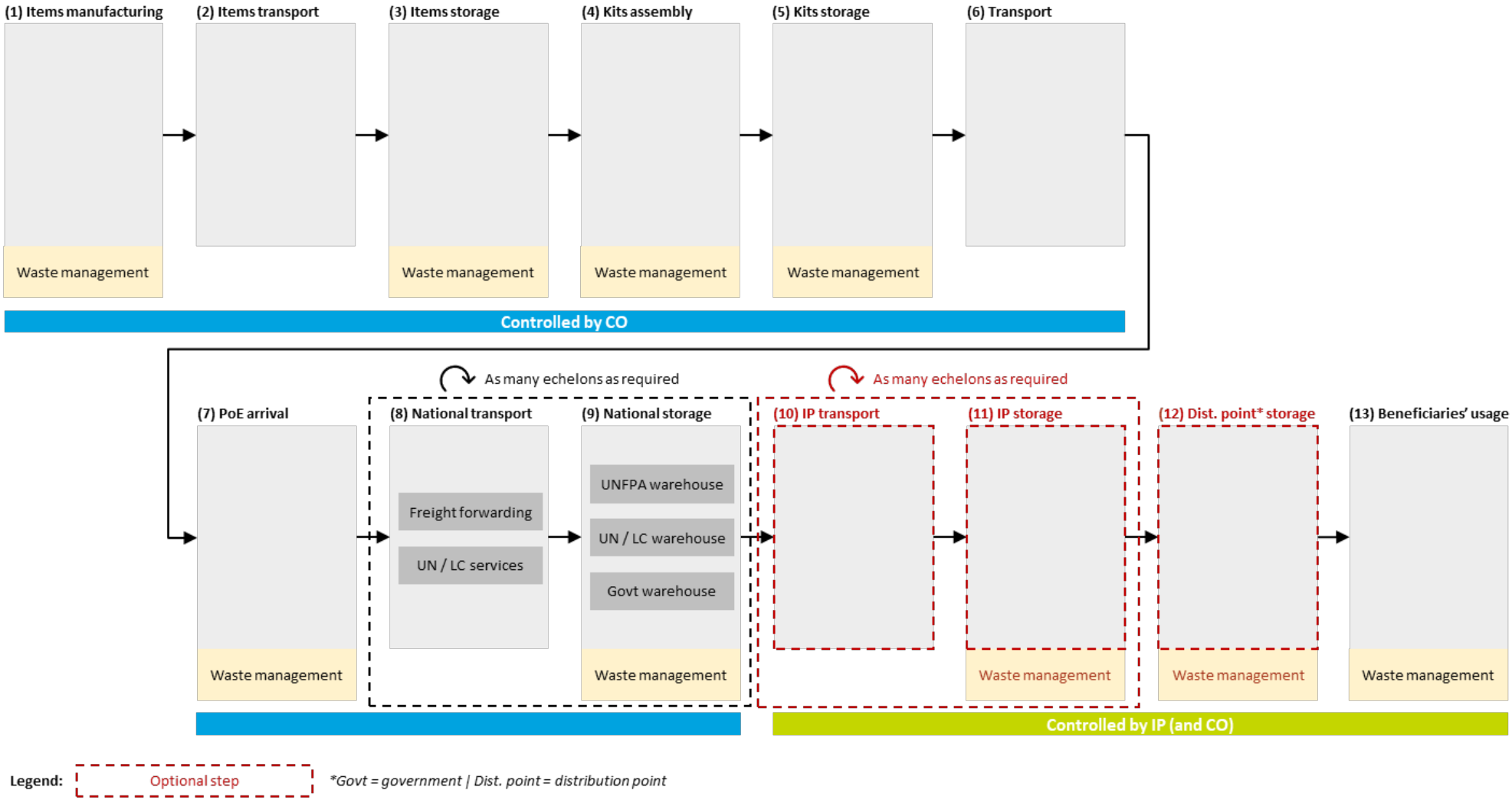
Appendix 2: Ordering process of IARH kits



Appendix 3: Physical flow of dignity kits in case of international procurement



Appendix 4: Physical flow of dignity kits in case of local procurement



Appendix 5: Assumptions for analysis on IARH kits' packaging volumes

A small plastic bag weights 0.5g.
A normal plastic bag weights 3g.
A (drugs) tablet contains 2g of plastic.
There are 6 capsules in a tablet.
Tubes are in plastic and weight 10g.
Ampoules are in plastic and weight 1g.
All bottles and vials are in glass.
Small plastic bags were assumed for individually packed items like the ones listed below: • Single-use medical/surgical items like syringes, needles, cannulae, extractors, catheters, tubes, sutures, and umbilical clamps • Compresses and tape • Tests • IUDs • Surgical gloves • Soaps
Normal plastic bags were assumed for the items listed below: • Packs of items • Medical sets • Containers like trays, basins, bowls, baskets, and drums • Large medical devices like sterilisers, suction pumps, resuscitators, stoves, and scales • Small medical devices like stethoscopes, tourniquets, pressure cuffs, and timers • Surgical instruments like forceps, scissors, clamps, speculums, retractors, cranioclasts, perforators, needle / blade holders, and uterine sounds • Draw sheets and cotton cloths • Brushes • Glasses
No plastic packaging was assumed for instruction sheets, leaflets, and books.

Note that:

- Some assumptions are not 100% correct (eg, all bottles are not always in glass), but it is estimated they are sufficiently correct for the purpose of the analysis.
- For some items, specific assumptions were required (eg, UNFPA procurement catalogue mentioned that cotton cloths can be packed by 1, 6, or 288 in one plastic bag, they were assumed in packs of 6).
- The entire analysis (including all assumptions) can be found in the Supplementary Material 1.

Appendix 6: Dignity kit in Country X

This is a picture of a dignity kit in Country X. Most items are packed in a plastic packaging, which does not appear as necessary (except for disposable menstrual pads). The Humanitarian Office advised the CO in Country X to collaborate with their NFI supplier to remove the unnecessary packaging. This might also require collaboration with the suppliers' suppliers who might be the ones that are putting items in a packaging in the first place.

Appendix 7: Assumptions for LCA

Main steps	Scenario 1: From NL by air	Scenario 2: From NL by sea	Scenario 3: From IN via UAE by sea
Manufacturing of the items	The items' purchasing prices were defined based on the UNFPA's procurement catalogue (so same prices for the two suppliers and same emission factors).		
Transportation of the items to suppliers' location	The distances from the manufacturer to the airport/seaport were not considered.		
	In case of sea and land transportation, 100% load capacity was assumed on dispatch, and 20% on the return route. EURO4 trucks were assumed for land transportation. For air transportation, load capacity is always assumed to 100% and no return is considered.		
	The distance between the NL/IN PoE and the suppliers' location were not considered.		
	The storage of the items at the suppliers' location were not considered.		
Assembly of the items into kits	The assembly of the kit (manual) was factored into the energy used for storage (based on study quantifying energy use of a distributional warehouse).		
Storage* of the kits	The kit is assumed to be stored for 90 days on average at the supplier.		The kit is assumed to be stored for 21 days on average at the supplier.
Transportation of the kits to Country X	EURO5 trucks were assumed to transport the kits from the suppliers' location to the airport. 50% load capacity was assumed for dispatch and empty return.	EURO5 trucks were assumed to transport the kits from the suppliers' location to the seaport. 80% load capacity was assumed for dispatch and empty return.	EURO3 trucks were assumed to transport the kits from the suppliers' location to the seaport. 100% load capacity was assumed for dispatch and empty return.
	1.5 days of storage time at the airport was assumed.	3.5 days of storage time at the seaport was assumed.	2 days of storage time at the seaport was assumed.
	For air transportation, load capacity is always assumed to 100% and no return is considered.	80% load capacity utilization of the boat was assumed for dispatch and 20% for the return.	100% load capacity utilization of the boat was assumed for dispatch to Dubai and 20% for the return.

			For transportation to/from Dubai's PoE, EURO3 trucks were assumed, with a 100% load capacity for dispatch and 20% for the return.
			120 days of storage in Dubai was assumed.
			100% load capacity utilization of the boat was assumed for dispatch to country X and 20% for the return. For the air transportation (of the keep cool items), load capacity is always assumed to 100% and no return is considered.
In-country transportation of the kits	EURO1 trucks are assumed to transport the kits throughout Country X. For keep-cool items, these are assumed to be transported in refrigerated EURO3 trucks (refrigerated EUR1 trucks do not exist); for the distributions in the capital segment specifically, keep-cool items are assumed to be transported in a cold box in a EURO1 truck.		
	80% truck capacity utilization was assumed for the transportation on the dispatch to UNFPA's warehouse in the south and then on the way to MoH warehouse in the north, and 0% for the return on these segments. 50% truck capacity utilization was assumed for the transportation on dispatch to the health facility, and 0% for the return on this segment. No distinction between regular and cold chain.		
	21 days of waiting time was assumed at the frontline. It is assumed that the general cargo truck will idle 5% of the time and the refrigerated truck to idle 100% of the time.		
In-country storage* of the kits	45 days of storage were assumed at UNFPA's warehouse in the south (with keep-cool items being kept cold in a refrigerated truck idling next to the warehouse).		
	90 days of storage were assumed at MoH's warehouse in the north.		
	At the health facility, 45 days of storage were assumed, based on the linear consumption of the kit (3 months – 90 days).		

Waste disposal	We assumed 10% of expired and damaged stock waste, and all of it to be incinerated at the health facility level (no extra transportation segment considered).
	All disposables are assumed to be disposed of through incineration at the health facility level (no extra transportation segment considered).
	Primary, secondary, as well as exterior packaging waste are assumed to be sent to landfill. The weights of primary plastic, glass, and carton packaging are assumed based on UNFPA catalogue, including 5 kg of secondary carton packaging. For the weight of exterior packaging, on the findings of a previous study done by UNFPA were used (16.8 kg of carton and 1.2 kg of plastic).

* RH kit 6B takes approximately 1 m^2 (1 pallet) in a warehouse. This was doubled to 2 m^2 to include all movements within the warehouse (common practice). For oxytocin, it take approximately 0.25 m^2 and again doubled this to 0.5 m^2. The warehouse energy usage was then estimated per m^2 and per day based on literature.

Appendix 8: Initiatives to reduce UNFPA's environmental footprint

Area	#	Recommendation	Change level *(Structural - Operational)* *	Action type *(Continue - Scale up - Advocate - Analyse - Implement)* **	Priority *(Low - Medium - High)* ***	Potential impact on waste volumes	Potential impact on waste management	Potential impact on GHG volumes
Supply chain network design and planning	1	Utilize historical demand and early warning insights to forecast kits' demand and feed procurement plans	Structural	Scale up	High	Decrease		Decrease
	2	Increase kits revolving funds and align SCMU's kits stock volumes to demand	Structural	Analyse, advocate	Medium	Decrease		Decrease
	3	Partially relocate kits assembly to Dubai	Structural	Analyse, advocate	Low			Decrease
	4	Institutionalise supply chain preparedness through roll out of supply preparedness operational guide	Structural	Continue	High	Decrease	Improve	Decrease
Procurement	5	Decrease reliance on air freight	Structural	Analyse, implement	High			Decrease
	6	Include environmental sustainability in *best value for money* definition	Structural	Scale up, advocate	High			Decrease
	7	Actively seek sustainable product and packaging alternatives	Structural	Scale up	High	Decrease		Decrease
	8	Train COs on green procurement strategies	Operational	Implement	Medium	Decrease		Decrease
	9	Update green procurement strategies	Structural	Implement	Medium	Decrease		Decrease
	10	Ban single-use plastic packaging for NFI kits (except in case of quality concerns)	Operational	Implement	High	Decrease		
	11	Reduce reliance on long-term kit procurement: transition from kits to bulk	Structural, operational	Scale up, analyse, advocate	High	Decrease		Unknown impact
	12	Compress lead times	Operational	Analyse, implement	High	Decrease		Decrease
	13	Increase ordering frequency	Structural	Analyse, implement	Medium	Decrease		Unknown impact
	14	Review IARH kits' orders (for COs by HO)	Operational	Continue	Medium	Decrease		
Logistics	15	Increase recruitment of humanitarian SCM and logistics specialists	Operational	Implement	High	Decrease	Improve	Decrease
	16	Build humanitarian supplies capacity of existing staff (operations and program level)	Operational	Scale up	High	Decrease	Improve	Decrease
	17	Provide ad-hoc SCM and logistics technical support (for COs by SCMU/HO/ROs)	Operational	Continue	Medium	Decrease	Improve	Decrease
	18	Further develop tools and resources to support SCM and logistics activities	Operational	Scale up	High	Decrease	Improve	Decrease

	19	Refurbish subcontracted warehouses (insulate warehouse and build cold rooms or install refrigeration units running on solar energy)	Operational	Implement	High	Decrease		Decrease
	20	Default energy sourcing at warehouses and health facilities to renewable energy	Operational	Implement	Medium			Decrease
	21	Advocate for greener warehouses with suppliers and UNHRD (and any other partner storing for UNFPA)	Operational	Advocate	Medium			Decrease
	22	Include environmental criteria when selecting international and national 3PLs and freight forwarders	Structural	Implement	Low			Decrease
	23	Default procuring green infrastructure (vehicles, refrigerators, etc.) for UNFPA operational needs with other UN agencies	Structural	Analyse, implement	Low			Decrease
Collaboration	24	Actively collaborate with RH working groups to align on distribution planning	Operational	Continue	Medium	Decrease		
	25	Utilize Logistics Cluster common services where possible	Operational	Scale up	Medium			Decrease
	26	Work with customs authorities and IMPACCT working group to improve customs processes	Operational	Scale up	Medium	Decrease		
Reporting and monitoring	27	Report carbon emissions resulting from supply chain activities, set reduction targets, and create transparency by sharing the results externally	Structural	Scale up	High			Decrease
	28	Improve applicability of LMA to IARH kits	Operational	Scale up	High	Decrease	Improve	
	29	Set up an "Engage-Improve" waste feedback loop	Structural, operational	Implement	High	Decrease	Improve	

Sources

Evans, Paul (2017). *Cooling Load Calculation – Cold Room*. Retrieved from https://theengineeringmindset.com/cooling-load-calculation-cold-room/ on 28.02.2022.

ICRC / IFRC (2021). *The Climate and Environment Charter for Humanitarian Organisations*. Retrieved from https://www.climate-charter.org/ on 04.02.2022.

Lewczuk K, Kłodawski M, Gepner P (2021). *Energy Consumption in a Distributional Warehouse: A Practical Case Study for Different Warehouse Technologies*. Energies (2021); 14(9):2709. Retrieved from https://doi.org/10.3390/en14092709 on 28.02.2022.

OCHA (2018). *US$21.9 billion needed in 2019 as average length of humanitarian crises climbs*. Retrieved from https://www.unocha.org/story/us219-billion-needed-2019-average-length-humanitarian-crises-climbs on 27.02.2022.

PRé (2016). *Introduction to LCA with SimaPro*. Retrieved from https://pre-sustainability.com/files/2014/05/SimaPro8IntroductionToLCA.pdf#:~:text=1%20Introduction%20to%20LCA%20with%20SimaPro%201.1%20Introducing,of%20the%20products%2C%20including%20material%20recycling%20if%20needed on 18.02.2022.

UNFPA (2018). *About Us*. Retrieved from https://www.unfpa.org/about-us#:~:text=UNFPA%20is%20the%20United%20Nations,young%20person's%20potential%20is%20fulfilled. on 01.03.2022.

UNFPA (2019). *UNFPA Procurement Procedures*. Retrieved from https://www.unfpa.org/sites/default/files/resource-pdf/PROC_Regular_Procurement.pdf on 24.02.2022.

UNFPA (2020). *UNFPA Humanitarian Supplies Strategy, 2021-2025*. Internal document.

UNFPA (2021a). *The UNFPA strategic plan, 2022-2025*. Retrieved from https://www.unfpa.org/sites/default/files/admin-resource/PROG_SP_2022_2025.pdf on 28.02.2022.

UNFPA (2021b). *Policy and Procedures on Management of Programme Supplies*. Retrieved from https://www.unfpa.org/sites/default/files/admin-resource/TECH_Programme_Supplies.pdf on 01.03.2022.

UNFPA (2022). *Humanitarian Action 2022 Overview*. Retrieved from https://www.unfpa.org/HAO2022-impact on 02.03.2022.

UNFPA Environmental Sustainability Team (2021). *UNFPA Greenhouse Gas (GHG) – Inventory Management Plan 2020*. Retrieved from https://www.unfpa.org/sites/default/files/resource-pdf/IMP_2020.pdf on 01.03.2022.

UNFPA HO (2017). Evaluation of the Use of Inter-Agency Reproductive Health Kits for Crisis Situations. Retrieved from https://iawg.net/resources/2017-evaluation-of-the-use-of-inter-agency-reproductive-health-kits-for-crisis-situations on 28.02.2022.

UNFPA SCMU (2019). *UNFPA Green Procurement Infographic.* Retrieved from https://www.unfpa.org/sites/default/files/resource-pdf/Green_procurement_final.pdf on 25.02.2022.

UNFPA SCMU and Deloitte (2013). *UNFPA Green Procurement Strategy*. Retrieved from https://www.unfpa.org/sites/default/files/resource-pdf/Green%20Procurement%20Strategy_NOV%202013_0.pdf on 25.02.2022.

UNFPA Yemen (2021). *Linking the Rapid Response Mechanism to Cash Assistance and Women's Protection*. Retrieved from https://yemen.unfpa.org/sites/default/files/pub-pdf/rrm_case_study_-_final_version_-_3_feb_2021-_pdf.pdf on 17.02.2022.

UN Press (2019). *Only 11 Years Left to Prevent Irreversible Damage from Climate Change, Speakers Warn during General Assembly High-Level Meeting*. Retrieved from https://www.un.org/press/en/2019/ga12131.doc.htm on 31.05.2022.

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