Creating Environmental Visibility in Humanitarian Supply Chain Operations

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CHORD
CENTER FOR HUMANITARIAN LOGISTICS AND REGIONAL DEVELOPMENT

Agenda

1. MOTIVATION
   Humanitarian operations and environmental sustainability
   4 minutes

2. RESEARCH
   Creating environmental visibility in humanitarian supply chains
   8 minutes

3. CONCLUSIONS
   Summary of findings and next steps
   4 minutes

4. Questions
   4 minutes

MOTIVATION

Humanitarian operations and environmental sustainability

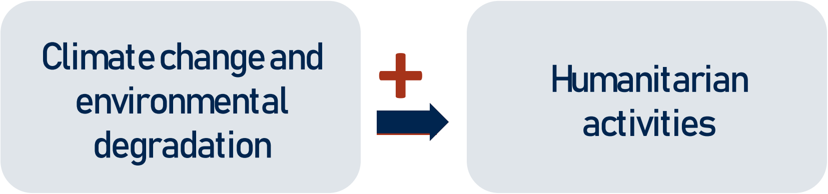
Photo: Philippines three months after Typhoon Rai (Odette) hit in 2022
©UNFPA Philippines/Ezra Acayan

Humanitarian activities are increasingly driven by environmental causes

©UNFPA/Paula Seijo
Akib, 27, at the displacement camp in Ethiopia with her eight children, after losing 180 goats and 15 camels to drought.

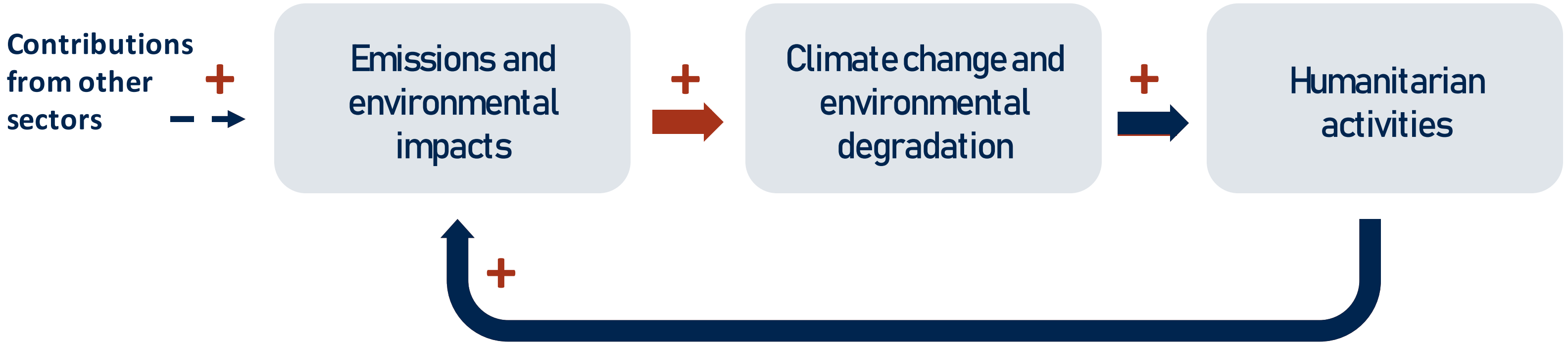
"We are trying to save all we have… we can't even feed our children."

- **Climate and environmental change** are top drivers of humanitarian need and human suffering[1]
- **Extreme weather** such as droughts, flooding, and other natural disasters are becoming more frequent and severe[2] – **displacing people, degrading the environment, and causing resource scarcity**



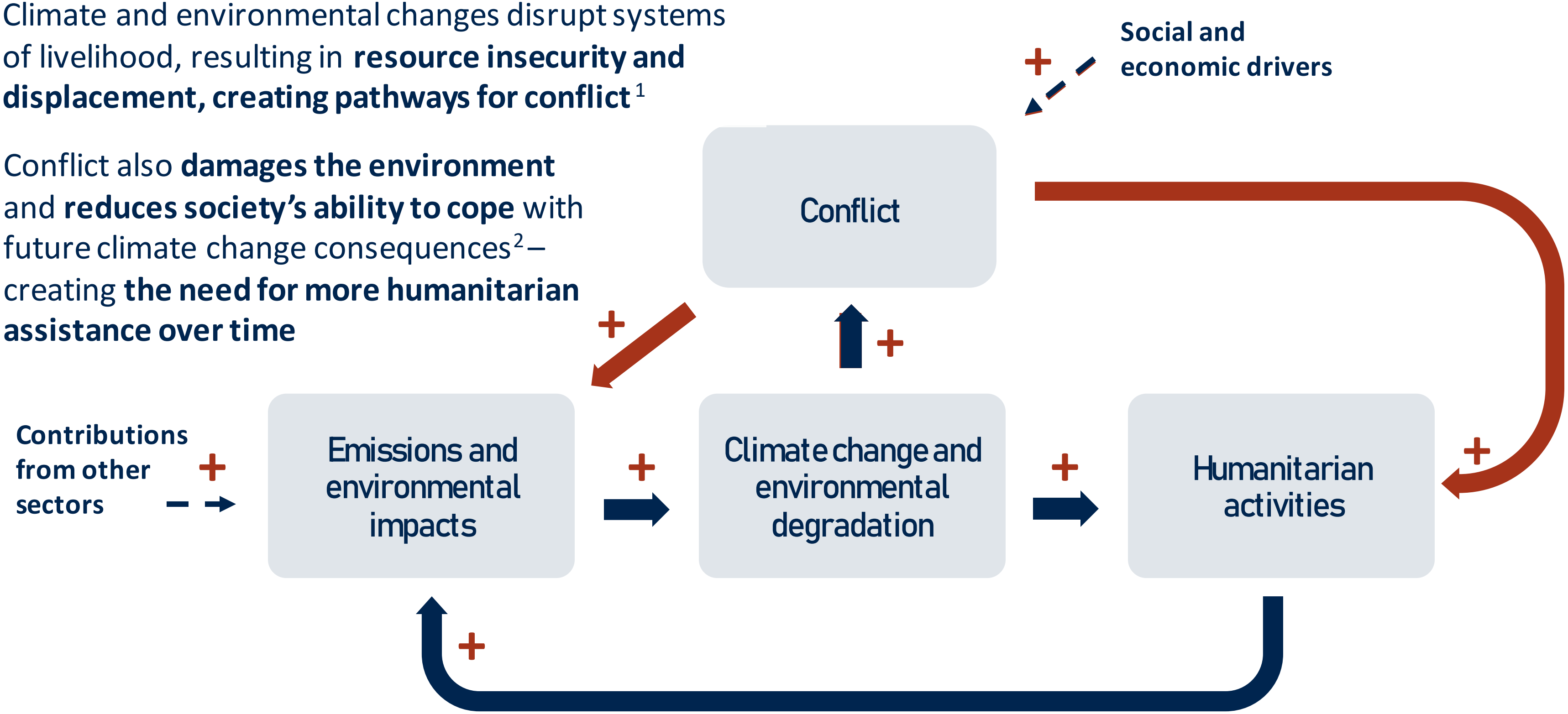
Humanitarian activities and climate change interact within a vicious cycle

- **Humanitarian organizations** need to scale up assistance as disasters become more frequent and severe, yet this leads to an increase in activities that **may harm the environment in different ways**
- **The ripple effects** of these impacts can be felt throughout the entire disaster management cycle and may create a vicious cycle of vulnerability, **leading to an increased need for humanitarian assistance over time**[1]



Climate change, conflict, and humanitarian activities also interact circularly

- Climate and environmental changes disrupt systems of livelihood, resulting in **resource insecurity and displacement, creating pathways for conflict** [1]
- Conflict also **damages the environment** and **reduces society's ability to cope** with future climate change consequences[2] – creating **the need for more humanitarian assistance over time**



[1](Laguna-Salvadó et al. 2019)

Breaking the cycle requires reducing emissions and environmental impacts

- **"Do no harm"** principle implies HOs need to understand the impacts of activities in communities in which they operate
- **Sustainability** is moving up to the top of humanitarian agendas and numerous humanitarian actors have identified **the need to integrate environmental sustainability into their strategy**

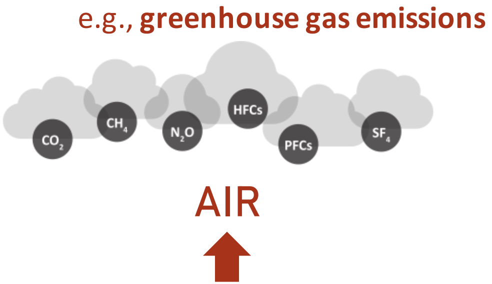
- **Widespread implementation** into practice, however, involves **several constraints** (e.g., costs, knowledge, capacity, infrastructure) and is **still in its infancy**
- There is a **lack of standardization or systematic methods** to measure and reduce the environmental impacts of humanitarian activities[1]
- **In times of crises,** environmental sustainability is **not considered a priority** (e.g., need to fly items in following disaster to reach the affected population as quickly as possible)

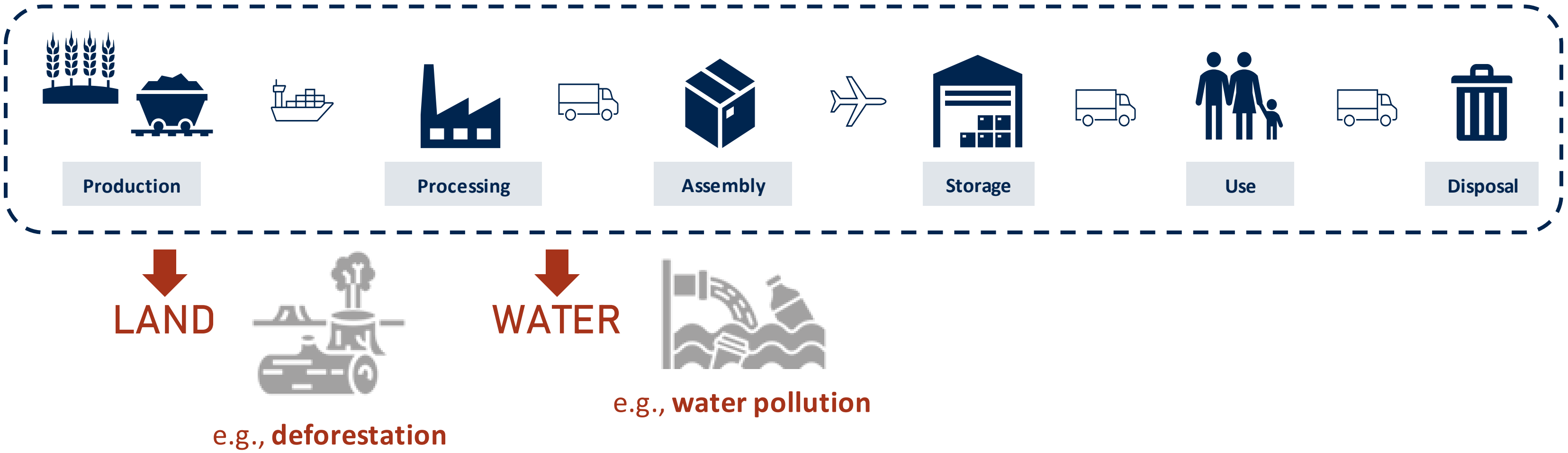
How can humanitarian organizations reduce the environmental impacts of their operations?

[1](Stumpf et al. 2023; Van Wassenhove 2006), [2](IFRC 2022a; OCHA 2022; UNEP 2022a)

Humanitarian operations and supply chain management is uniquely positioned to answer this call

- Supply chains account for **roughly 75% of humanitarian spending**[1] and contribute to the bulk of environmental impacts (e.g., contribution to climate change)[2]
- Emissions are embedded in **each step of the end-to-end supply chain**





RESEARCH

Data-driven approach to create environmental visibility in humanitarian supply chains

Objective

Can humanitarian organizations adapt their way of operating to be more environmentally sustainable or is the clash between humanitarian priorities and sustainability too strong?

Where are emissions to air, land, and water embedded in end-to-end humanitarian supply chains?

What is the role of conflict in increasing this challenge?

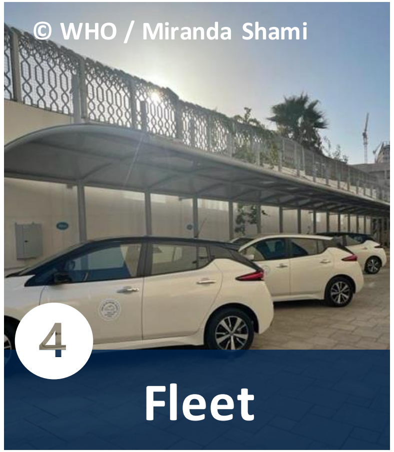
What is the potential for alternative solutions to reduce the clash in times of crises?

Case studies

Medical kit distributed to a **conflict** zone, including **prepositioning**, and **cold chain** logistics

Fortified **food** product delivered for development and air efforts considering local and global **procurement** sourcing, and different **production** methods

Tarpaulin distributed to a **conflict** zone, including **prepositioning** and direct **procurement**



Electric and internal combustion engine vehicles used by humanitarian staff considering different **sizes and energy sources**

Data-driven approach

1

2

3

4

- Measure the environmental impacts of **entire supply chain**
- Include **range of emissions to air, land, and water**
- Use primary data gathered **directly from practitioners**
- Analyze the **influence of conflict**
- Test the **effect of alternative inputs and operations**

Evidence

Informed decisions

Reduce environmental impacts

Data

- Collected **directly with practitioners for the full supply chain**, including suppliers and farmers (for food case study)
- Modeled to a **regional level** (e.g., production of Maize in Belgium or use of the local grid in Dubai)
- Transport modes are modeled according to **specific characteristics** such as 10-20t truck, EURO 4, 100% full)
- Disposal is according to **different processes for various waste materials** (e.g., landfill of plastic)

Supported by the **background database** in the LCA software

Methodology

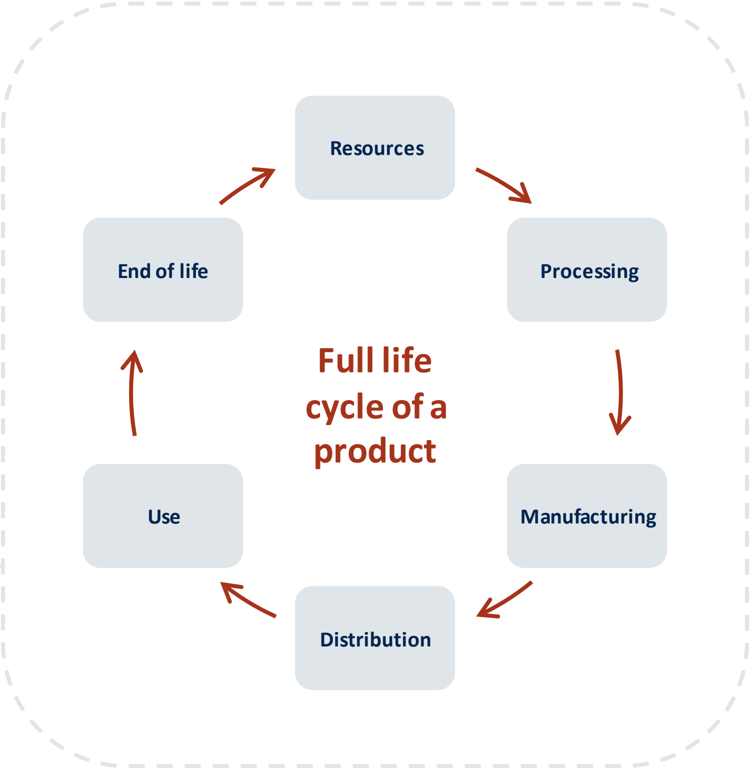
What it is and why it is done

Life cycle assessments (LCA) are performed to understand the **contribution of the life cycle stages** to the overall environmental load of products, usually with the objective of:

- identifying and prioritizing improvement opportunities, and/or
- comparing similar products with each other

A comprehensive methodology

An LCA can consider the **entire life cycle** of a product (from raw materials extraction to the use and disposal of the product itself) **across multiple environmental dimensions** (e.g., global warming, land pollution, water pollution).



Study 1: Health

Medical Kit

Question motivating study

Is prepositioning better for the environment? Does conflict lead to increased environmental impacts?

Consider 3 procurement scenarios of a medical kit (68 items, mainly consisting of pharmaceuticals, disposables, and packaging) to **a conflict zone**:

1. **From Europe by air***
2. **From Europe by sea***
3. **From India with prepositioning in Dubai by sea**

*One item in the kit, Oxytocin, requires a cold chain and must be flown in in both scenarios

Study1 baseline

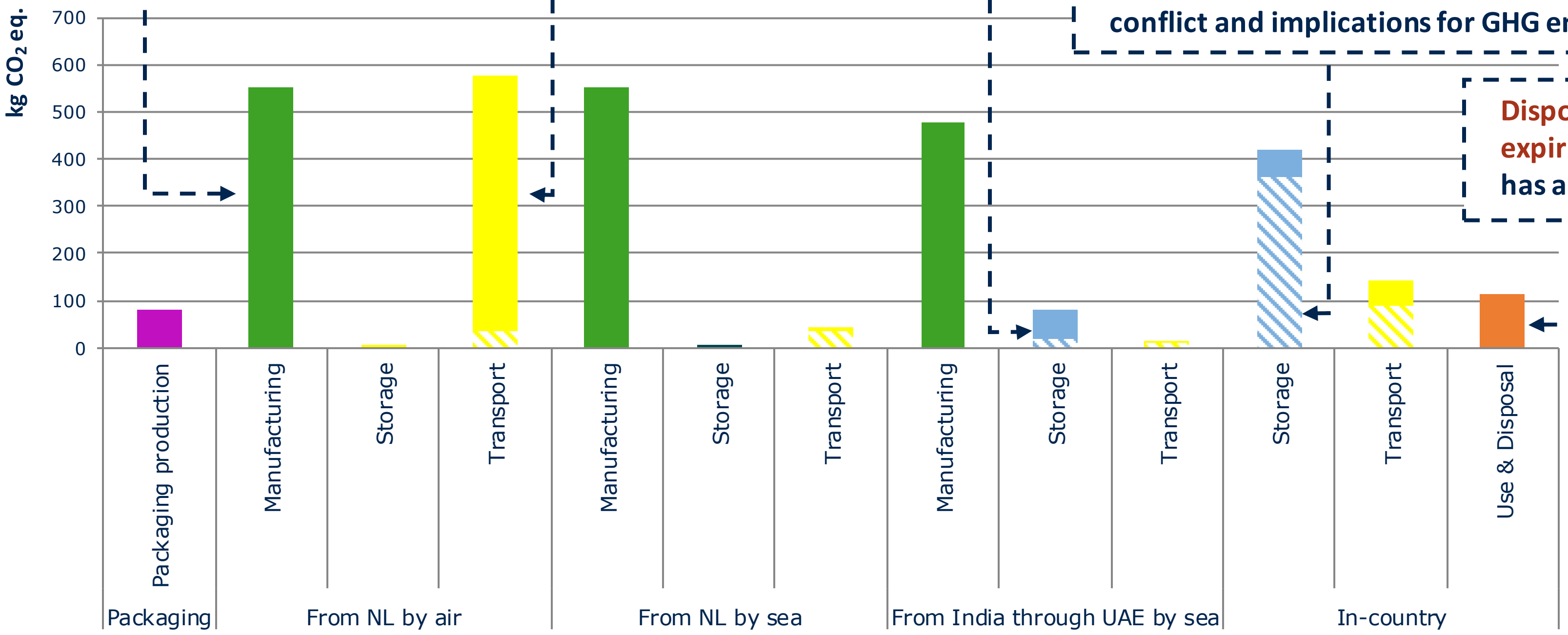
Manufacturing represents 30-40% of the kit's carbon footprint.

Air transport is a dealbreaker. When distributed by air, GHG emissions by increase by nearly 90x per unit.

Prepositioning (180 days) imply greater GHG emissions for storage than direct delivery.

In-country distribution is like that of manufacturing and air transport. The cold chain is a significant contributor, especially because the truck transporting the Oxytocin remains idle for an average of 45 days at a border. This is in addition to 3 different stops in-country before the kit reaches the end-users. This illustrates the complexities associated with conflict and implications for GHG emissions.

Disposal (including expired stock) also has a high impact.



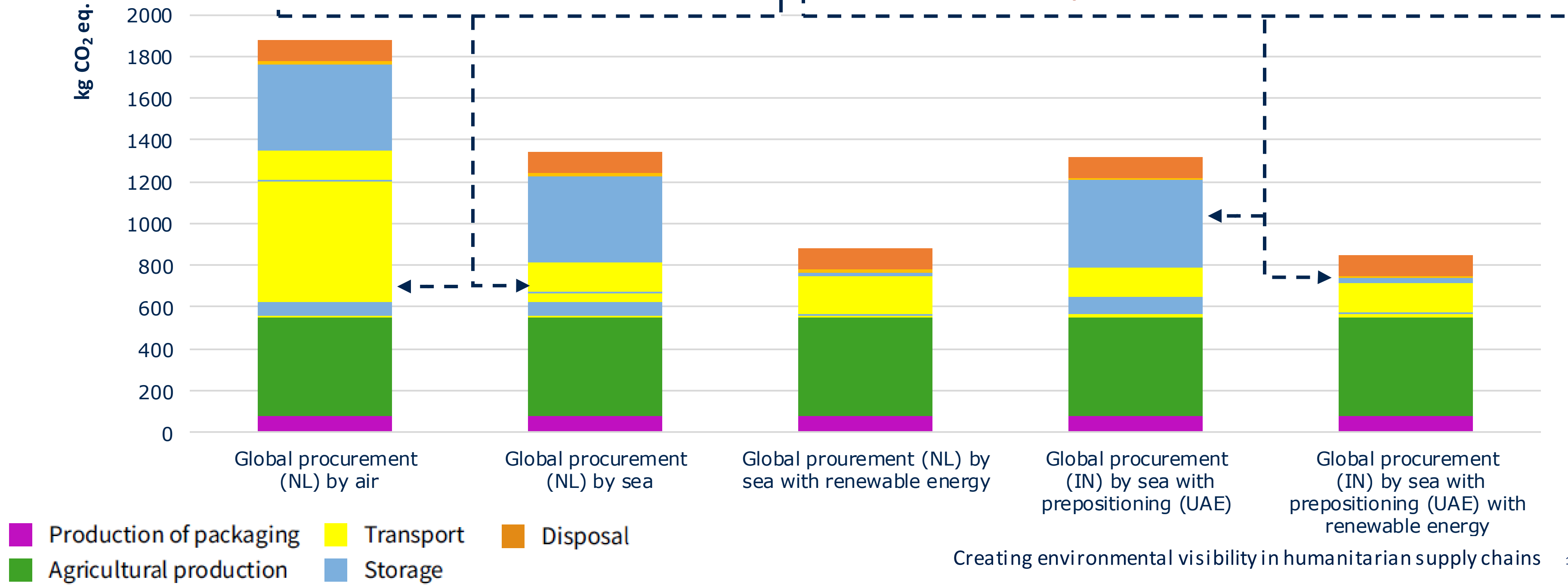
Cold chain storage

Cold chain transport

Study 1 alternatives

When **the general cargo is distributed by sea**, the GHG emissions of transport is reduced significantly. This can be enhanced **when air transport for the cold chain can also be eliminated.**

All energy sources are **replaced with renewables**, including wind power in the NL and solar in India, UAE, and the destination country. This implies a significant reduction in GHG emissions and illustrates how integrating sustainable alternatives can **help reduce the environmental challenges associated with complex contexts and conflict.**



Study 2: Food

© WFP / Evelyn Fey

Fortified food

Question motivating study

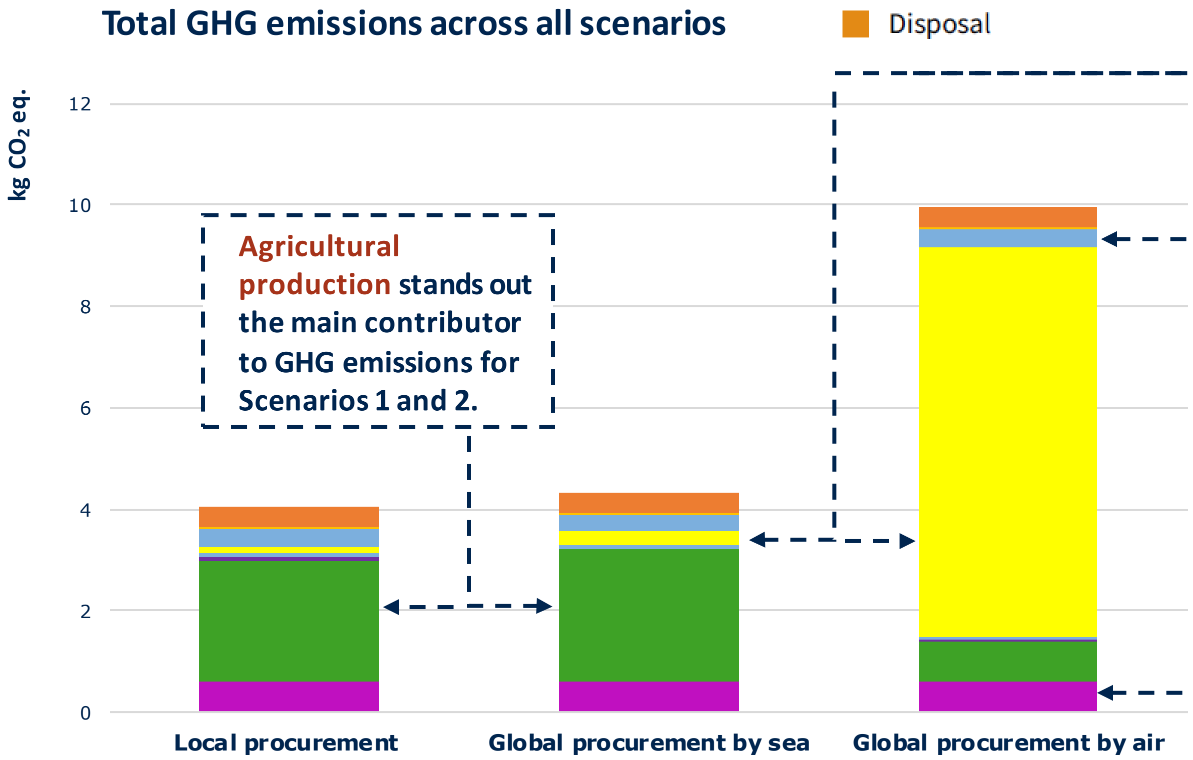
Is **local procurement** more environmentally sustainable than global?

Consider 3 procurement scenarios of a food items to **a development region (East Africa):**

1. **Local procurement from East Africa***
2. **Global procurement from Europe by sea**
3. **Global procurement from Europe by air**

*78% of the weight of the item are sourced locally (maize and soy). The other ingredients are sourced globally by the supplier.

Study 2 baselines



The impact of transportation is slightly higher in the global vs. local scenario when transported by sea. When air is included, the story changes significantly.

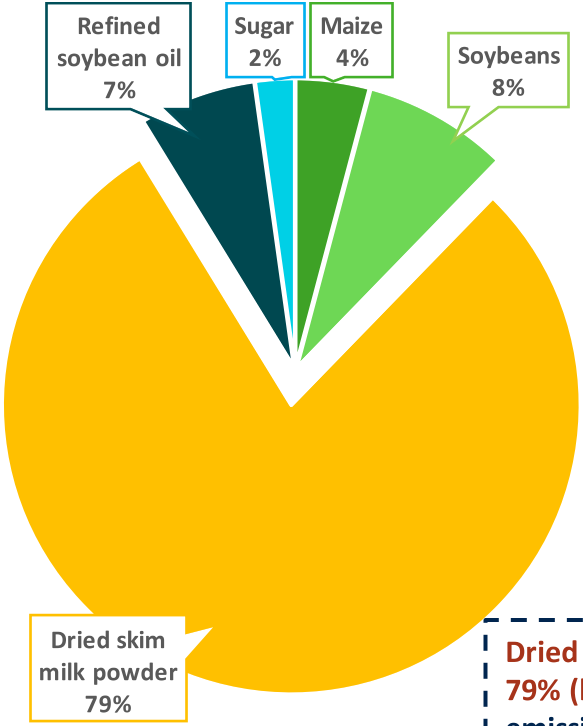
Note that for the local scenario:

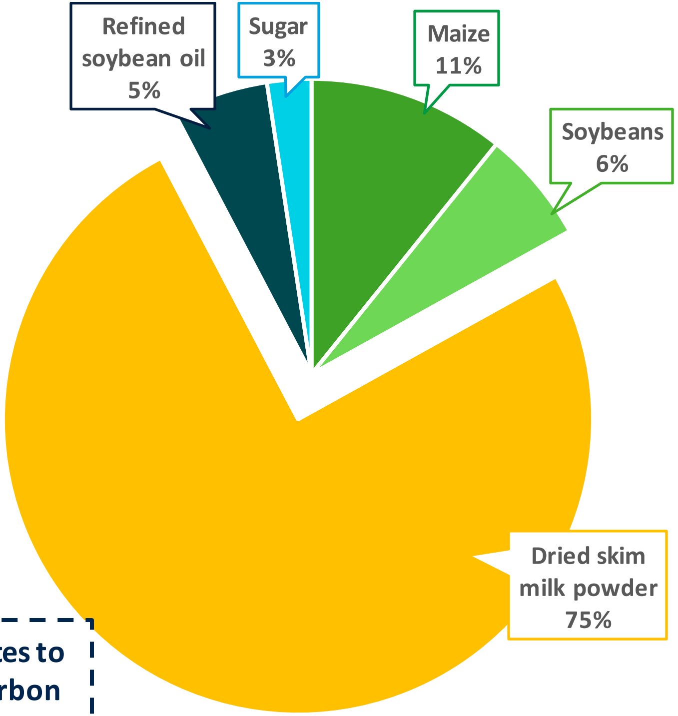
- *GHG from maize and soy (sourced locally): **0.03 kg CO_2 eq (78% weight)***
- *GHG from rest (sourced globally): **0.04 kg CO_2 eq (22% weight)***

Energy required for storage also have high environmental impacts (more than international transport for Scenarios 1 and 2).

Packaging production is also relevant, especially considering the disposal at the end of the life cycle (combined approx. 25%).

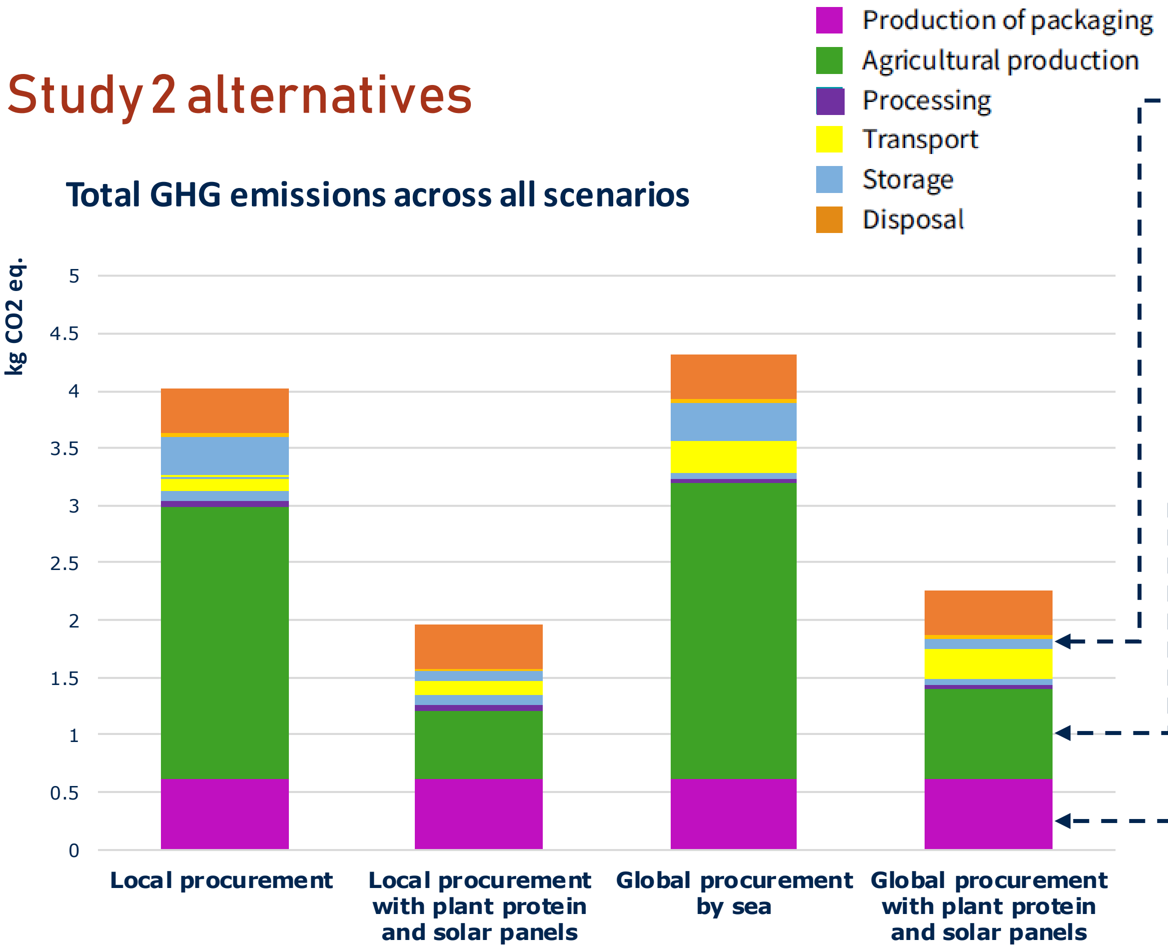
Study 2 baselines





Dried skim milk powder contributes to 79% (local) and 75% (global) of carbon emissions despite accounting for just 8% of total weight of the CSB++

Study 2 alternatives



The impact of storage, especially in-country, also decreases when solar panels are implemented.

Opting for a plant-based soy protein concentrate[1] can significantly reduce the GHG emissions associated with production. This must be balanced with nutrition requirements, however. Although agricultural production is no longer dominating the footprint of the supply chain, there are **still room for improvements (namely through production methods).**

More exploration into the potential for **sustainable packaging production and disposal (e.g., reuse and recycling)** should be a next step.

[1] (Regier et al., 2019; Ward et al. 2020)

Study 3: Shelter

Question motivating study

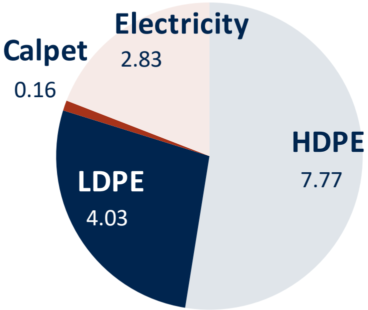
Is **prepositioning** better for the environment? Does **conflict** lead to increased environmental impacts?

Measure the environmental impacts of a **tarpaulin used for shelter delivered to Ukraine** including different procurement and distribution scenarios:

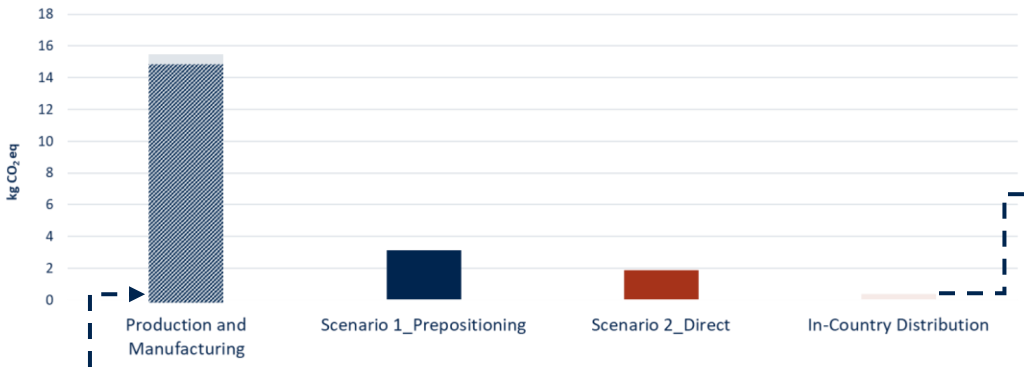
1. **Manufacturing in China with prepositioning in Belgium**
2. **Manufacturing in China and direct delivery through Romania**

Study 3 baselines

Production and manufacturing stands out as the main contributor to GHG emissions, **mainly due to the virgin plastic.**

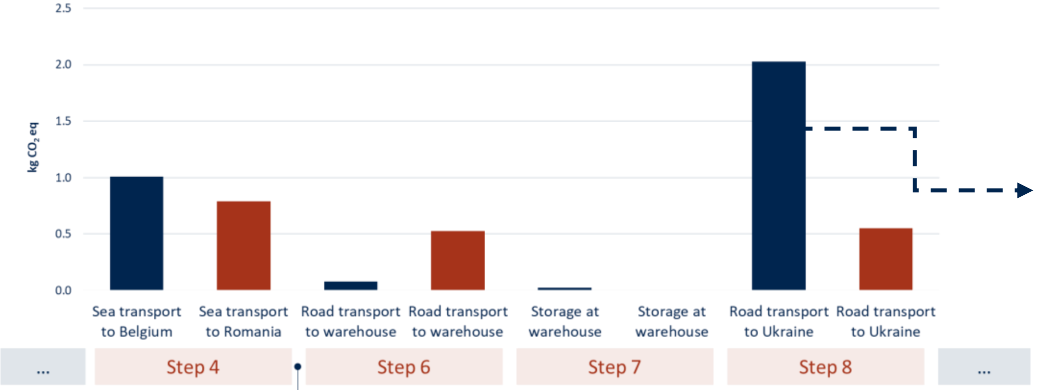


GHG emissions associated with each step of the supply chain



With comparatively shorter transport distances and storage times, **in-country distribution** is the step that contributes to the **lowest GHG emissions.**

GHG emissions associated with international distribution steps

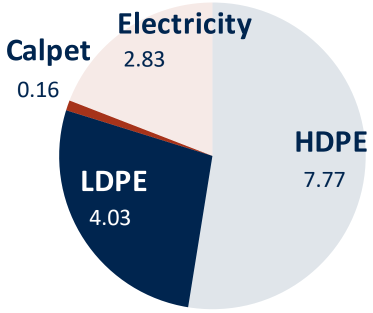


Step 5 (storage at port) has no modeled inputs as items remain in containers before moving on to the next destination

Directly delivery results in lower GHG emissions. In this case, prepositioning implies **longer transport distances**, for both sea and road, leading to a higher footprint than direct delivery.

Study 3: Shelter

Production and manufacturing stands out as the main contributor to GHG emissions, mainly due to the virgin plastic.



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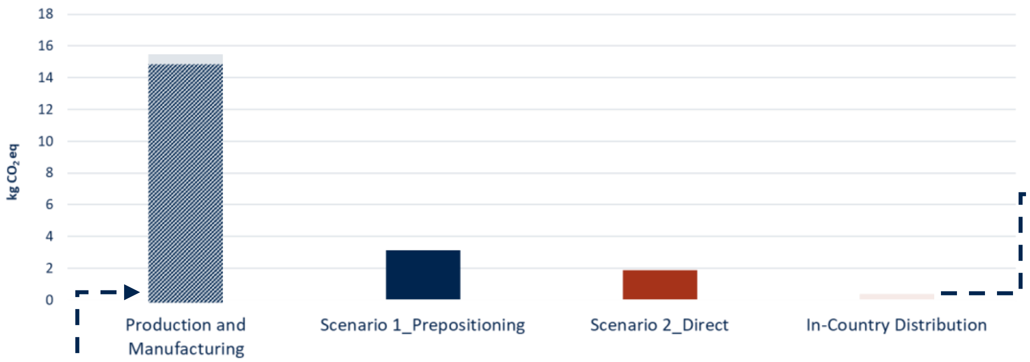

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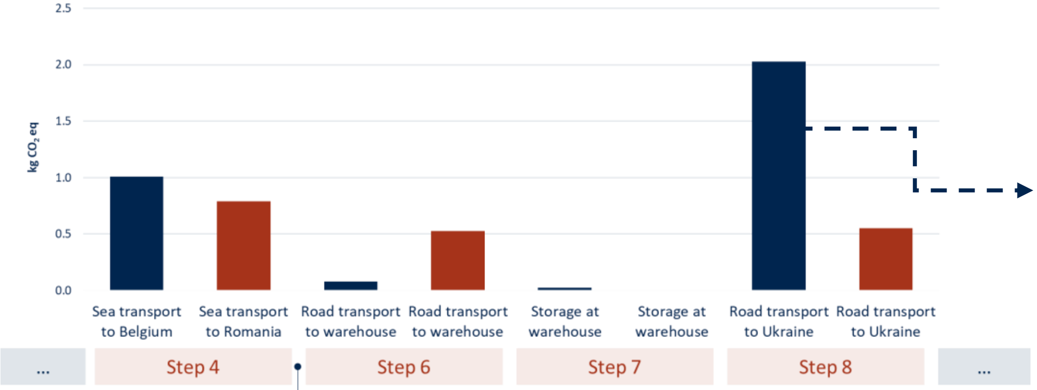

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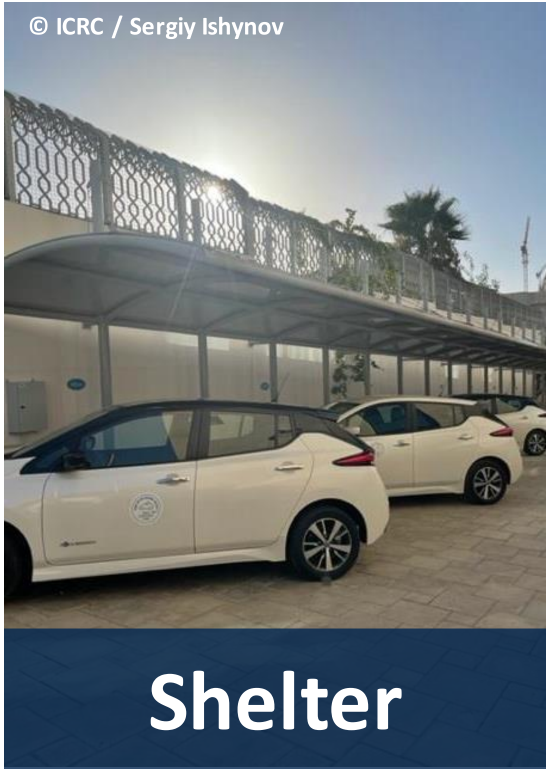
Study 4



Question motivating study

Are **electric vehicles** better for the environment than internal combustion engine vehicles?

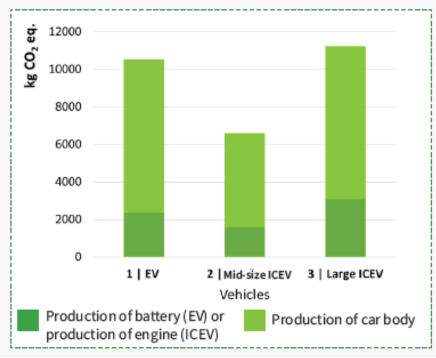
Compare **mid-size EV to mid-size and large ICEV,** considering different fuel and electricity scenarios in **East Africa and Middle East:**

1. **Mid-size EV**
   a) **Kenya local grid**
   b) **Lebanon local grid**
   c) **Jordan local grid**
   d) **Diesel generator**
   e) **Solar panels**
2. **Mid-size ICEV with petrol**
3. **Large ICEV with diesel**

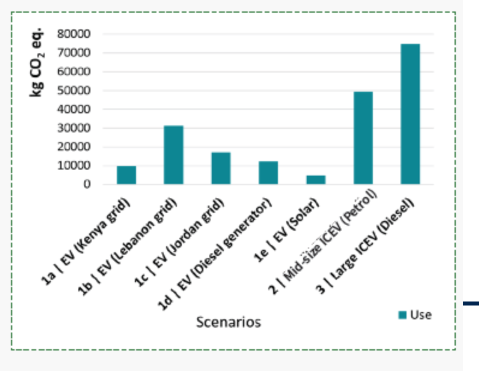
Study 4: Fleet

Production of EV is greater than mid-size ICEV due to higher resource requirements.

GHG emissions associated with production

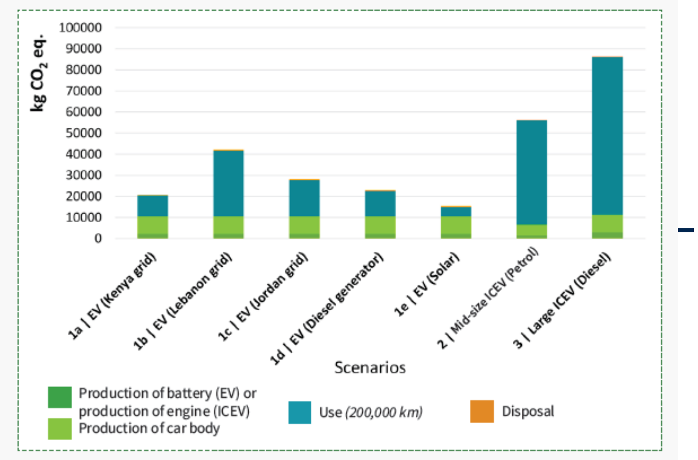


GHG emissions associated with use



GHG emissions from use phase (200,000 km) are higher for both ICEVs than the EV, but degree depends on source of electricity.

Total GHG emissions across full life cycle



Considering the full life cycle, the EV implies lower GHG emissions than both ICEV. However, the impact of the Lebanon grid (mostly oil) is more than double that of the Kenyan (mostly renewables) and triple that of solar.

CONCLUSIONS

Summary of main findings, recommendations, and next steps

Photo: Fertile fields due to improved agricultural techniques in Chad in 2021 ©WFP / Evelyn Fey

Summary of main findings

Production and procurement are the top drivers in all case studies.

Conflict can increase environmental impacts, but is dependent on several operational and contextual factors

Air transport is a "game changer" in terms of environmental impacts, especially carbon emissions

Life cycle of items (from production to disposal) is key

Efficiency is also a means to reduce environmental impacts

Energy source is consistently a major factor in contribution to impacts

Lower distances add up, but many dynamics are at play in localization

Work in progress

Recommendations for practitioners

1

Consider your supply chain end-to-end including inputs to operations

Measuring only specific steps **limits the picture** and does not allow for the identification of the **"hotspots"** within the supply chain, which are necessary to create a **comprehensive strategy** to reduce environmental impacts.

e.g., production and manufacturing often represent the largest impact, but aren't considered a direct activity for the organization

2

Implement change at both operational and strategic levels

Developing (longer-term) strategies to support environmental sustainability should be **aligned with (shorter-term) operations.** Assessing how **day-to-day activities support (or hinder) sustainability goals** is a necessary step.

e.g., implementing EVs in areas with a fossil-fuel dominated electrical grid may limit benefits; this should be coupled with energy source

3

Improve the efficiency of operations and increase planning and preparedness

Efficiency is also a means to reduce environmental impacts through optimizing resource use. **Better planning and preparedness** can improve efficiency and reduce clash between humanitarian priorities and environmental sustainability.

e.g., planning makes it easier to opt for slower transport modes (with lower environmental impacts) and reduce waste from expired stocks

Next steps

Nov. 2023

Test effect of alternative solutions (e.g., solar panels)

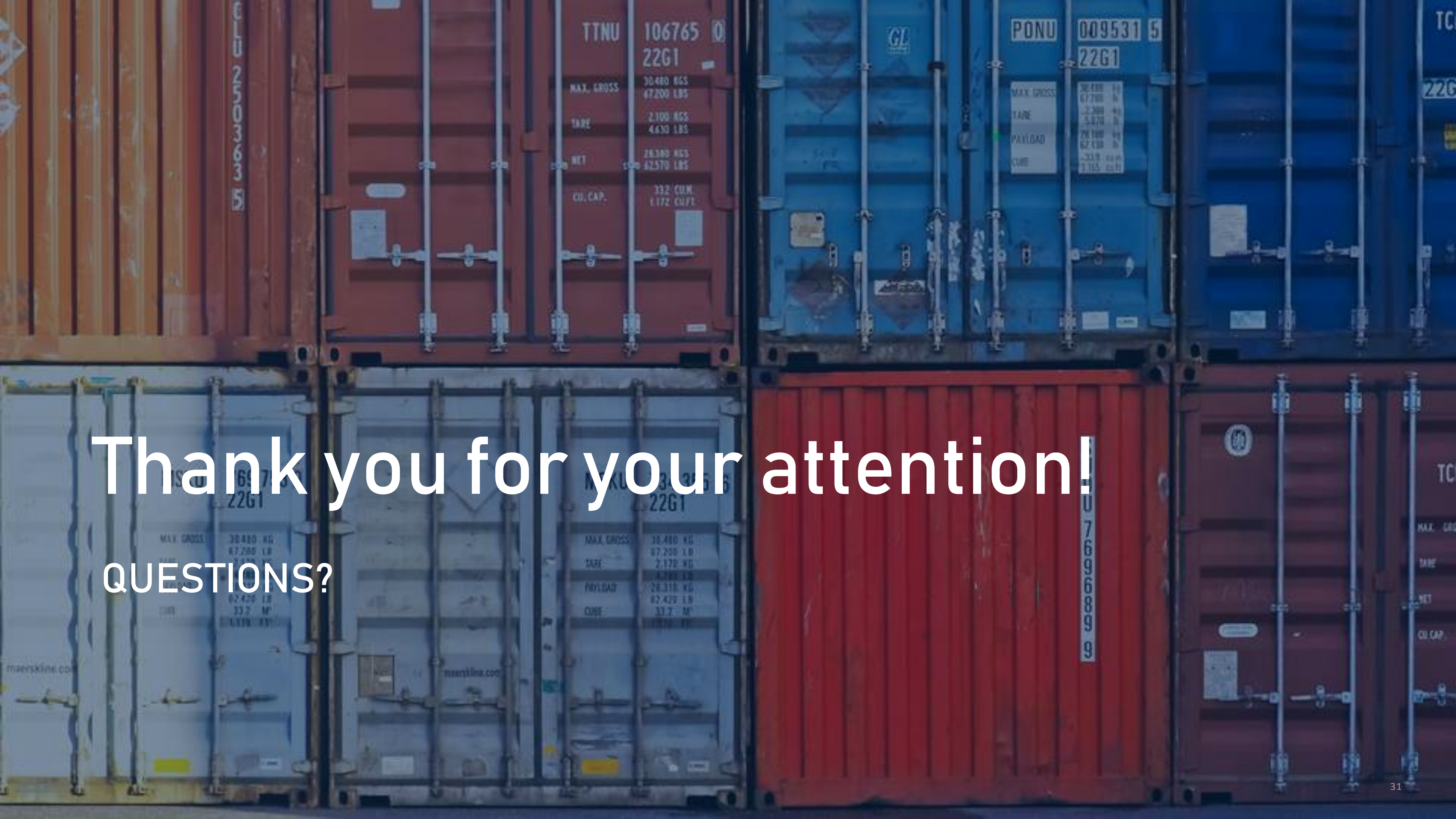
Dec. 2023

Paper 1

Integrate Study 4 into draft and prepare for submission

Paper 2

Combine LCA with System Dynamics methodology



Thank you for your attention!

QUESTIONS?

Appendix

What environmental **impact categories are considered?**

Note:

Some categories express more **global impacts** (e.g., climate change), while others refer to more **local impacts** (e.g., land use, freshwater ecotoxicity

*these are the categories reported according to ReCiPe 2016.

Study 1: LCA of a medical kit **comparison basis**

One medical (reproductive health) kit

The analysed kit is used for clinical delivery assistance and contains a mix of pharmaceuticals and disposables. It is one of the most important kits for HO in terms of delivery volumes.

Analysed kit is more complex than the one shown here

Comprised of:

Kits' Components

The kit is comprised of a total of 68 items, a mix of pharmaceuticals and disposables: medicines, catheters, extractors, tubes, syringes, compresses, gloves etc.

77 kg

Packaging

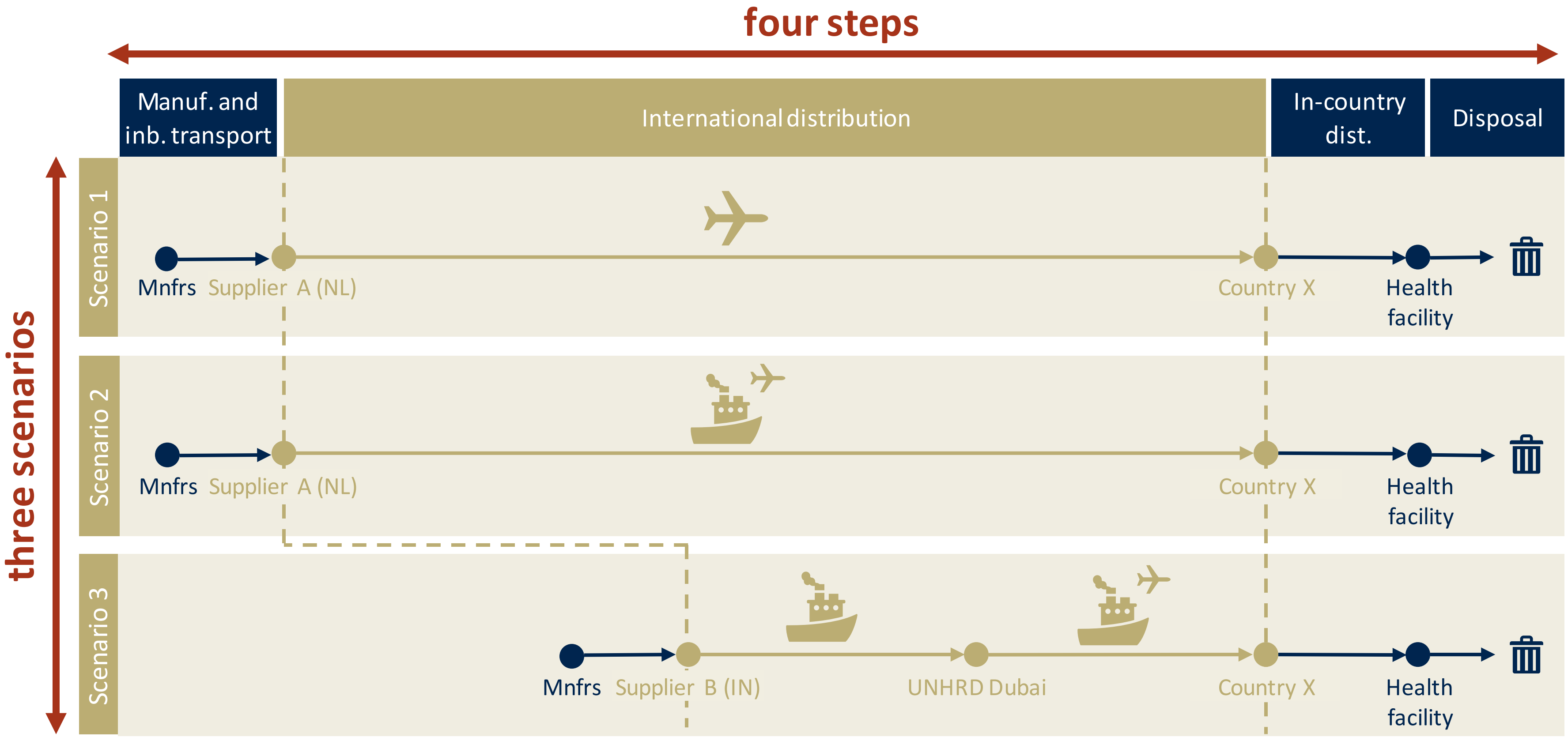
Primary: plastic
Secondary: carton box
Tertiary: carton box

25 kg

Total weight: 102 kg

Three life cycle assessment studies

Study 1: LCA of a medical kit **scenarios considered**



Dist.: Distribution | Inb.: Inbound | Manuf.: Manufacturing | Mnfrs: Manufacturers

Study 2: LCA of a food product **comparison basis**

One food aid product: CSB++ (a.k.a. Super Cereal Plus)

We compare the **full life cycle of the CSB++** (including packaging production and disposal) **from two sourcing options: one global and one local supplier** (from a selected humanitarian organization)

CSB++

Comprised of:

Agricultural Components

55% Corn
24% Soy
8% Dried skim milk powder
3% Refined soybean oil
9% Sugar
1% Fortification products

1.5 kg

Packaging

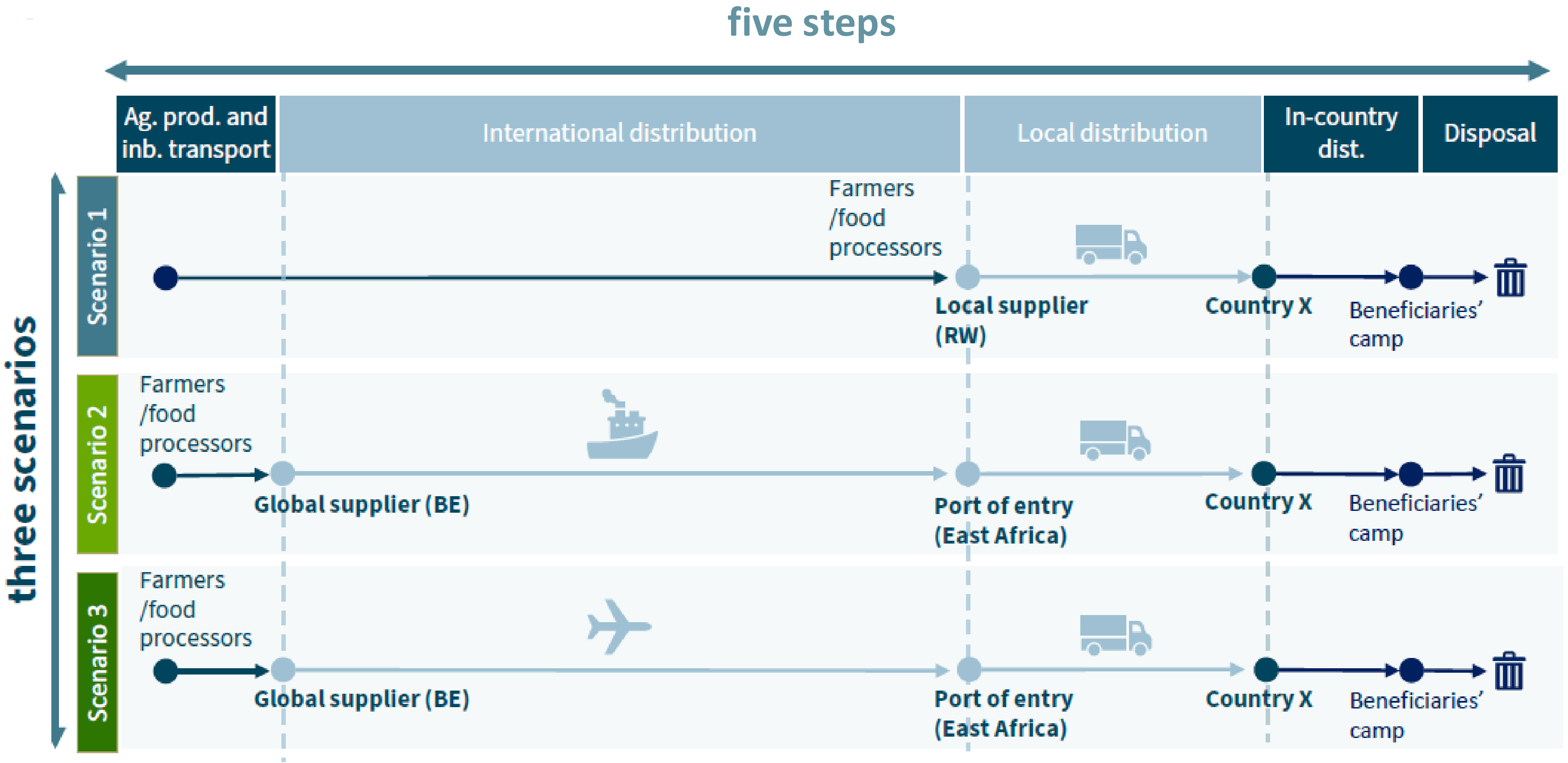
Primary: metalized plastic
Secondary: carton box

0.2 kg

Total weight: 1.7 kg

Three life cycle assessment studies

Study 2: LCA of a food product **scenarios considered**

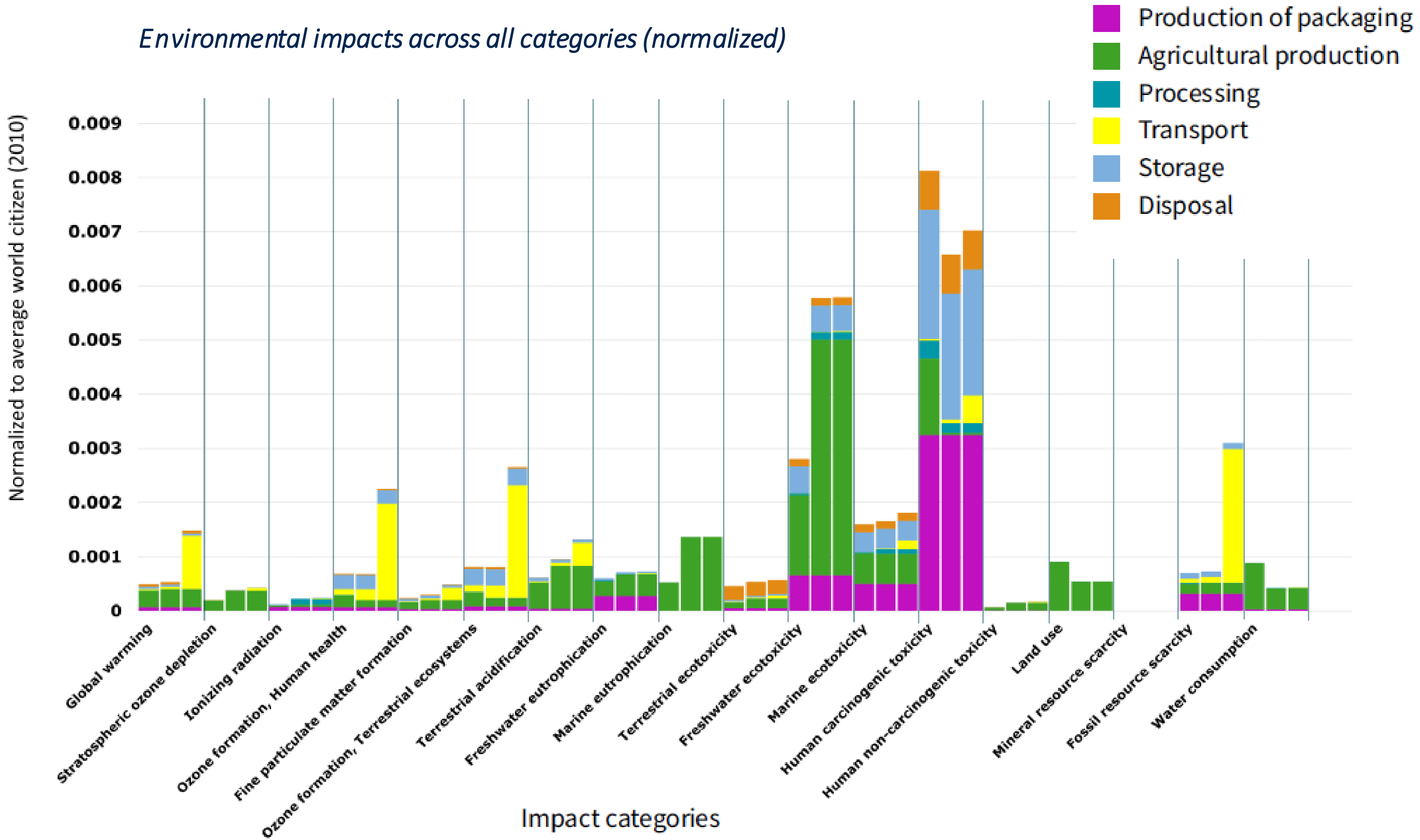


Dist.: Distribution | Inb.: Inbound | Manuf.: Manufacturing | Mnfrs: Manufacturers

Three life cycle assessment studies

Study 2: LCA of a food product **results**

Environmental impacts across all categories (normalized)



Three life cycle assessment studies

Study 3: LCA of a EV vs. ICEV **comparison basis**

The life cycle of three vehicle types: mid-size EV vs. mid-size and large ICEV

We compare the **full life cycle of an EV and two ICEVs** (including production, use, and disposal) for humanitarian operations in three countries: **Kenya, Lebanon and Jordan**

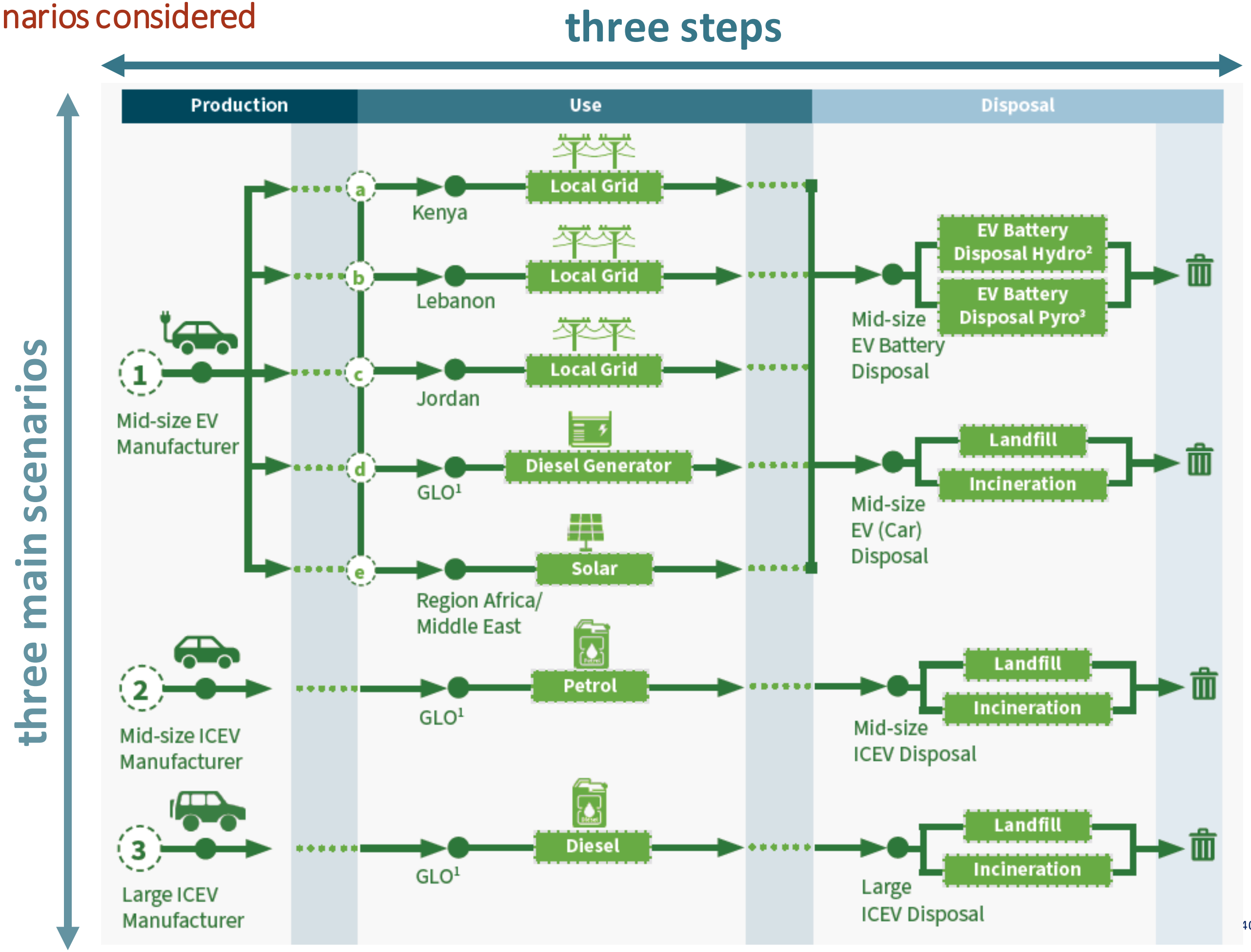
Specifications	Mid-size EV	Mid-size ICEV	Large ICEV
Model	Nissan Leaf (2019)	Toyota Corolla (2019)	Toyota Land Cruiser (2015)
Kerb weight (kg)	1322	1350	2182
Battery weight	286	*n.a.*	*n.a.*
Body style	Hatchback, 5-seater	Hatchback, 5-seater	SUV, 8-seater
Fuel source	Electricity	Petrol	Diesel
Consumption	0.138 kWh/km	.058 L/km	.158 L/km
Lifespan of battery / car (km)	200000	200000	200000

Three life cycle assessment studies

Study 3: LCA of a EV vs. ICEV **scenarios considered**

The composition of the local grid is a key component to the overall impact of the EV. According to the LCA background database, the local grids are as follows:

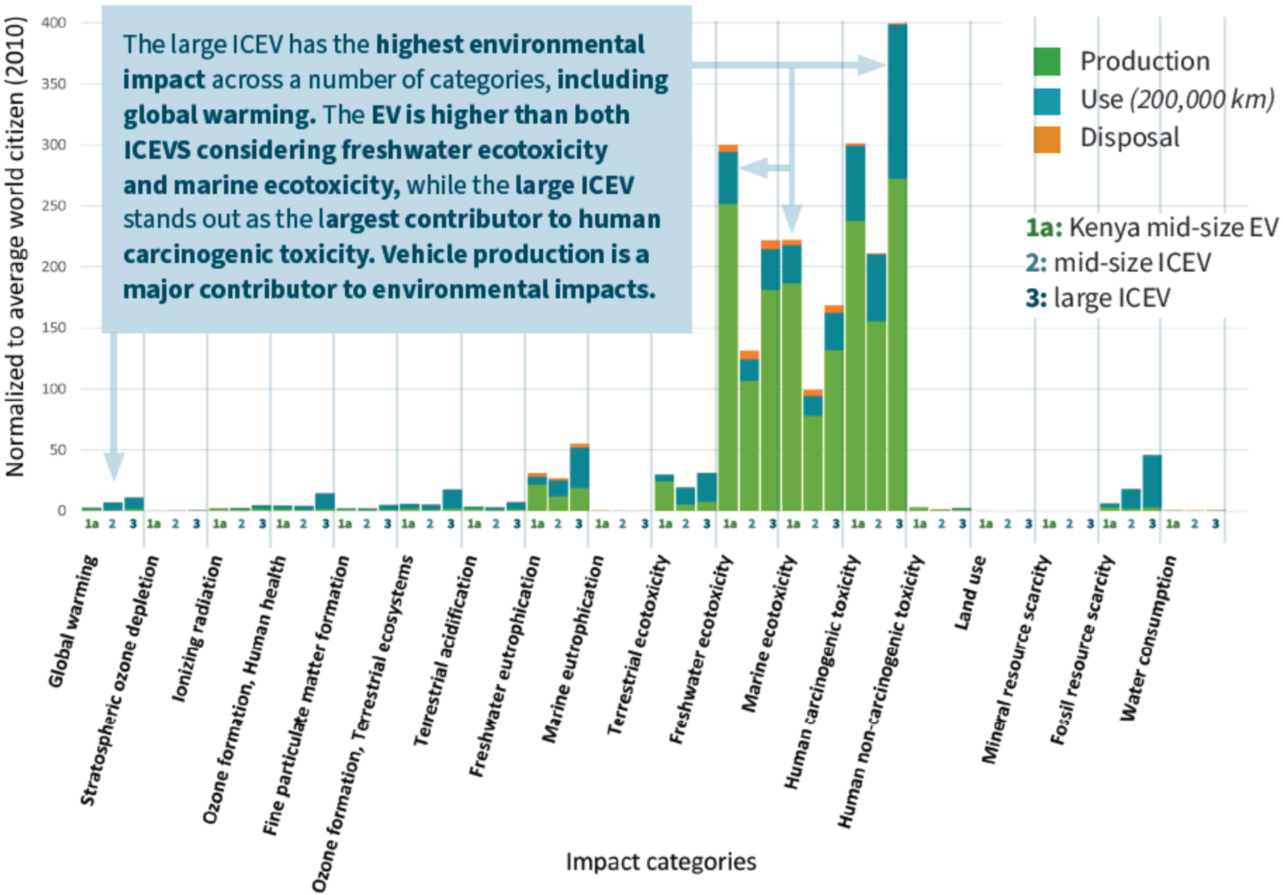
Energy source	Kenya	Lebanon	Jordan
Geothermal	38%		
Hydro	32%	2%	
Wind	2%		4%
Solar	1%		12%
Natural gas	1%		77%
Oil	16%	93%	3%
Other	10%	5%	4%



Three life cycle assessment studies

Study 3: LCA of a EV vs. ICEV **results**

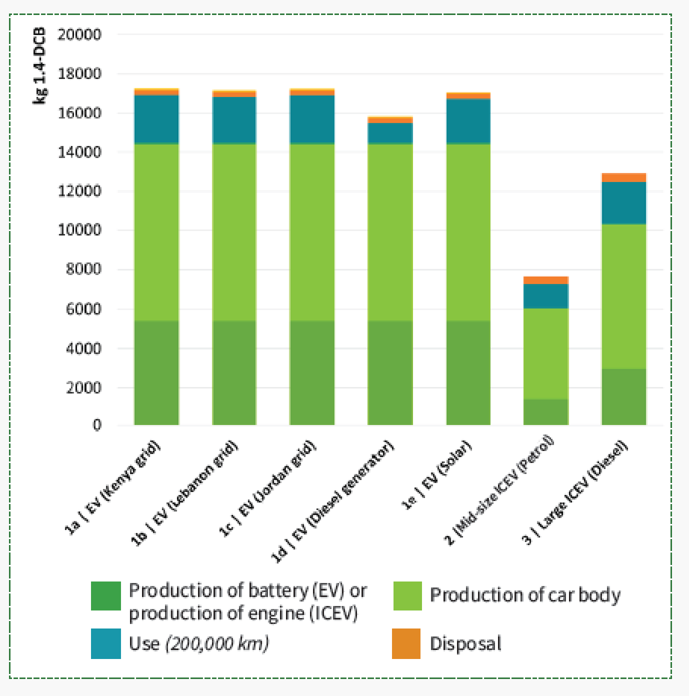
Environmental impacts across all categories (normalized)



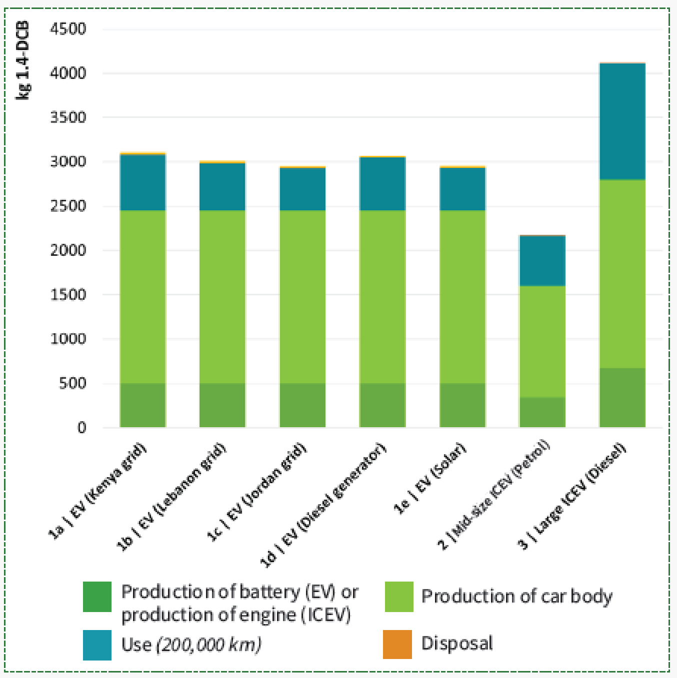
Three life cycle assessment studies

Study 3: LCA of a EV vs. ICEV **results**

Results for freshwater and marine ecotoxicity



Results for human carcinogenic toxicity

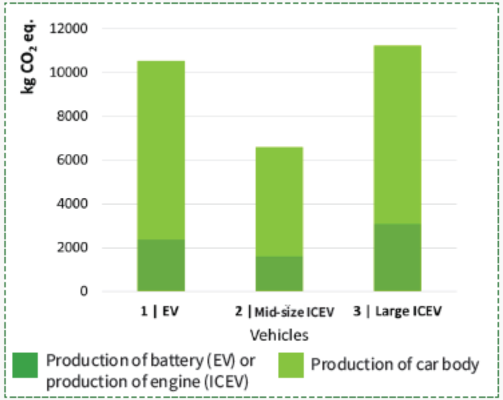


The production of the EV, especially the battery, has a high contribution to water ecotoxicity (damage to water ways) and human carcinogenic toxicity (damage to human health).

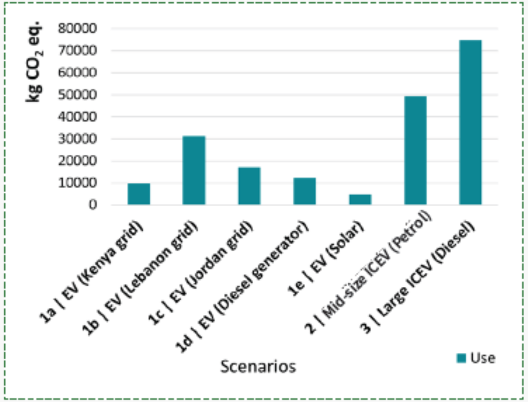
Three life cycle assessment studies

Study 3: LCA of a EV vs. ICEV **results**

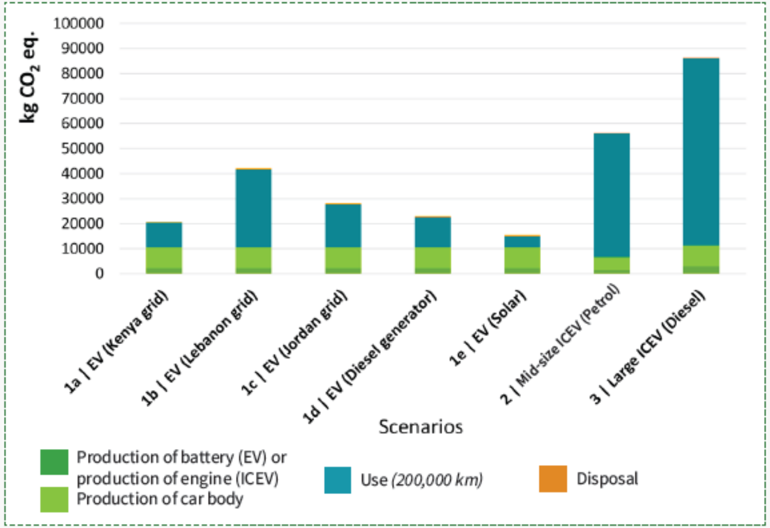
GHG emissions associated with production



GHG emissions associated with use



Total GHG emissions across full life cycle



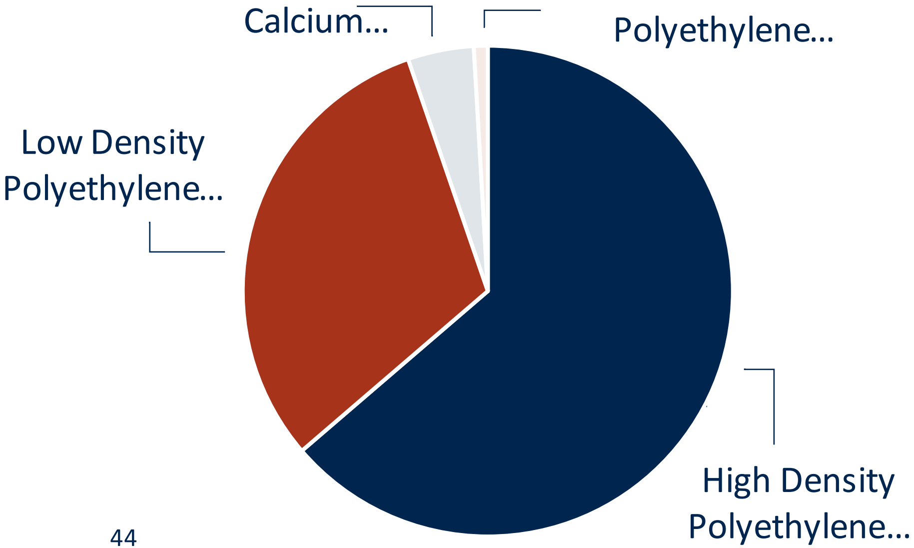
GHG associated with the production and disposal of each vehicle (kg CO_2 eq.)

Vehicle	Production	Disposal	Production & disposal
mid-size EV	10,530	444	10,974
mid-size ICEV	6,589	287	6,876
large ICEV	11,231	320	11,551

At what point does the EV have lower carbon emissions than the mid-size ICEV?

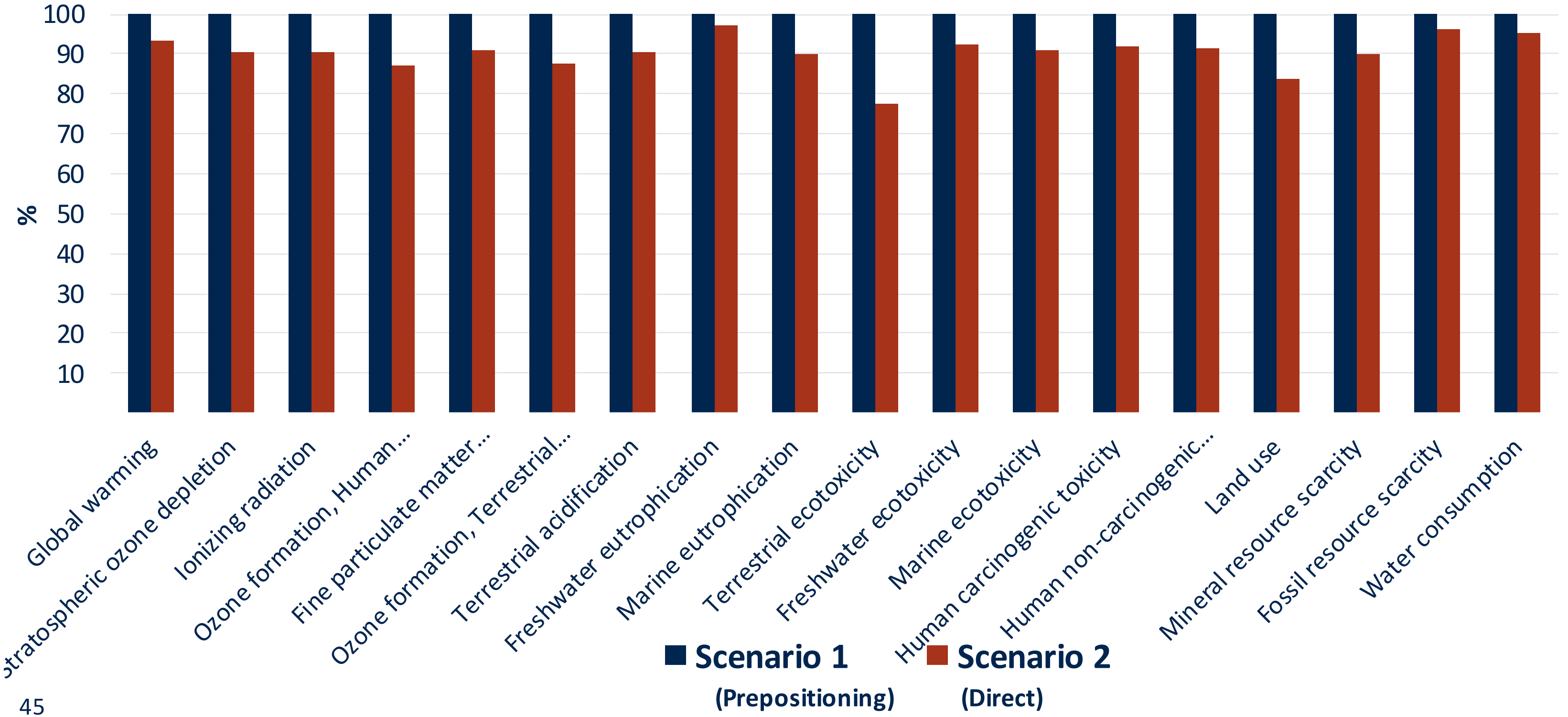
Comparison basis

1 **ICRC standard tarpaulin** (6x4 m) and **packaging comprised of:**

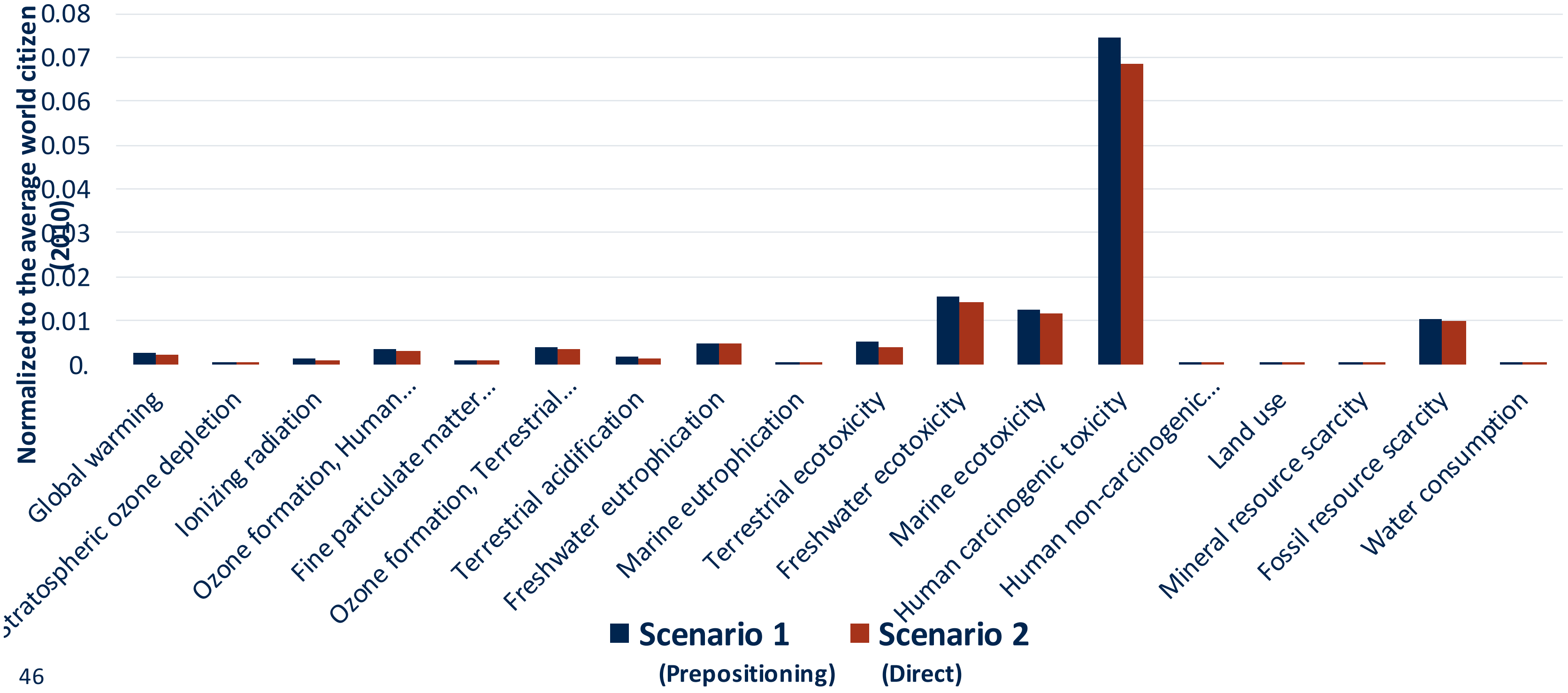


	Materials	Weight (kg)	Input into model
Tarpaulin	High Density Polyethylene (HDPE) granulate	2.654	*Polyethylene, high density, granulate [Global average]*
Tarpaulin	Low Density Polyethylene (LDPE) granulate	1.496	*Polyethylene, low density, granulate [Global average]*
Tarpaulin	MB white & grey	0.290	*Polyethylene, high density, granulate [Global average]*
Tarpaulin	Calpet	0.241	
Tarpaulin	• Calcium carbonate	0.212	*Calcium carbonate [Global average]*
Tarpaulin	• High Density Polyethylene (HDPE) granulate	0.014	*Polyethylene, high density, granulate [Global average]*
Tarpaulin	• Low Density Polyethylene (LDPE) granulate	0.014	*Polyethylene, low density, granulate [Global average]*
Tarpaulin	MB UV	0.097	*Polyethylene, high density, granulate [Global average]*
Tarpaulin	MB black	0.049	*Polyethylene, high density, granulate [Global average]*
	Tarpaulin weight	**4.825**	
Packaging	PET straps	0.010	*Polyethylene terephthalate, [Global average]*
Packaging	HDPE sheet	0.080	*Woven PE tarpaulin [Global average]*
	Packaging weight (per unit)	**0.090**	
	Total weight	**4.915**	

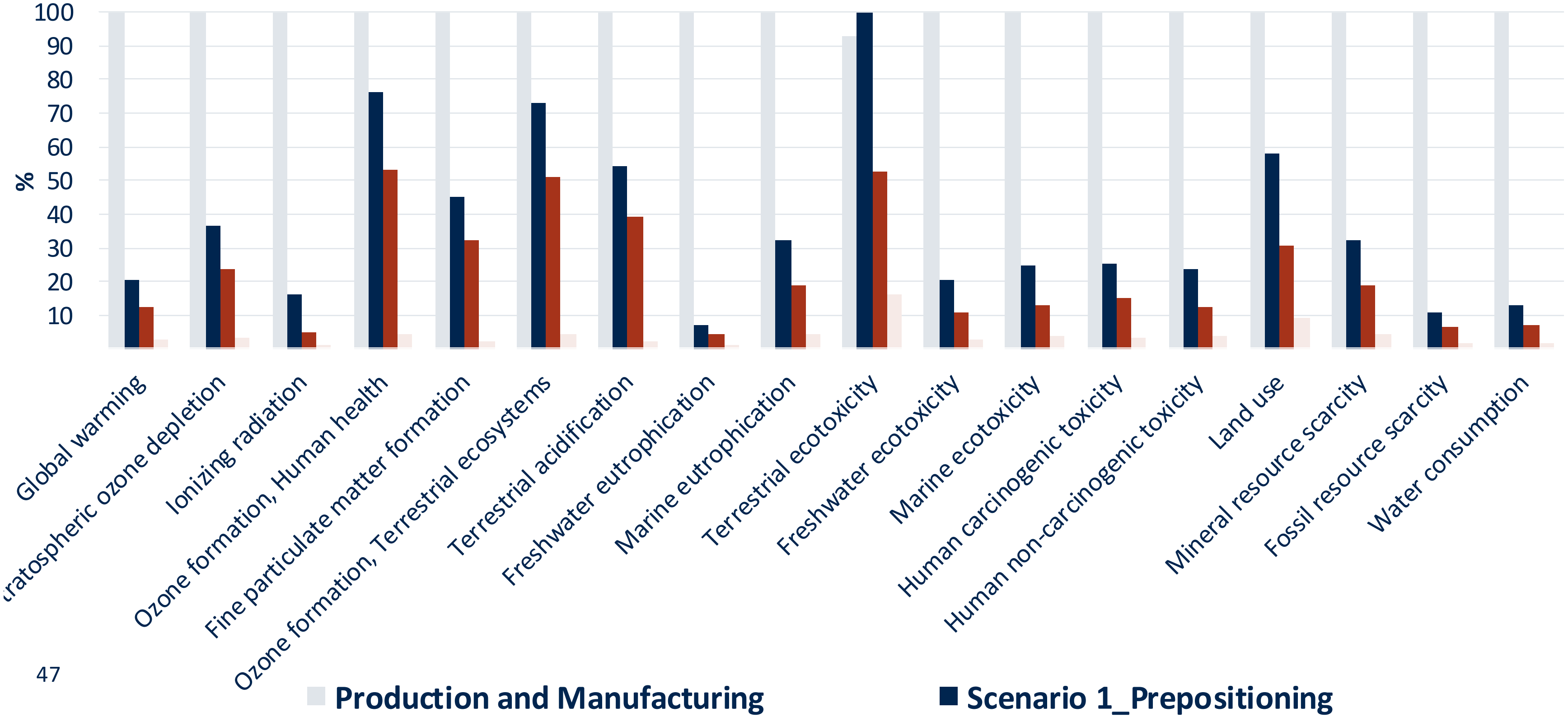
Comparison by impacts categories



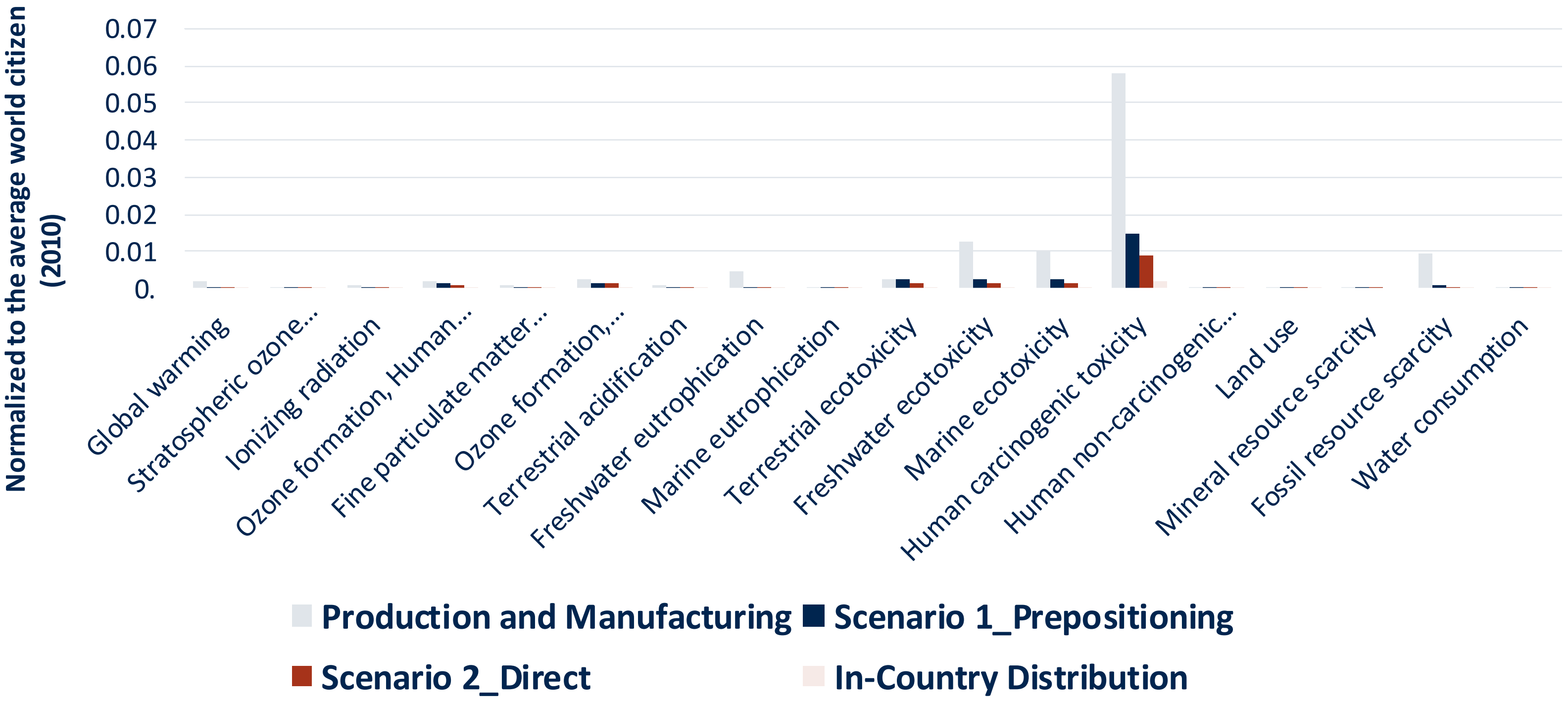
Comparison by normalized impact categories



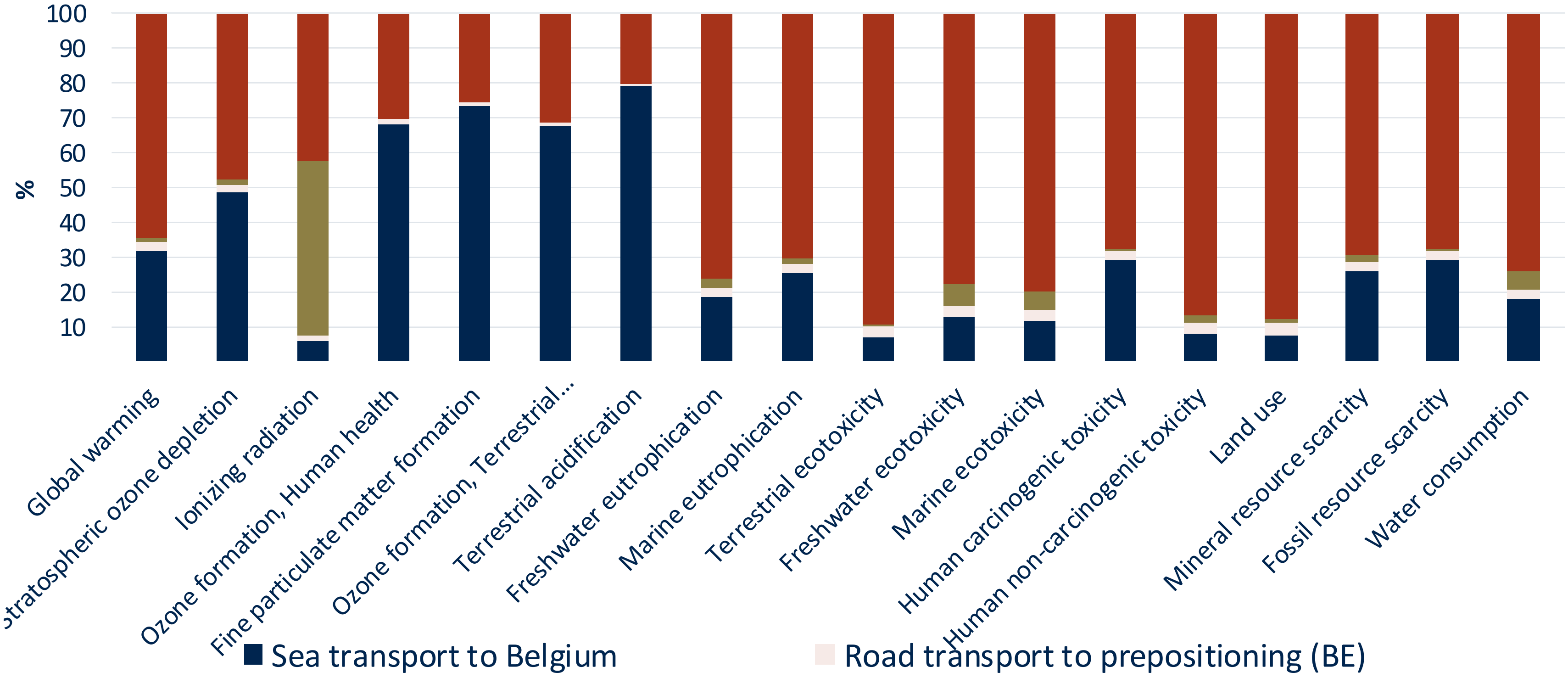
Comparison by impact categories by step



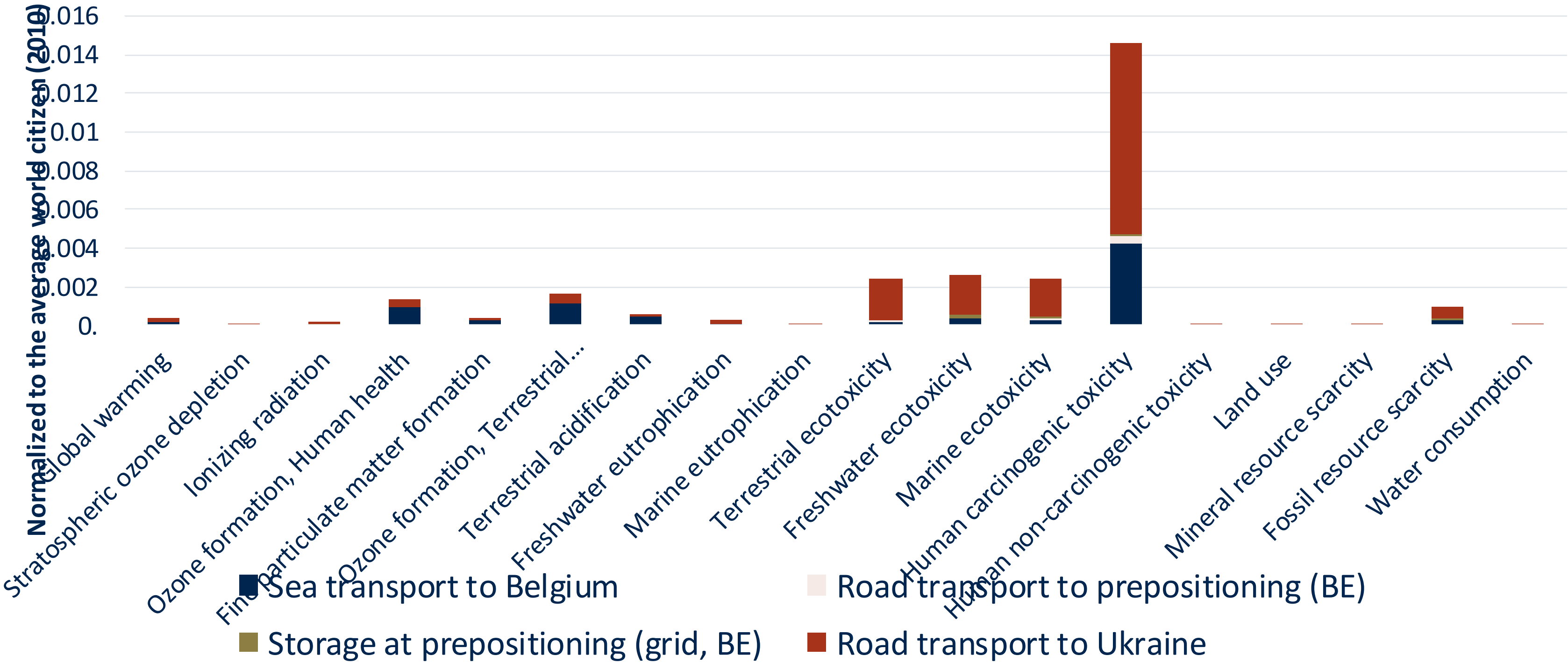
Comparison by normalized impact categories by step



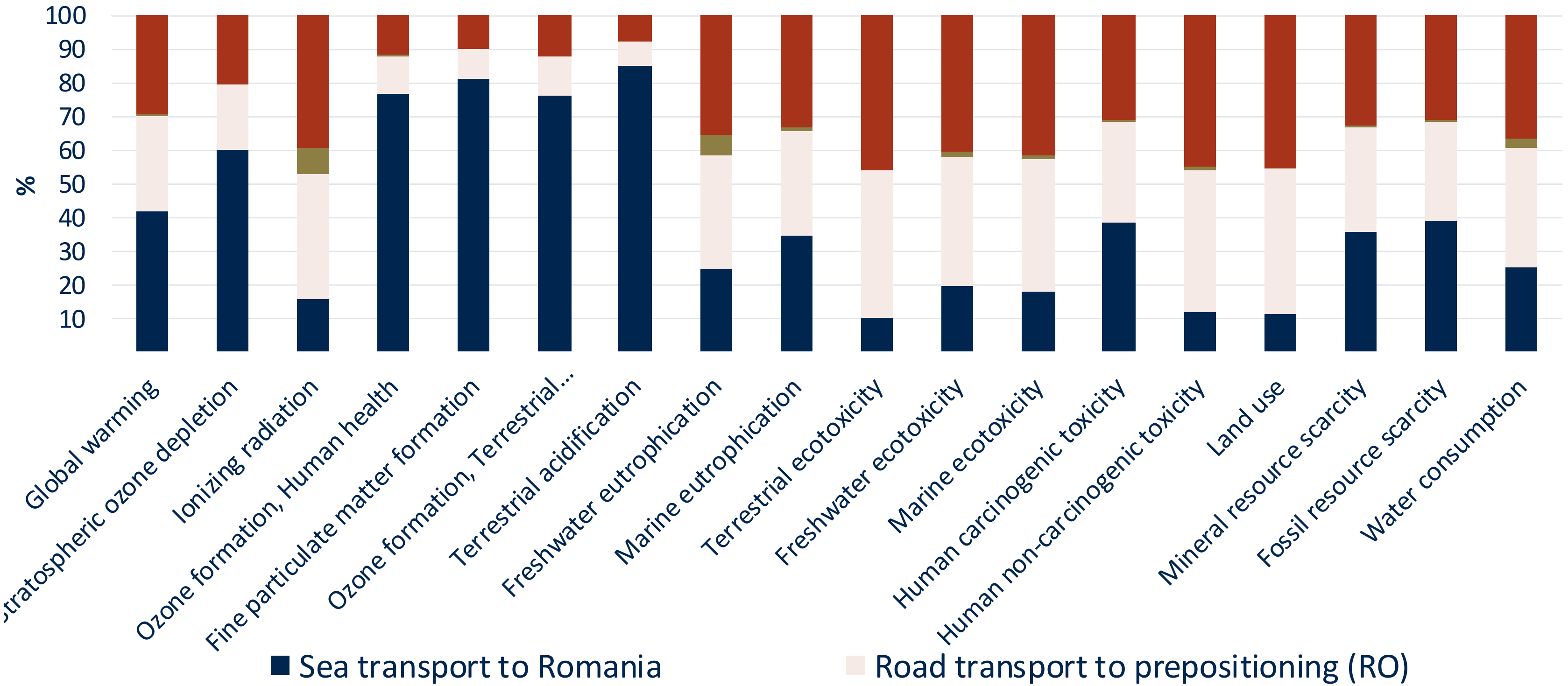
Scenario 1 (Prepositioning) by step



Scenario 1 (Prepositioning) normalized by step



Scenario 2 (Direct) by step



Scenario 2 (Direct) normalized by step