



Decommissioning guideline 2021

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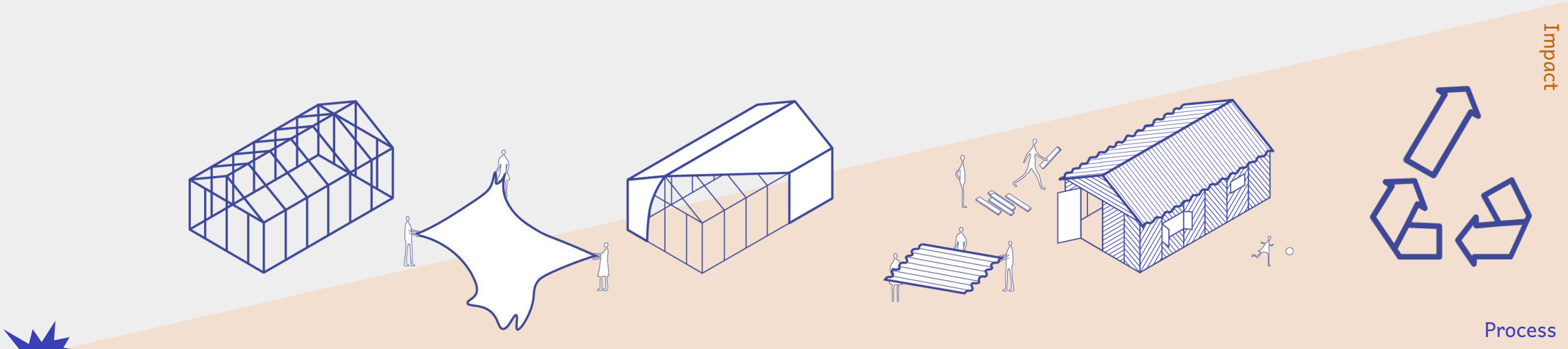
AN INCREMENTAL PROCESS



DEPLOY

UPGRADE

UPCYCLE



Frame

Lifespan 10 years

Tarpaulin / Panels

Lifespan 1 year / 3 years

Local Materials

Thatch, plaster, CGI, Mudbrick, concrete hollow block, reed mats, timber, bamboo etc.

Relief Housing Unit (RHU)



Relief Housing Unit (RHU)

The RHUs are dignified, safe, all-in-a-box shelters that can be deployed quickly without the need to rely on local materials or supply chains. The RHUs are modular and can be upgraded and upcycled.

Key Features

- ✓ 17,5 m²
- ✓ 36 months life span
- ✓ Lockable door
- ✓ 160 kg
- ✓ 4 windows & 4 ventilations
- ✓ Solar-powered, portable lamp
- ✓ Semi-hard and opaque plastic panels.
- ✓ Assembly by a team of 4 in 5-6 hours without additional tools.

Performance



Wind

Up to 28 m/s or 101 km/h gust speed.



Rain

Passes artificial rain test – no leakage.



Snow

10.5 kg/m²*



Fire

Fire and flammability protection: Fire retardant materials allows for minimum 2-minute escape time.

Applications



Shelter



Education



Health



Protection



Communal infrastructure

* Eurocode 1 - EN 1991 – calculations, 20 kg/m² Internal test.

General

Better Shelter develops and provides modular temporary shelters with the aim to provide forcibly displaced families with a higher level of safety and dignity. These are used in humanitarian emergencies and refugee camps. The Better Shelter RHUs are designed to provide shelter for up to five persons for a minimum of three years. However, the lifespan of the shelter is often much longer.

The waste management systems in the regions where the shelters are used are often disrupted, of poor quality or non-existing. Collected waste is disposed of in landfills or incinerated. Badly constructed landfills can lead to ground water contamination and health problems.

These guidelines present different end-of-life strategies for the Better Shelter RHU, with focus on ecological, economic and technological values. Part of the information included in these guidelines is literature-based.

The most effective means to reduce the shelter's environmental footprint is to prolong its lifespan. The steel frame will last longer than the roof and wall panels, and we encourage maintenance and repair first-hand, followed by refitting of the frame with local material or with tarpaulin.



Upcycle - Waste hierarchy

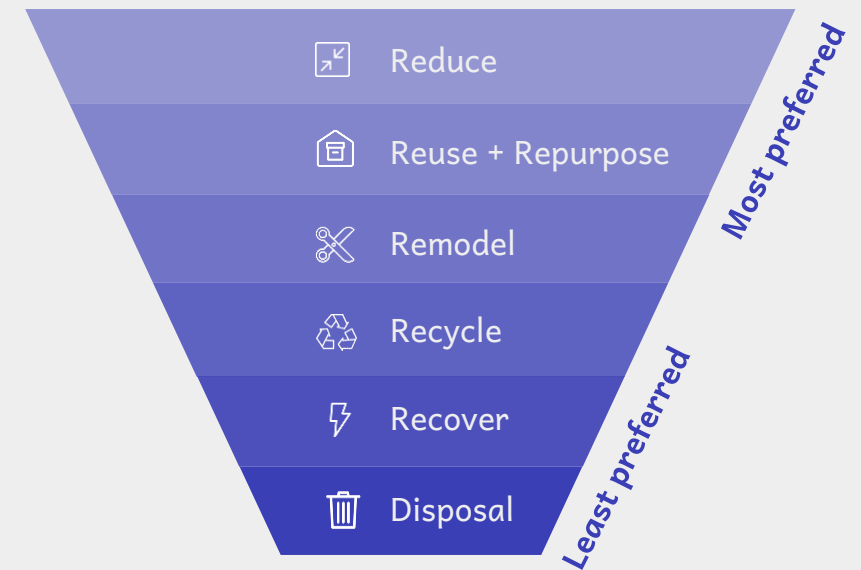
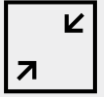


Figure 1. Waste hierarchy

The waste hierarchy is a priority order to provide guidance on how to manage waste. Better Shelter has adopted this model in its product development processes with the aim to reduce the amount of ingoing materials and components in its product and packaging, to reduce future waste in the end-of-life stages of the product.

Better Shelter added the step remodel to visualize the use of different element as raw materials to obtain an output without going into a proper recycling mechanism.



Reduce

Reduction of material is the highest priority of the waste hierarchy. It decreases the amount of produced material and thereby also decreases the amount of waste. This priority is incorporated in the design phase, during which Better Shelter takes strategic design decisions to limit the amount of material and ensures its use to be as environmentally friendly as possible. The goal of reducing materials, and thereby environmental footprint per shelter, can be achieved by extending a product's lifespan.

Extending the lifespan can also be achieved by exchanging or repairing parts that are broken (see for example BS Maintenance Manual). Better Shelter provide a spare parts kit within the RHU boxes so it can be used to repair eventual damages, as a first response to avoid the RHU replacement.

If the roof, walls and panels lose their functionality, the best practice is to refit the steel frame with local materials. Shelters that are owned by the residents themselves are often in better shape due to continuous repairs and maintenance.

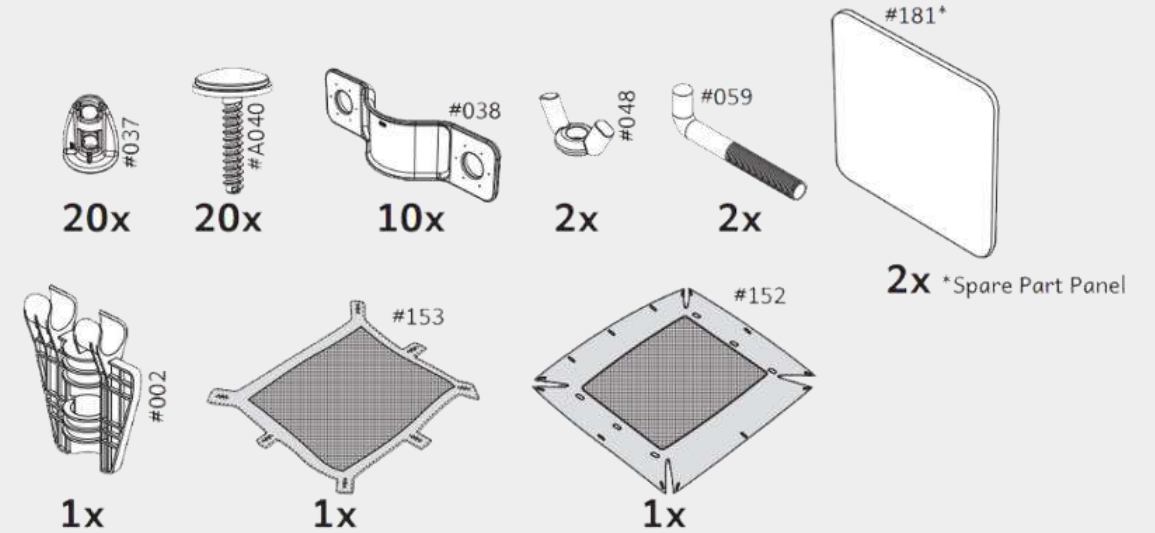


Figure 2. Reduce: spare parts provided within the RHU



Reuse and Repurpose

The Better Shelter RHU can be disassembled after a period of use and reassembled in a different location upon need. In most cases, the RHUs are reused for other purposes when no longer used as a shelter to live in. This is enabled by the shelter's modular design and by not containing any glued joints. All components can also be disassembled and reused in other combinations.

The unit can be reused as:

- Storage facilities: the inside of the walls can be reinforced, if used as storage of valuable goods.
- Livestock: more entry points or ventilation openings can be cut out from the panels if needed.
- Shading areas: panels can be removed to achieve better air flow through the unit.
- Local material upgrade: the steel frame can be used on its own with local materials.
- Varied-sized shelters: the modularity of the shelter allows for creating larger and smaller units.
- Reuse of individual parts: parts can be individually used for the same or other functions.



Figure 3. Reuse: Shelter extension



Figure 4. Reuse of door



Figure 5. Reuse and Repurpose: a Structure used as vaccination point relocated in 14 places and then upgraded in a final destination as a side building of a small hospital.



Remodel

RHU components, such as panels, even if damaged, can be used as materials for the manufacture of other useful items. As a reference, different remodelling measures are ordered by their cost-effectiveness: value added vs. energy and resource costs for their production.

Please note that during the remodel process the density of the material (i.e. the plastic panels) will increase significantly and thus its fire load.

- Furniture (manual processing, low energy consumption). The UV exposure might affect the material integrity and flexibility making its mechanical work more difficult.
- Flakes (mechanical shredding, low energy consumption): thermal insulation filler for walls and roofs in buildings or hot water pipes. Fire safety must be specially considered as the chambers in which these flakes are filled can generate a chimney effect accelerating the burning of these particles.
- Moulded objects (mechanical shredding, thermal cohesion): bricks, stool, tiles, corrugated roof... Special additives may be required to provide these parts with adequate cohesion, making this process more complex.



Recycle

61 % of the shelter's weight can be directly recycled to its raw material with the right recycling processes in place. All steel and aluminium articles and packaging are recyclable, as well as all plastic material that is not reinforced or contains additives: the door, door frame, door canopy, window hatches, ventilation hatches, windows and ventilation frames, gable profiles and gable hats.



Figure 6. Remodel - furniture: sink made out shelter parts



Figure 7. Remodel - moulded objects: Recycled corrugated tetra pack roofing system. External reference



Recover – Incineration

With and without energy recovery

Incineration is a waste method that largely reduces the mass of waste. It is preferred in countries with a lack of space. Globally, 11 % of waste is incinerated². The advantages and disadvantages of incinerating plastics strongly depend on the incineration facility. If incinerated in a facility with energy recovery and collection of toxic substances, incineration can be a relatively environmentally beneficial strategy³. More than 90 % of the waste in low-income countries are either disposed of in landfill or openly burned. Having said that, incineration with energy recovery is unlikely to be commonly available. If the plastics are openly burned, it can cause both health and environmental problems.

Energy recycling of plastic parts and cardboard can be a more beneficial method than material recycling². It, however, strongly depends on the incineration facility and the waste-to-energy efficiency achieved. For glass, steel and aluminium materials, recycling is always preferred.



Disposal - Landfills

A landfill is where waste material is disposed of by burying it and covering it over with soil. Landfills are the least preferred waste method according to the waste hierarchy. Nevertheless, landfilling is the most common waste disposal method in the world.

Sanitary landfills and dumping are two different landfill strategies. Compared to dumping, a sanitary landfill is more environmentally friendly as it is controlled to avoid leakages of environmentally abusive substances into the ground. Non-sanitary landfills could lead to leachates that may contain high amounts of toxic substances in the environment. These can be potential sources of ground water contamination.

Recommended end of life-treatment



To summarize, Table 1 below shows recommendations on how to prioritize the end-of-life strategies for the parts of the Better Shelter RHU. Reduce is not included since it is relating to the design and production of the unit.

	Metal parts	Plastic & Electronics	Cardboard/paper
1	Reuse	Reuse	Reuse
2	Recycle	Recycle	Recycle
3	Sanitary landfill	Incineration with energy recovery	Incineration with energy recovery
4	Dumpsite	Incineration without energy recovery	Incineration without energy recovery
5		Sanitary landfill	Sanitary landfill
6		Open burning or dumpsite	Open burning or dumpsite

Table 1. Recommended end-of-life treatment for the holder of the unit, segmented in metal and plastic parts (1=Most Preferable 6=least preferable)

As a rule, all materials used in the Better Shelter RHU should be disposed of in accordance with local legislation and as stipulated by the corresponding authority. It is the operational organization's responsibility to follow the guidelines and applicable legislation for the dispose of the waste.

Below an overview is given of all parts in the shelter, the tools and the packaging. Of each (group of) part(s), the material and the Resin Identification Code (RIC) as defined by the European Commission (EC) are provided. This enables the recycling of a large amount of the homogeneous parts if recycling systems are locally available.

Shelter components

Plastic components	Material	Group	Resin id. code	Metal components	Material	Group	Resin id. code
Door, door frame, door canopy, window hatch, ventilation hatch	ABS copolymer	Shelter		All joints, all pipes, wires, bolts, nuts, hinge parts, lock slide bar, turnbuckles	Steel	Shelter	
Panels; wall, roof, gable, top gable, spare part	Polymer blend with flame retardant	Shelter		Hammer, drive steel, anchor drive steel, ground template	Steel	Tools	
Plastic sheet floor	LDPE/HDPE	Shelter		Ground anchor, PV panel bracket	Aluminium	Shelter	
Plastic joint, bolt, bracket, mosquito net hook	Reinforced nylon	Shelter		Paper based components			
Plastic gable profile, window frame, ventilation frame, ridge hat, lock housing plates	PP	Shelter		Manuals, spare part label	Paper	Tools	
Mosquito nets, curtain	Polyester	Shelter		Boxes, end caps, fillers	Cardboard	Packaging	
Plastic bags	PE	Packaging		Electronic components			
Ground template	PP	Tools		LED-lamp ⁴ , PV-panel, cable	Electronics, LiFePO battery	Shelter	
Plastic nut, puncher	Nylon	Shelter, Tools					



Contact us

We encourage you to contact us to ensure a right implementation!

The purpose of this document is to show implementing partners the options for using structures or RHUs.

If you find any inconsistency in the content of this document or have any suggestions, we would love to hear from you.

We facilitate a phone number to make technical communication as quick and easy as possible.



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