



# Winterizing the RHU

November 23rd 2022



# RHU winterization

- The Relief Housing Unit (RHU) is an all-weather shelter modular for global use.
- For use in cold climate, the shelter needs to be winterized, i.e. insulated and heated.

**Better Shelter has collaborated and supported several partners in winterizing the RHU:**

- MSB / DG-ECHO winterization of family shelters in Ukraine, Q3-Q4 2022.
- EuroRelief winterization of ca. 240 family shelters in Mavrovouni camp Lesvos, Greece, 2021-2022.
- UNHCR winterization of reception centres in the Balkans, 2015-2016.



UNHCR Winterization upgrade 2015-2016





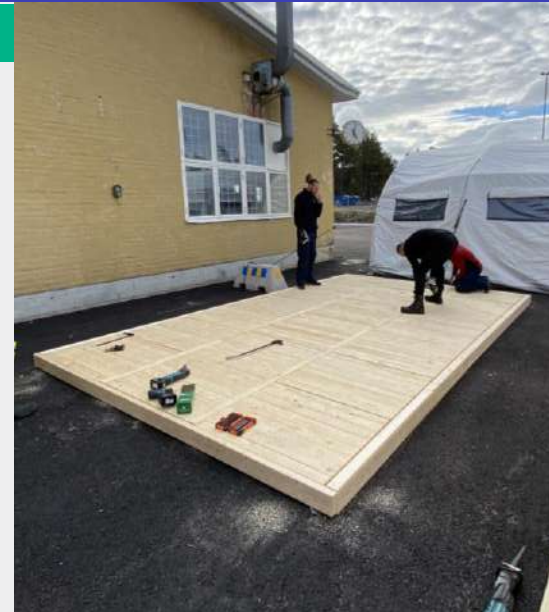
# RHU winterization

EuroRelief Lesbos, Greece upgrade 2021-2022



“A few women came up to us to say thank you because it’s been making a huge difference. One woman has arthritis and it’s been getting less painful because it’s warmer inside her place. Some women don’t even use their heater anymore and can live in t-shirts in the wintertime in their RHUs.”

Statement by EuroRelief,  
January 2022



MSB winterization upgrade 2022 for Ukraine response

# RHU winterization approach for Ukraine

## Design objective

Together with MSB, Better Shelter has developed and tested a winterization approach for the Ukraine response, which:

- provides adequate indoor temperatures during winter
- is possible to retrofit to already installed RHU (and thereby enable a phased approach where the RHU is provided in phase 1 and winterization in phase 2)
- consists of standard building materials commonly available in the supply chain in and around Ukraine.
- Cost of approximately 1000-1500 Euro for 1 shelter of 17.5m<sup>2</sup>
- Installation time of less than six hours

## General description

### Foundation and floor

- Raised floor/deck made of joists and plywood
- 50mm hard insulation below floor
- RHU installed on top
- Plastic sheeting floor

### Externally

- Wooden frames around openings
- Tarpaulin skirts for water proofing
- Wooden frame over RHU walls and roof with a 1200mm distance
- Stone wool 100mm
- Tarpaulin to cover gable, walls and roof
- RHU door, window and ventilation frames installed

Please see Annex 1 for BoQ and Annex 2 for a more step-by-step description. Appendix 3 shows a more durable cladding alternative to the plastic sheeting.





# Climate chambre test

## Conclusion

Climate testing indicates that the winterized RHU will achieve a 30-degree difference between the inside and outside temperature, i.e., at  $-15^{\circ}\text{C}$  outside the RHU will maintain an indoor temperature of  $+15^{\circ}\text{C}$ .

Better Shelter has tested the winterized RHU (17.5m<sup>2</sup>) in a climate chamber, where it was built and winterized, and equipped with sensors and heaters.

Winterization: wood framing around openings and C-C every 1200mm, 100mm stone wool on walls and roof, plastic sheeting, 50mm of stone wool/polystyrene on floor, 15mm plywood floorboards, 50mm of stone wool in door opening.

The internal and external temperatures were measured, while the climate chamber temperature was lowered to  $-20^{\circ}\text{C}$ .

Results from the tests show:

- a temperature difference of 37-degrees between the interior and the exterior can be achieved with insulation and the use of a 2100W heater.
- Since there was no soil nor wind affecting the temperature in the chambre, it is estimated that a **temperature difference of around 30-degree** can be reached in the field. E.g.,  $15^{\circ}\text{C}$  outside and  $+15^{\circ}\text{C}$  inside.
- **To compensate for heat loss while opening the door a bigger heater than 2100W is recommended.**

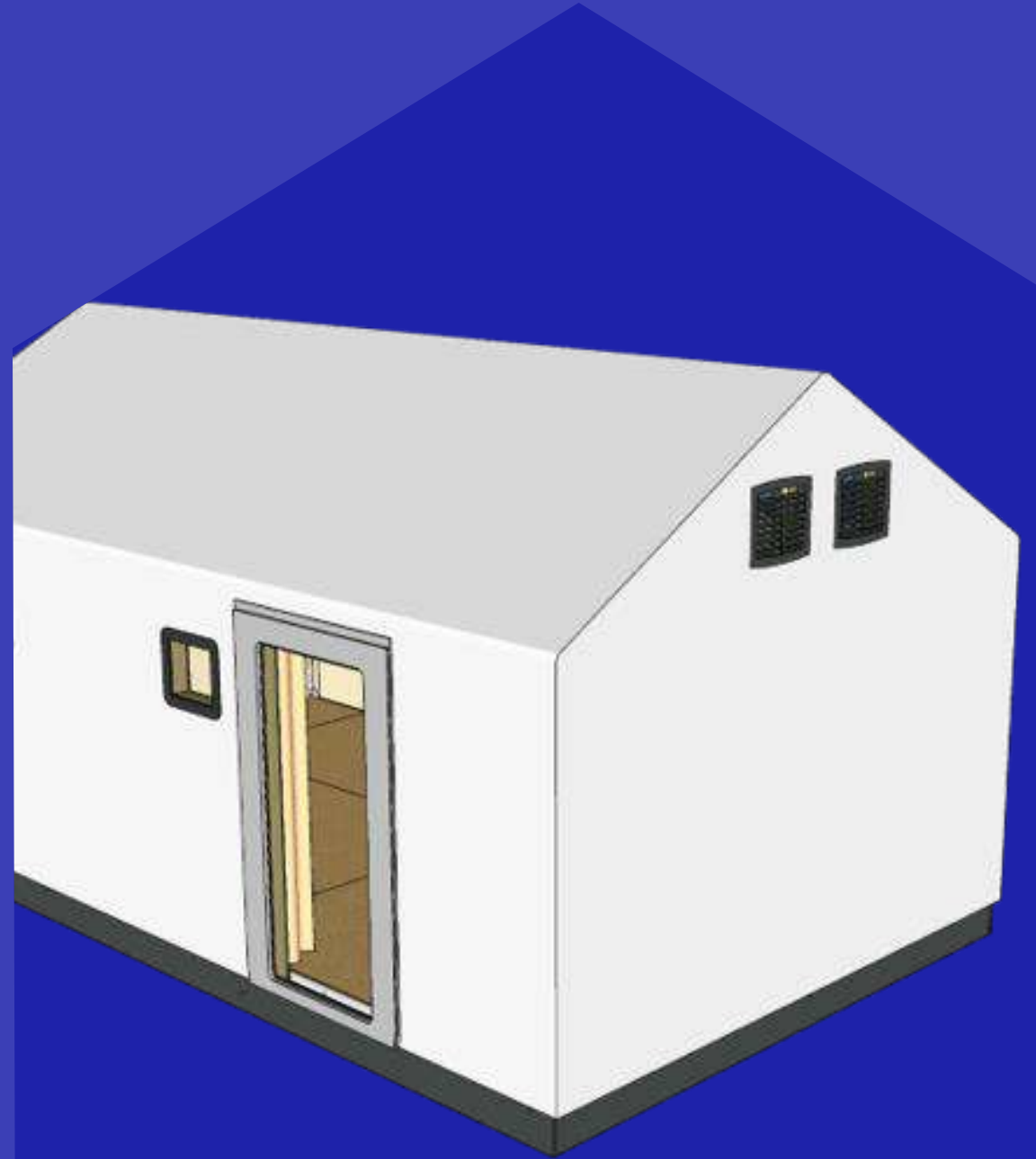
The difference in temperature can be increased if the heater power is increased.

In addition, Better Shelter will measure on an insulated and heated RHU placed in Sweden to gain more knowledge throughout the winter of 2022-2023.





## Appendixes



# Appendix 1 – RHU winterization approach BoQ

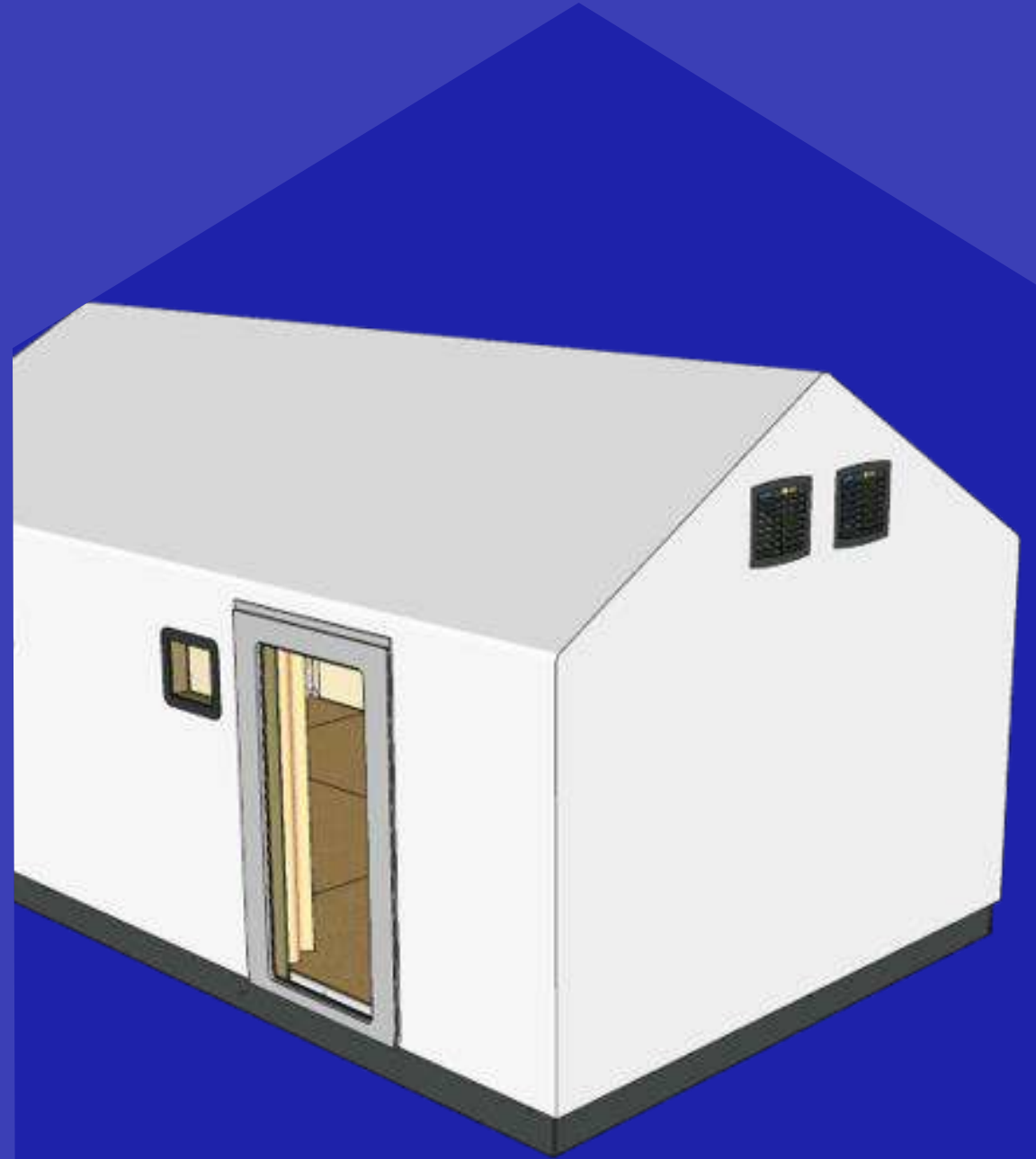


## Winterization of a 3 bay, 17.5m2 RHU (single unit), estimated quantities

Element	Material	Specifications	Unit	Amount	Comment	Link to product
Floor, construction, footing	Concrete tiles	350 x 350 x 50mm (or a local available equivalent)	pcs	6		
Floor, structural, beams	Wood	alternative, 45 x 145 x 3600mm, pressure impregnated	pcs	15		
Floor, structural, beams	Wood	alternative, 45 x 145 x 4200mm, pressure impregnated	pcs	-		
Floor, structural, floor	OSB	1220 x 2440 x 18mm	pcs	7		
Floor, insulation	Polystyreen	50mm thick, 600 x 1200mm	pcs	29	Please consider fire safety	
Floor, plastic sheeting	HDPE tape fabric, LDPE coating	delivered with RHU	pcs	0	incl. in RHU box B	
Floor, plastic sheeting	HDPE tape fabric, LDPE coating	Size:2,3x4m, 180 gram/m2, 100Kly	m2	-		
Tarpaulin	HDPE tape fabric, LDPE coating	Size:roof 8,5x8,5, gable 2x 4x3,5m, 200 gram/m2, 300Kly	m2	85	Durable and UV resistant	<a href="https://landskroon.nl/products/super-tarp-premium/">https://landskroon.nl/products/super-tarp-premium/</a>
Walls, insulation	Stonewool	Stone insulation panels 95X580X1170mm ~0.035W/mK	pcs	91		<a href="https://www.rockwool.com/se/produkter-och-konstruktioner/produktoversikt/byggisolering/flexibatts-1/">https://www.rockwool.com/se/produkter-och-konstruktioner/produktoversikt/byggisolering/flexibatts-1/</a>
Walls & roof, frame	Wood	28 x 95 x 4200mm, impregnated wood	pcs	19		
Window, frame	Wood	28 x 95 x 4200mm, impregnated wood	pcs	2		
Ventilation, frame	Wood	28 x 95 x 4200mm, impregnated wood	pcs	2		
Door, frame	Wood	28 x 95 x 4200mm, impregnated wood	pcs	1	plus left overs window and ventilation frames	
Fastening & Fitting	Screws	40 x 4mm, galvanised	pcs	366	Screw for roof/wall woodwork	
Fastening & Fitting	Screws	80 x 5mm, galvanised	pcs	60	Floor beam screws	
Fastening & Fitting	Screws	65 x 4mm, galvanised	pcs	116	Screws for insulation	
Fastening & Fitting	Screws	40 x 4mm, galvanised	pcs	84	OSB to floor beams screws	
Fastening & Fitting	Screws	40 x 4mm, galvanised	pcs	96	Tarpaulin screws	
Fastening & Fitting	Screws	40 x 4mm, galvanised	pcs	90	Screws for opening	
Fastening & Fitting	Plastic disk	Disks to fixate insulation by screw	pcs	116		
Fastening & Fitting	Washers	M5, 25mm, galvanised	pcs	282	Openings, tarpaulin, panel	
Fastening & Fitting	Gaskets	Rubber, 25mm	pcs	186	For water tightening of the tarpaulin	
Fastening & Fitting	Tape	Ducttape 50mmx50m	pcs	1		
Window, Glass	Plexiglass	Plexiglas windows 2mm, single window panel	pcs	4	ca. 333x297mm / pcs	

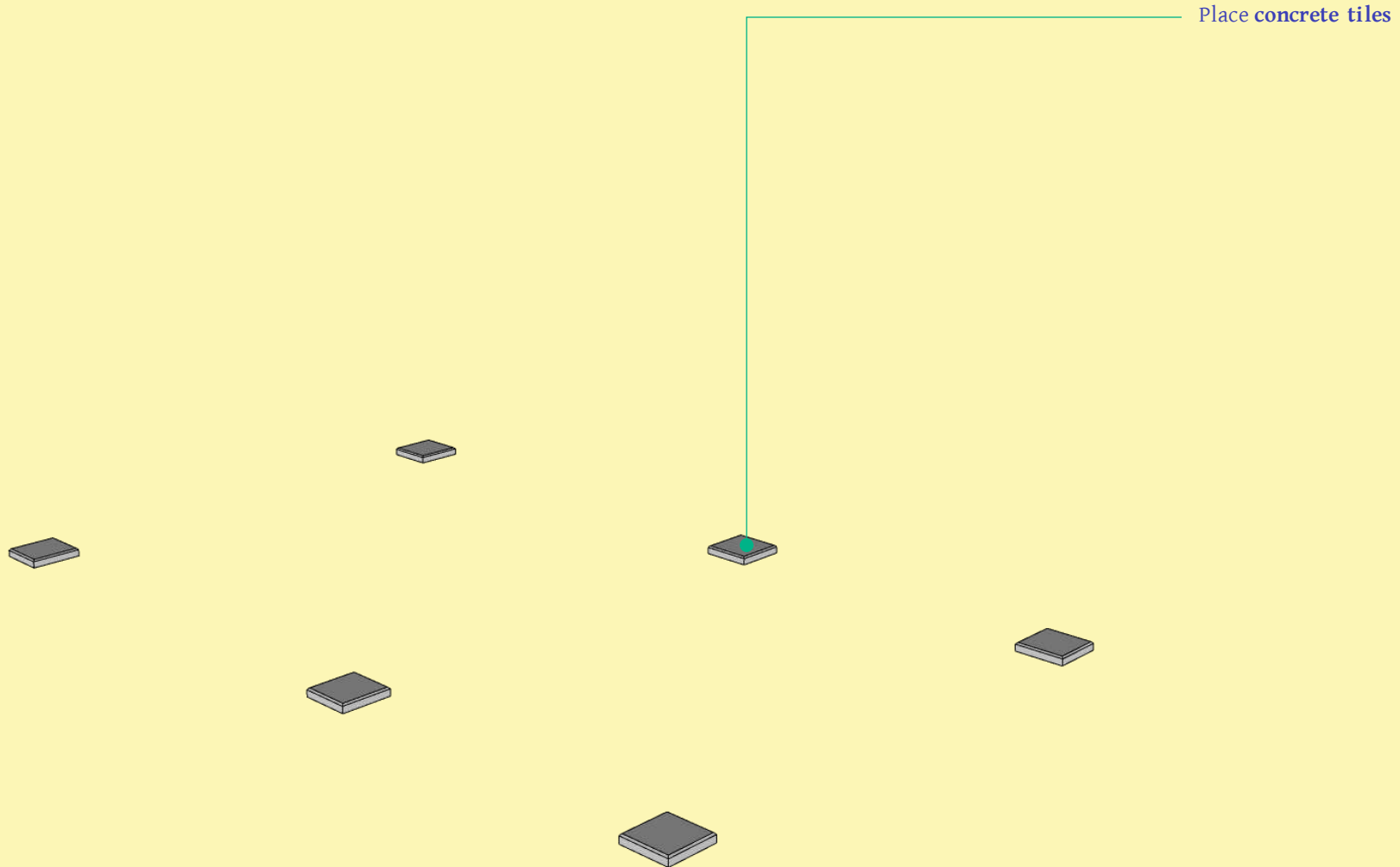


## Appendix 2 – RHU winterization approach



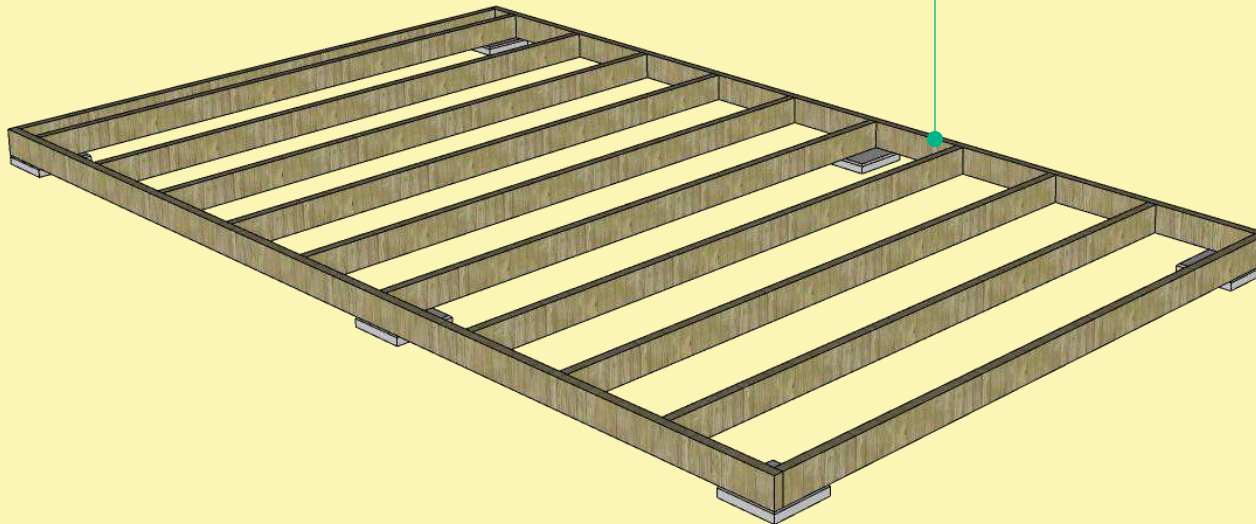


## Step by step RHU Winterization



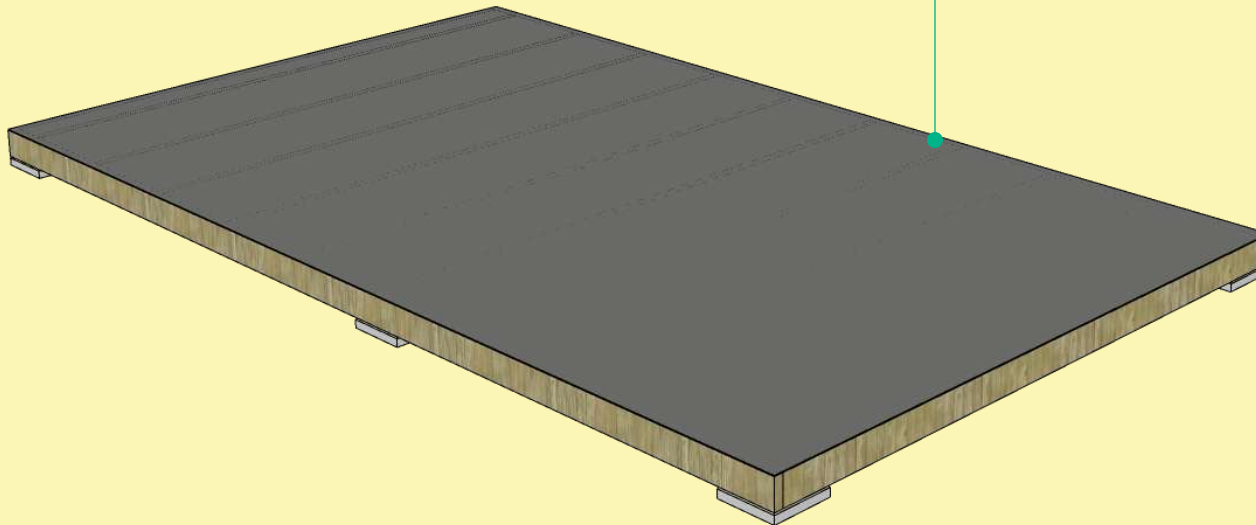
## Step by step RHU Winterization

Place wooden beams



## Step by step RHU Winterization

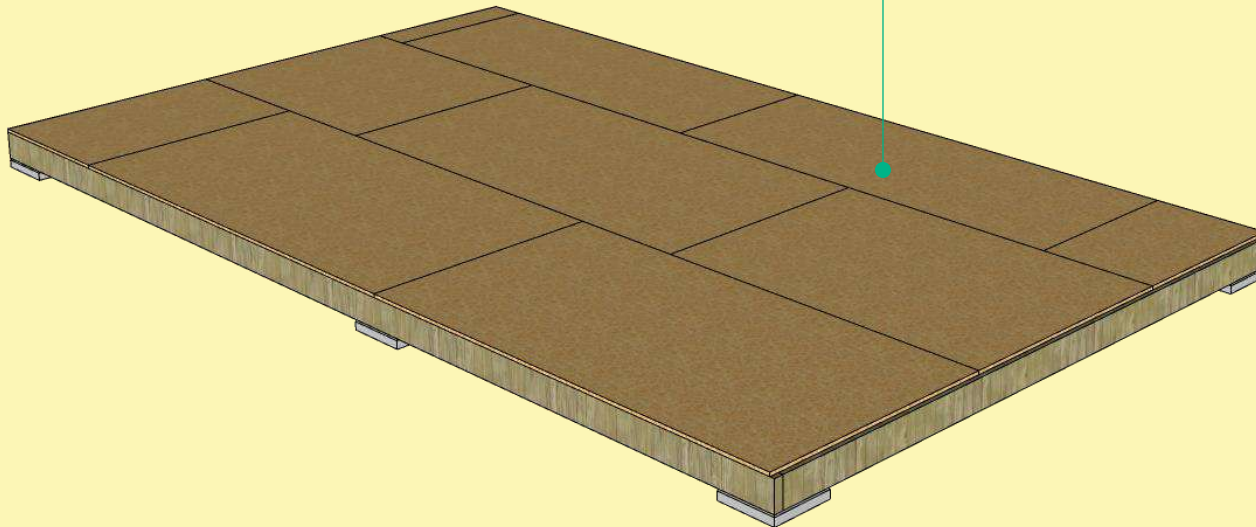
Attach tarpaulin to floor beams: tarpaulin from RHU





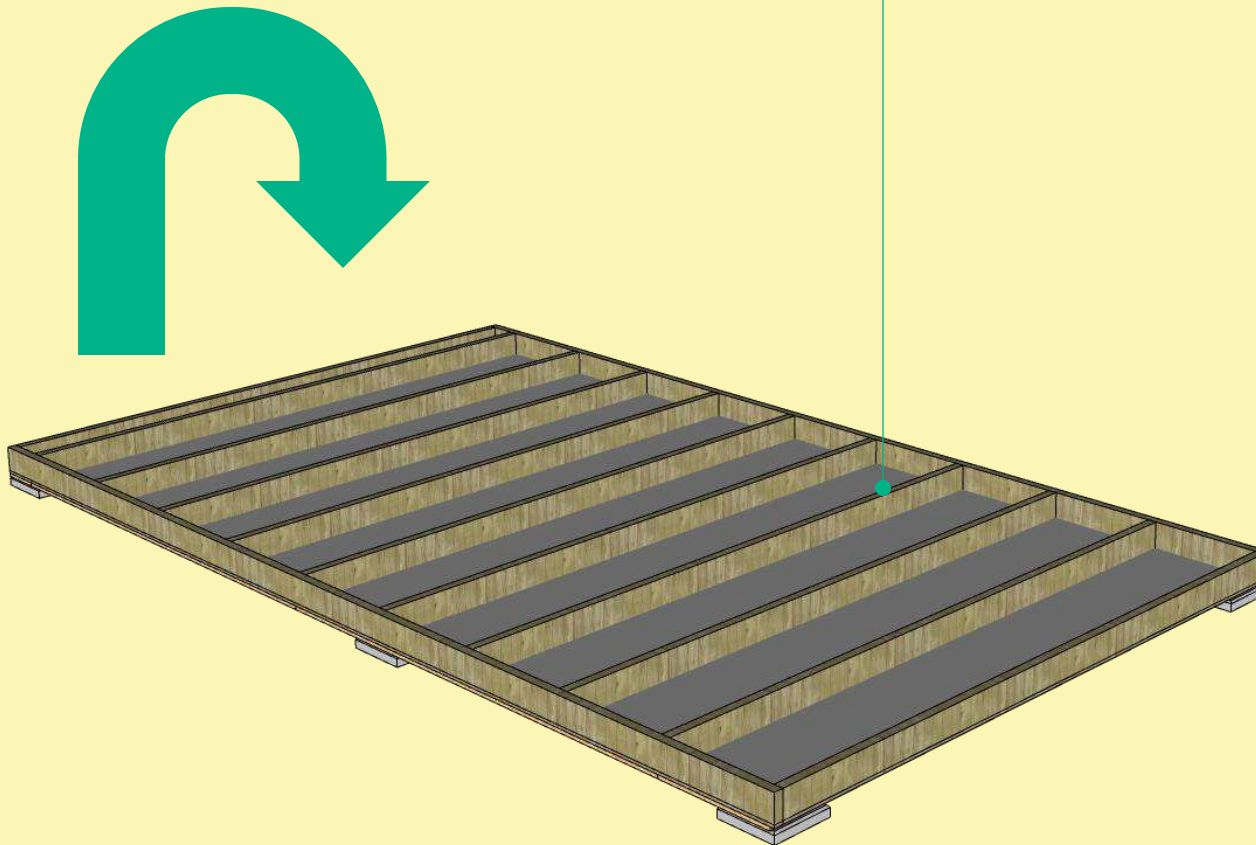
## Step by step RHU Winterization

**Install floor sheets** and continue with placing skirting and floor insulation as described in the 'standard' design.



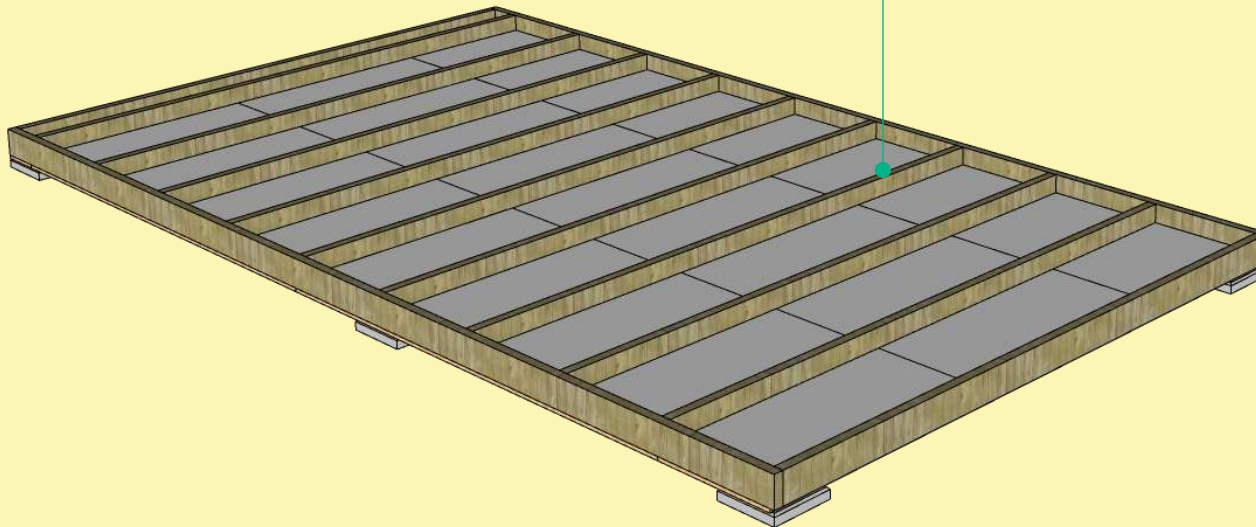
## Step by step RHU Winterization

**Flip the floor upside down.** This can be done in as one or multiple pieces depending on the weight and amount of people available



## Step by step RHU Winterization

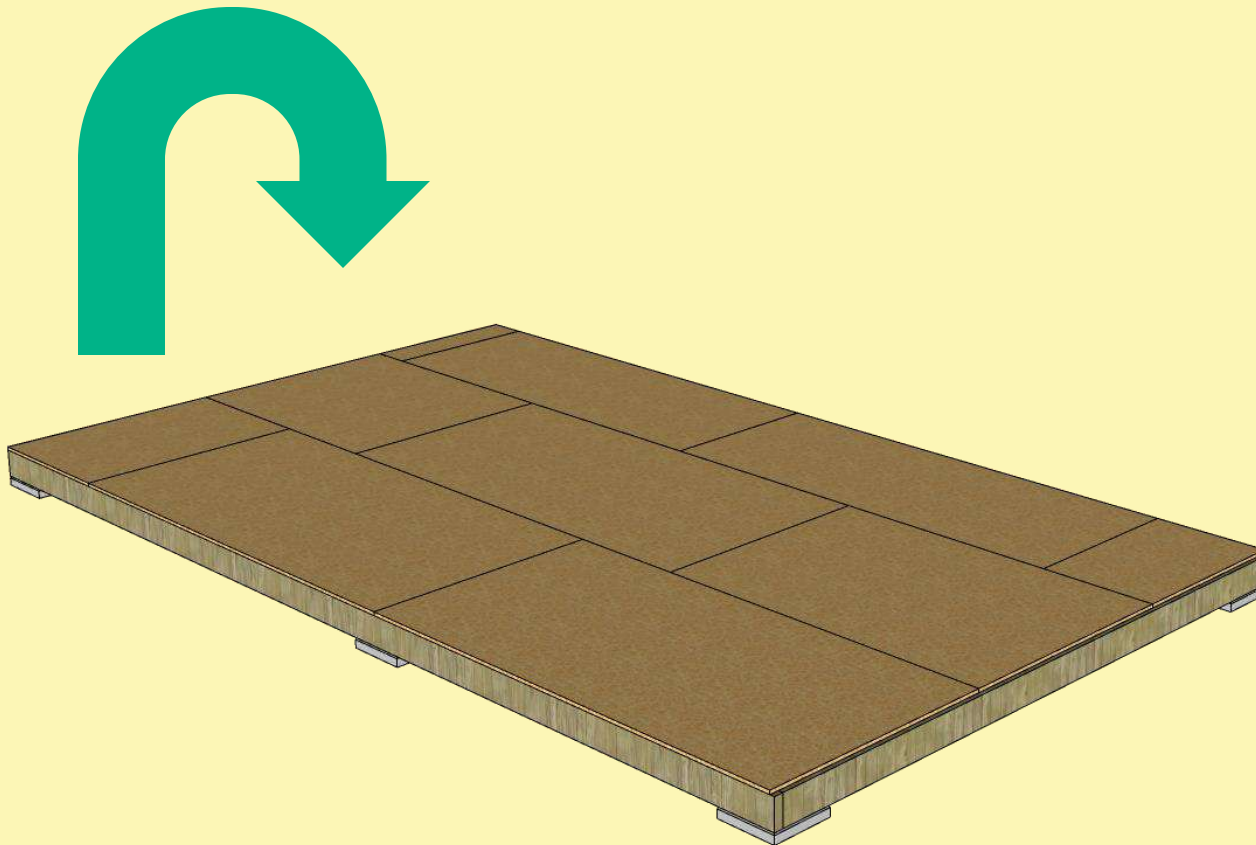
Insulate directly against floor





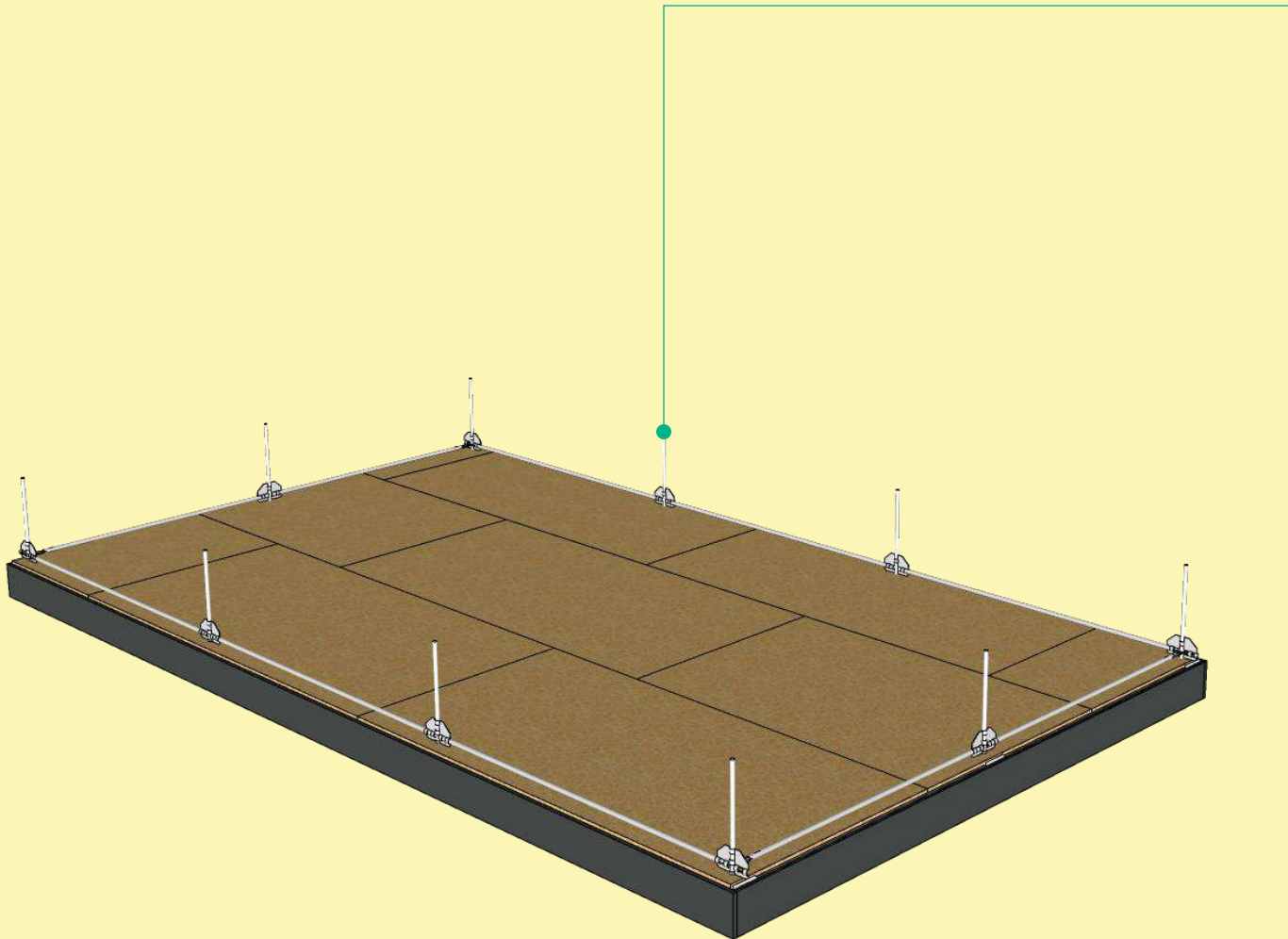
## Step by step RHU Winterization

Flip the floor with the right side up

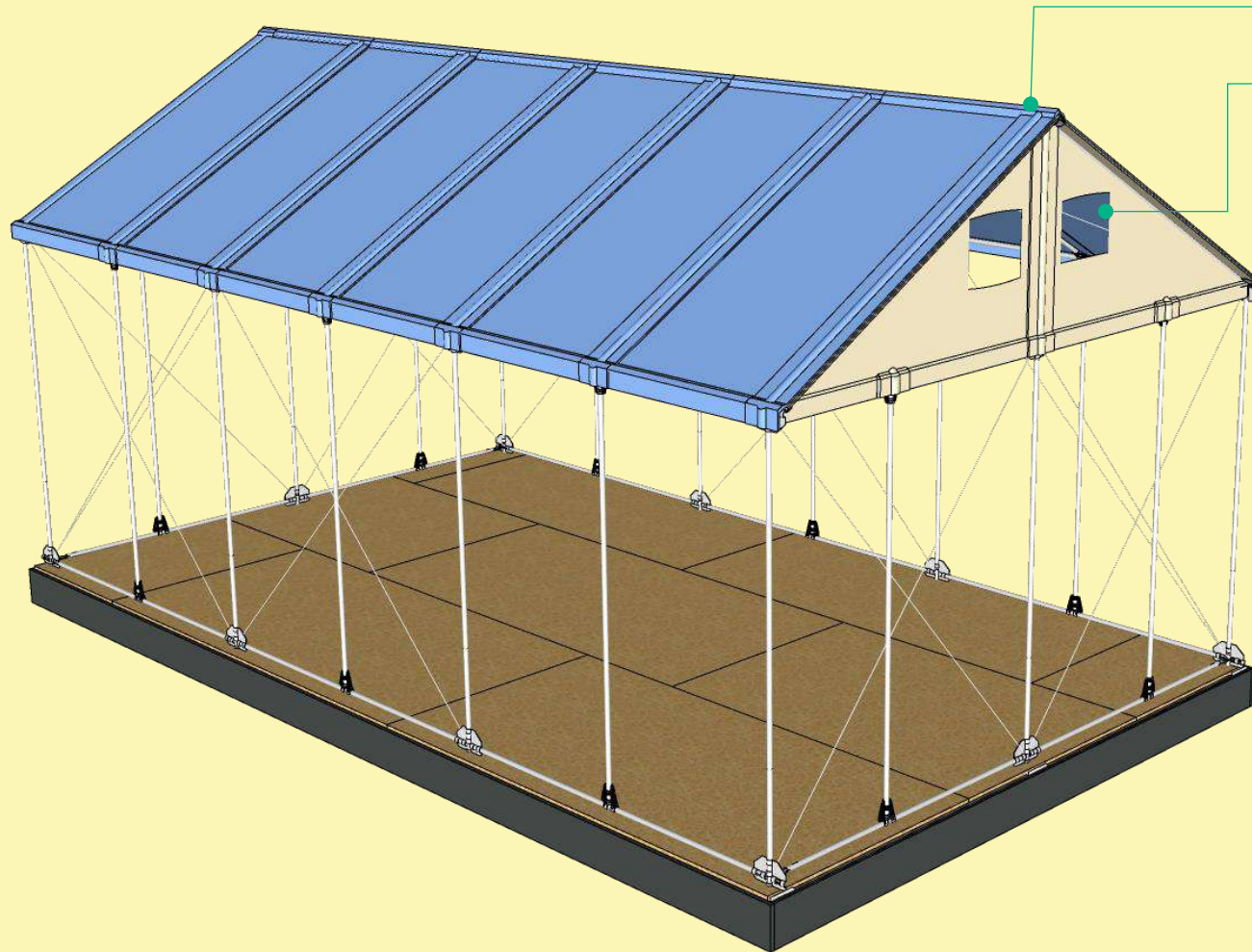


## Step by step RHU Winterization

**Install foundation of the** frame following the standard assembly manual



## Step by step RHU Winterization



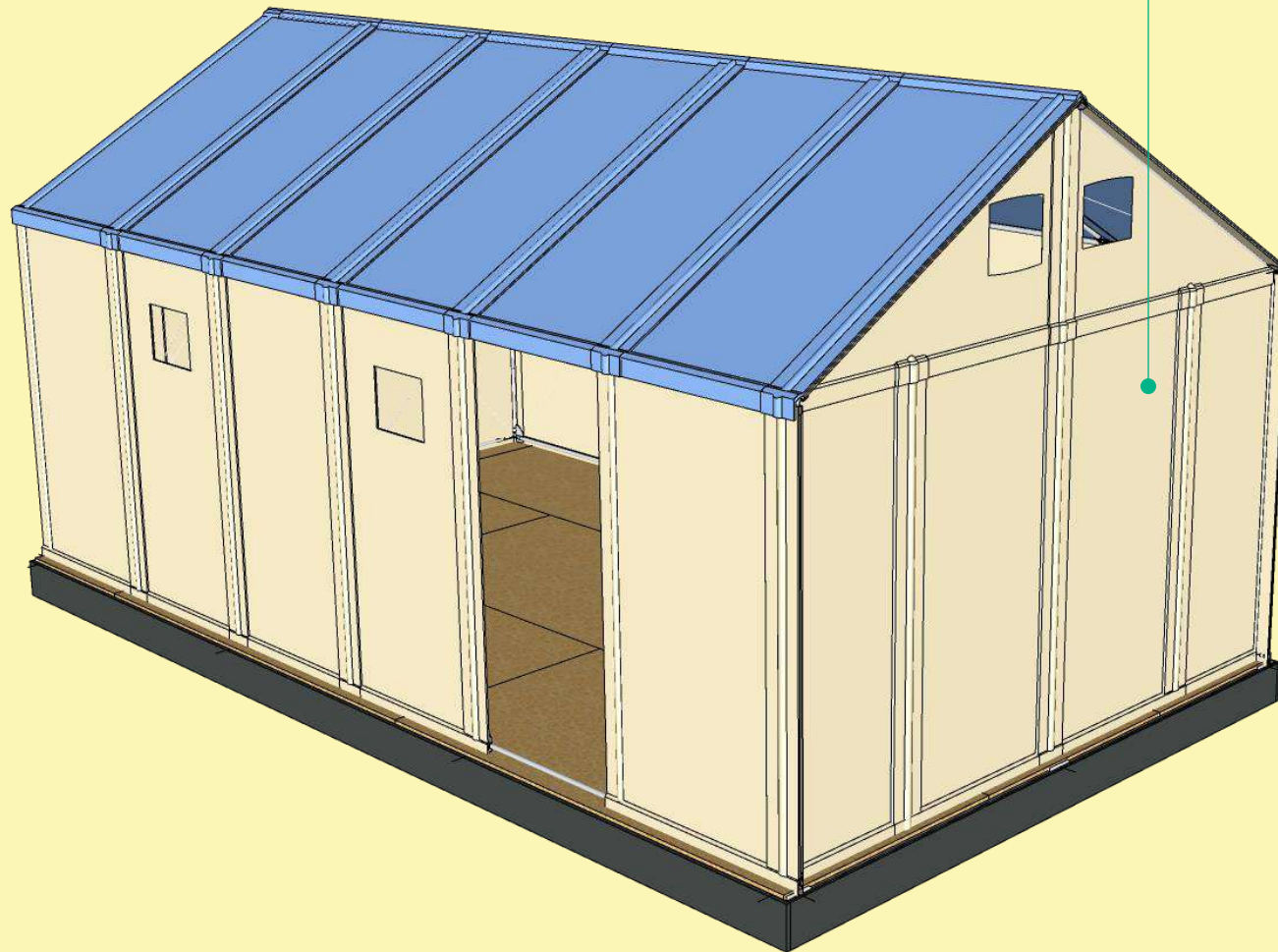
**Install roof:** following the RHU manual install the roof including roof panels and gable panels on the structure.\*

\* The ventilation windows will be installed at a later time (4 x)

\* Ridge hats not installed (6x)



## Step by step RHU Winterization



**Wall panels:** according to RHU manual\*

\*leave windows out at this point in the assembly

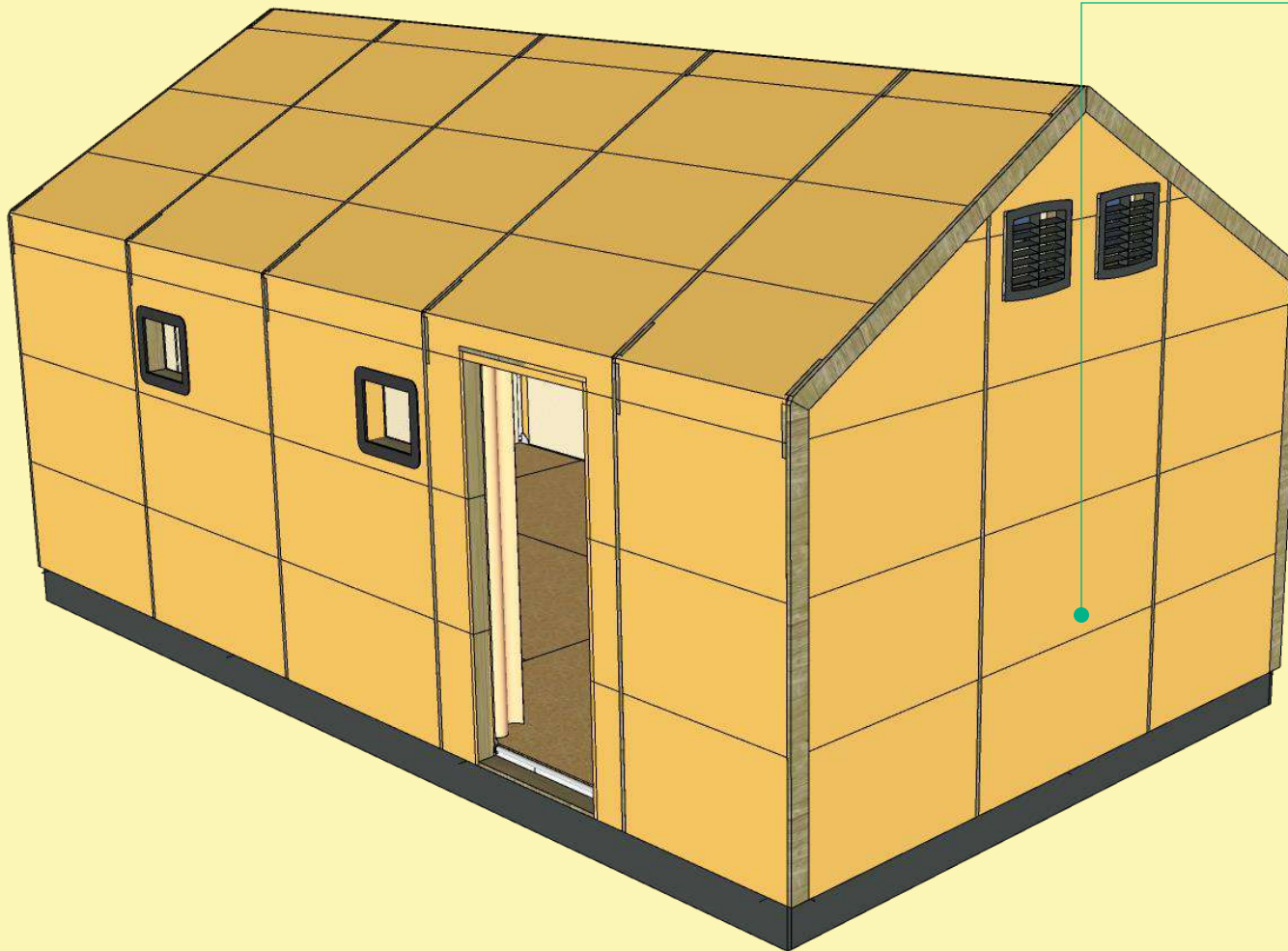
## Step by step RHU Winterization

**Wood framing:** creates attachment points for tarpaulin and openings and prevents insulation from being compromised



## Step by step RHU Winterization

**Roof and Wall insulation:** install stone wool insulation, 100mm on all walls and roof surfaces



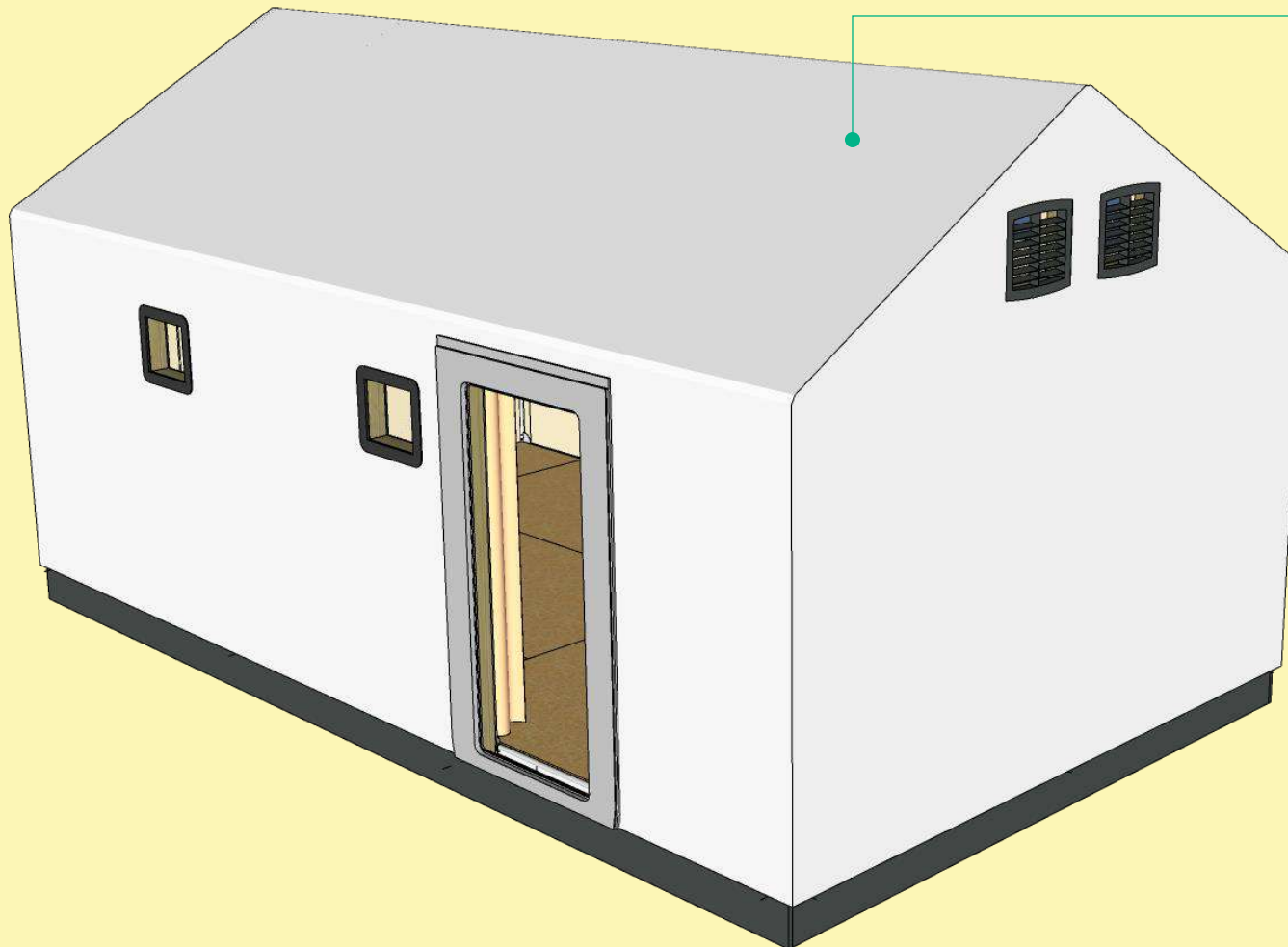


## Step by step RHU Winterization

**Install tarpaulin:** attachments according to plastic-sheeting guideline. Pay extra attention to waterproofing; use washers and rubber gaskets to close off attachments.

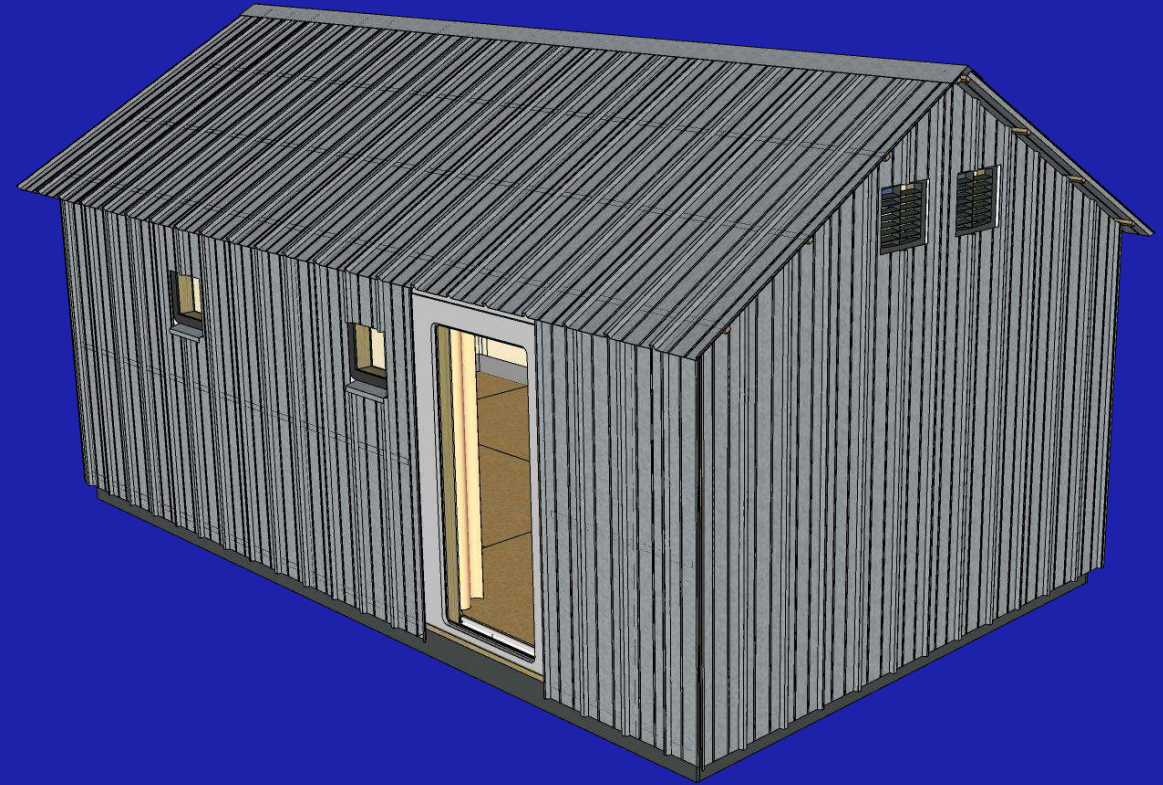
Quality of tarpaulin and attention to detail is of the utmost importance. The insulation is sensitive to moisture to preventing water from passing through the tarpaulin is imperative.

Plastic-sheeting guideline at: [www.plastic-sheeting.org](http://www.plastic-sheeting.org)





## Appendix 3 – RHU winterization approach upgrade roof/walls

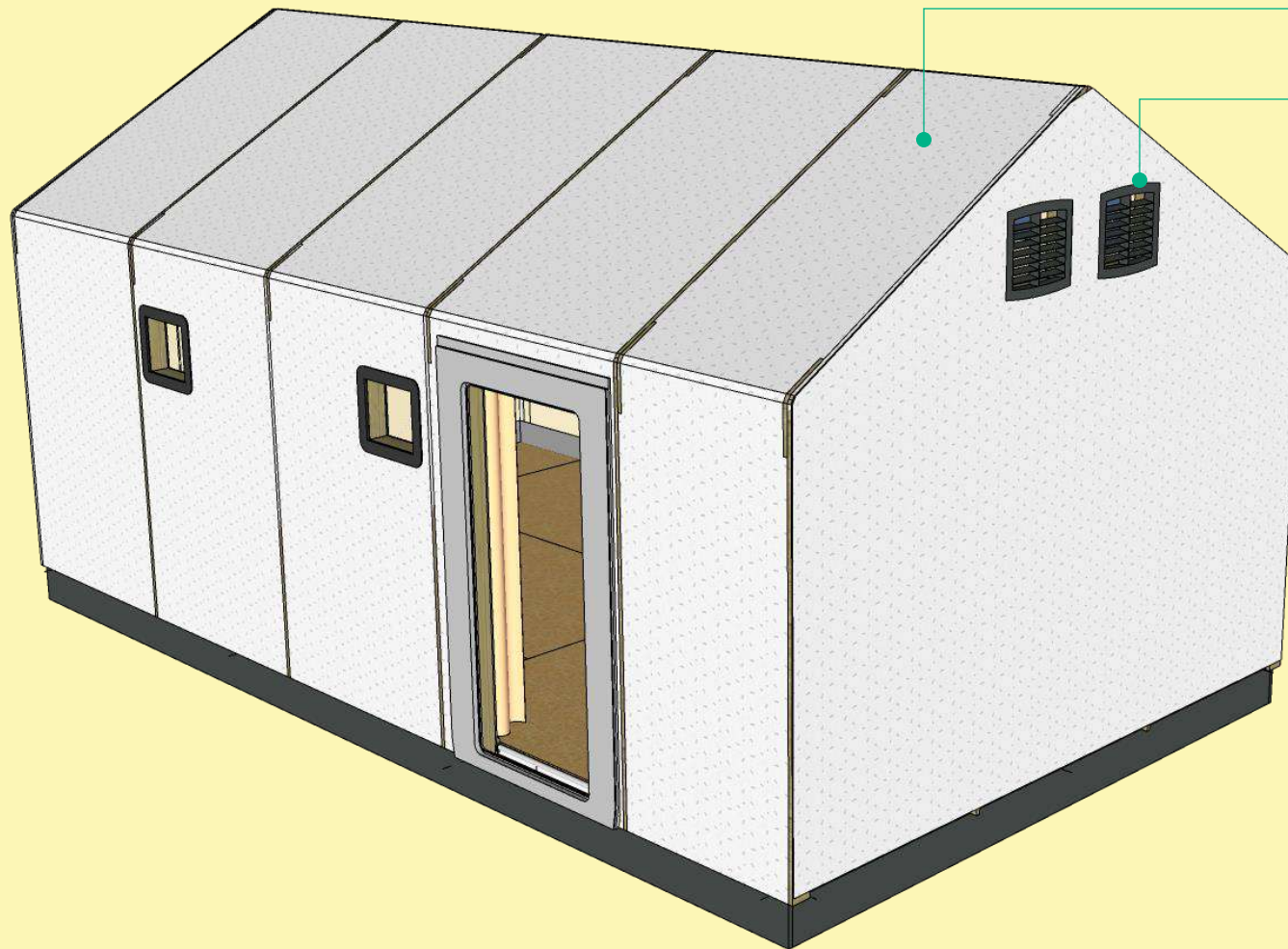


## Step by step RHU Winterization





## Upgrade

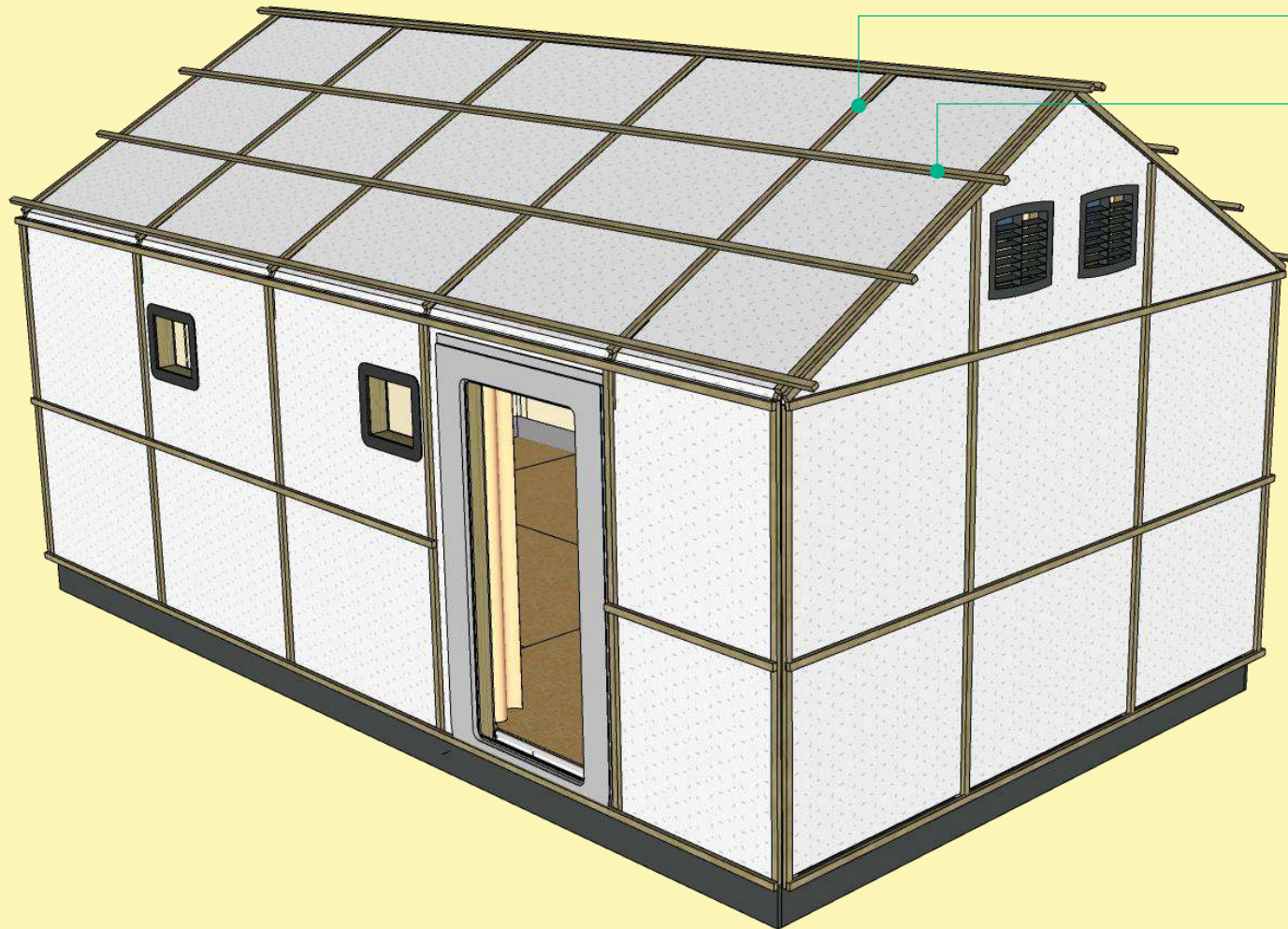


**Place vapor open membrane** such as Tyvek on the insulation according to the product specifications

**Tape off membrane** on wooden window and door frames and reassemble frames



## Upgrade



Place wooden battens **vertically** on top of the membrane at the locations of the wooden frames.

Place wooden battens **horizontally** on top of the previous battens

## Upgrade

Install **lightweight finishing layer** such as CGI on roof and walls or wood on the walls





## 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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