SPHINX Circular Economy – Reusable Pallet Cases for SPHINX Freesuns Solar Roof Tiles

Involved partners:

Fraunhofer Institute
M10 Industries
Freesuns Solar Roof Tiles

Short introduction

A quantity of 5000 Freesuns Solar Roof Tiles were made by the Fraunhofer Institute as part of the Horizon Europe SPHINX project during the course of 2025. Normally Freesuns Solar Roof tiles, when manufactured, are packed into single use wooden crates with a dimension of 1m x 1mx 1m that hold 100 Freesuns Solar Roof Tiles.

These wooden crates are designed for the single use, they are usually disposed once the Freesuns Solar Roof Tiles are unpacked on site for installation into the roof. The wooden crates are expensive and only used once before the wood is disposed into recycling.

News item

Objective: The objective was to take the opportunity to replace 50 single use wooden cases with approximately 24 re-usable 3D printed packaging case that can hold 100 Freesuns Solar Roof tiles.

One of the problems to solve was the unpacking on the roof. The single use wooden case was difficult as it required the roofer to lean over and into the case to remove the solar tile resulting in the roofer bending in the lower back to retrieve the tile. Another issue would occur when the Freesuns Solar Tiles were packed into the wooden case solar tiles: they would lean into each other during unpacking inside the case, which we were certain this could be improved through design

Research: We had the opportunity to, instead of purchasing 50 single use wooden cases for SPHINX, propose a new design 3D printed reusable packaging case. The SPHINX team choose to attempt and implement the 3D printed reusable design which also solved the reusability, the ease of unpacking on the roof, the ergonomics for the roofer and offer greatly improved stability of the packaging of the Freesuns solar roof tile. A further benefit was realised in the design allowed the reusable packaging to be flat packed when empty for easier removal off the roof.

The SPHINX 3D Printed reusable Freesuns Solar Roof Tile Packaging case was a success

The original single use Wooden cases are shown below

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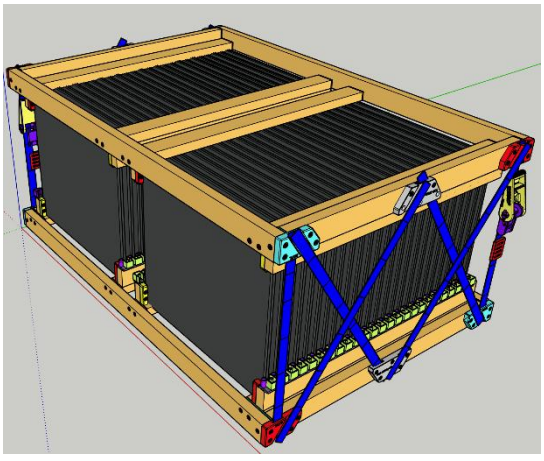
How has this been done?

By design a 3D Printed reusable packaging case, where the Freesuns Solar Roof Tiles can be packaged vertically and held independently. That gives the following benefits:

- Easier to pack, tiles are not leaning on each other
- A mirror design of the base becomes the top and when strapped together provides a locked and rigid packing case.
- The packaging case is lifted into place on the roof in the same way a single use wooden case was lifted onto the roof.
- Unpacking the 3D Printed reusable case is much easier as the straps are released and the top framer of the 3D Reusable Packing case is lifted and placed onto the scaffolding.
- The roofer has direct access to each pair of Freesuns Solar Roof tiles supported independently and in the upright position. Removal of the Freesuns Solar Roof tile from the 3D printed Reusable case no longer requires the roofer to bend over when lifting and removing a tile

Result: The design for the 3D printed reusable packing case that holds 100 Freesuns Solar Roof Tiles is shown below



What will it be used for: The results will be used to bring an injection modeled reusable packing case to hold 100 Freesuns Solar Roof tiles into production.

Impact: The impact was a 50% reduction in package cost on the SPHINX project. Instead of 50 single use wooden case at a cost of 100 Euro per case we were able to design and prototype 25 3D Printed re-usable Packaging cases for the same 100 Euro cost per case. The 25 reusable packing case were used to transport all 5000 Freesuns Solar tiles to 5 demonstration sites located in Switzerland after the tiles

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were manufactured by Fraunhofer Institute in the Module-Tech in Freiburg in Breisgau. M10 Industries assisted with providing storage space for the materials required to assemble the 3D Printed Reusable Packing case which was of great assistance.

Pictures of the results:

1. Prototype April 2025

2. New 3D Printed Reusable Packing case versus old single use wooden case.

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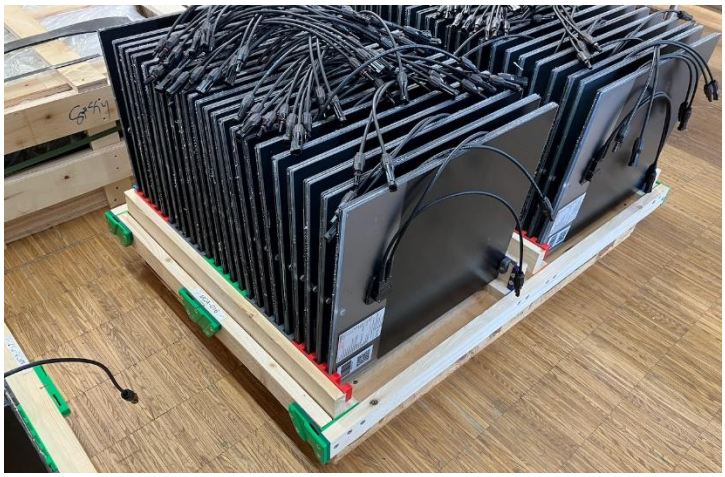
3. 3D Printing Farm Fraunhofer – Module-Tech – Freiburg-Ims Breigau

4. Packed 3D Printed Reusable Cases Storage M10 Industries

5. Freesuns Solar Roof Tiles aligned in the new 3D Printed Reusable Packing case. Note the tiles do not lean on each in the 3D Printed Reusable case!



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6. Packed Roof tiles in 3D Printed Reusable Cases

7. Tiles ready for transport to demonstrator site

8. Return of flat packed 3D Printed Reusable Packaging cases, some of the case were used five time reaching all demonstrator sites!

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