SOLARA

solar powered emergency & deep expedition backpack

the team

Michaela Dial

Industrial Design Student

Felicia Head

Industrial Design Student

Maya Fernandes

Industrial Design Student

problem statement

Challenges

Ease of access to portable refrigeration is a common problem for users across countries and disciplines.

Solution

Our group focused on designing a sustainable cooling system that would address a variety of problems across many user spaces.

team goals

Sustainably Powered

Research a range of sustainable power sources to implement into the design of our product.

Portability

Ideate a mobile experience which allows the user to cool items even when traveling or off the grid.

Design for Repair

Designing the system to be easily accessible for repair; establishing a model that encourages users to return and recycle broke pieces.

Specific User Spaces

Establish the needs of specific user spaces to define design choices based off of personas and interviews.

breakdown of user spaces

Developing World

- Providing a way for families and farmers to save, transport, and sell food at safe temperatures
- Focus on the problem of food waste due to spoilage/high temperatures

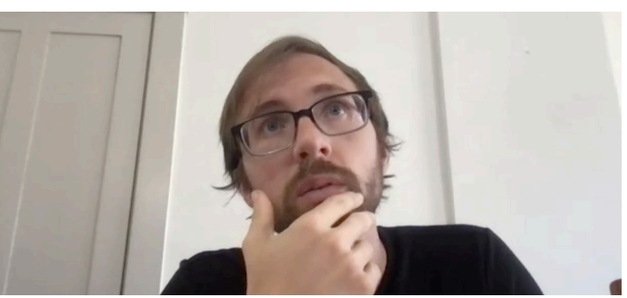
Medical / Disaster Relief

- Providing a way for families and rescue teams to access emergency food, water, and medicine without having to carry around a heavy cooler with melted ice
- Avoid medical waste (throwing out vaccines) by offering a portable way to keep medicine at regulated temperatures

Off the Grid Expedition

- Ease of access to food and water while on long term or short term camping/hiking trips where users are off the grid
- Focus on users who work or live off the grid; fielding, scouting, scientists, etc.

virtual interviews



Nate Maggard

Go-Sun Stove Lead Designer

Ruben Brown

FEMA External Affairs Officer

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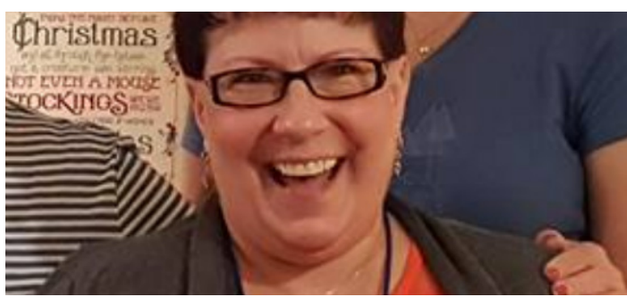


Cathy Stuggmyer

Christ Hospital Registered Nurse

email interviews

Liz Ricketts

Director of the OR Foundation

Refrigeration in Ghana

QUESTIONS

1) What is your current solution for refrigeration or cooling?

Where I stay they install secondhand mini refrigerators. Most of our team has the same or has no refrigerator.

2) Does this solution and/or product use any sustainable materials or processes?

Nope

3) Does this device improve the process?

Nope

4) Where does the device get its energy from?

ECG meter, the household pays for what we use from the grid. The electricity goes off often, however. This past two n
so it is for about 6-12 hours every other day when bad and once a week when "normal".

5) How is the product dissembled?

The refrigerators I have used in Ghana have probably already been disassembled or repaired a couple of times. It's q
to need a replacement or to have a tech come to the apartment.

Patrick McGlade

Archaeologist

- Could you summarize your experience with fielding?

Archaeology is conducted as Phase 1 survey where tracts of land in a project area(pipeline, road construction, anything using govt $) are walked over for visual inspection f
for artifacts/sites, photo surveys of structures, trenching for deep features, backhoe stripping for structures and features and cemetery delineation and recording. It also includes
radar, metal detecting, LIDAR, magnetometry, photogrammetry, resist ivory or any combination of the above. It can also include Phase 2 and Phase 3 traditional block excavatio
artifacts, features, structures, industrial and craft complexes and data recovery which is more static.

- How do you store food or medicine during a fielding trip?

For Phase 1 the common practice is to not pack perishable food for lunches since we wouldn't be near refrigeration and hiking with a cooler or ice is impractical and in some
2&3 are more static cooler with ice can be packed, large water cooler with ice are used. It also helps for those with medication that needs refrigeration.

- How are discovered pieces stored during fielding?

Artifacts are generally kept in plastic sealable bags or brown paper bags. Anything as acid free as possible. Soil float samples are stored in cotton draw string bags and artifa
samples, burned organic sand other organics, cloth or leather are stored in foil bags. Delicate artifacts are stored in more sturdy plastic or cardboard containers.

- Are there certain discoveries that need to be kept out of sunlight/cooled?

Various editing bottles or bottles that have a stopper and liquid need a stable temperature and no light so expansion of the liquid doesn't occur it's chemical reaction happen t
archaeologists to hazardous fluids or vapors. Artifacts removed from a constantly wet or dry environment need to remain wet or dry so exposure to sun and elements would spe
kept as stable temperature and moisture wise as possible too.

- What kind of ways do you keep products cooled now?

Generally ice packs and coolers. After that it's a cool hotel room if out of town work is being done before bringing the artifacts into the lab in the office. The lab is climate contr
doing survey and small coolers on Phase 2&3.

- What is the longest time you have been out fielding without electricity?

Generally the entire work day is without electricity which is generally 8 to 10 hours.

Noah Gripshover

Biological Sciences Graduate Student

Fielding Interview

NG

Noah Gripshover <ngripshover@gmail.com>
Sat 6/19/2021 8:03 PM
To: Dial, Michaela (dialmm)

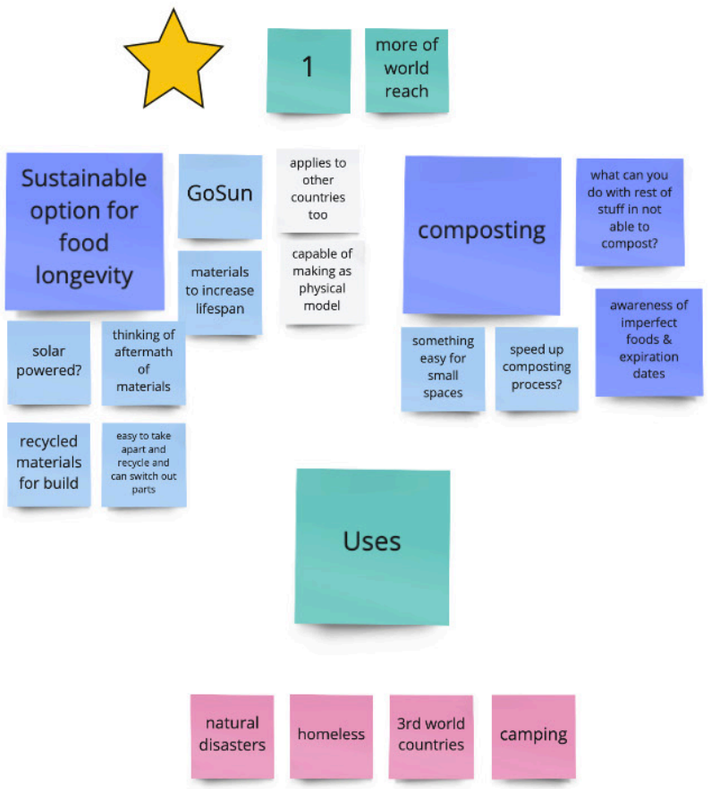
Michala,

Sorry for the late reply, I am currently conducting field work in Panama. I hope this response is not tc
help if you have any further questions.

Could you summarize your experience with fielding? I have done extensive field work as a biolog
and northern Kentucky collecting snakes and crayfish as part of my Master's research. As an undergr
have conducted field work in Panama working at the Smithsonian Tropical Research Station. In Panar
involving lightning, canopy ant diversity, and anole ecology. I have also worked in central Texas colle
ecology study. In all of these environments, the weather is very hot and can lead to animals dying if
field.

How do you store food or medicine during a fielding trip? In all of my trips, we have housing (i.e

team brainstorming



borgenproject.org

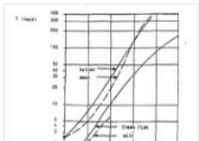
Cooling in Developing Countries | The Borgen Project

Cooling in developing countries is a major problem that affects health, disease treatments and hunger. Many developing countries do not have access to electricity and consequently do not have proper cooling systems either. Lack of cooling makes it diffi...

www.borgenmagazine.com

Providing Affordable Refrigeration in Developing Countries - BORGEN

DENVER, Colorado - Engineers Without Borders (EWB) USA announced that seven recipients received grants as a result of its "Chill Challenge," an initiative to create affordable refrigeration technologies and community ice-makers for off-grid communities ...



www.appropedia.org

Refrigeration for developing countries

Refrigeration plays an important role in developing countries, primarily for the preservation of food, medicine, and for air conditioning. Examples of these applications are: In agriculture and dairies: removal of field heat immediately after harvesting...

www.prnewswire.com

New Portable Solar Refrigerator to Use in Power Outage Emergencies

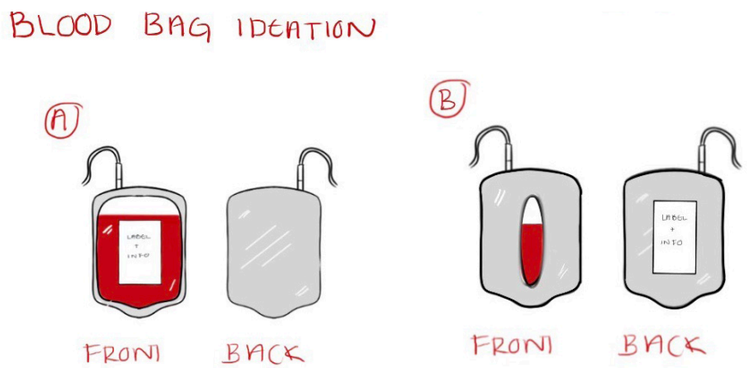
DELAWARE CITY, Del., March 2, 2021 /PRNewswire/ -- The dramatic power losses in Texas and Colorado left people without ways to keep their food cool and protected. This resulted in hundreds of dollars lost per household. EcoSolarCool's new solar-powered,...

Design Direction

Based off of our initial research and the interviews we conducted, we saw that there was a strong need to a portable cooling system in the medical and disaster relief spaces.

We chose to focus on those spaces going forward into ideation.

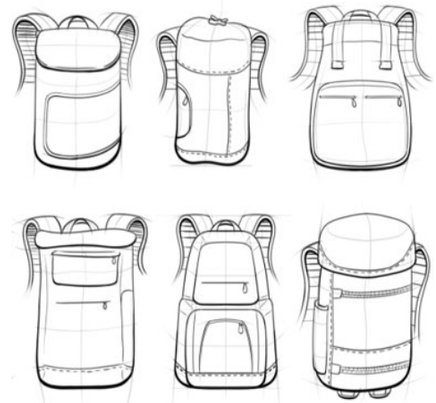
overview of concept spaces



Blood Bag Cooling Sleeves

Medical Space

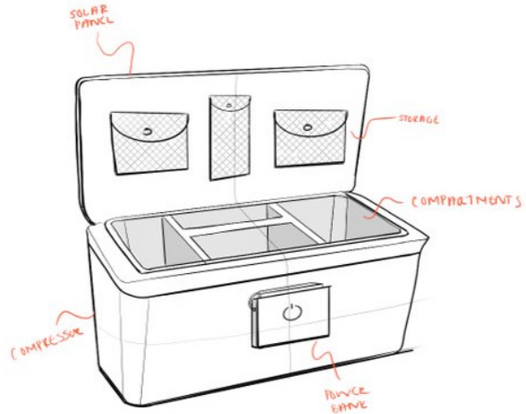
- Reusable cooling sleeve for individual blood bags; application during internal transport of blood to OR trauma surgeries
- Made from recycled material and meant to replace the need for Igloo coolers in hospitals



Solar-Powered Backpack

Expedition / Disaster Relief

- Portable cooling solution to distribute supplies or contain artifacts.
- Sustainably powered or built with sustainable materials.



Solar-Powered Cooling Box

Medical / Expedition / Disaster Relief

- Portable cooling solution for use in hospitals to transport blood & organs; for supplies distribution in natural disasters; and containment of artifacts & supplies during fielding.
- Sustainably powered or built with sustainable materials.

concept: solar powered backpack

Current Methods

- First responder: During a natural disaster, the current transport and distribution option is an Igloo cooler; however the ice melts often, and there is no hands-free portable solution.
- Archaeologist: The current method for keeping artifacts/supplies cool are coolers, but there is a lot of waste with how many bags of ice are used. There is no portable cooling option for this space.

Interview Feedback

- *Patrick McGlade/Noah Gripshover:* A portable cooling option that can transport supplies and has dark compartments for artifacts would be extremely viable; also looking at the amount of waste created by using Igloo coolers and plastic bags of ice.
- *Ruben Brown (FEMA):* There is a real need for a product like this, as this is a real problem that FEMA has experienced and having a portable cooling option would remove the need to carry heavy coolers around a destroyed site.

User Needs

- *Portability*
- *Long-term cooling*
- *Compartments for storage*
- *Waterproof material*
- *Durable / long lasting quality*
- *Comfortable / able to be worn for long periods of time*

System Analysis

- Interior frame to keep backpack from shifting
- Wheels on the base for portability
- Compressor compartment at the bottom of the backpack
- Waterproof canvas and recycled polyester for majority of fabric body
- Interior cooling pockets for supplies
- Solar power strip on front of backpack
- Power bank attached to the side

benchmarking

Blood Bag Cooling Sleeves

Medical Space






Solar-Powered Cooling Backpack

Expedition / Disaster Relief






Solar-Powered Cooling Box

Medical / Expedition / Disaster Relief





final design direction

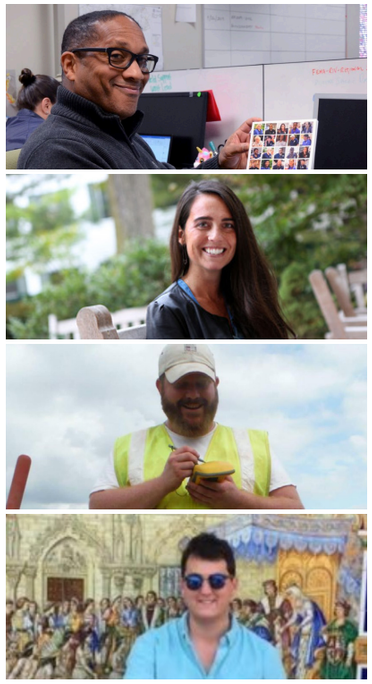
Solar-Powered Backpack

Expedition / Disaster Relief

- Portable cooling solution to distribute supplies or contain artifacts.
- Sustainably powered or built with sustainable materials.

Project Decision - *why we chose to go forward with this concept*

Interviews & Area of Opportunity



By interviewing professionals in different business spaces, we felt that a portable sustainable-powered backpack could be most applicable to a wide variety of users to solve real problems.

We saw a real opportunity to design a product and mechanical system that is currently not on the market, and by doing this we would be solving a real problem.

For our studio, we focused on designing based on the needs of rescue teams, archaeologists, & deep expedition workers, but our hope is that this technology could be eventually applied to other spaces.

Creative Solution

My team was very excited at the prospect of designing a solar powered backpack.

The three of us were new to soft goods going into this project, and we knew it would be an immense challenge to not only design a backpack but to also research and establish the cooling system.

However, we felt very passionate about the idea and the opportunity we found in the market, and so we moved into the first stages of ideation.

backpack design direction

Structure

- Boxy frame inspired by the Yeti back-pack cooler
- Unzips from the front for easy access of materials, similar to a suitcase

System

- Exterior solar panel on the front of backpack, secondary can clip to the top
- Panel kept in a fabric sleeve with a clear plastic face as a layer of protection
- Ease of access to panel in case of replacement or repair

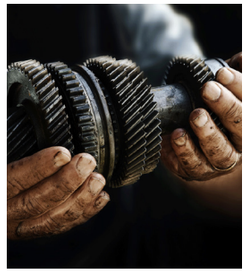
Hard Shell Base

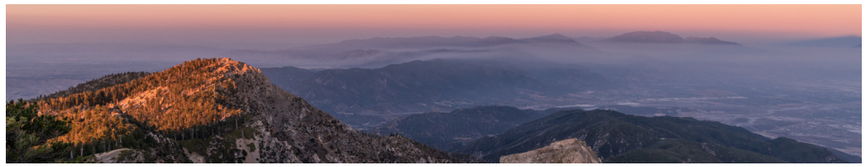
- Material split at the bottom half of bag; shifts from fabric of backpack to hard rubber shell of base
- Protects the internal system
- Base zippers off in order to easily access the system for replacement or repair

Details

- Plenty of cooled internal storage & temperature unregulated exterior storage
- Heavy duty padding / waist & chest straps
- Internal wall structures to protect fans & battery
- Mesh pockets on sides to allow fans to filter air

design aesthetic / mood board





branding

Logo

- Our logo mimics the font. Simple, minimal, yet clearly portrays power from the sun.

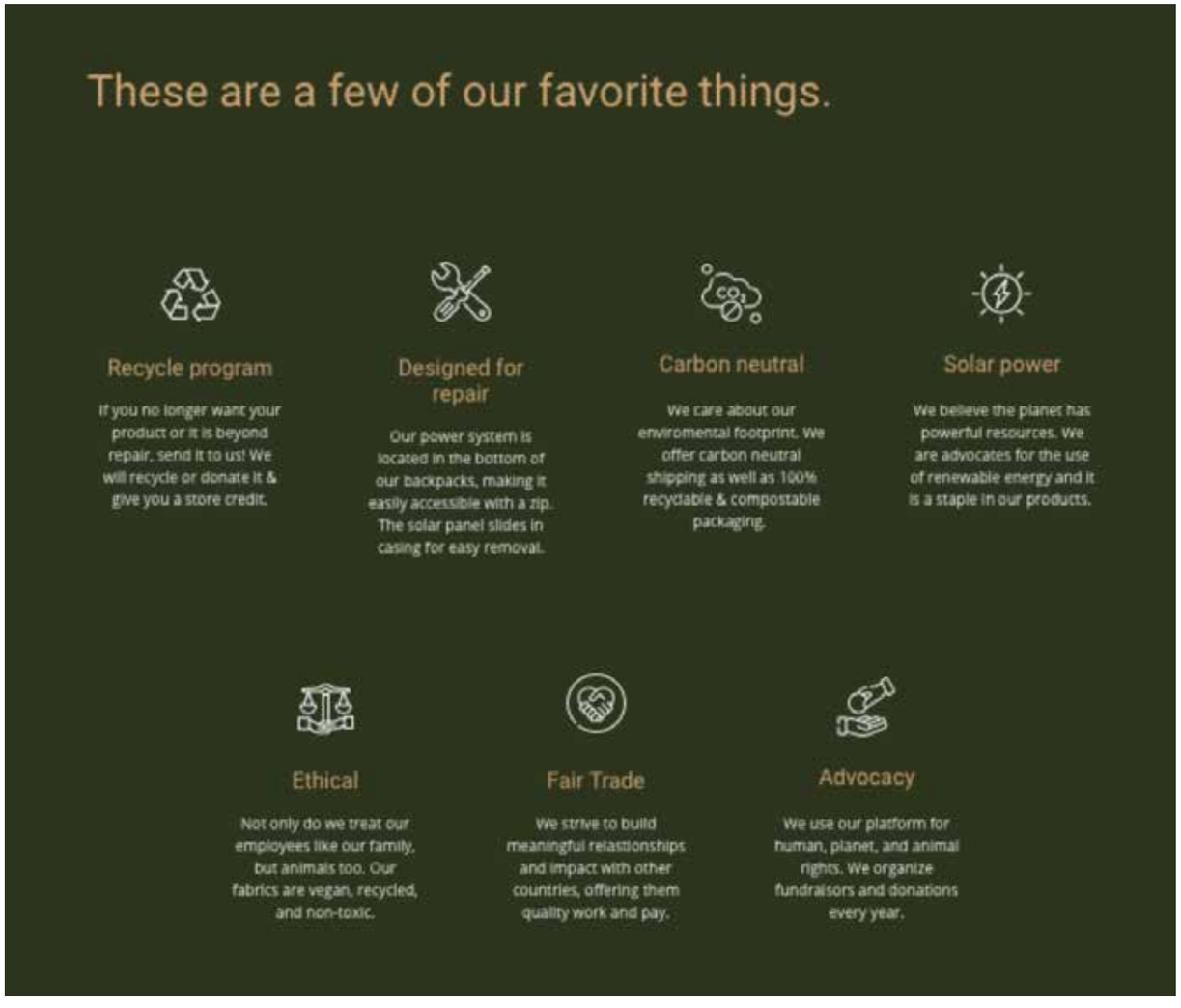
Font

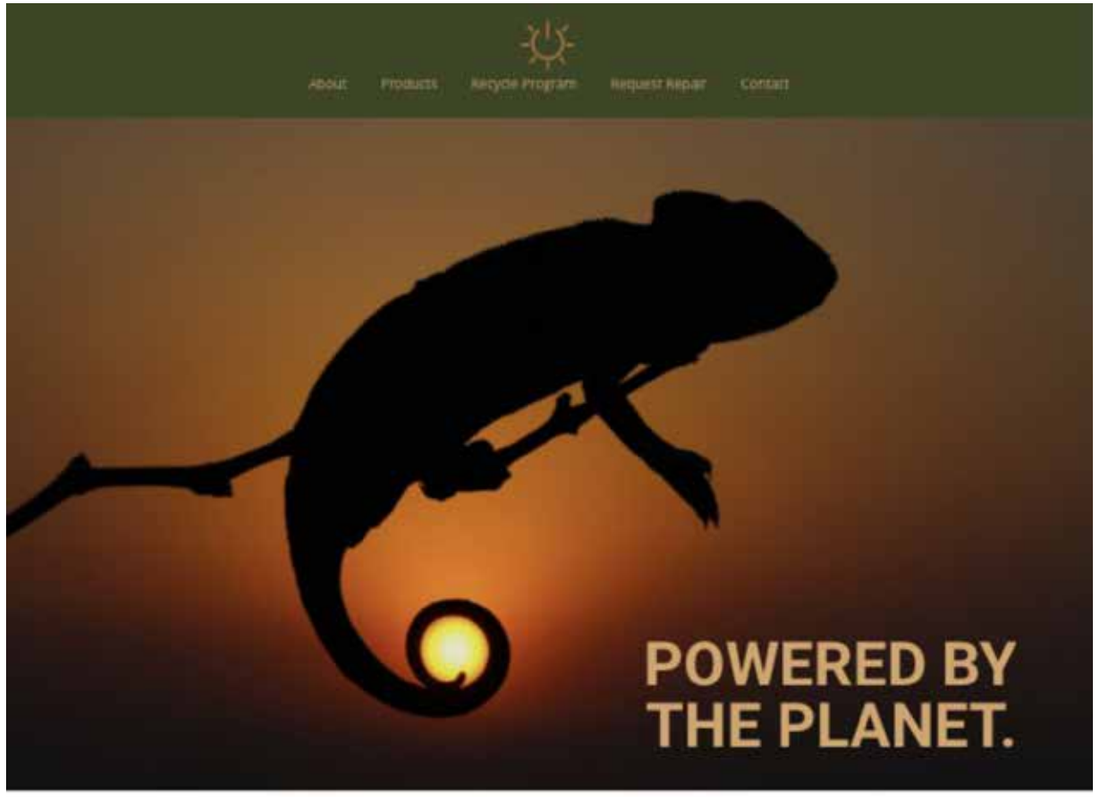
- A clean, minimal font. The letters are not full, we wanted to show that we could take things away and still get the point across. It shows our brand can use minimal resources, do little harm on the envrioment and our products still get the job done.

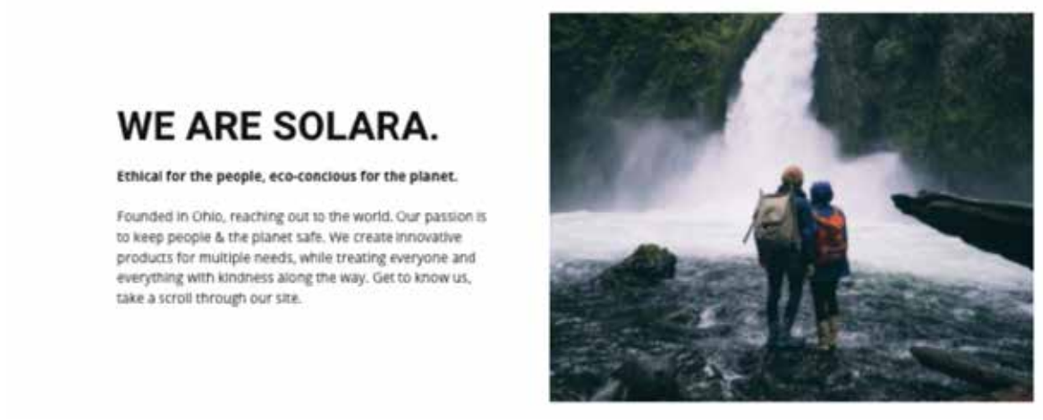
Color Palette

- We wanted to go with a palette that was inspired by nature. We wanted to have an elemental feel and have product colos based off fire, water, earth, and air.

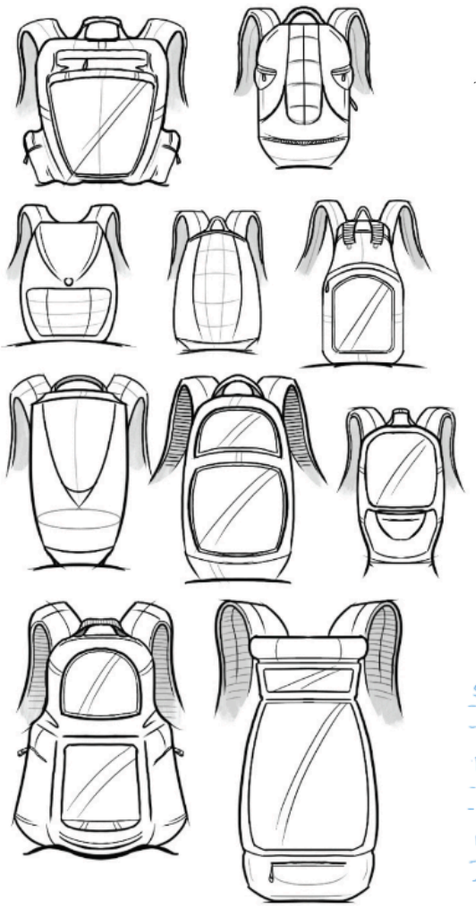
branding - website & brand persona

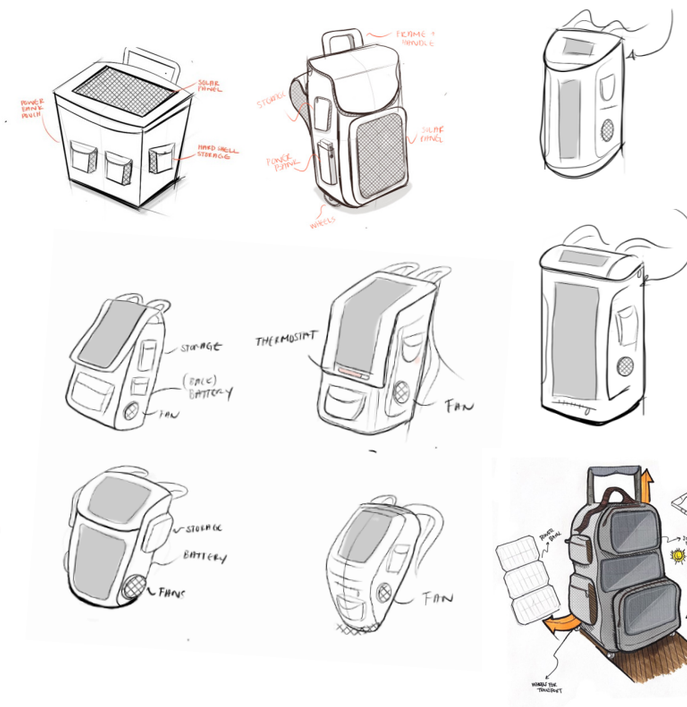


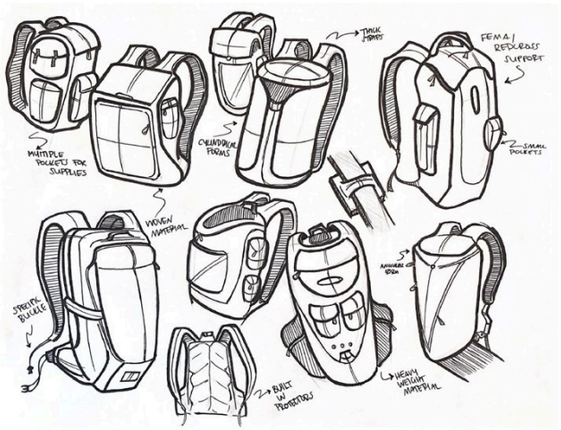


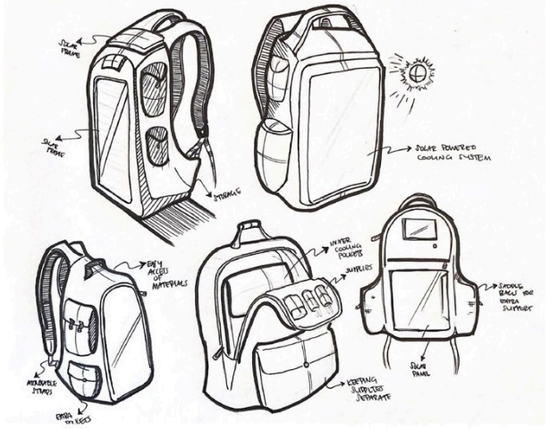


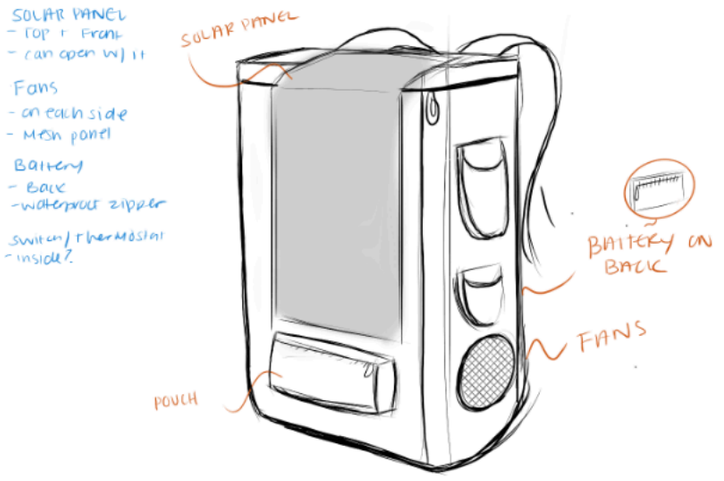
group ideation



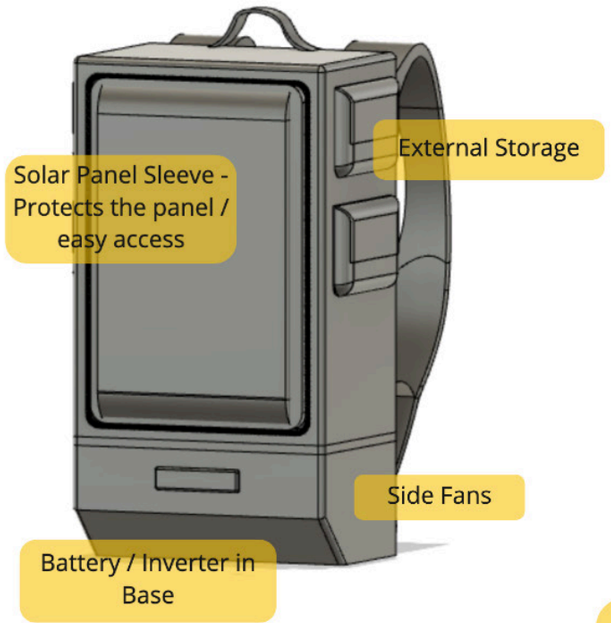


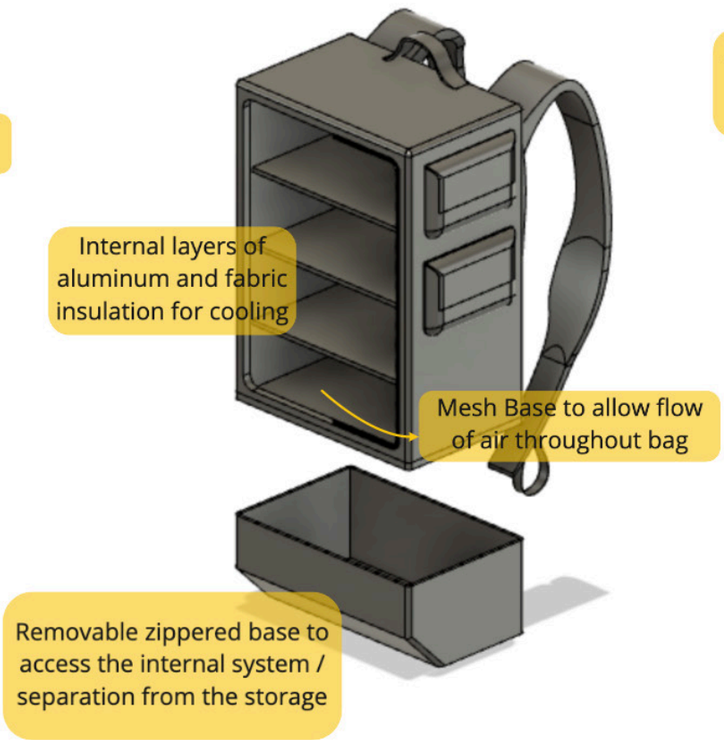


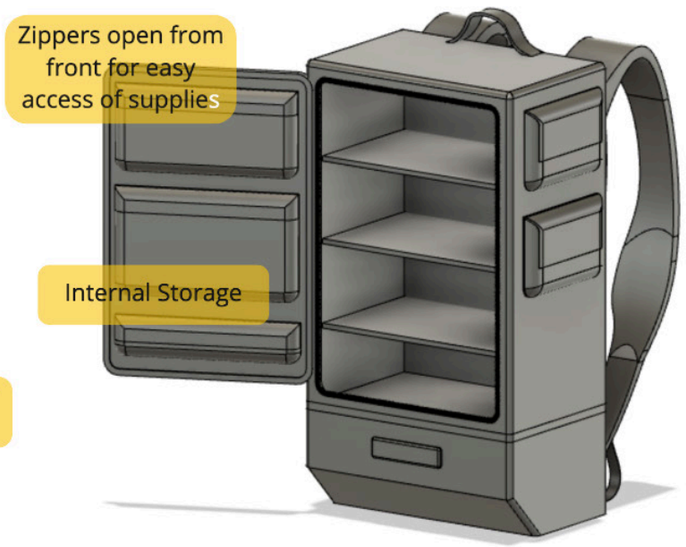




final design - 3D modeling & reworking the form







Focus Points:

Incorporate waist strap as well as a chest clip to offset the weight of the bag during use

Integrate padding on the straps and back piece to create a more ergonomic experience during use

Adjust deliverables accordingly for studio; consider prototyping during co-op semester

final form - design decisions

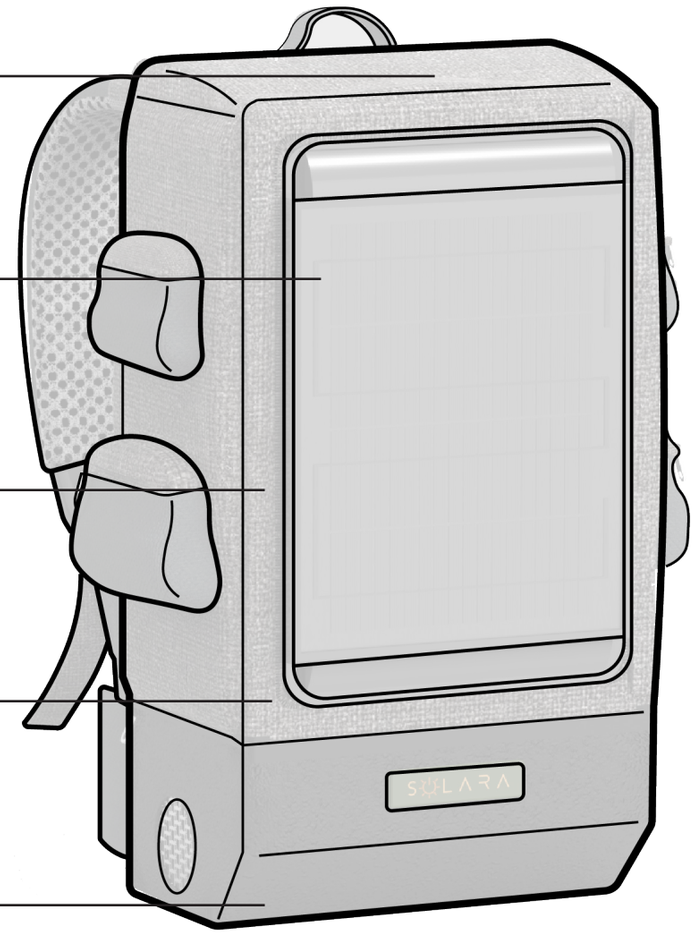
Second solar panel can be clipped to the top for back-up power storage on cloudy days

Solar panel on front flap allows for highest rate of energy collection

Opens from the front for easy access of materials

Boxy, structured design allows for backpack to sit upright or be placed on its side and opened

Internal system housed in zip-off hard shell base

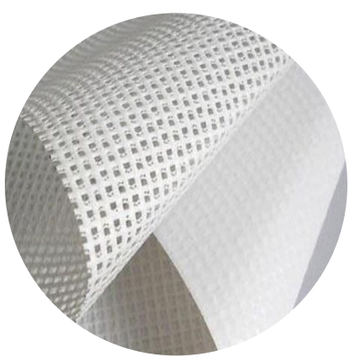


22x13x8	*10 lbs*

final design - materials

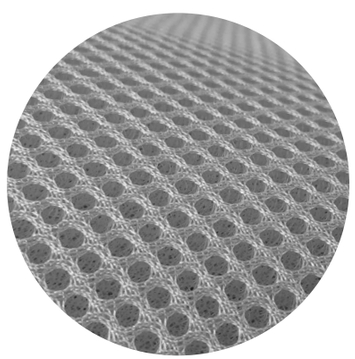
Recycled PTFE plastic
(Body structure)

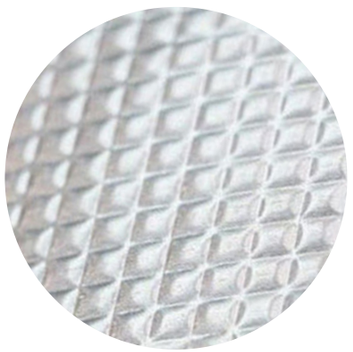
Recycled PTFE fabric
(straps)



Nylon & Steel
(zippers)

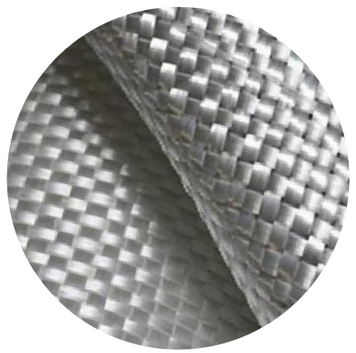
Air mesh fabric
(padding)





Aluminum foil insulation
(insulation lining)

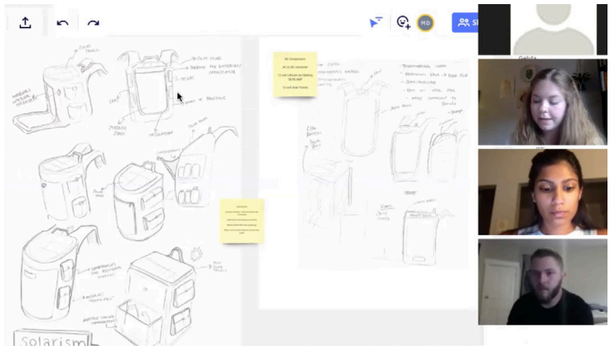
Recycled PLA plastic
(internal structures)



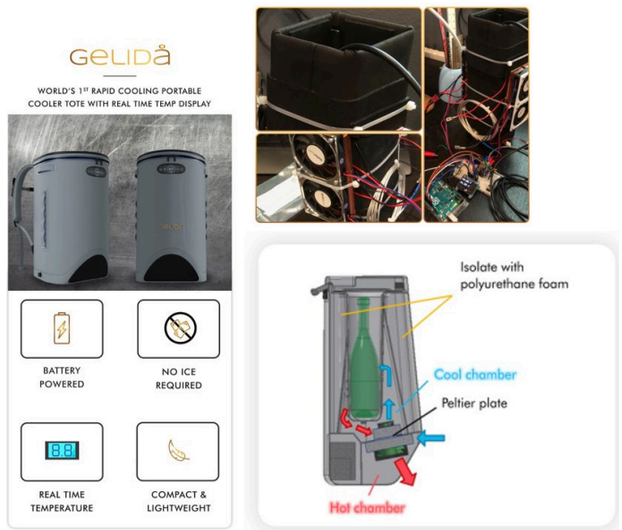
Woven insulation cloth
(insulation lining)

Cactus leather
(logo block)

final design - system pioneering

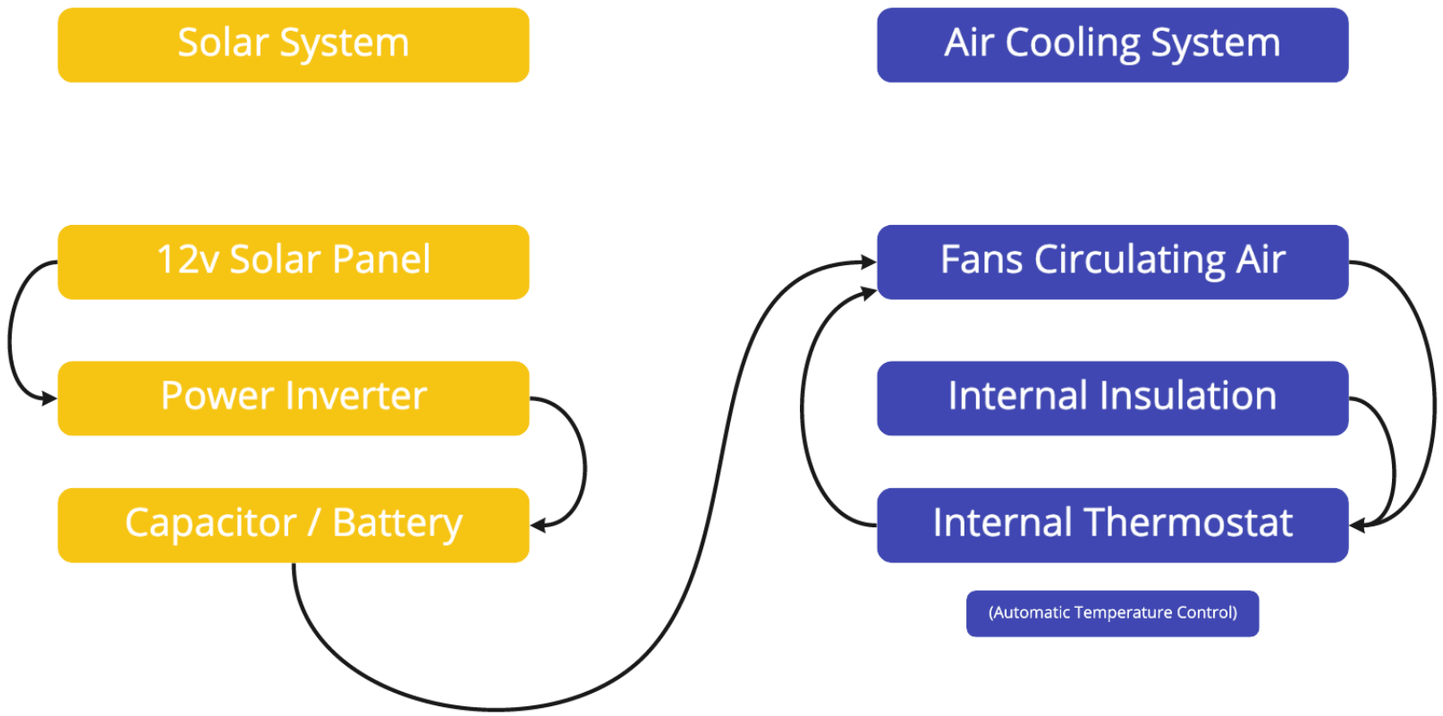


Mechanical engineering meeting with Nick Wallace



System Benchmark: ***Gelida Portable Cooling Backpack***

High Level Graph of System

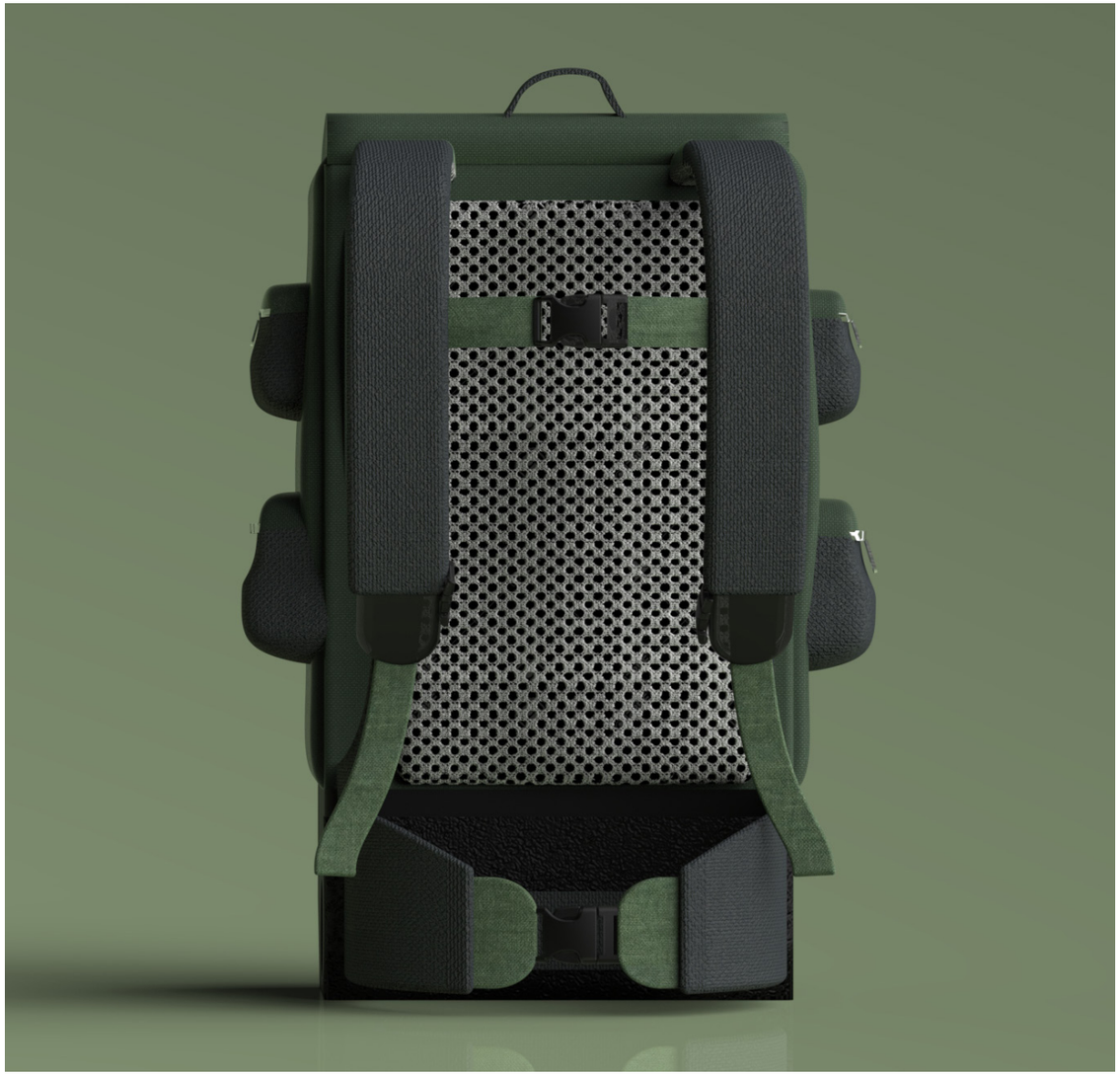


Inspired by thermoelectric cooling, our system uses similar pieces to the Peltier effect, which uses an active heat pump to transfer temperature.

For our product, we are using a blend of Peltier technology and an air-cooled system, eliminating any need for water or coolants.

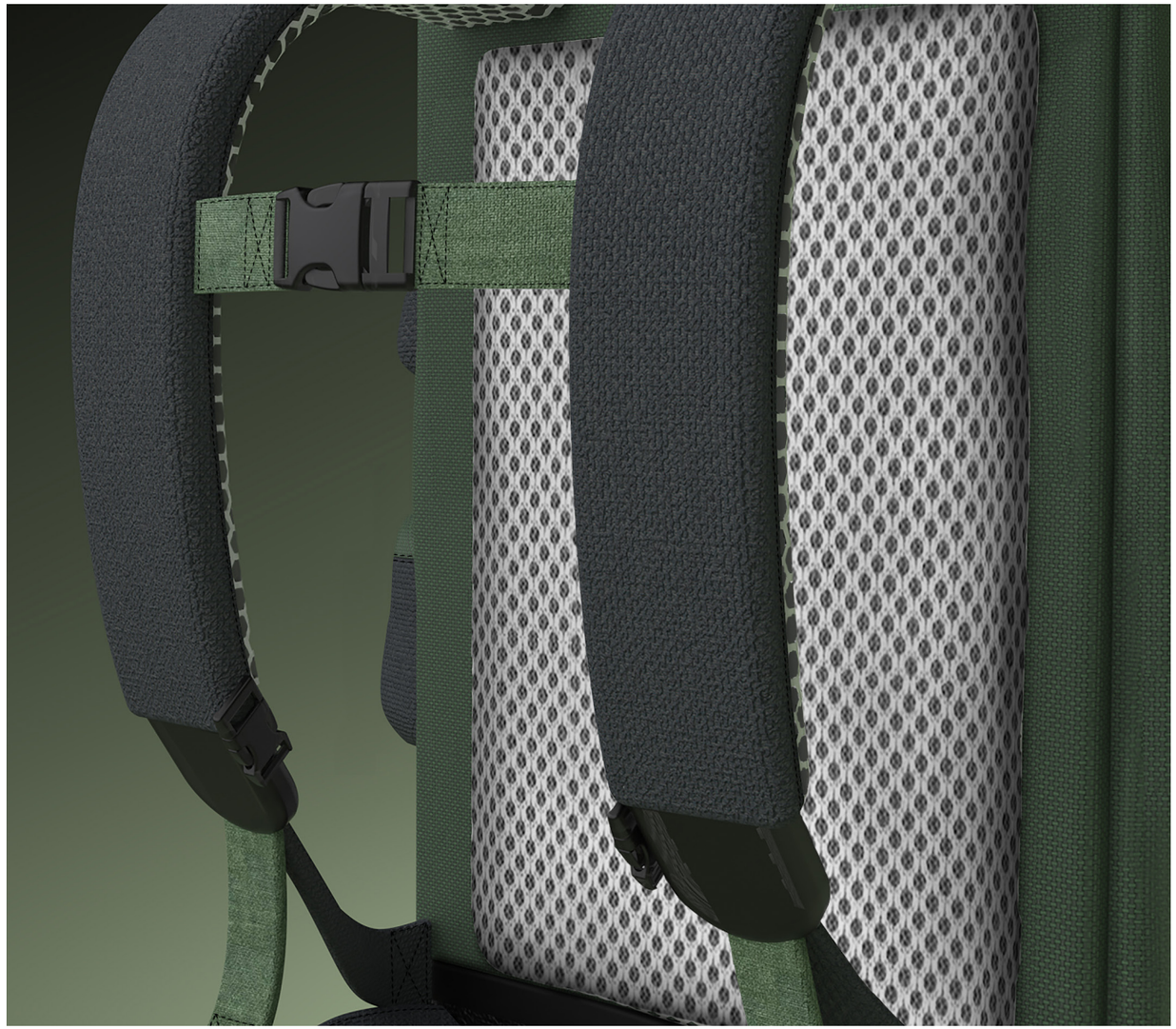
SOLARA

solara final model



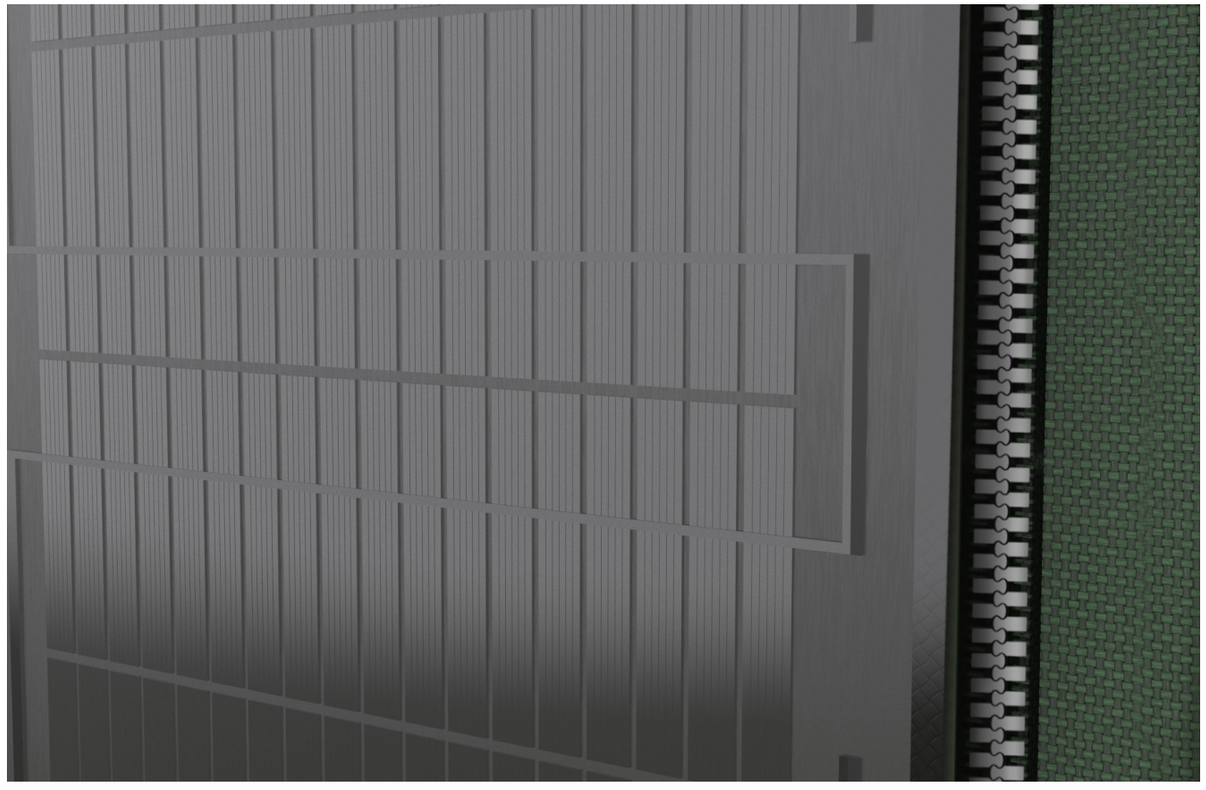
Our final Solara model is defined by its structured, boxy form and front facing solar panel. The front flap zips open for access to the temperature-cooled storage shelves, with additional exterior side pockets for non-regulated temperature storage.

padding & waist strap



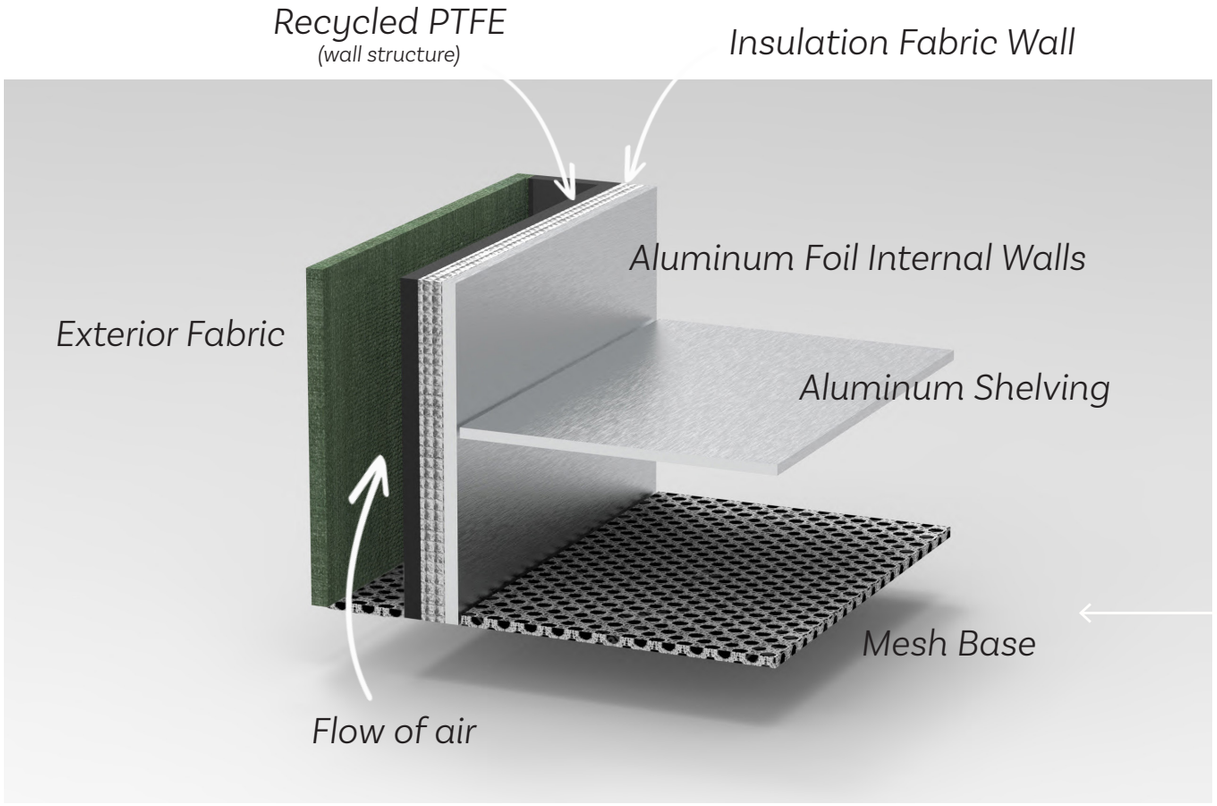
An important process in our design was equipping the backpack with heavy duty padding as well as waist & chest straps. This backpack could be worn for most of the work day, and we specifically designed to accommodate these details for offsetting the weight of the bag.

exterior solar panel

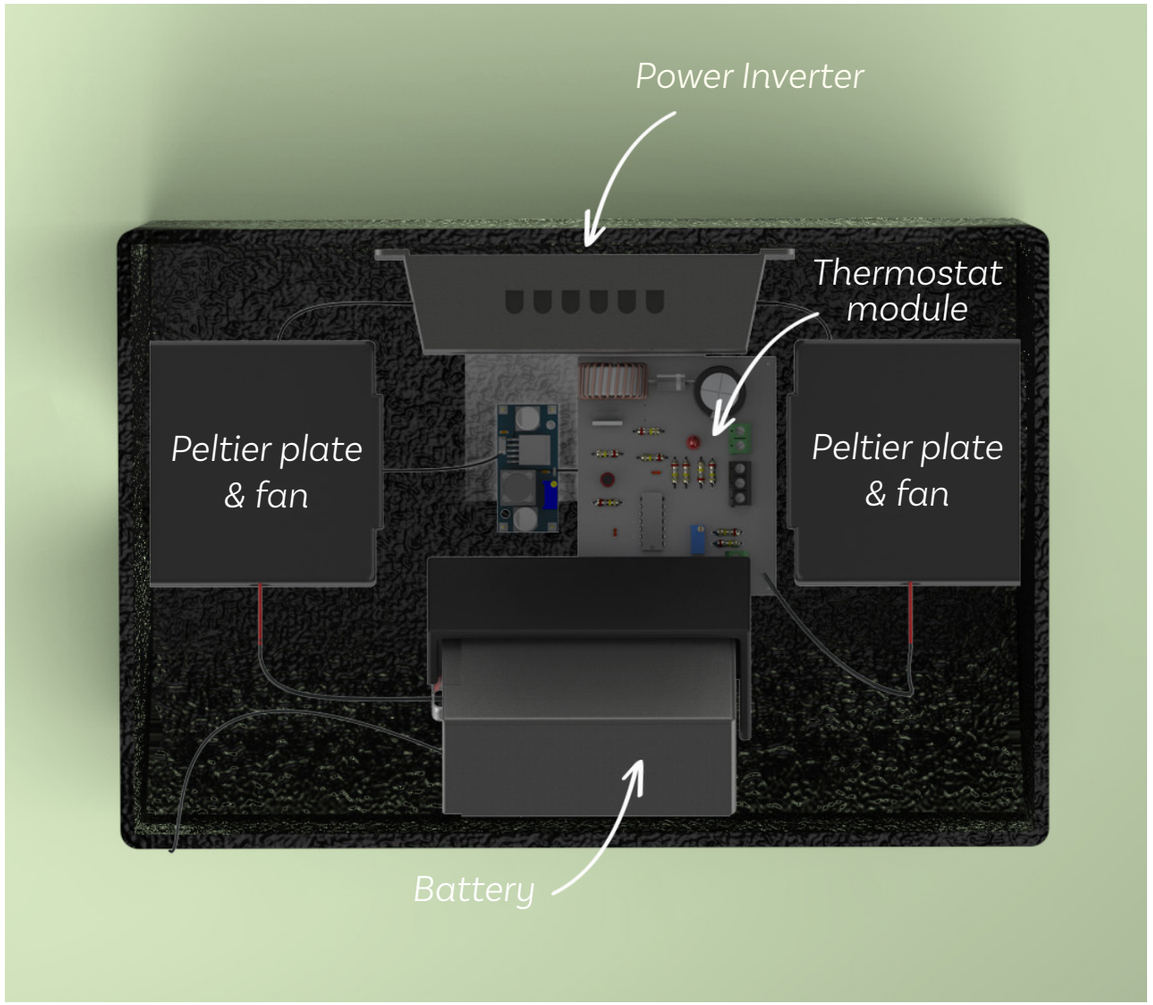


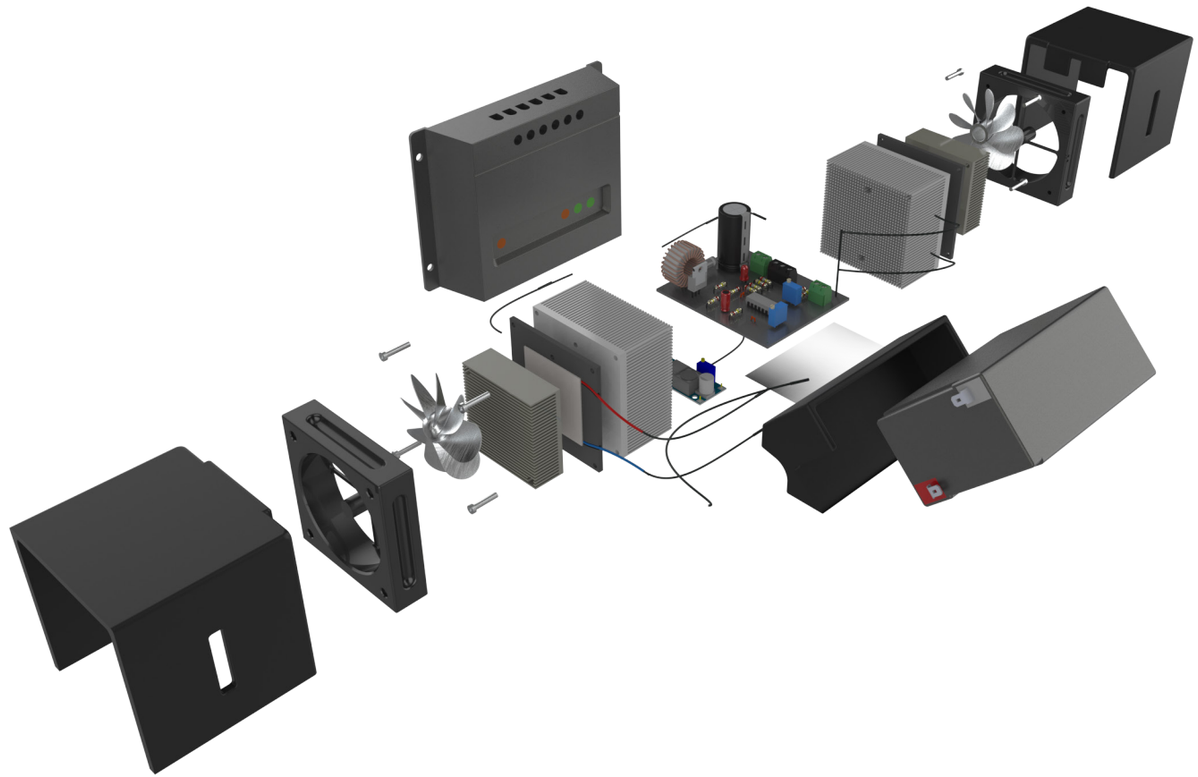
The exterior solar panel is protected by a frame built onto the face of the backpack. This way, our users can easily access the panel when needed, while also allowing it to collect power during the day. The front panel zips open to allow access to the internal cooling shelf storage.

closer look at wall structure

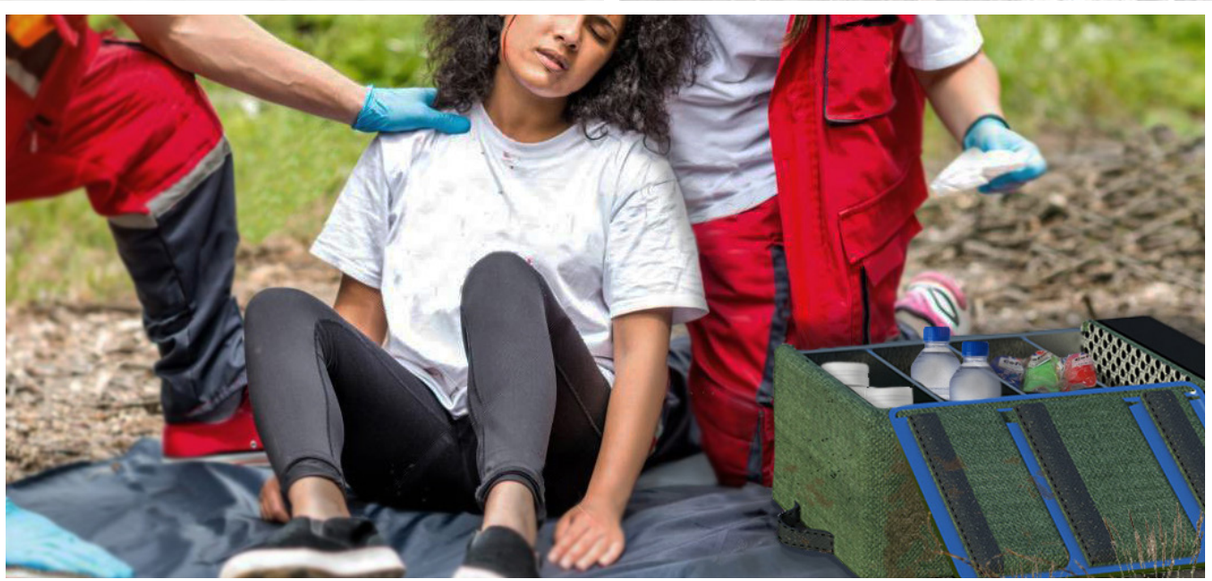


internal system





off the grid work



colorways

Slate

Coal

Forest

Atlantic

Ember

connecting back to problem statement

Solution

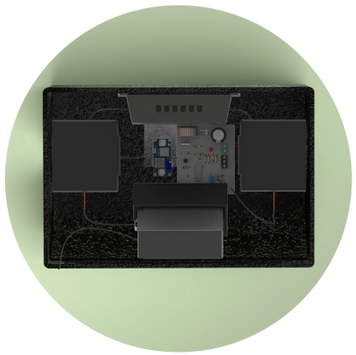
Our group focused on designing a sustainable cooling system that would address a variety of problems across many user spaces.

Design Goals

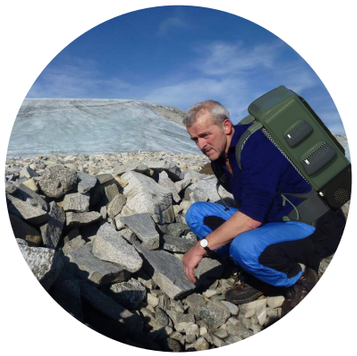
- Sustainably Powered
- Portability
- Design for Repair
- Specific User Spaces

SOLARA

Solar-Powered Cooling System



Designed for Disassembly and Repair



Portable Backpack

Designed for off the grid expedition and rescue work

next steps

Incorporate Feedback from Critique

Individual Prototyping

Small Scale Prototype of System

thank you

This project would not have been
possible if not for the impactful
mentors and interviews we had during
the research and design of SOLARA.

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