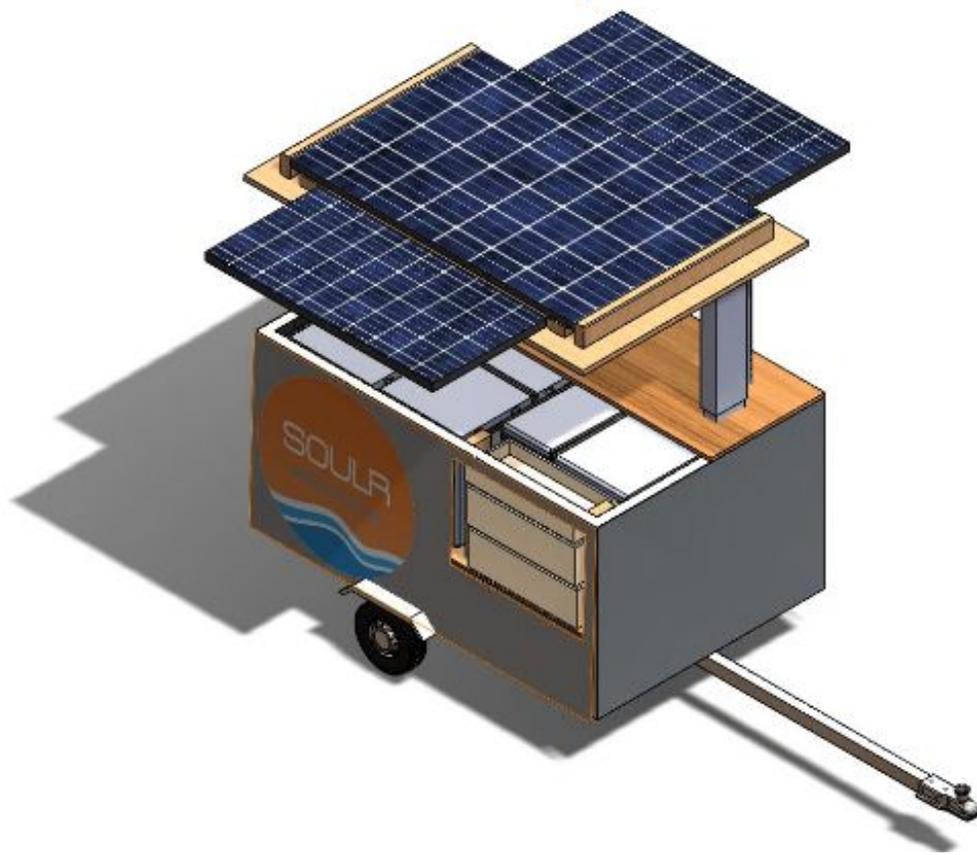


SOULR CART

A.S. SPRING 2017 SUSTAINABILITY GRANT

APPLICATION

FEBRUARY 23, 2017



SUBMITTED BY JACOB PLATZ

In a world of constant growth, our environment slowly suffers its consequences. In order to innovate, we must work towards a more sustainable future and decrease our carbon emissions as a whole. Our sponsor, Soulr Cart, has taken the first step toward this goal by creating a business that emphasizes the power of solar energy and strives toward an affordable and green version of today's food cart standard.

Our design team aims to address this goal by building an innovative solar powered, off the grid food cart. After considering many different designs, we decided to revamp the alpha prototype of the cart built by our sponsors. Our food cart will incorporate a two freezer array that consists of 85 qt Whynter aluminum freezers, along with two lead acid Alcatel-Lucent AGM Deep Cycle 12V batteries wired in parallel. These components will be shelled by a aluminum cart structure and protected by a star-board counter top. In order to innovate the original cart, several new mechanical features will be added to the new cart. The concept of a retractable roof using linear actuators will deploy during hours of operation and retract during transportation and storage. Along with this feature, a solar umbrella is implemented by attaching two solar panels to the steel frame of the roof using weatherproof drawer slides. The third panel will be in a fixed position in the center of the roof.

For franchising purposes, customers include college students, commuters, and beach goers. Soulr Cart provides the perfect option for an on-the-go item. Customers who purchase products from our carts are looking for something fast and delicious. Vending of the product and ease of use for the operator is key. All of our products are prepackaged which allows for very simple distribution. No chopping, hand washing or the like. Customers will be able to spot the Soulr Cart, know exactly what we sell, and walk away happy in under five minutes.

For purchasing purposes, customers may be utilizing the carts for a number of different things. For example, a catering company may want to transport one hundred salads to a wedding where they will simply distribute the food onto tables or a golf course may want to keep a cool snack for golfers in the middle of the day while they're out on the course.

The alpha prototype of the cart has been so popular that it runs out product very quickly. We want to increase capacity so that the cart will be able to stay on site for a longer period of time, allowing for more business and profit. We will also be increasing efficiency of the

battery allowing for the cart to be used on a cloudy day or even store the bowls overnight while maintaining FDA temperature standards for freezers. Currently the cart is not able to stay cold without direct sunlight for very long.

Soulr Cart is looking for a solar powered refrigeration cart that is aesthetically appealing, more efficient, and has a larger food capacity than their alpha model. Along with these characteristics, it is necessary that the vendor will be able to accomplish the goals of vending, operating, and maintaining the cart simply, efficiently and effectively. We are proposing a cart that will fit these needs while also providing a gateway into mobile refrigeration market all while having a net-zero energy production and consumption.

Below is a list of all the goals we wish to accomplish provided your funding.

1. Convert solar energy into usable energy to power a DC refrigeration unit in the cart
2. Store food overnight or during the day while there is no sunlight, this is achieved by battery power or an AC power outlet into the freezers
3. Retractable roof for safe transportation
4. Trailer towed directly using trailer hitch
5. Food storage access panels configured to provide food to customers quickly and easily
6. One man setup and lockup taking no longer than 5 minutes
7. Manufacturing cost will not exceed \$5,000
8. Must store a minimum of 100 acai bowls
9. Freezer temp must reach 0° F per FDA standard
10. Easily moved by one person on smooth ground
11. Wheels lockable to prevent rollaway on slopes up to 15 degrees
12. System maintenance required after 90 days operation takes no longer than 1 hour to complete.
13. Daily maintenance requires no hand tools and take less than 5 minutes to complete
14. Fully charged cart must keep the fully stocked food storage area within temperature limits for at least 6 hours without additional solar or electrical input
15. Indicators for system temperatures, state of charge of energy storage devices, and instantaneous solar energy collection
16. Operator and customers are protected from electrical shock or chemical fumes

17. Operational noise less than 50 dBs with food storage lids closed
18. The cart is mobile (i.e., easy to move around by hand and also on a car)

The following are requirements that must apply to our Soulr Cart:

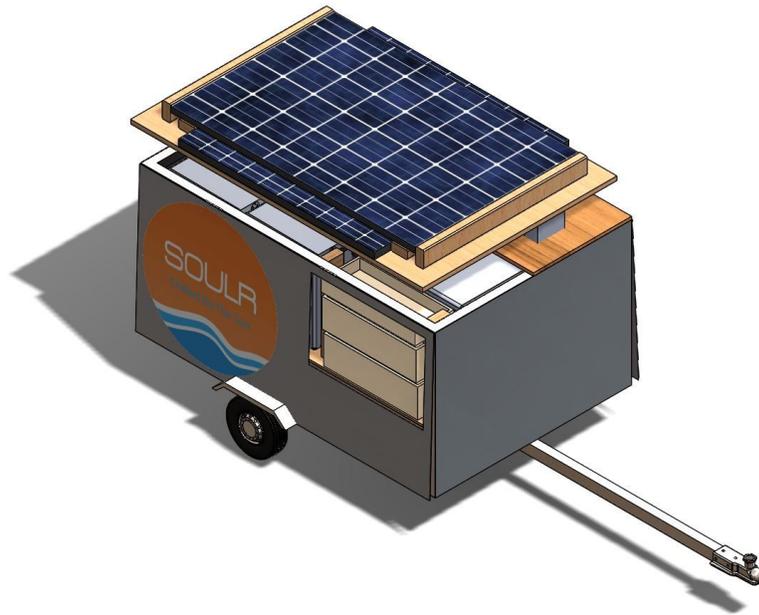
1. Fully stocked mass limitation: <1000 lb
2. Fully deployed size: less than 7' tall x 4.25' wide (not including solar umbrella when deployed) x 6' long
3. Towing size (stowed): less than 4.5' tall x 4.5' wide x 6' long
4. The overall shape of the unit is a rectangular box which serves as the refrigeration and storage unit along with acting as a service counter.
5. Linear actuators holding up a roof over the service counter safely
6. There must be a roof
7. The roof must not buckle or fail under the weight of the solar panels.
8. The roof must have a minimum head clearance height of 80 in
9. The cart will be aesthetically pleasing

The cart is split into two subsystems, power and structure. Power refers to all electrical components of the cart including the solar panels, microinverters, charge controllers, batteries, freezers, AC/DC converters, and accessories. Structure refers to all the mechanical aspects of the cart and also the basic frame of the cart. The frame includes a utility trailer, steel frame work, and aluminum siding.

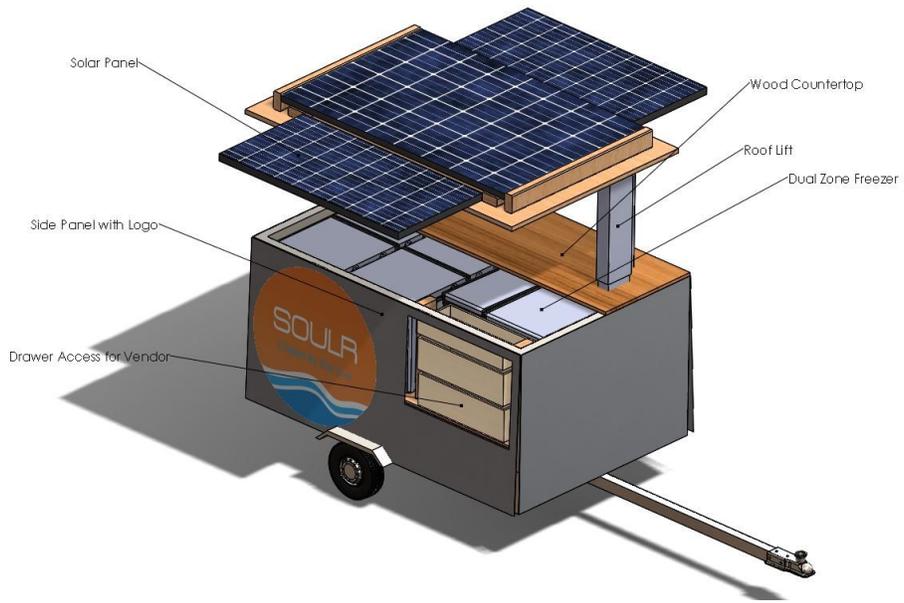
The Soulr Cart design features two refrigerators that are powered by rigid solar panels. The solar umbrella design is utilized to maximize the amount of solar power that is stored in several batteries inside the body of the trailer. The panels slide onto each other to store at night when the cart is not in operation. The roof is retractable, raising and lowering using linear actuators ensuring safe travel while on the road. Two refrigerators and two batteries are used in this system. All of the components are interconnected, meaning all three panels feed into the batteries which are connected in parallel which feed power to the freezers.

Most of the required components such as the solar panels, utility trailer, freezers, microinverters, charge controllers, and batteries for our project are purchased from vendors. Some of these components require modifications, such as the trailer that has a mesh bottom,

that will need a thin layer of solid sheet metal on top of the mesh to act as a floor. This provides protection to the freezers, batteries, and other internal components. Another unique aspect to the cart that requires construction is the solar umbrella that consists of the two solar panels sliding out from under the main panel on drawer like tracks. Although this requires no modification in the panels, it does require modification in the wiring in order for all the movement to be possible. We will be using wire carriers to securely move and protect the wires during the deployment and retraction of the umbrella. The aspect that requires the most attention is the linear actuator, which is a crucial mechanic component that has the highest complexity and is essential to the cart's ability to operate. All previously mentioned components and any additional manufacturing occurs in Loma Hall, while storage of the cart is on the patio of Loma Hall and within the basement of the building.



Transportation mode for Soulr Cart



Fully deployed Soulr Cart

Task Name	Duration	Start
Demolition of old cart	14 days	Thu 2/2/17
Material Acquisition	14 days	Tue 2/14/17
▸ Construction of Subsystems	28 days	Tue 2/21/17
▸ Structure	21 days	Tue 2/21/17
Frame	7 days	Tue 2/21/17
Trailer Valet	1 day	Tue 2/21/17
Roof	14 days	Thu 3/2/17
Solar Umbrella	14 days	Thu 3/2/17
▸ Power	7 days	Tue 3/21/17
Refrigeration	1 day	Tue 3/21/17
Electronics/ Wiring	7 days	Tue 3/21/17
Solar Roof Electrical Wiring	1 day	Tue 3/28/17
▸ Testing of Subsystems	29 days	Thu 3/30/17
Testing Capacity	1 day	Thu 3/30/17
Testing Linear Actuators	7 days	Tue 4/4/17
Testing Solar Umbrella	7 days	Tue 4/4/17
Test Movement/ Trailer Valet	4 days	Thu 4/13/17
Test Electrical System	14 days	Thu 4/20/17
▸ Final Deliverables	6 days	Thu 5/11/17
PDR Presentation	1 day	Thu 5/11/17
Showcase Open House	1 day	Fri 5/12/17
FDR Due Date	1 day	Thu 5/18/17

Second Semester Schedule

	Part/ Material	Supplier	Cost (\$)	Quantity	Subtotal (\$)
Structure	Trailer**	Northern Tool + Equipment	750	1	750
	Frame**	Industrial Metal Supply	473.19	1	473.19
	Plexiglass	Eplastics	75	1	75
	Wood Laminent	Home Depot	0.79	3	2.37
	Starboard**	King Plastics	7	25	175
	Drawer Slides	Rockler	30	2	60
	Hindges	Home Depot	2	15	30
	Trailer Valet	Trailer Valet	340	1	340
	Lifting Mechanism	Progressive Automations	745	1	745
Electronics	Refrigerator**	Whynter	668.69	3	2006.07
	Batteries**	Whole Sale Batteries	85	3	255
	Charge Controller	Tmart	13.58	1	13.58
	DC converter	Ebay	3.1	1	3.1
	AC Inverter	Tripp-light	27.99	1	27.99
	Speakers	SoundBot	19.99	1	19.99
	Lights	Way Fair	20	1	20
Solar Roof	Solar Panels	NewPowa	219	3	657
	Microinverter**	Northern Arizona wind and sun	160.88	1	160.88
	Stainless Steel	Industrial Metal Supply	154.17	1	154.17
Total Cost:					5968.34
Contingency(20%)					1193.668
Total Budget:					7162.008
** Denotes sponsor funded					

Final Budget