Final Report

to

City of Albuquerque

at the Completion of Funding Period

(Contract # RCL0005806)

on

Sponsorship for SunChaser Program

From

New Mexico Solar Energy Association (NMSEA)

August 2022

1.0 Introduction

SunChaser2k22 is a Mobile Educational Tool (SC2k22MET) for instruction of solar technologies to New Mexico students. The goal of this project is to meet all five mission goals of any educational outreach program i.e. 1) Inspire, 2) Educate, 3) Employ, 4) Engage, and 5) Collaborate. This project based instruction and learning is so innovative that American Solar Energy Society had the SunChaser2k22 on display in their SOLAR 2022 National Conference at the University of New Mexico, Albuquerque, during June 21st to 24th, 2022.

Figure 1: Mayor Tim Keller showing his support for this project by having his picture taken in front of the SunChaser at ASES SOLAR 2022 National Conference at University of New Mexico and posting in his Facebook page [Courtesy: City of Albuquerque Environmental Health Department]

1.1 Development Phases

Development of SC2k22MET is planned to be completed in following four phases:

Phase I – Conceptualization of the program followed by the Engineering Design [January 2020 to August 2021]

Phase II – Construction of the mobile unit at ACE Leadership High School, Albuquerque [August 2021 to August 2022]

Phase III – Incorporation of the Smart System at Mechanical Engineering Department at New Mexico Tech [August 2021-August 2023]

Phase IV – Implementation in educating New Mexico students on solar technology [After August 2023].

Careful thinking from a large number of solar enthusiasts has gone into making every decision towards the building of this educational tool. This report has been prepared at the end of Phase II. Thus, this report briefly describes Phase I activities that have been accomplished before embarking onto Phase II which was just completed at ACE Leadership High School. A short account is also provided on the tasks that will be considered in Phase III. Once SunChaser2k22, a Mobile Educational Tool is ready, in Phase IV, it will be used to educate New Mexico students.

The project tasks are designed such a way that students find it a learning tool during each of the phase. At the end of Phase II, instructors from ACE leadership school has shared their thoughts collectively in following paragraph:

"For ACE students, there were many benefits from this project, including students taking on a real-world client with a strict deadline, and being introduced to a new and emerging industry in New Mexico. The largest and most significant component, however, is the positive youth development embedded in this project. ACE students have taken on leadership roles, with an emphasis on collaboration, all while learning new skills in blue print reading, carpentry, welding, sheet metal, photovoltaic, solar energy, and project management, which all happen to be in-demand trades in New Mexico and across the US. This is such a unique opportunity for our students and in the construction of the Sunchaser2k22, we get to teach our students skills that will carry on with them as they enter industry jobs and be workforce ready, including having firsthand knowledge of solar energy," said Brad Humble, instructor for the class that did the construction during Phase II.

1.1.1 Phase I: Conceptualization and the Engineering Design

Conceptualization for this project started towards the beginning of 2020 among the NMSEA board members. Under the leadership of Ashok Ghosh, a team of advocates/advisors, Athena Christoudoulou, Lois Fuller, Walter Gerstle, Greg Crabtree, Tom Solomon, Jayne Stewart, and Stefi Weisburd, conceptualized the path forward for this project. Some seed fund was created within NMSEA to support a number of summer interns to carry out a feasibility analysis. Gabriel Maestas, a graduate student in mechanical engineering and a NMSEA board member took the lead. Undergraduates from New Mexico Tech, Isaac Flores, Dana Figueroa and Seth Sisneros, were summer interns, worked under Gabriel towards collecting information. Preliminary model of this educational tool along with an informative short video was created that was used to contact City and County Councilors and local businesses to raise fund to support the construction of the SC2k22MET. The deliverables from 2020 summer internship were:

1. A preliminary design of the SunChaser Educational Tool, and
2. Created a 2 ½ minutes video to be used for marketing and fundraising for the project. The video is available at. https://www.nmsolar.org/sun-chaser-2020/

NMSEA successfully raised the required $20,000 fund from local government and for-profit entities for the construction of this project. The project also attracted in-kind support from a number of businesses local as well as out-of-state. Following table lists these sponsors for the SC2k22MET project.

ID#	Name and Affiliation	Amount ($ value) Cash or in kind
1	Debbie O'Malley, Bernalillo County Commissioner	8,000
2	Isaac Benton, Albuquerque City Councilor	8,000
3	Cynthia Borrego, President, Albuquerque City Councilor	2,000
4	Trudy Jones, Albuquerque City Councilor	1,000
5	Sherrick Roanhorse, PNM	1,000
6	ACE Leadership High School	In kind towards construction
7	UniRAC	In-Kind
8	Warmboard	To be added
9	Affordable Solar	To be added
10	Future Mechanical	To be added

1.1.2 Phase II: Construction of SC2k22MET at ACE Leadership High School

The SC2k22MET Project Based Education has improved the skills in science, technology, engineering, and mathematics of the students involved at New Mexico Tech and in ACE Leadership High School. The project also created a productive dialogue regarding how a large number of institutions collaborate and complement each other to make any project a success. The full concept of this educational tool is aired through Explora's NM Science Fiesta 2021. The recording is available at the link below:

https://drive.google.com/file/d/19qebnlfUcHKdieddIo_wP2vwru1K-Tb7/view

During the summer of 2021, two new undergraduate interns, Yazbeth Montoya and Frank Maldonado from New Mexico Tech joined to complete the design of SC2k22MET. They worked alongside Gabriel to finalize the construction drawings. A new board member Andrew Stone joined NMSEA and got involved advising the interns during the summer.

During the Fall of 2021, NMSEA partnered with ACE Leadership High School in Albuquerque to construct SC2k22MET. ACE has a focus of hands-on learning through Architecture, Construction, and Engineering (ACE) https://www.aceleadership.org/. The SC2k22MET project brought together NMSEA board members, engineering interns, City of Albuquerque Councilors, Bernalillo County Commissioner, ACE leadership high school instructor and students, and a number of businesses.

Figure 2: Students at ACE Leadership High School with the newly completed framing for the SC2k22MET project.

Over the course of the 2021-2022 school year, the vision of NMSEA for a modern Sun Chaser was realized by students in the senior class at ACE. Through project-based instruction at ACE, students learned and used various construction techniques including welding, carpentry, and sheet metal work to create this mobile classroom from an existing flatbed trailer. In addition to learning and applying blueprint reading, technical construction skills, and project management, the students learned the importance of communication and working as a group to complete a large project.

Figure 3: The construction of the Sunchaser2k22 is seen here from its initial framing to near completion

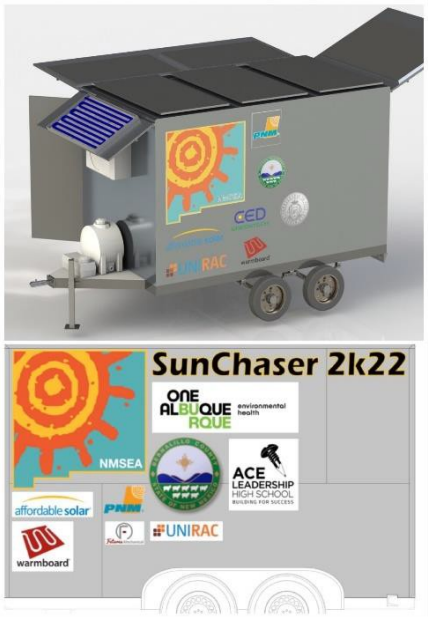

Figure 4: A design of what the Sunchaser2k22 will look like once completed.

"No other project like this exists in the United States and the impact it has will carry with the students as they begin their post-high school life and entering the ACE industries. This project also helps educate the public about the benefits of renewable energy" said by Mathew Salas of ACE Leadership high school.

1.1.3 Phase III: Adding Smart System to SC2k22MET at Mechanical Engineering Department at New Mexico Tech [August 2022-August 2023]

During this phase, the following tasks will be performed by the Mechanical Engineering Design Clinic team at New Mexico Tech:

1) **Installation of a water system** - The water system will be included in order to demonstrate solar heating using a thermal panel and a radiant flooring system. The piping will be made up of mostly of aluminum PEX so that the radiant flooring can be the most efficient it can be. There will be three 15-gallon water tanks on the outside of the model to store cold water, hot water, and gray water. A sink and a water pump will also be included.
2) A 700W microwave and a minifridge will be added in the interior of SC2k22MET.
3) **Electronic Control System** - Smart control system for the solar panel awnings. The awnings will be on both of the smaller sides and on the side with the door. The same smart system will control the water system.
4) A mini split will also be included. The data module that will be attached will be a 4G data module that will allow the user to view and control the charge coming into the home from their phones and finally

5) Adding Grade wise Instructional material.

Figure 5 illustrates the water system to be added during Phase III.

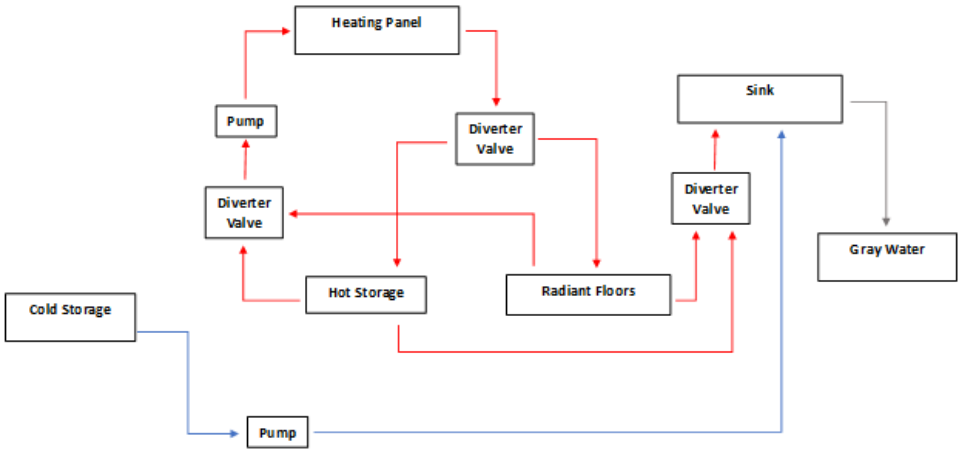

Figure 5: Water flow diagram in the SC2k22MET

1.2 Financial Information

Construction of the SC2k22MET project has been greatly impacted by the recent price rise due to inflation. The table below provides the line by line expenditures for the project.

	A	B	C	D	E	F	H	I	J	K	L
	original transaction	Date to Bank	Check #	To/From	Category	Notes	Deposit	Expense	Balance (Checking)		
	5/19/21	5/20/21		PNM	Income: Donations (Sunchaser)		$1,000.00		$1,000.00		
	7/22/21	8/20/21		City of Albuquerqu	Income: Donations (Sunchaser)		$11,000.00		$12,000.00		
	5/19/21	5/24/21	137	J&B Automotive	Expenses: Sunchaser	deposit on trailer		$500.00	$11,500.00		
	6/25/21	6/29/21	141	J&B Automotive	Expenses: Sunchaser	trailer balance		$2,795.00	$8,705.00		
	6/25/21	6/29/21	142	J&B Automotive	Expenses: Sunchaser	electrical brake adapter		$42.47	$8,662.53		
	6/21/21	7/28/21	144	Walter Gerstle	Expenses: Sunchaser	Title and Registration for Trailer		$200.88	$8,461.65		
	8/16/21	8/19/21	146	Gabriel Maestas	Expenses: Sunchaser	summer stipend		$2,000.00	$6,461.65		
	9/17/21	9/17/21	debit card	CamperiD	Expenses: Sunchaser	door and two windows		$1,336.70	$5,124.95		
0	9/22/21	9/22/21	debit card	Reliance Steel Company #12	Expenses: Sunchaser	steel		$690.18	$4,434.77		
1	10/4/21	10/14/21	150	nce Steel Company	Expenses: Sunchaser	more steel		$690.46	$3,744.31		
2	10/15/21	10/27/21	153	Warm Board Inc.	Expenses: Sunchaser	shipping and		$323.63	$3,420.68		
3	2/17/22	2/18/22	debit	Marco Steel	Expenses: Sunchaser	aluminum sheets		$568.56	$2,852.12		
4	2/20/22	2/21/22	debit	Amazon	Expenses: Sunchaser	2 rolls of tape		$159.66	$2,692.46		
5	2/20/22	3/20/22	debit	Amazon	Expenses: Sunchaser	2 more rolls of tape		$197.74	$2,494.72		
6	2/22/22	3/23/22	debit	Marco Steel	Expenses: Sunchaser	aluminum sheets		$568.56	$1,926.16		
7	5/3/22	5/3/22		Amazon	Expenses: Sunchaser	battery cable set		$31.05	$1,895.11		
8	5/3/22	5/4/22		Amazon	Expenses: Sunchaser	charge controller		$771.66	$1,123.45		
9	5/3/22	5/4/22		Amazon	Expenses: Sunchaser	3 more battery cable sets		$74.01	$1,049.44		
0	5/3/22	5/5/22		Walter Gerstle	Expenses: Sunchaser	electrical equipment - reimburse Walter, who paid Renogy with his credit card		$6,189.84	-$5,140.40		
1	5/17/22	5/17/22	Debit	Amazon	Expenses: Sunchaser	4 gas struts		$98.32	-$5,238.72		
2	5/24/22	5/24/22		Amazon	Expenses: Sunchaser	3 linear actuators		$168.24	-$5,406.96		
3	5/26/22	5/26/22	debit	Fast Signs	Expenses: Sunchaser	decals		$302.64	-$5,709.60		
4	6/5/22	6/5/22		Amazon	Expenses: Sunchaser			$92.75	-$5,802.35		
5	6/9/22	6/15/22	#172	Lowe's	Expenses: Sunchaser	misc. supplies for SunChaser (see paper invoices)		$1,184.73	-$6,987.08		
6	5/17/22		debit card	Amazon	Expenses: Sunchaser	3 linear actuators; 2 55 lb gas struts, 2 35 lb gas struts		$266.56	-$7,253.64		
7	6/27/22		#178	Gabriel Maestas	Expenses: Sunchaser	PV wires for		$149.87	-$7,403.51		
8	6/27/22		#179	Alpha and Omega Electric, LLC	Expenses: Sunchaser	Electrical Work		$373.79	-$7,777.30		
9	6/28/22		#180	FastSigns	Expenses: Sunchaser	more decals for Sunchaser		$534.63	-$8,311.93		
0	6/28/22		#181	Stefi Weissburd	Expenses: Sunchaser	Print Brochure for Sunchaser - reimbursement		$117.00	-$8,428.93		
1	7/9/22		#3001	Lowe's	Expenses: Sunchaser	supplies		$1,816.27	-$10,245.20		
2	2/17/22	3/14/22	Inv. 105	Bernalillo County	Income: Sunchaser	alum sheets: reimb	$568.56		-$9,676.64		
3	4/7/22	4/12/22	vs 107,1	Bernalillo County	Income: Sunchaser	2 rolls of tape; alum sheets: reimb	$766.30		-$8,910.34		
4	5/3/22	6/27/22	Inv. 109	Bernalillo County	Income: Sunchaser	invoice #109	$148.09		-$8,762.25		
5	3/20/22		Inv. 106	Bernalillo County	Income: Sunchaser	2 rolls of tape reimb.	$159.99		-$8,602.26		
6	5/4/22		Inv. 110	Bernalillo County	Income: Sunchaser	reimbursement for Renogy (balance of $8000 pledge)	$3,115.21		-$5,487.05		$7,947.21
7	10/21/21	10/21/21	Inv. 102	County through W	Income: Sunchaser	reibursement	$1,336.70		-$4,150.35		
8	10/4/21	10/27/21	Inv. 103	County through W	Income: Sunchaser	reimbursement invoice 103	$1,380.64		-$2,769.71		
9	10/15/21	12/6/21	Inv. 104	Bernalillo County	Income: Sunchaser	Warmboard Inc.	$323.63		-$2,446.08		
0	5/3/22	6/27/22	Inv. 109	Bernalillo County	Income: Sunchaser	invoice #109	$148.09		-$2,297.99		
5							$19,947.21	$22,245.20	-$2,297.99	-$2,297.99	
6							Deposit	Expense	Balance	Income Less Expense	
7											

Thus, a sum of $2,297.99 was over spent to complete the construction of Phase II. The same amount is contributed by NMSEA towards the construction of the project. NMSEA is preparing for a new fund raising drive to raise another $10k towards the completion of remaining tasks of the project during Phase III.

2.0 Conclusions

The project got wide publicity from community members all across US during the SOLAR 2022 National Conference. American Solar Energy Society's March issue of Solar Today has an exclusive article on this project written by Gabriel Maestas. The same is available on page 13 of the magazine [softcopy of the magazine is available at the link]
https://www.omagdigital.com/publication/?i=742296