Hydrogen Farming

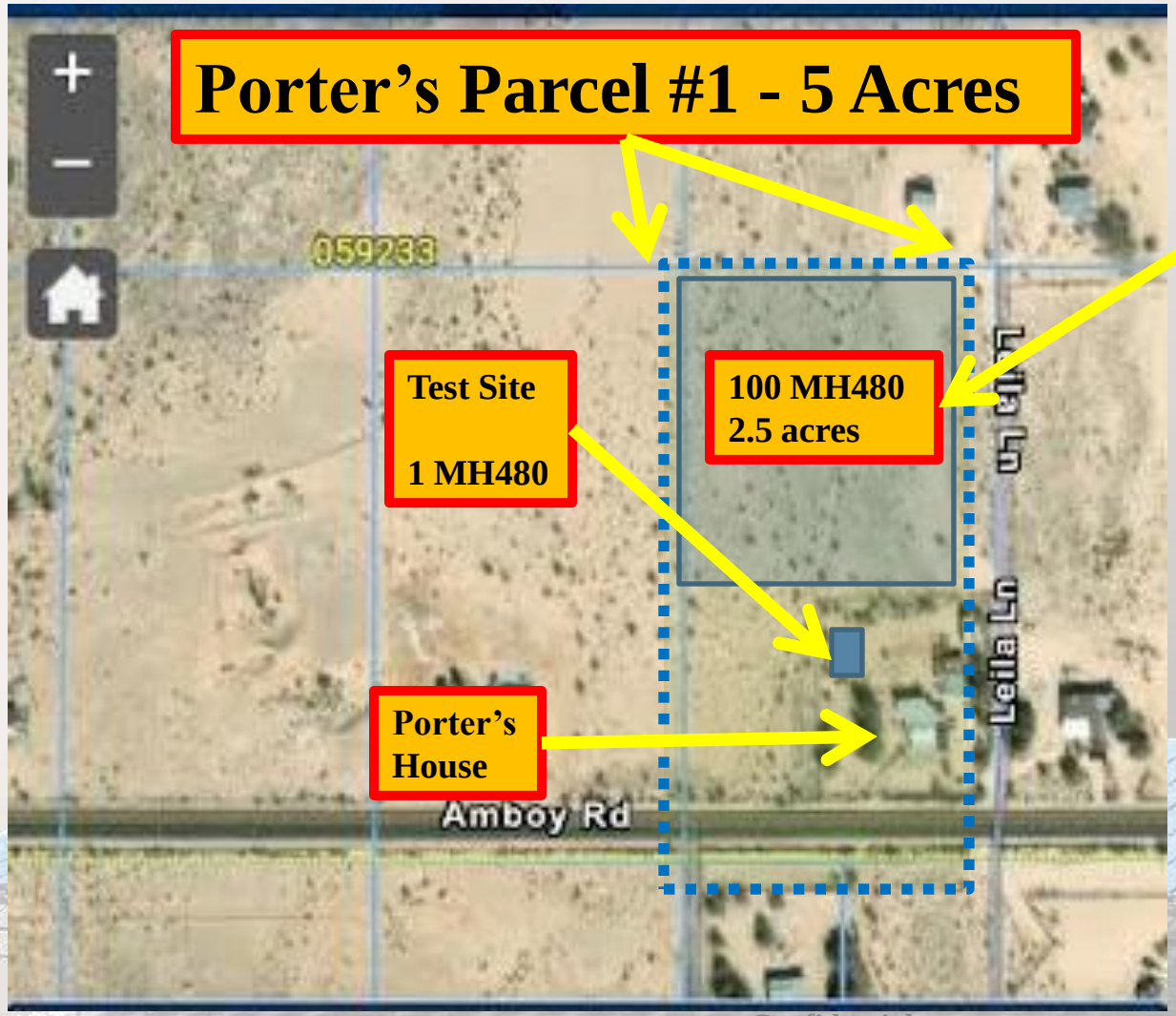
Green Hydrogen from the Desert

The Mini Power Tower

- Introducing the worlds first Solar collector that can be considered as **real-estate** because of long life and easy maintenance.
- The All aluminum construction (99%) is life time!
- Key words: agrarian, ergonomic, upwardly compatible, robotically maintained, economical.
- Fits conveniently on 2.5 acres. 100 units fit in a 10 by 10 grid, 330 feet X 330 feet is 2.5 acres

SITE FOR THE PROPOSED HYDROGEN FARM

5 Acre Parcel with my Home



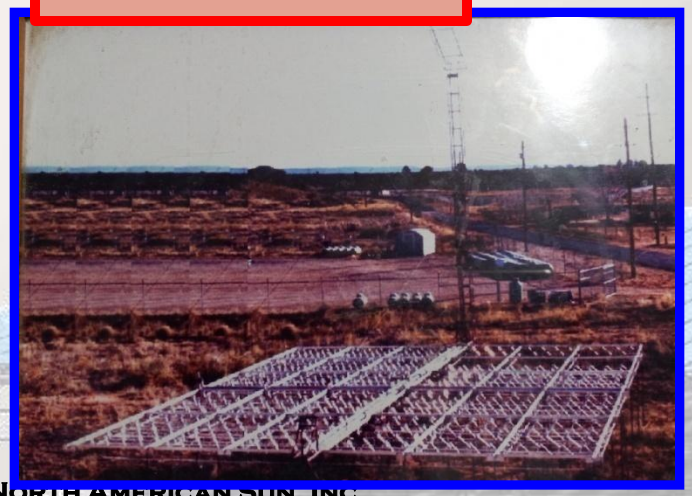
Fits conveniently on 2.5 acres. 100 units fit in a 10 by 10 grid, 330 feet X 330 feet is 2.5 acres

THE MINI POWER TOWER PROTOTYPES

MH32 and MH480 Prototypes

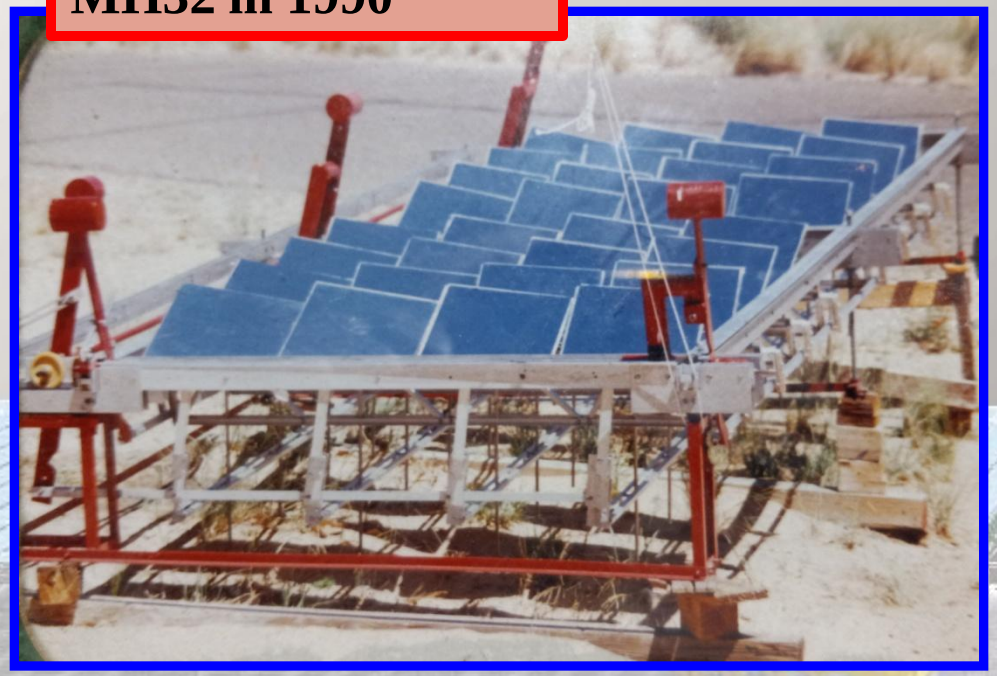
MH480 in 1996

MH480 in 1998



All Aluminum Construction is why these prototypes survive today! 30 years old

MH32 in 1990



Test Site in 2024 - 30 years later

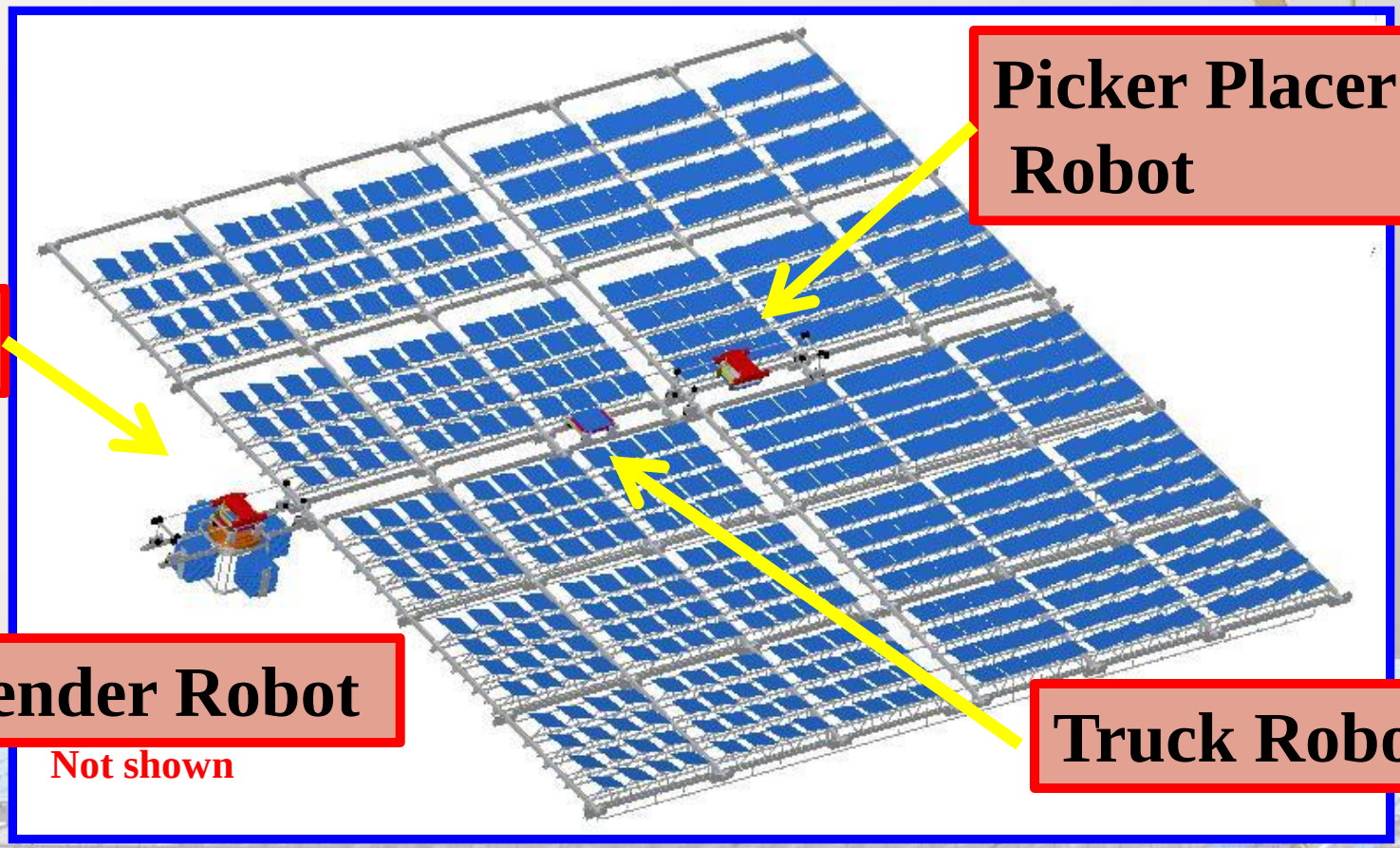
Ready for testing: tracking, robotics & first receiver. 30 year old Test BED is as good as new!

It stood the Test of time!

AUTOMATIC SERVICING ROBOTS

MH480 Re-Imagined 2024

Robots provide for effortless maintenance



Purpose of the Robots

- Robots provide for automatic servicing and refurbishing.

- Each day the mirrors are retrieved from the Kiosk and installed in the field.

- Each night they are returned to the Kiosk to be protected in a dust free environment.

- Daily the mirrors are cycled through an air cleaning process. This keeps them pristine and dramatically increases mirror life. Which means system performance does not degrade with time. This is consistent with life time performance goal's and Solar Collector that behaves like real-estate

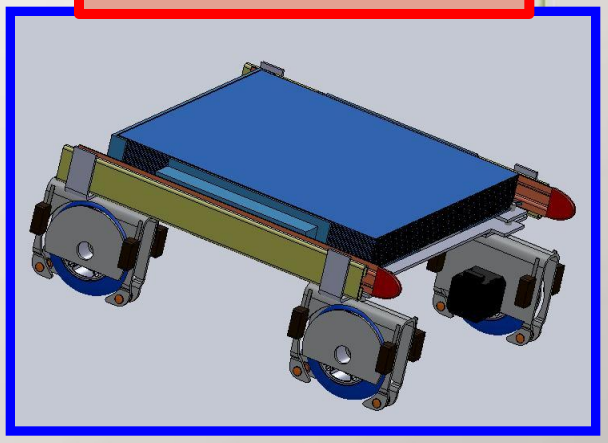
- If bad weather: wind, rain or snow comes the mirrors can be quickly stored and protected.

- The Tender Robot's Purpose is discussed below.

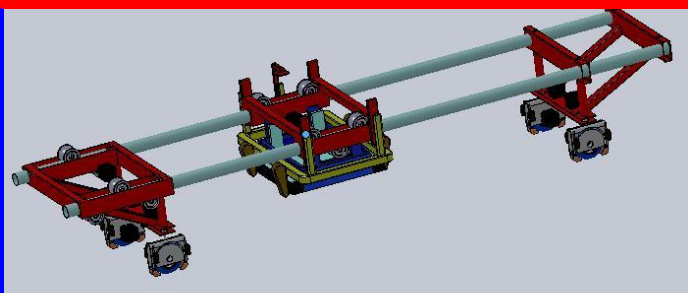
Main Frame Refitted with a Track

NEW Robot Track

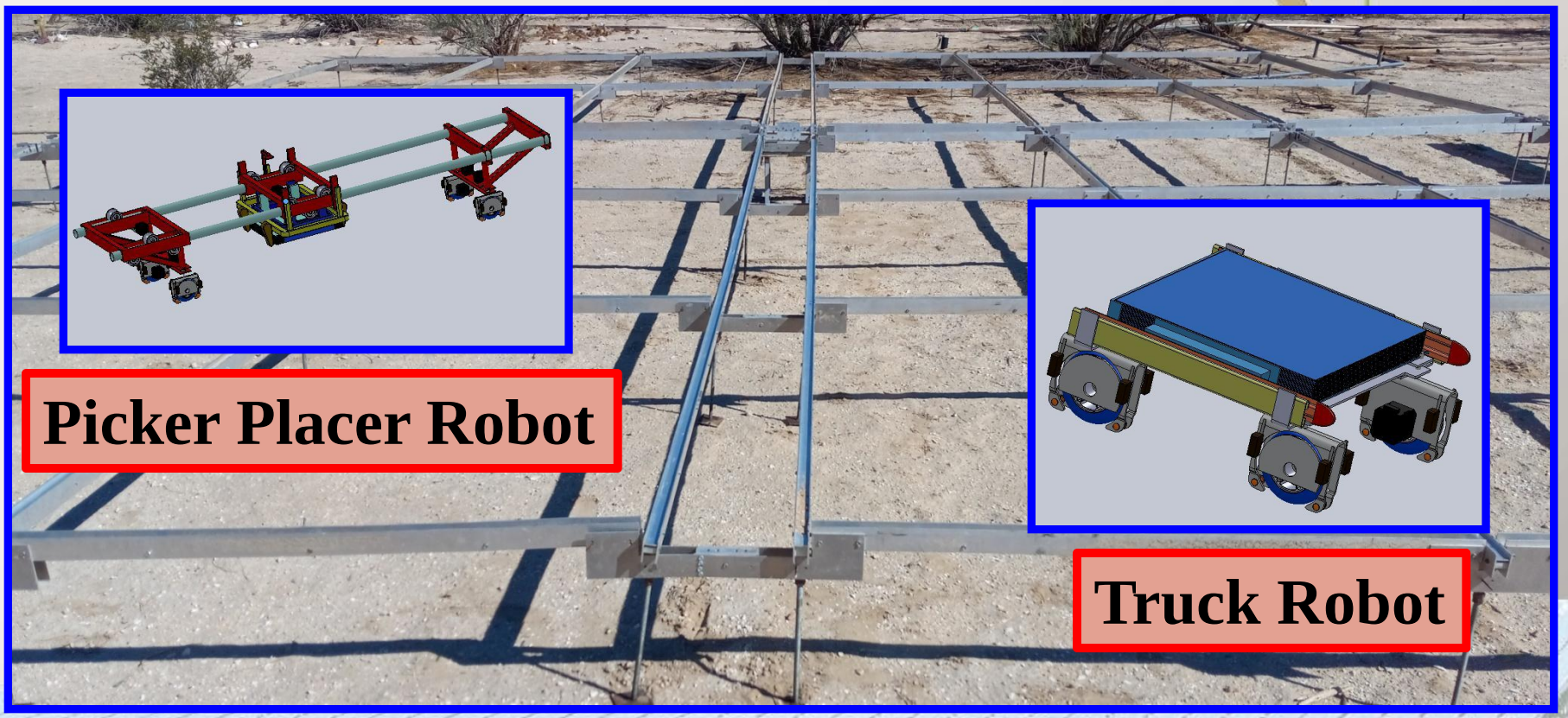
Truck Robot



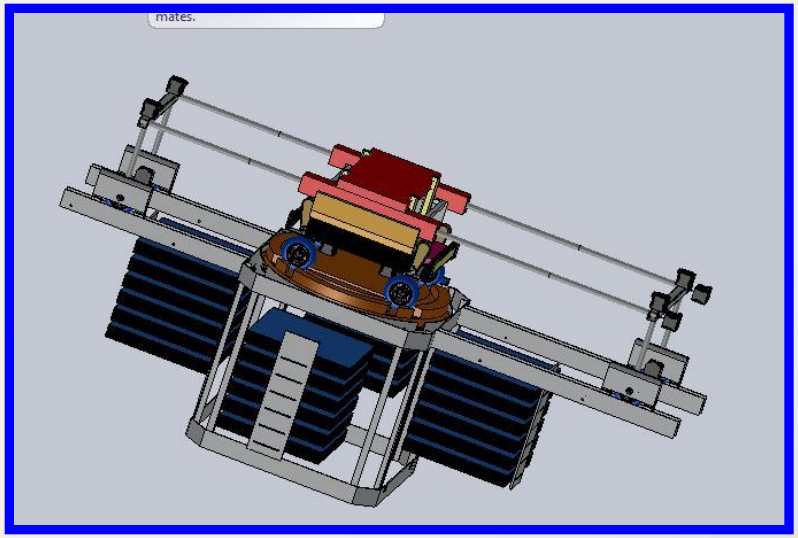
Picker Placer Robot



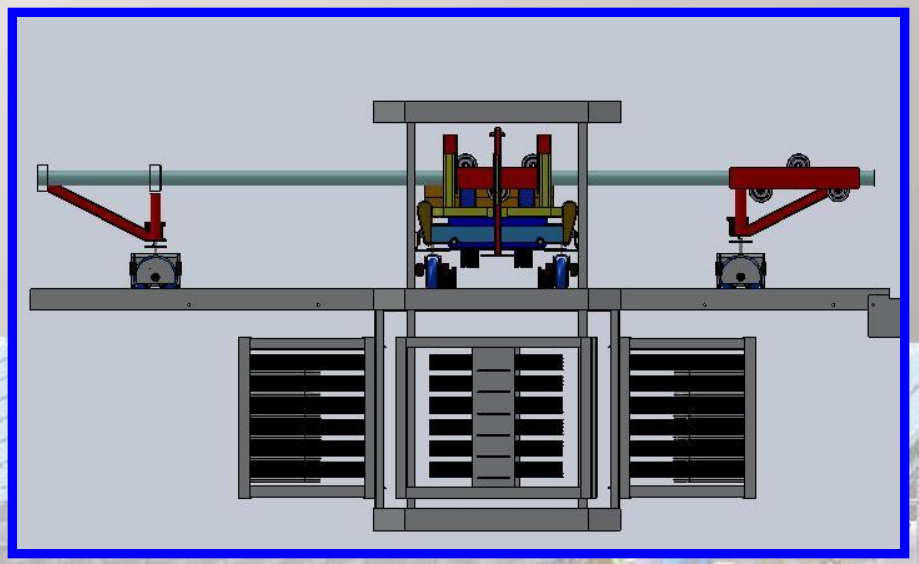
View Looking North



The Kiosk with Elevator



Robots meet at the Kiosk to Perform Air Cleaning



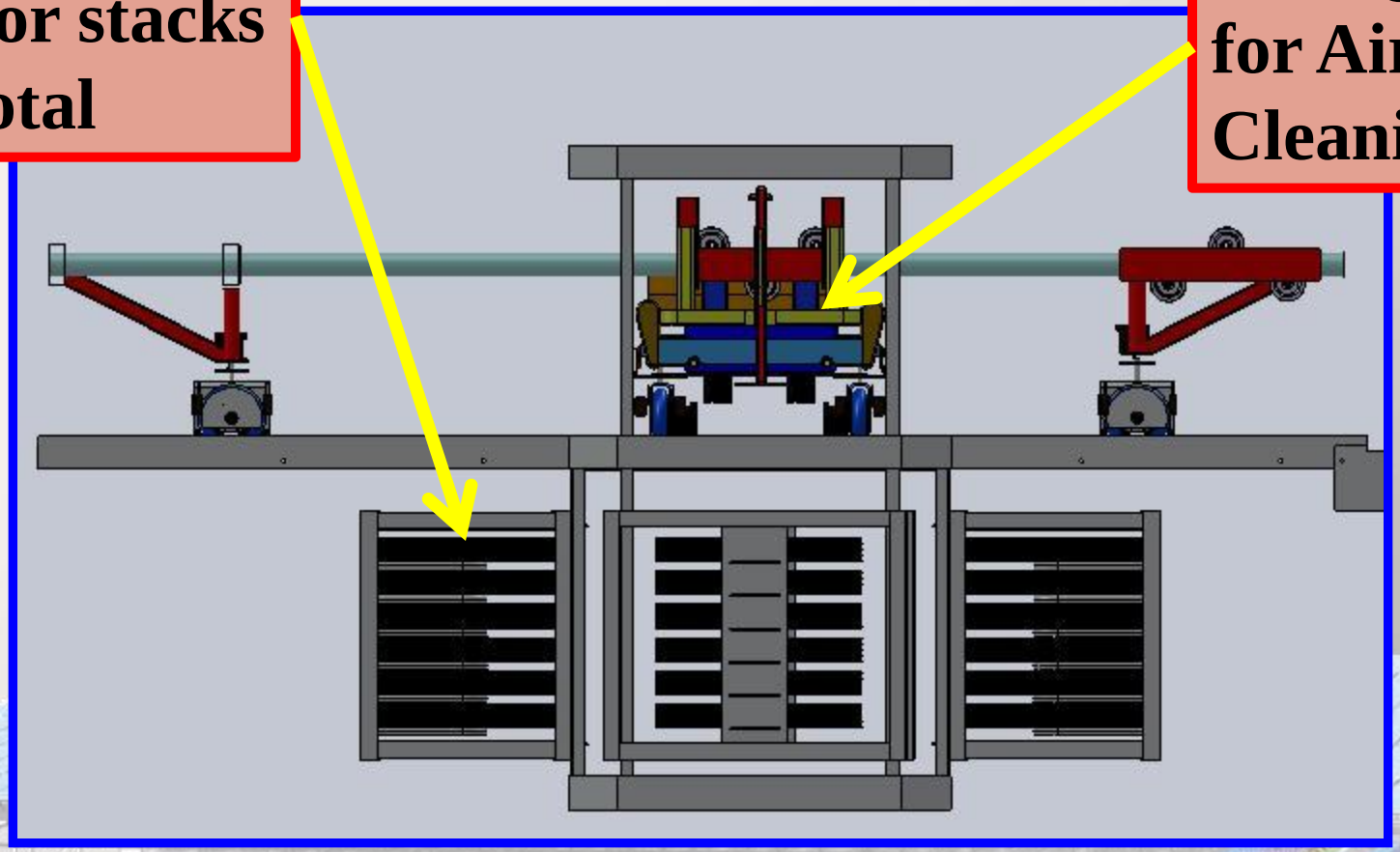
Mirrors are Packetized for Convenient Storage

There are 20 mirrors to a single packet
24 packets per Solar Collector

Kiosk Shown Without its Covering

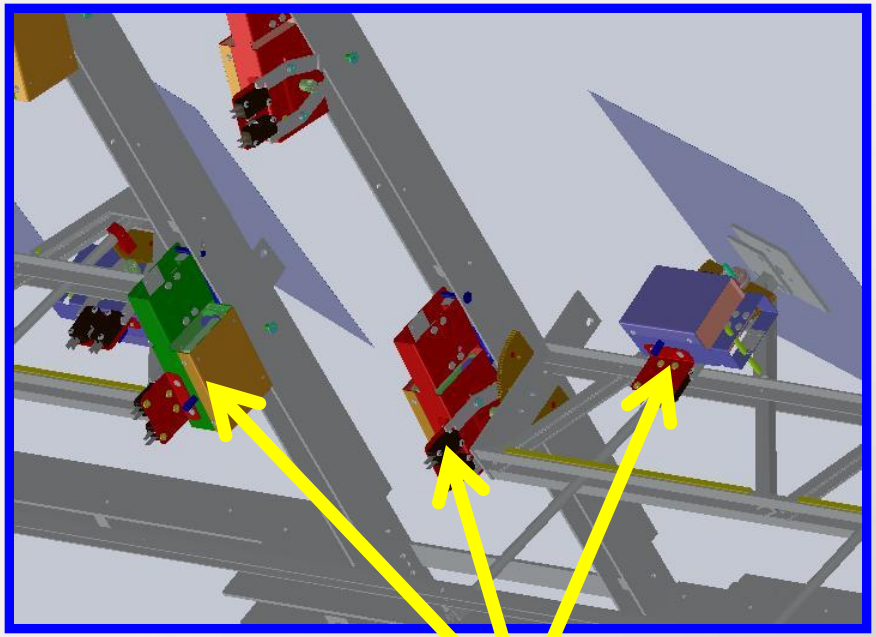
Packetized mirror stacks 24 Total

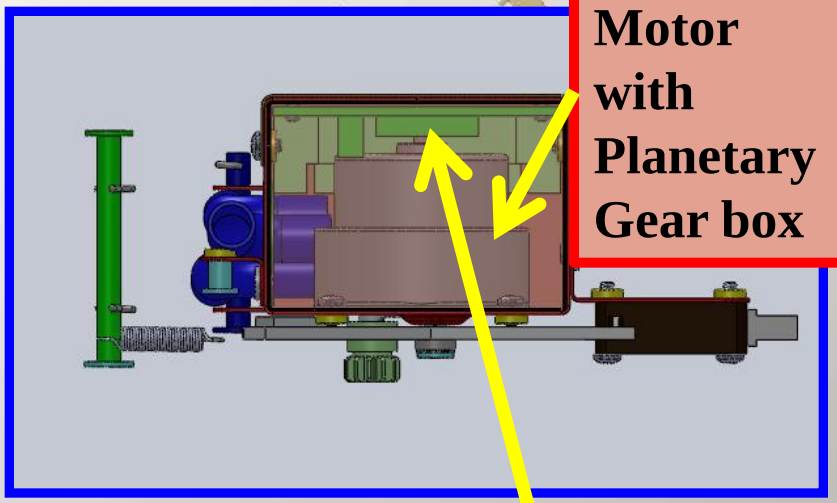
Configured for Air Cleaning



CONTROL BOXES AND GEAR DRIVES

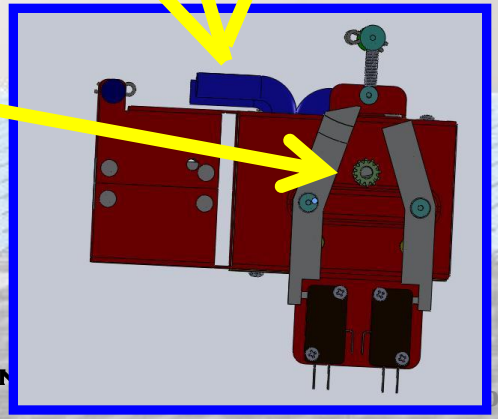
Control Motors and Gear Boxes





Stepper Motor with Planetary Gear box

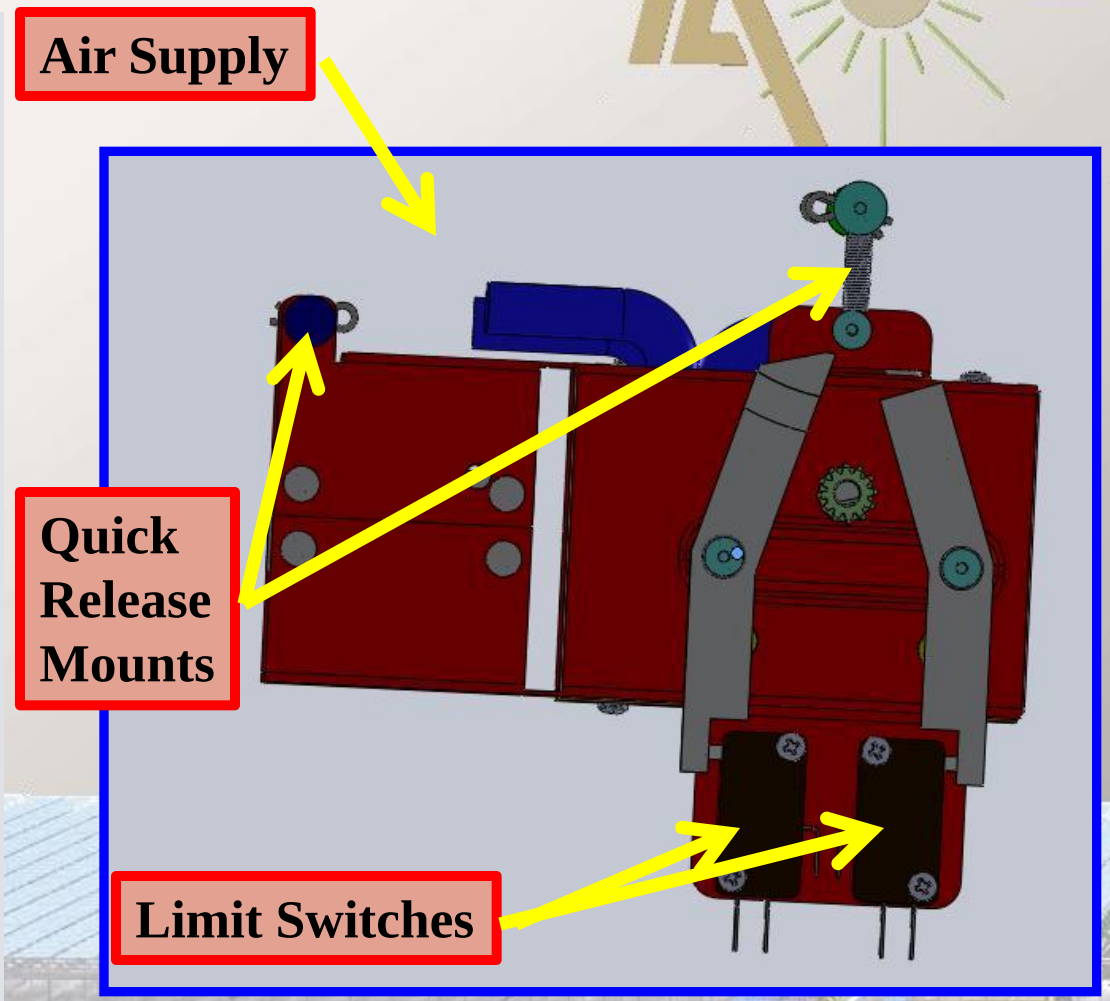
Pinion Gear



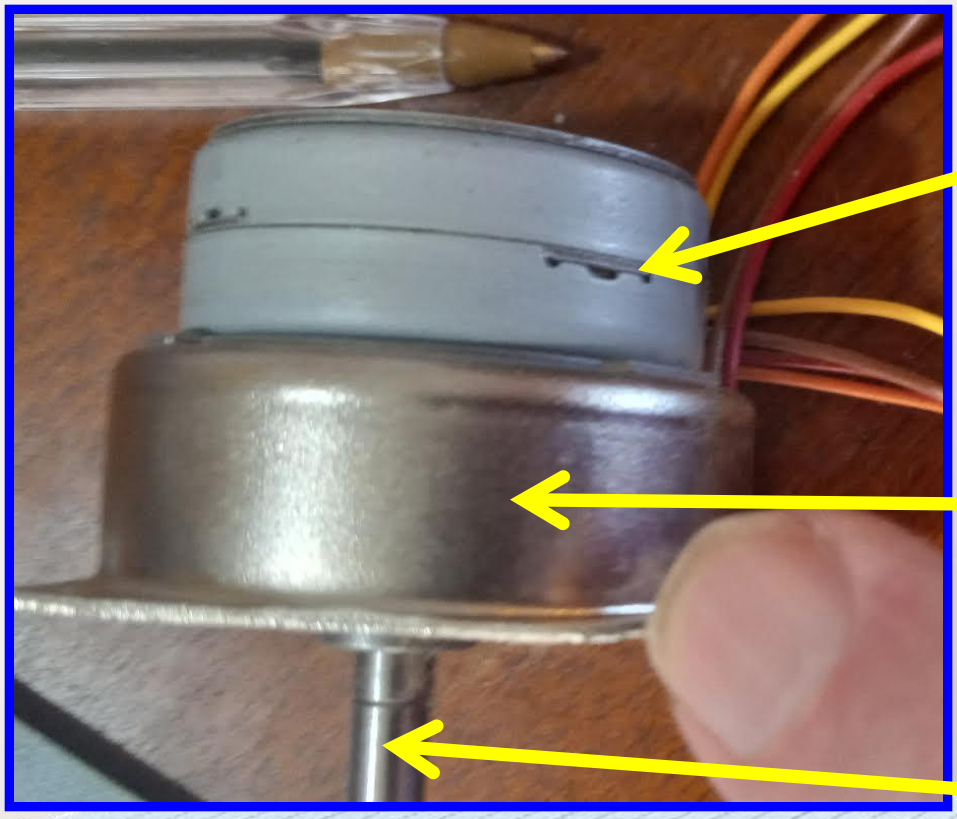
Motor Control Board

Drive Motor features

- Easy to calibrate Long Life.
- Dry Air supply so that even outdoors motors only see dry air and age like they are in an indoor environment.
- Limit Switches allow for accurate calibration when working with the Tender Robot Calibration System.
- Quick release allows for convenient replacement.
- 40 motors daisy chained in one “snake” that supplies dry air, Power and communications.
- Snake easy to replace. Design target 10 years.

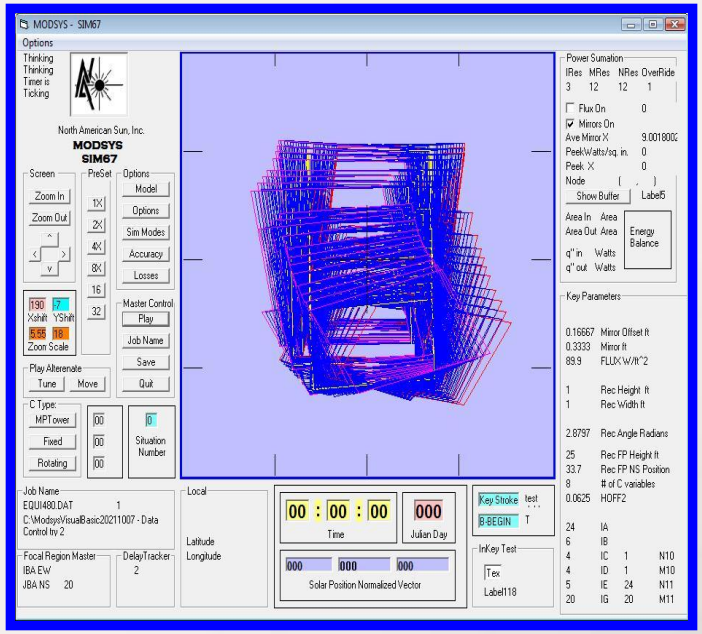


Gear Motor

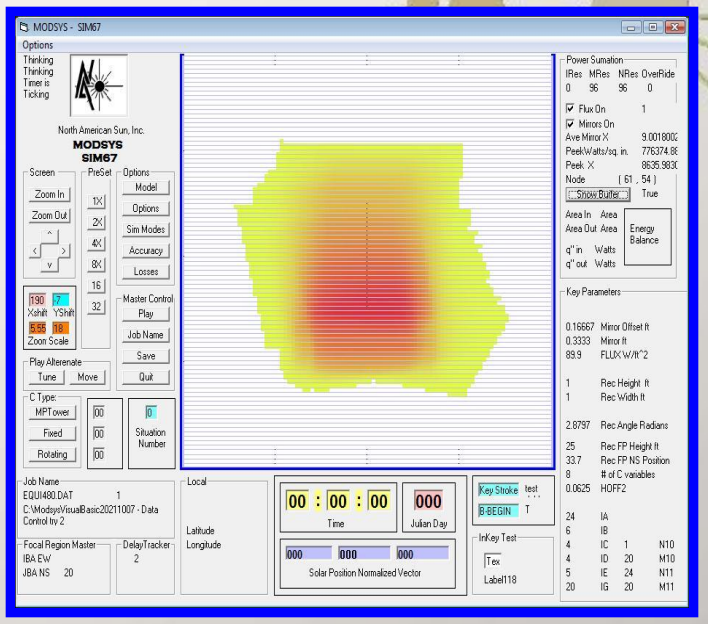


SIMULATION DRIVEN TUNING

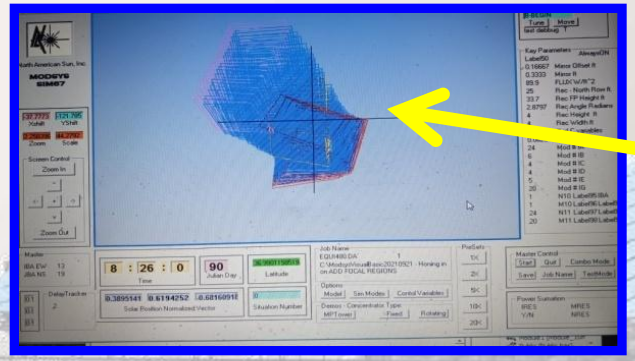
Simulation Driven Tuning



Simulation of 480 Mirror Images

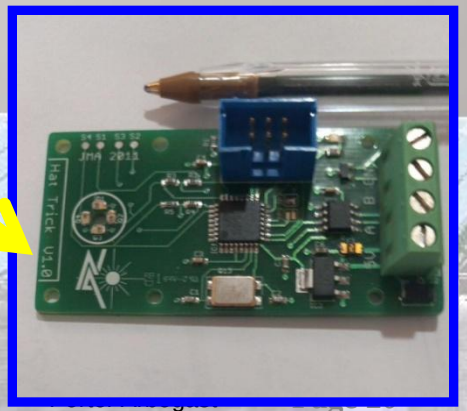


Heat flux Contour Map



Simulated image changes shape with time of day and season

Proprietary Sensor with our Logo



MODSYS Simulation
Our secret Sause

Goal 1000 Concentrations

Screen represents the receiver.

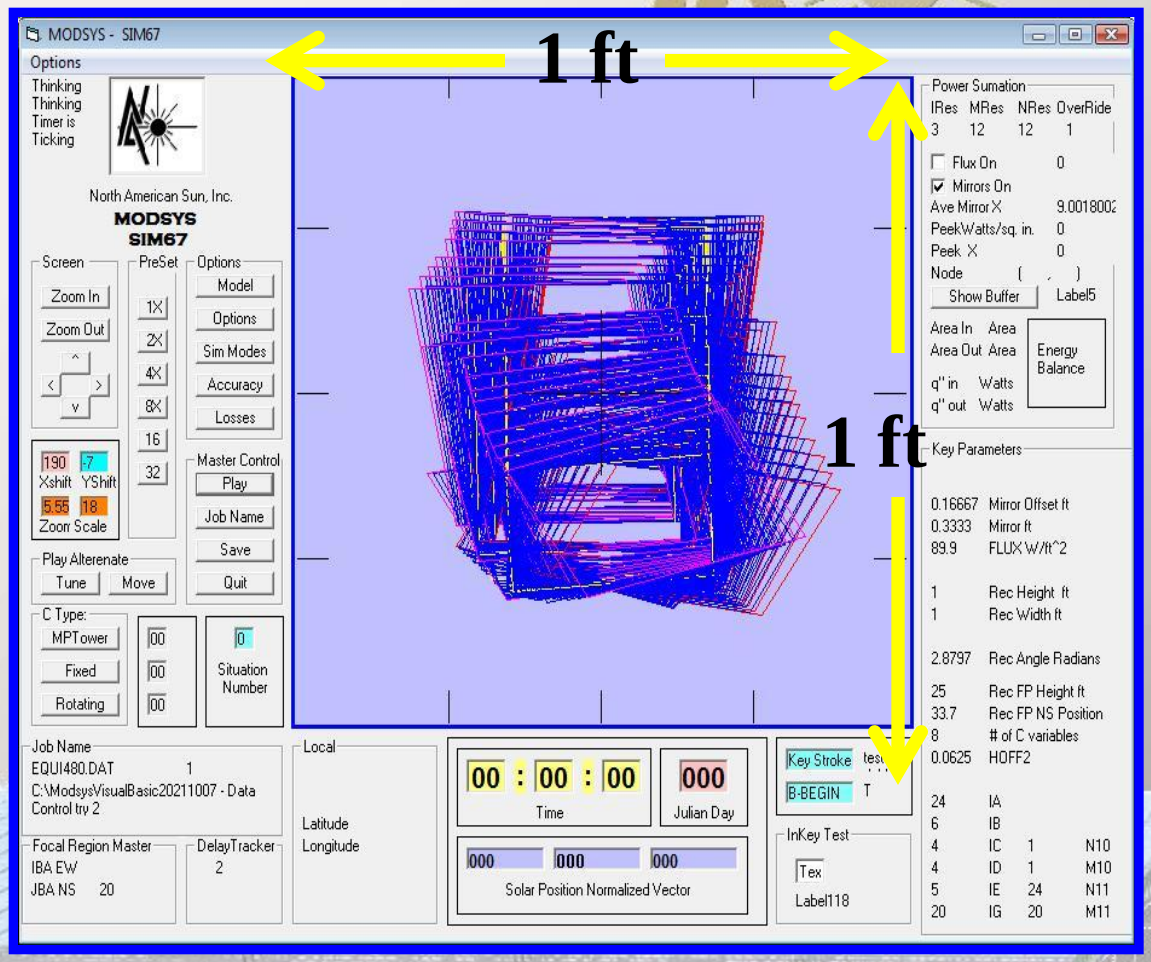
The image is of 480 mirrors overlapping

The Mirrors are curved to provide additional concentration.

The images on the receiver are approximately 4 inches in diameter.

We use a 4 inch 4 sided trapezoid to simulate this. Here 480 trapezoids are over lapping .

They all fall within about a **8** inch by **8** inch square which represents 1000 concentration s, just right for the HCPV cells well be using



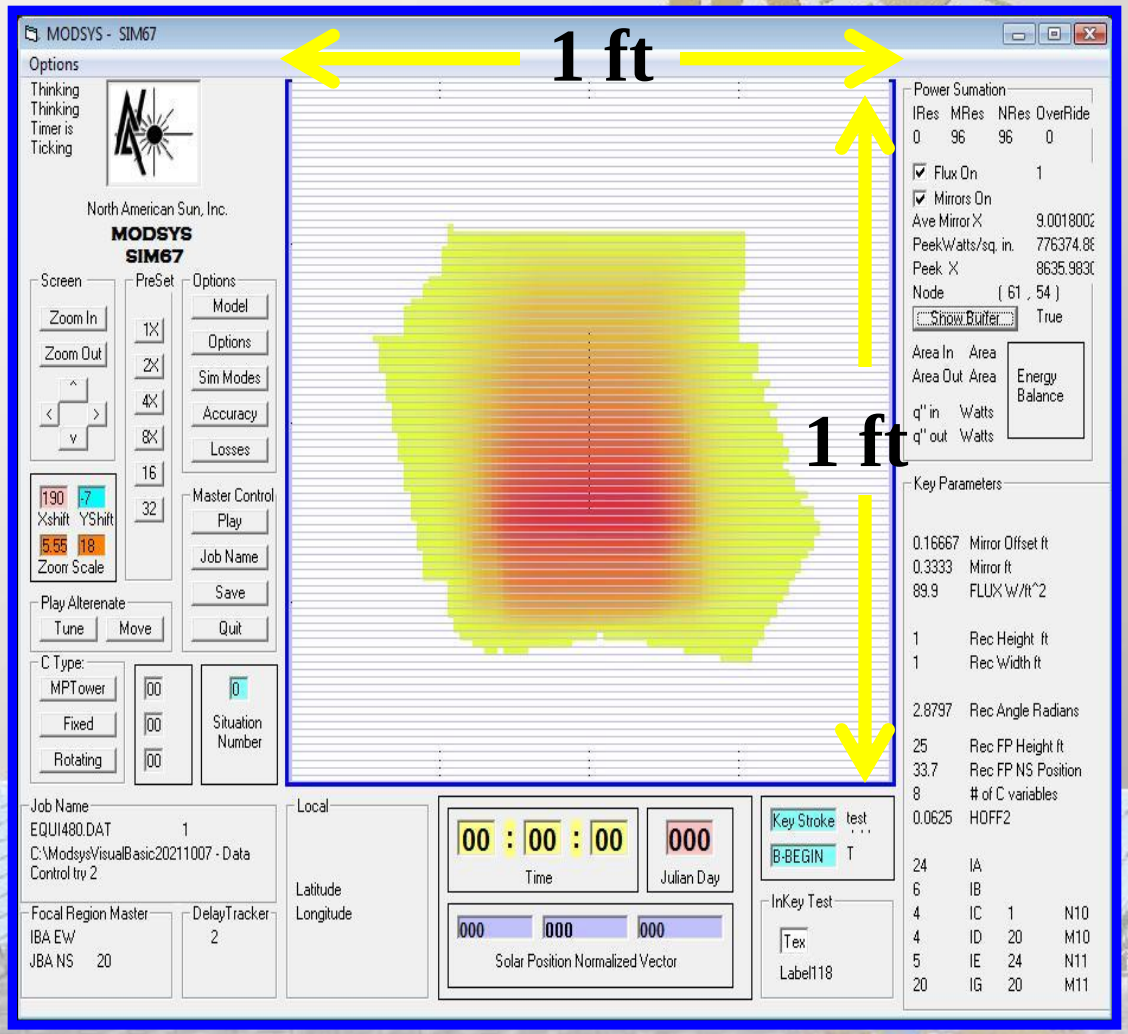
Goal 1000 Concentrations with no hot Spots

- MODSYS Simulation

Heat Flux Contour Map

Heat Flux Contour Map

Shows the shape of the Expected Flux with and where peek flux occurs



The Tender Robot "OUR SECRET SAUSE"

- The Tender Robot is the Tuning Robot.
- You need just one for a field of 100 Mini Power Towers.
- It's budgeted to cost about 6000 dollars to build. However it only adds 60 dollars to the cost of each Unit as it is shared by all the Units.
- It assists the in tuning by moving the tuning sensor around the field to calculate the pose.
- Then it tweaks the system every couple of weeks to optimize performance, according to simulation predictions.
- Rechecks the Pose as necessary, all Automatically!

MIRROR

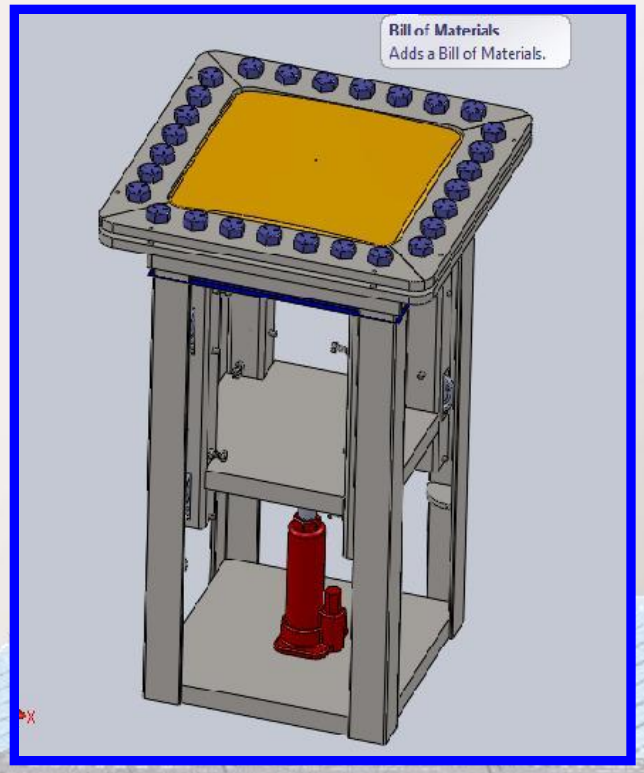
Mirror Technology

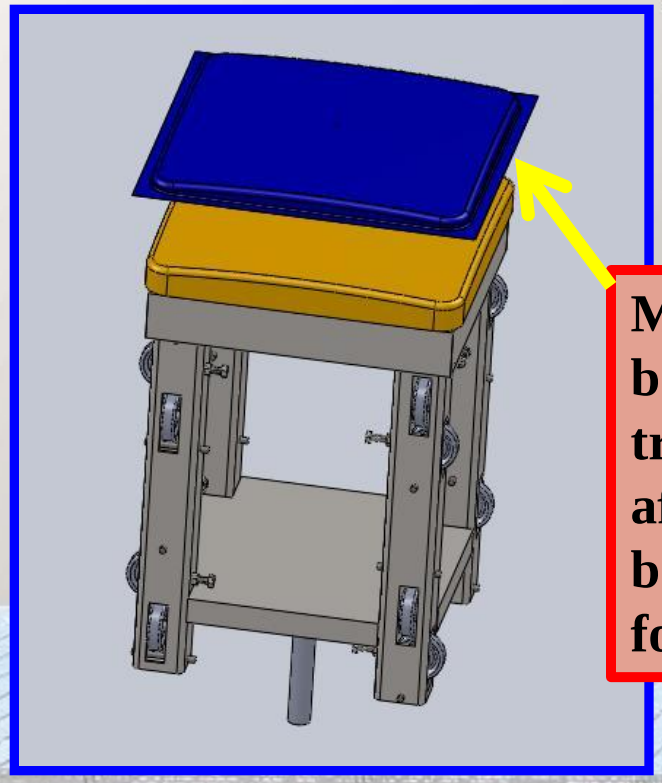
- Our Mirrors made from Alanod
- Alanod in general is not thought to be a good solar product, because it wares out with water cleaning. But we are air cleaned!
- Our air cleaning system changes that. It Keeps the mirrors pristine day after day with practically no wear.
- If water is never allowed to emulsify with dirt then the surface stays very clean.
- These samples were of course abused and scratched over 20 years.
- If the mirrors do degrade over time. They are very easy to refurbish a new set just needs to be loaded into the Kiosk.
- The old set still has value and can be sent to be resurfaced.
- As mirror Technology improves Mirrors again can be easily automatically replaced.

Alanod Mirror Samples

Mirror Production

We utilize a stretch forming Technique to produce the curved mirror surface





Mirror before trimming after it has been stretch formed.

Magnetic Mirror Mounts

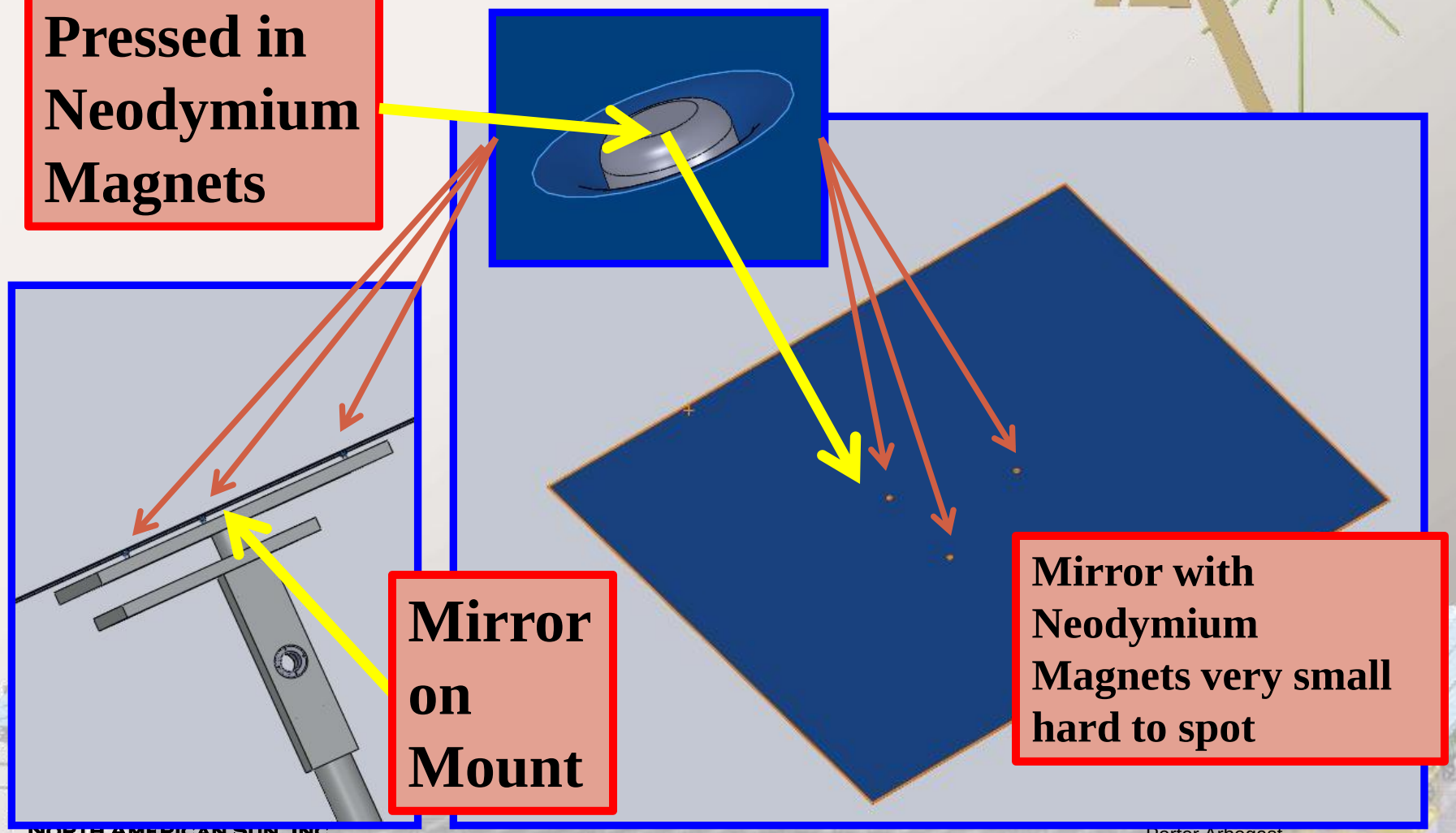
Ceramic Magnets

- Neodymium is a rare earth metal that makes extremely strong magnets.
- In our older prototypes we used ceramic refrigerator magnets for the mirror mounts. Neodymium magnets did not become readily available till around 2005
- In our current design we've replaced ceramic magnets with nickel plated neodymium magnets which cost less and are 10 times as strong.
- There are 3 Magnets per Mount for a secure fit
- All the Mirrors have matching magnets.
- There are 2 MP4's to view at this time too memory demanding to include in a PowerPoint presentation please view them now: **MirrorMount.mp4**

PickerSimulation.mp4

- With Neodymium the magnetic bond is so strong that even heavy winds wont knock the mirrors off if properly feathered.

Mirrors with pressed in Neodymium Magnets



RECEIVER

Receiver Design

High Temperature PV Cell handles 1200 X concentrations.

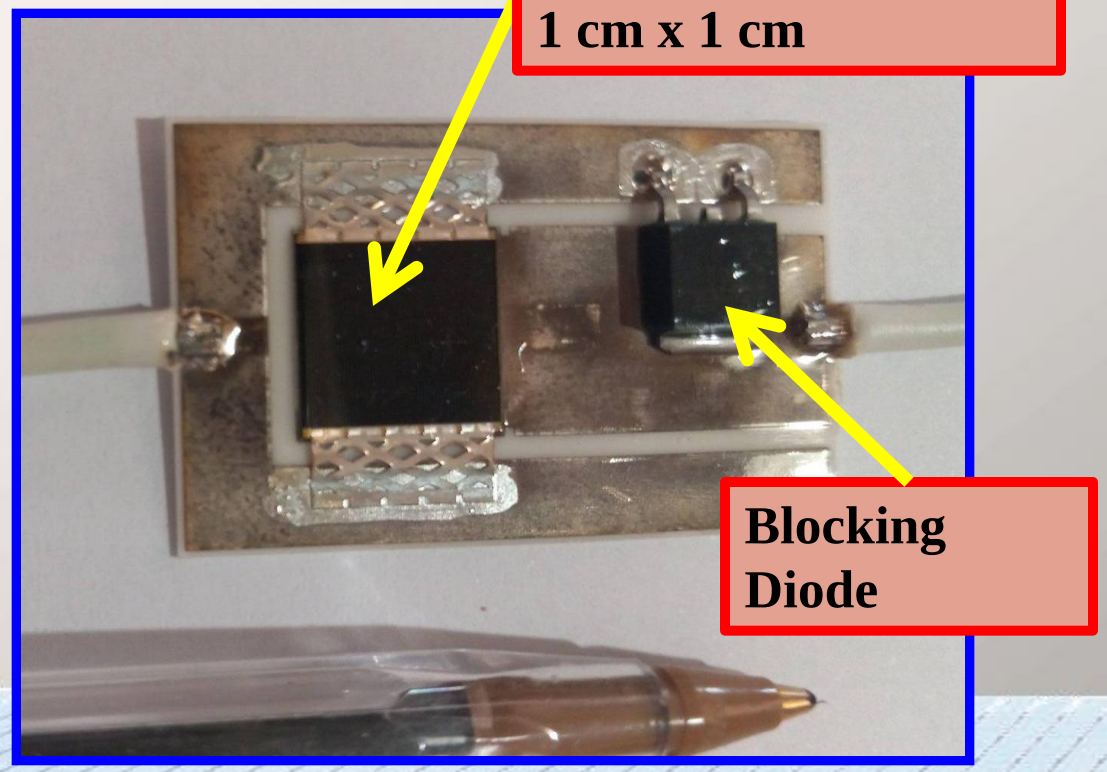
256 Cells in all with prisms attached to the front.

Dual cooling chambers provide for impingement cooling to the back of cell while allowing for easy disassembly.

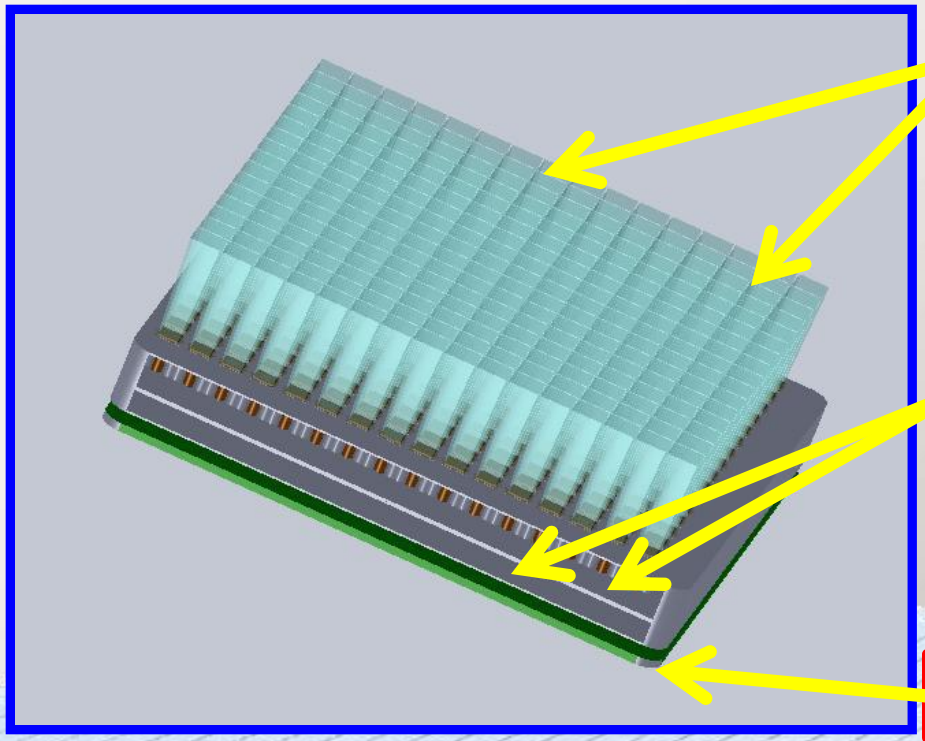
Circuit board mounted on back consolidates the 3 volt output of the cells.

Electrolysis is performed - Hydrogen is made on an adjoining package. From the power supplied

24 % efficiency has been achieved



HCPV Receiver



Prisms TIR

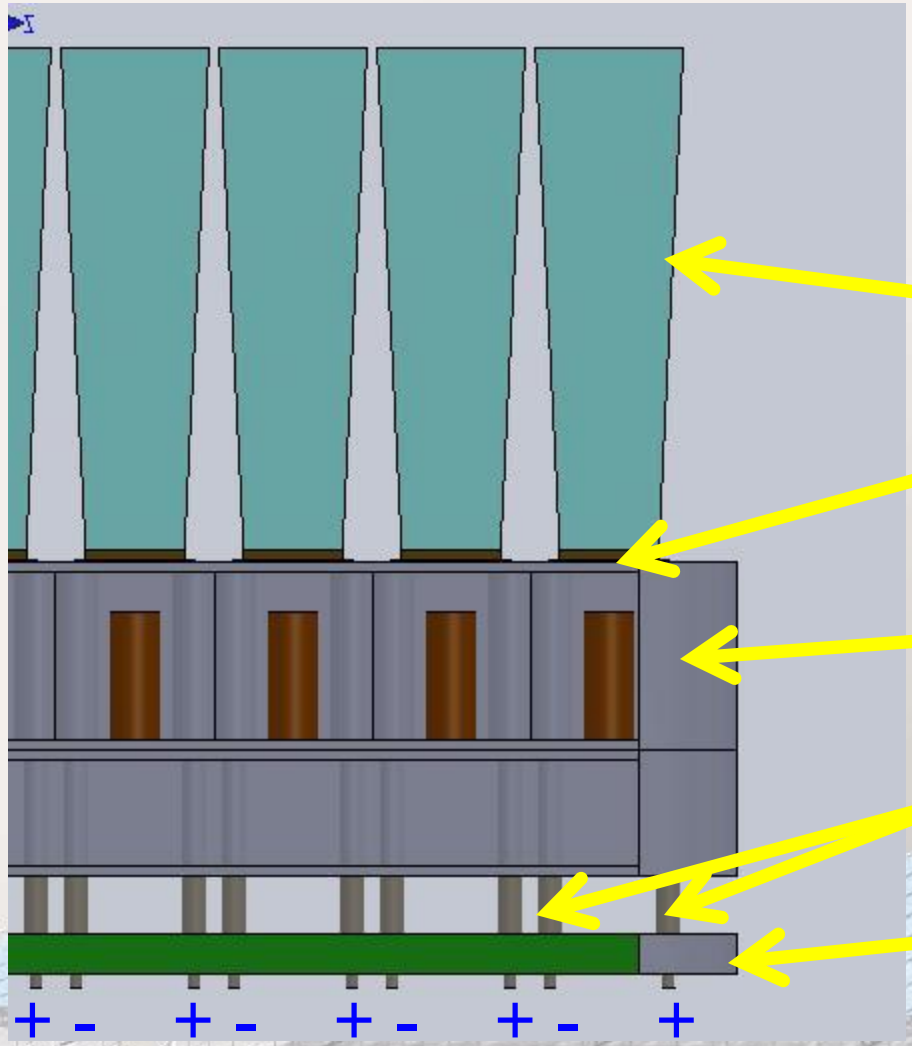
Cooling Headers
Front & Rear

Circuit Board

Functions of the Receiver Assembly and its parts

•Two headers must allow for HCPV leads to pass through to circuit board,
•Top header design allow for water jets i.e. impingement cooling which ptovides even cooling through to all the HCPV cells
• Seal in-between prevents front and back header prevents leaks.
•The TIR prisms direct most of the incoming light to the cell surface. TIR is Total Internal Reflectance – once light is within the prism and within prism acceptance angle it is trapped. It is the principle behind fiber optics.
• Quick connects on Circuit Board allow for easy assembly and disassembly,
• Circuit Board Processes the Energy to optimize the feed to the electrolyzer. Around 3 Volts is just right for making Hydrogen,
• Secondary concentrator helps distribute light evenly to the prisms and the underlying HCPV Cells.
•The Rear header is the cooling fluid supply.
•Front Header retrieves water from jets and sends it back to the feed water supply.

Receiver Design



Prisms TIR

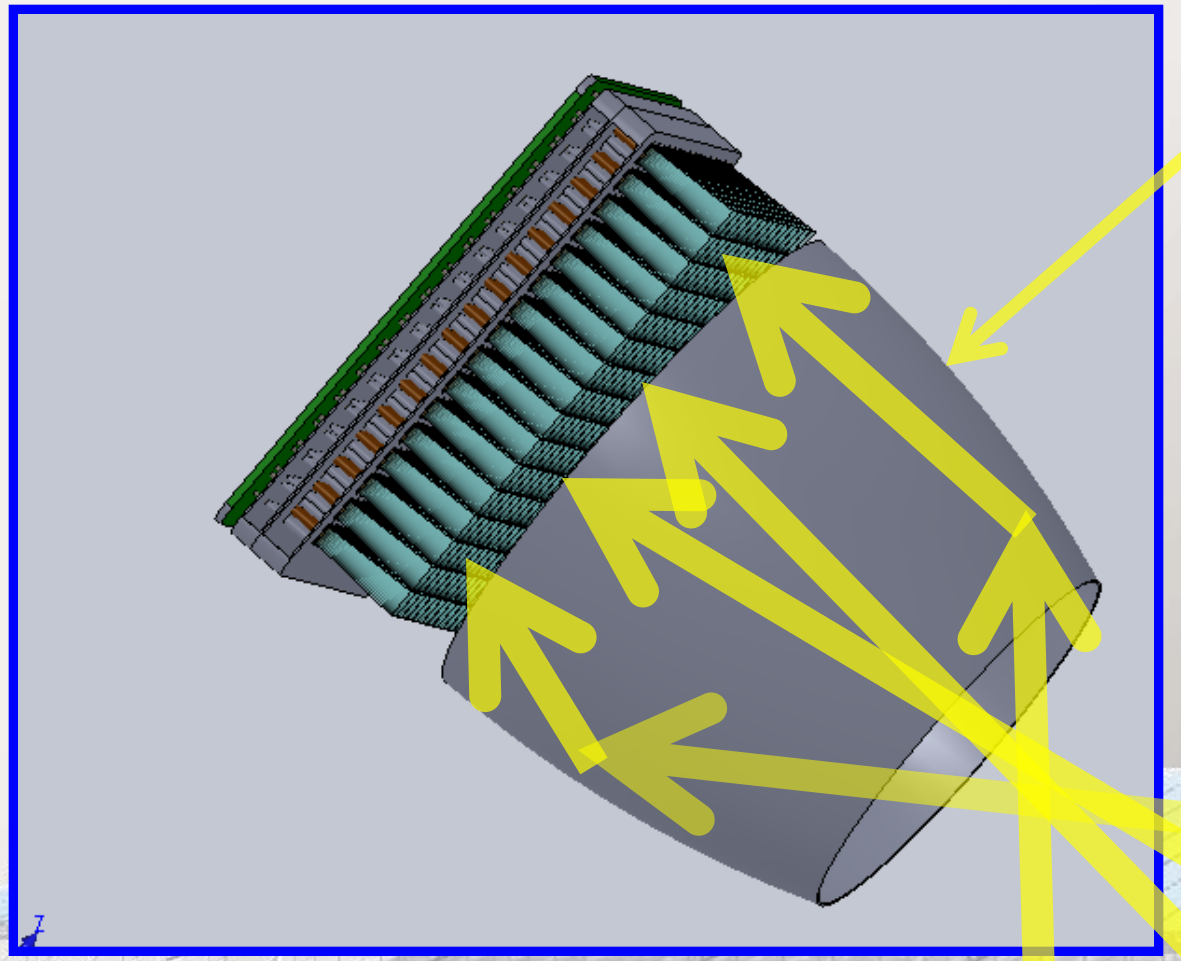
HCPV Cell

Cooling Headers
Front & Rear

Leads Positive and negative

Circuit Board

Secondary Concentrator



A secondary concentrator properly designed can redirect rays from the collector perifery and spread them more evenly into the TIR prisms.

ELECTROLIZER/ELECTROLYSIS MAKING HYDROGEN

Producing Hydrogen at 24.4 %

Applied Physics Express

Nakamura in 2015

A 24.4% solar to hydrogen energy conversion efficiency by combining concentrator photovoltaic modules and electrochemical cells

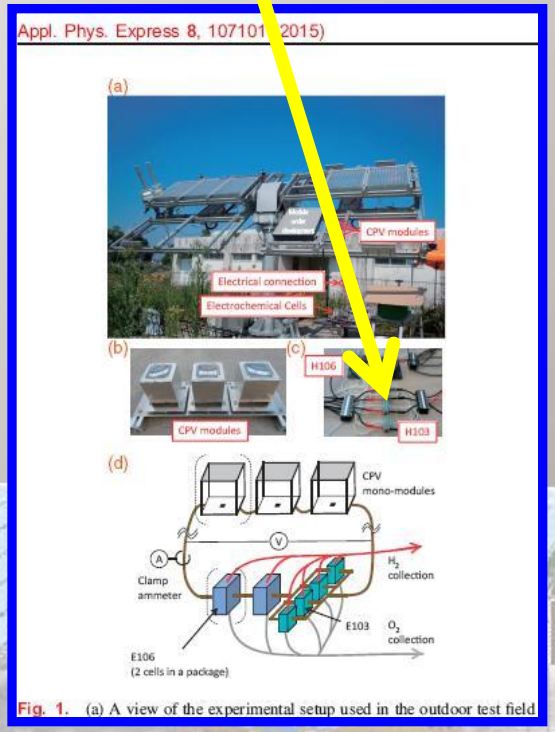
To cite this article: Akihiro Nakamura *et al* 2015 *Appl. Phys. Express* 8 107101

Nakamura in 2015 published his results of 24.4 % by combining CPV Cells and EC Cells.

We've found the EC (Electro Chemical Cells) they used in their experiment . Turns out they are off the shelf educational tools easy to obtain They are about 33 times the cost of what we need. Adding batteries reduces to **11 X** still way too Much!

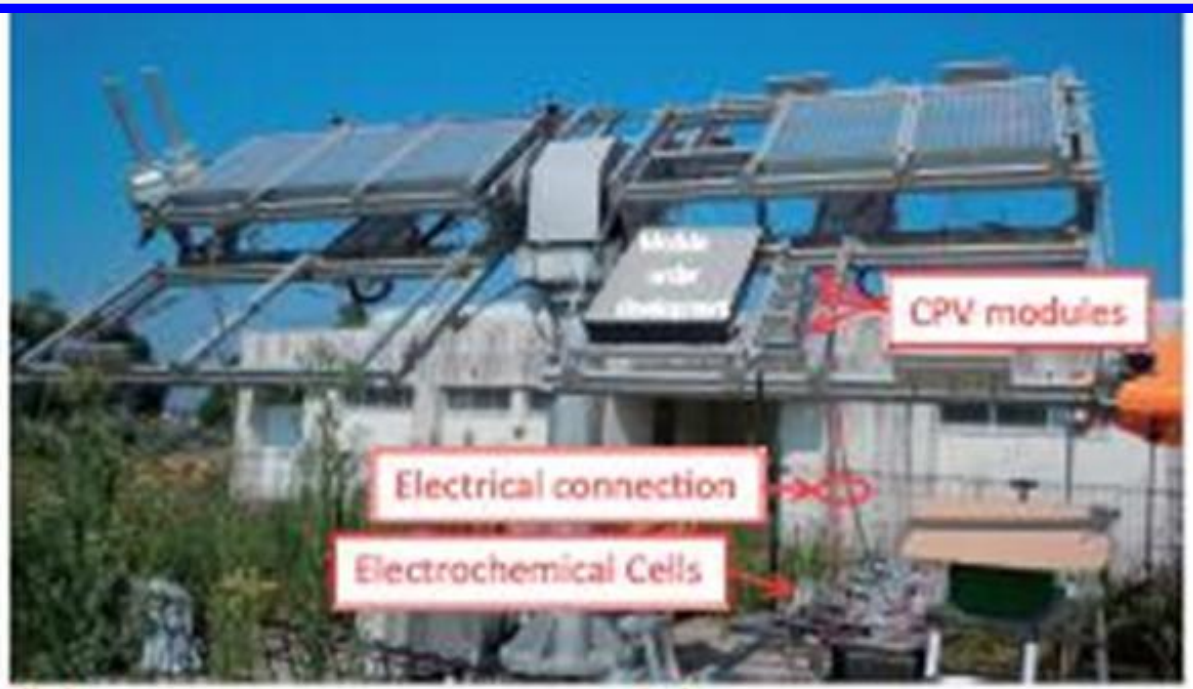
We're designing the electro chemical cells in house and we should be able to stay close to our budget!

Experiment Used Off the Shelf Educational Cells to set World Record

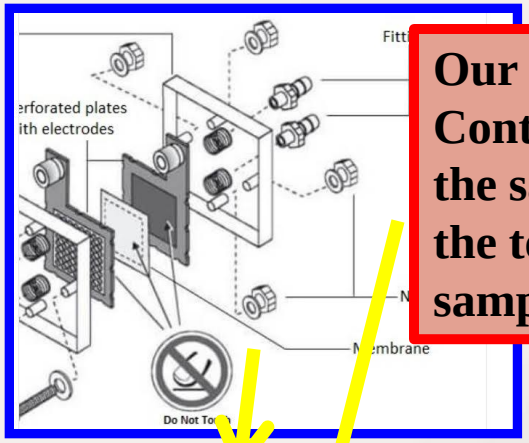


Hydrogen Cell - Electrolyzer Production			
20	cm cubed /min	from cells specification	
0.0	kg/min	from hydrogen conversion calculator	
24	hours of generation per day		24 hours possible with batteries
0.00258869	Kg		3 volt rechargable lithium
0.500	Kg/Day		
193.1	cells		
$80.0	dollars/cell		
$15,451.8	Cost of Cells		
$1,400.0	Budgeted		
11.0	Factor high by		

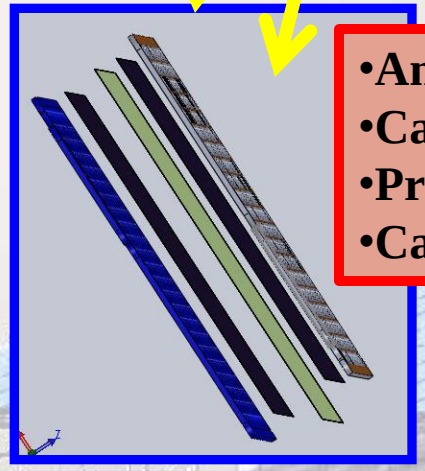
Nakamura Experimental Setup



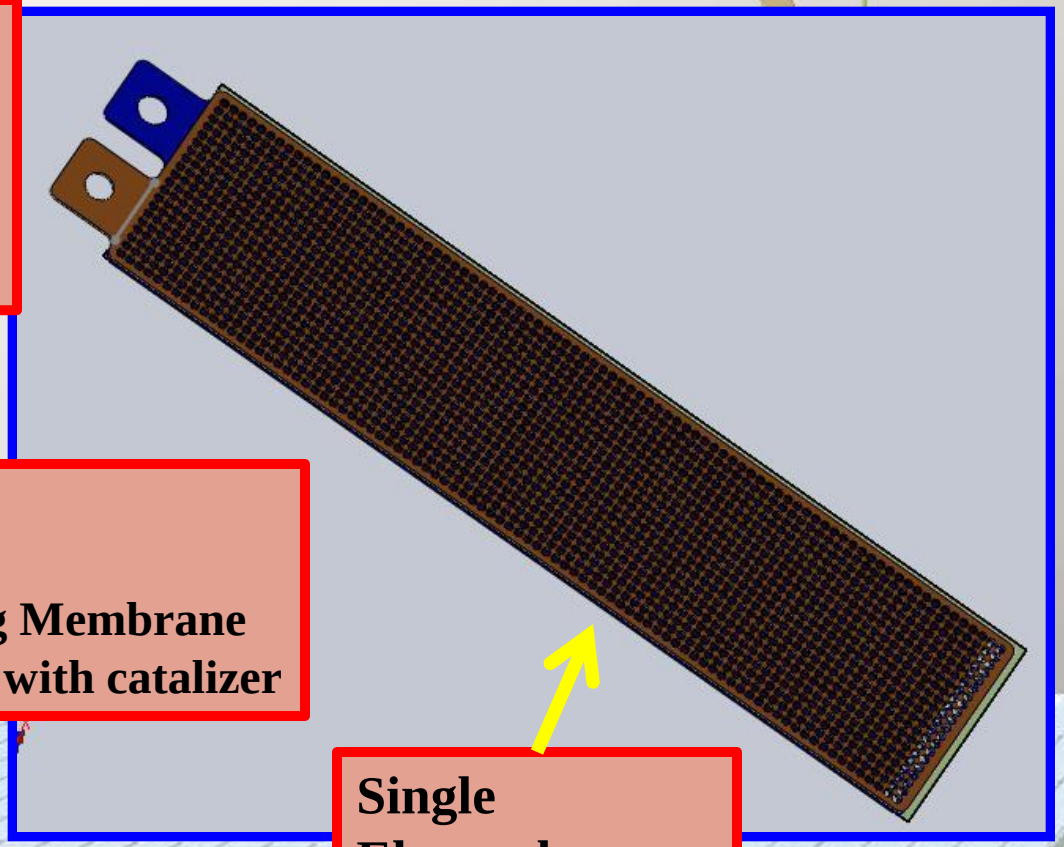
Single Electrode Package



Our Package Contents are the same as the teaching sample

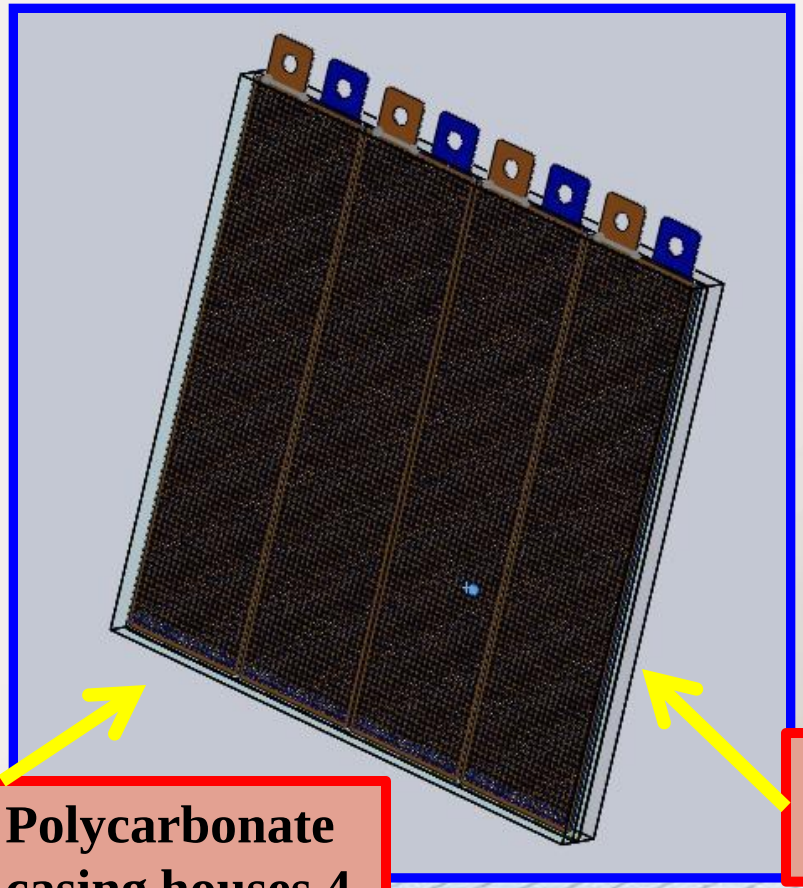


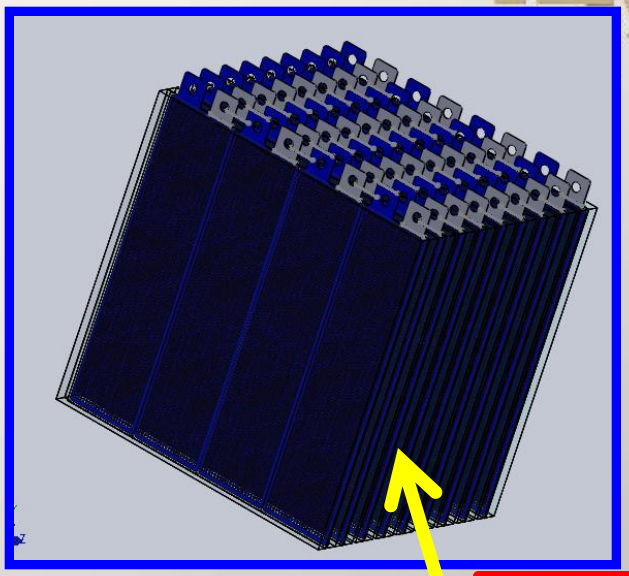
- Anode
- Cathode
- Proton Passing Membrane
- Carbon Paper with catalizer



Single Electrode Package (sandwhich)

Electrolyzer bundle



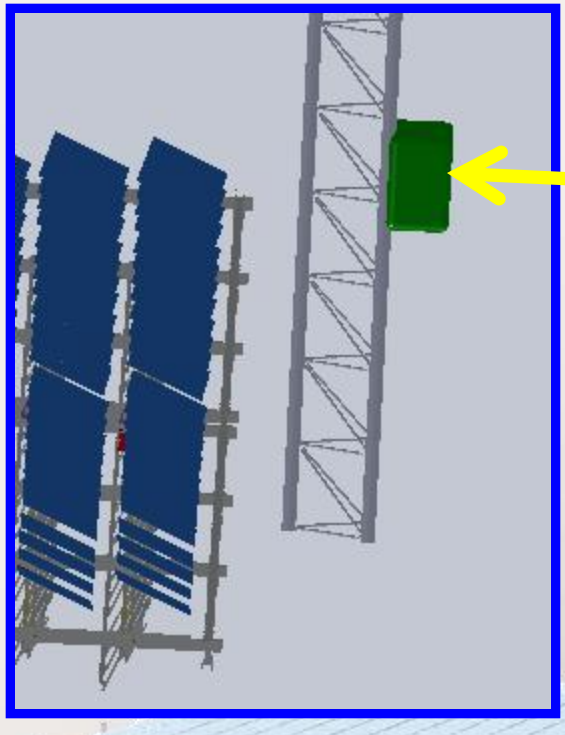


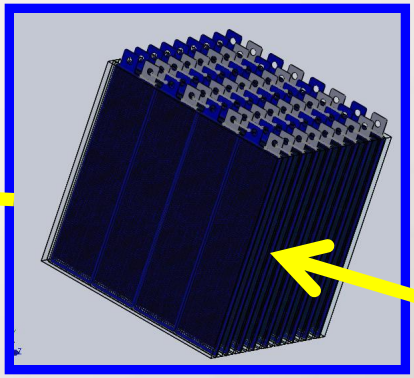
Polycarbonate casing houses 4 electrodes.

Electrolyzer Single Panel

9 total Electrolyzer Panels bundled to make a hydrogen producing unit.

The Electrolyzer
What's in the Green Box

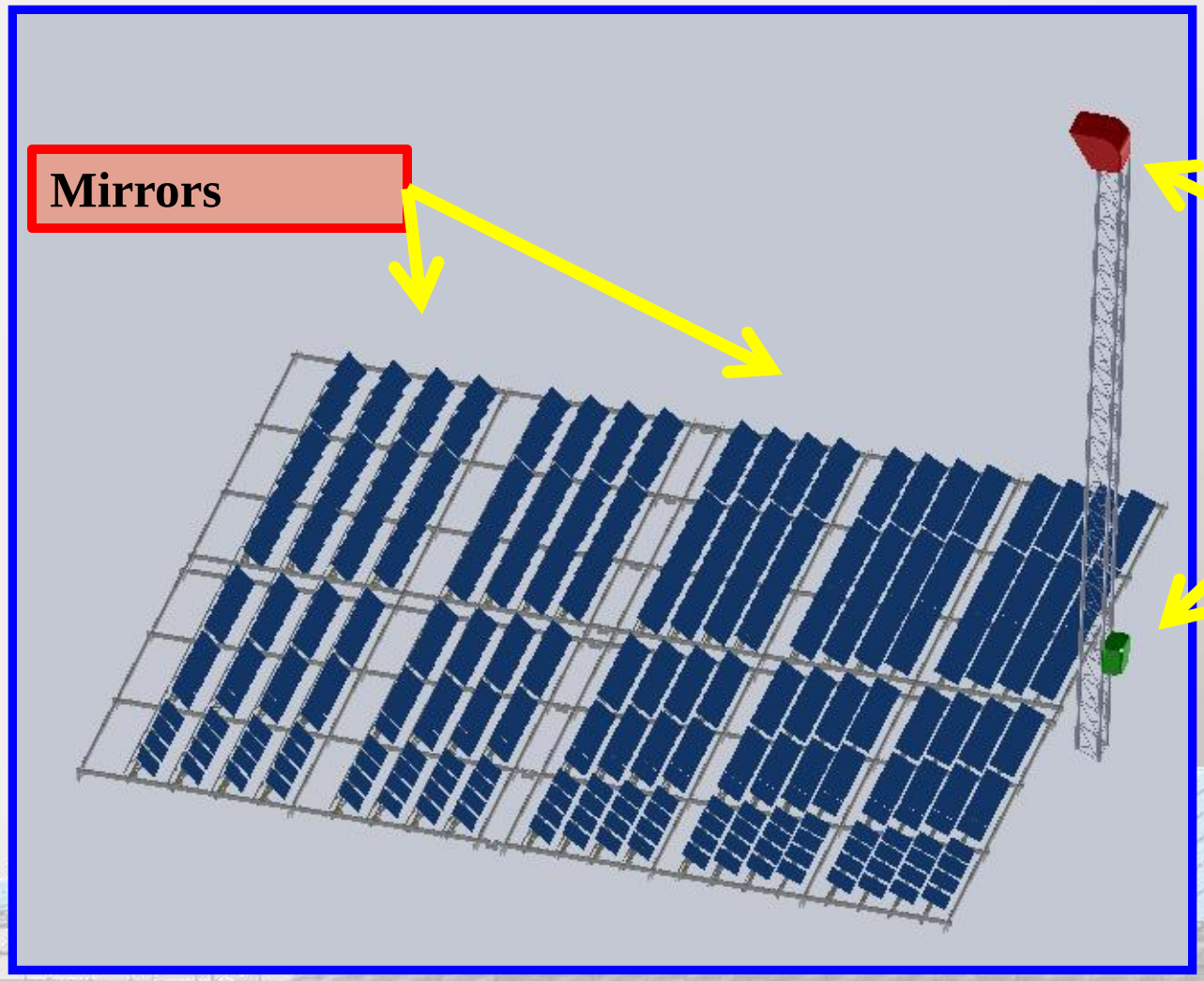




Electrolyzer Bundle - Hydrogen producing unit.

THE COMPLETE MH480 SYSTEM

Tower and Mirror field



Receiver

Electrolizer – the hydrogen producing unit (Green Box)

Green HYDROGREN

Our Solar Collector Solution

It Converts Solar Energy into Economical Green Hydrogen

It Makes Green HYDROGREN

The Hydrogen Farm
Direct vs. Two step

Current Status of the state of the Solar Driven Hydrogen Production

Reformed Hydrogen Market - Most Hydrogen (dirty Hydrogen) today comes from steaming a petroleum product. It's a 105 Billion Dollar Market that we can compete in.

2 Step 24% efficient

1 Step 17% efficient

COST ANALYSIS: MARKET ANALYSIS, LIFETIME ANALYSIS

Various Markets we are interested in

1. Grid Electric - supplying electric energy direct to the grid.
2. Hot water – sweet deal when it can be found
3. Combined Electric and Hot water
4. Reformed Hydrogen*****
5. Gasoline
6. Heating Oil General Transportation and the rest

Reformed Hydrogen Market

A	B	L	M	N	O	P	Q	R	S
Key Markets:				Reformed Hydrogen Market				Reformed Hydrogen Marke	
		r		Hydrogen Current Market 2 step				Hydrogen Production Dire	
20 Year				1 unit	100 units			1 unit	100 units
20 Year income				$52,284.00	$5,228,400.46			$37,034.50	$3,703,450.33
energy 20 year				4,068.79	406,879.41	kilograms		2,882.06	288,206.25 kil
				8,951.35	895,134.71	lbs		6,340.54	634,053.75 lbs
20 Year				135,612.91	13,561,290.85	KW - hr		96,059.14	9,605,914.35 KW
0.05 percent			Based on Offset	$36,365.96	$3,636,595.75			$25,759.22	$2,575,921.99
	total amount paid l				$3,167,787.55				$3,167,787.55
	monthly payment				$13,199.11				$13,199.11
	total income		Total income over life of Loan		$2,060,612.92				$535,662.78
	monthly income				**$8,585.89**				**$2,231.93**
20 Year									
0.03 percent									
	total amount paid l				$2,662,068.47				$2,662,068.47
	monthly payment				$11,091.95				$11,091.95
	total income				$2,566,331.99				$1,041,381.86
	monthly income				**$10,693.05**				**$4,339.09**
30 Year									

Gasoline Market

A	B	T	U	V	W	X	Y	Z	AA	AB	AC	AD
Key Markets:		ket			Gasoline Market					Gasoline Market		
		rect One Step			Hydrogen Current Market 2 Step					Hydrogen Production Direct		
30	Year											
0.03	percent											
30 Year					1 unit	100 units				1 unit	100 units	
30 Year income .					$47,004.59	$4,700,458.75				$33,294.92	$3,329,491.61	
energy 30 year					6,103.19	610,319.12	kilograms			4,323.09	432,309.38	kilograms
					13,427.02	1,342,702.06	lbs			9,510.81	951,080.63	lbs
					203,419.36	20,341,936.28	KW - hr			144,088.72	14,408,871.53	KW - hr
					$54,548.94	$5,454,893.63				$38,638.83	$3,863,882.99	
	total amount paid l					$3,035,549.04					$3,035,549.04	
	monthly payment					$8,432.08					$8,432.08	
	total income					$1,664,909.71					$293,942.57	
	monthly income					**$4,624.75**					**$816.51**	

Total income over life of Loan

COMPONENTS COSTS - BUDGETED

Concentrator Costs

Collector: Concentrator Component

Materials	Each	Quantity		
$3,248	$2.50	1299	lbs.	(Lbs.)Structure
$3,000	$25.00	120		Motors And Gear Heads
$720	$1.50	480		Mirrors
$600	$10.00	60		Boards Wiring Control
$7,568				
Labor				
$800	$20	40		Labor Assembly
$1,200	$15	80		Labor Custom Parts In-house
$500				Contracted Parts
$500				Standard Parts
$3,000				
Total Concentrator				
$10,568				

Receiver Costs

Collector: Receiver					
Tower Electric And All			16	256	
	$4,096	$16.00	256	cells	High tempurer cells
	$1,024	$4.00	256		prisims
	$300				special glues
	$600				2 piece housing
	$1,400				3 volt hydrogen producing
	$100				blowers and pumps
	$100				tubing
	$300				tower
	$7,920				
Hydrogen infrastructure, air Drying, compressed air, clean water RO					
	$600	$60,000.00	100	units	infrastructure
					Hydrogen storage
					filling station
					hydrogen distribution
					clean dry air distribution
					clean water
	$8,520				
	$8,520	This Number Widely Varies Dependending On What Is Being Produced And Stored			

Robotics Costs & Overhead

Collector: Robots				
Picker And All				
	$500	based on the idea that a massed reduced computer printer is about 250 dollars		
	$500	kiosk		
			number of collectors serviced	
	$60	$6,000.00	100	tuning robot
Collector Total Cost				
	$20,148			
Operating Costs				
	Keeping 4 Robots Going		host responsibility -picker truck kiosk and tender	
	eventual Motor and snake Replacement		10 year	
	watching the weather knowing when to Stow		host daily responsibility	
	slider grommet		20 year	
	Mirrors		20 years	
	bearings		30 year	
	grooming and land scale		host responsibility	
	receiver		10 year	
	infrastructure		10 year	
	All Other Maintenance		unknowns	

5 MILLION MAN PLAN

5 million man Plan to save the World

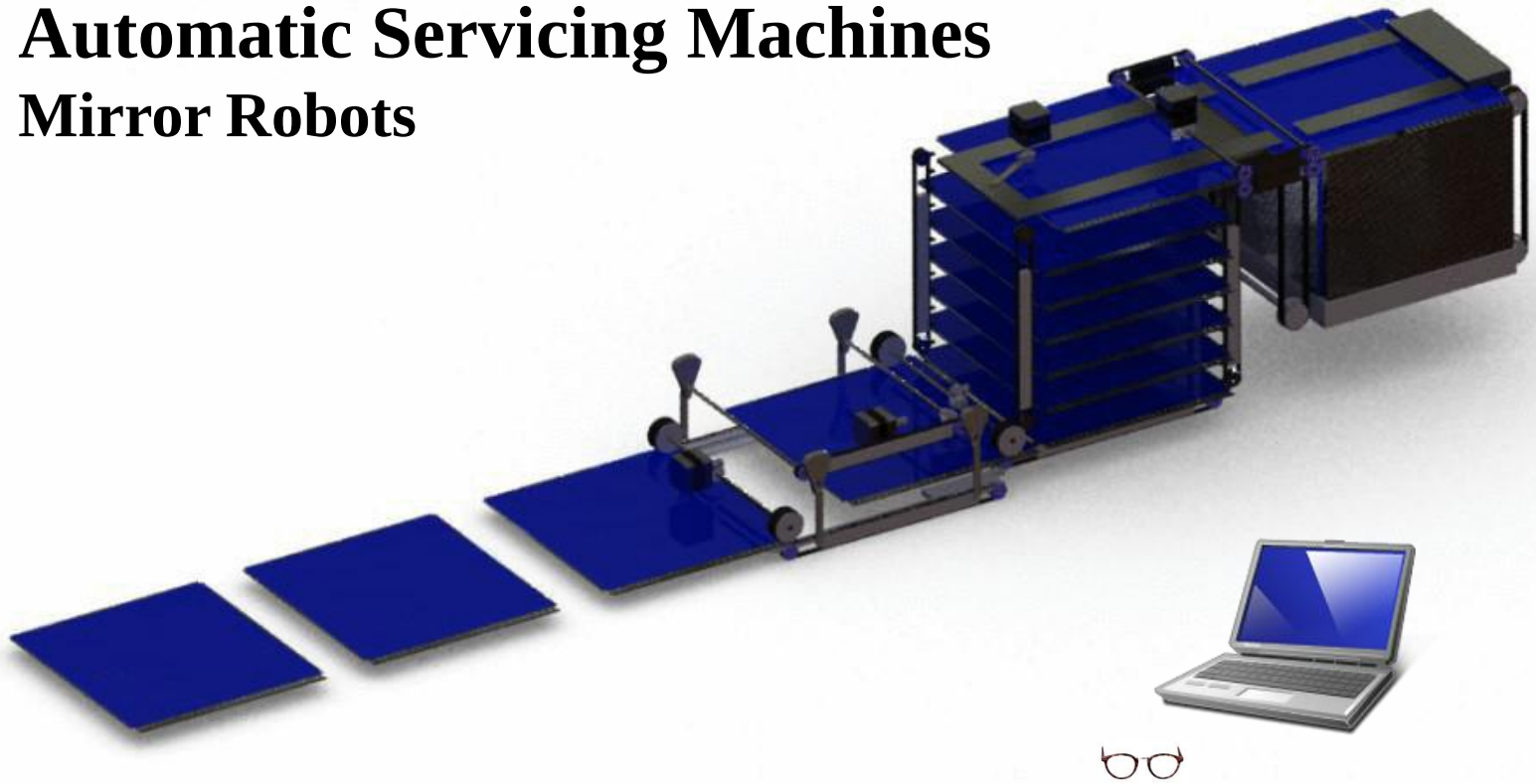
Solar Farmers					
5,000,000	Solar Farmers				
5.86	Average Number Of Farmers Per Square Mile of the total South West				
109.27	Average Number Acres Per Farmer of the total South West				
How Much Land In The US Is Utilized?					
Match US Electric Grid Only				Match US All Energy Sources	
750,000,000	Collectors			2,326,989,563	Collectors
150	# Of Collectors Per Farmer			465	# Of Collectors Per F
1,024	Sq. ft Per Collector			1,024	Sq. ft Per Collector
153,600	Sq. Ft Per Farmer			476,567	Sq. Ft Per Farmer
3.526	Acres Per Farmer			10.940	Acres Per Farmer
1260	KW Per Farmer Peek			3,909	KW Per Farmer Peek
0.00126	Gw Per Farmer Peek			0.003909342	Gw Per Farmer Peek
210	KW Per Farmer Average			652	KW Per Farmer Aver
$690,630	Farm Income per year			$2,142,785	
750,000,000	Collectors			2,326,989,563	Collectors
6300000000	KW	Peek		19,546,712,329	KW
6300000	Mw	Peek		19,546,712	Mw
6300	Gw	Peek		19,547	Gw
1050	GW	Ave		3,258	GW
1.05	TW	Ave		3.26	TW

Land Use

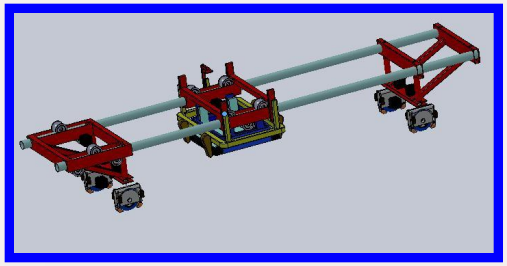
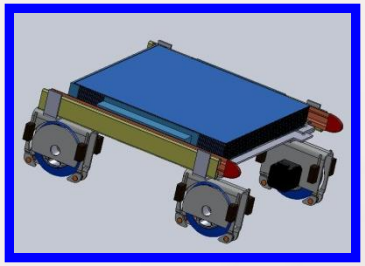
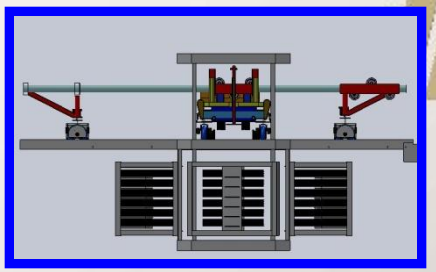
Solar Farmers	
5,000,000	Solar Farmers
5.86	Average Number Of Farmers Per Square Mile of the total South West
109.27	Average Number Acres Per Farmer of the total South West
Area Based On Elec. Capacity. Based On Average	
1024	Sq. Ft Per Collector
3.67309E-05	Sq. Mile Per Collector
750,000,000	Total Number Of Collectors
27,548	Square Miles Elec.
166	**Square N Miles On A Side**
Area Based On Total U S Consumption	
879	Collectors Per Sq. Mile
0.0323	Square Miles Of Collector Per SW Mile In The South West Selected Area
3.227%	Percent Coverage South West Electric Only
10.0127%	For All
85,473	Square Miles All
292	Square N Miles On A Side

Our Previous Solution

Automatic Servicing Machines
Mirror Robots



Our New Evolved Robotic Solution

- **Compatible with the original MH480! Because the MH480 was built to be upwardly compatible**
- **We already have a 30 year old MH-480 that's like new with life time design and real-estate market qualified design.**

And it makes Green HYDROGREN !

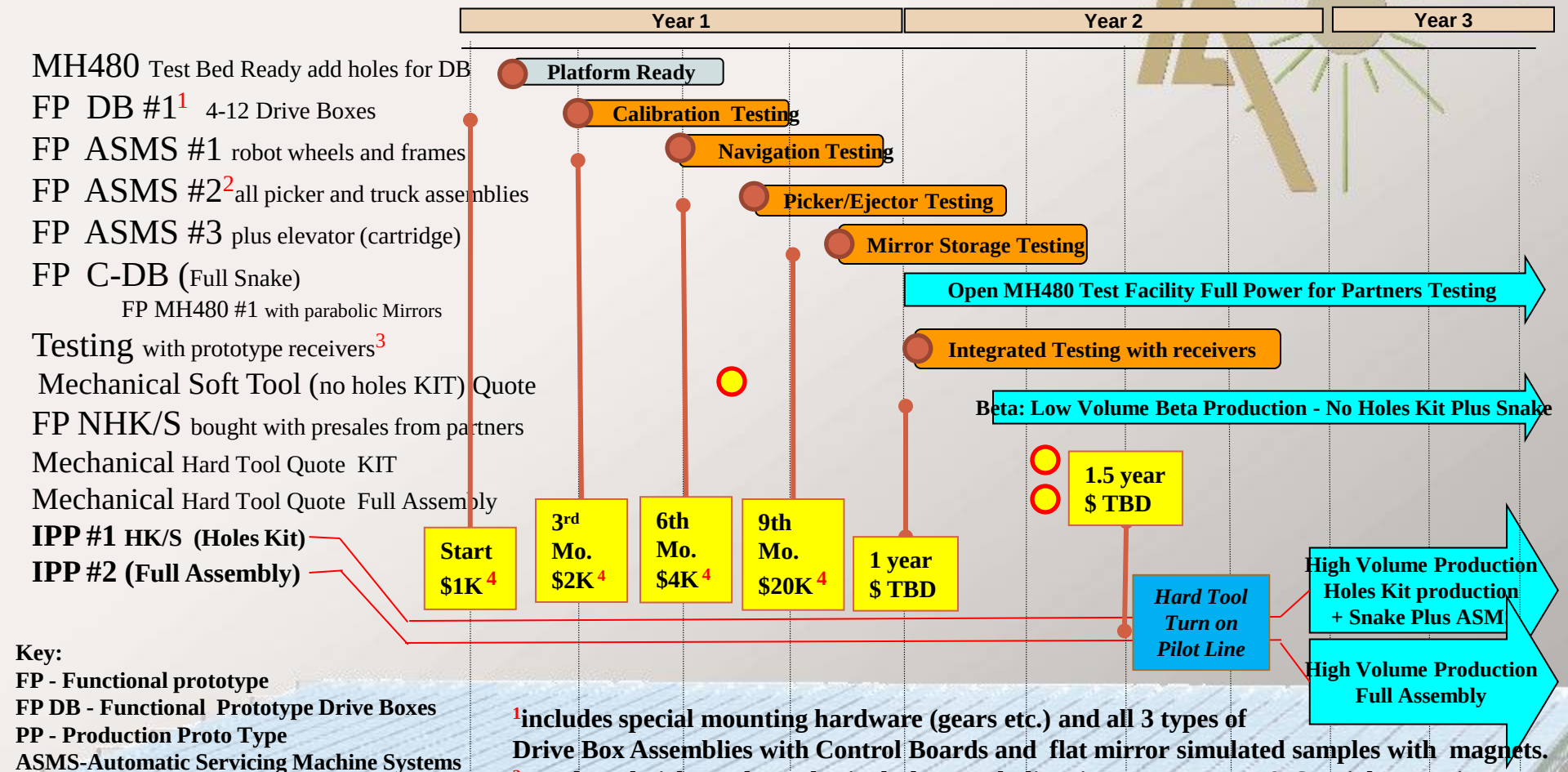
Our Previous Automated Solution

and
It Makes Green
HYDROGREN

That I Can be sold
to
Finance a Real-Estate Style Loan

Timeline and Milestones

Beta Testing To Production Turn ON



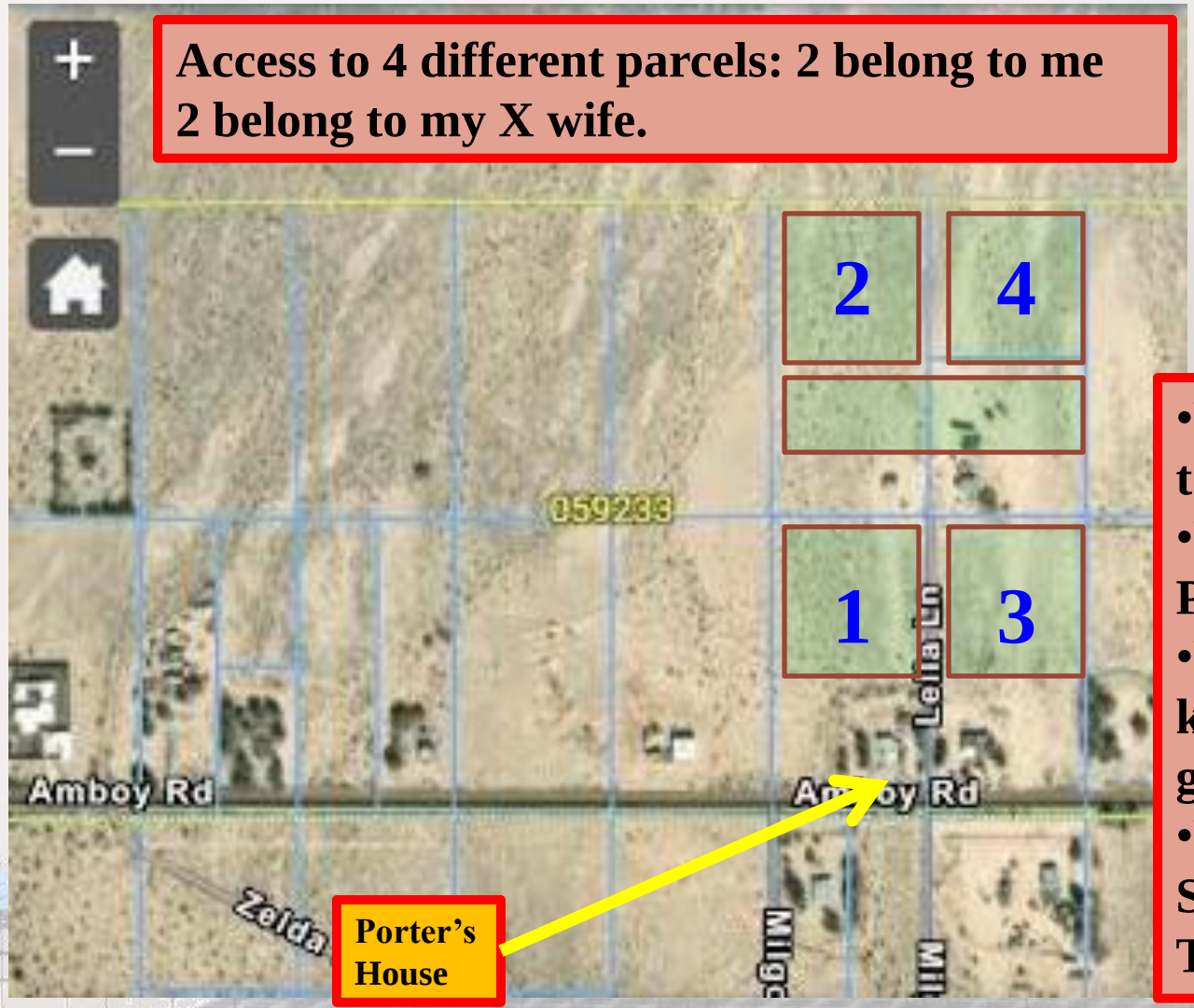
Key:
FP - Functional prototype
FP DB - Functional Prototype Drive Boxes
PP - Production Proto Type
ASMS-Automatic Servicing Machine Systems
C – MH480 Concentrator
FP NHK/S No-Holes Kit with Snake
HK/S – Holes Kit with snake (C+ASMS)
IPP - Integrated Production Prototype (C+ASMS)

[1]includes special mounting hardware (gears etc.) and all 3 types of Drive Box Assemblies with Control Boards and flat mirror simulated samples with magnets.
[2] truck and picker robots also includes parabolic mirror prototypes & Special Mounting Hardware for 20 trusses (1/6th of an MH480)for pick & place testing +20 Magnetic Mirror Mounts.
[3]prototype receivers from partners.
[4] rough cost estimate.

Comments on Time Line and Milestones

- **The preceding miles stones chart was created 2019 for our manufacturing partners it does not reflect recent knowledge.**
- **We never expected to design the receiver or the electrolyzer to produce hydrogen. Naturally first year costs will be higher to achieve this goal.**
- **We hadn't even conceived of the Tender, that's our biggest outcome of the last few years of work and our secret sauce, but it also limits project to 2.5 acre parcels. But reflecting on this it is actually ideal as it puts us squarely in the hydrogen farm real-estate market exactly where we should be!**

How do we ramp up initially ?



Potential for 500 to 600 MH480's on the parcels I have access too near buy.

- Year 1 - first MH480 test Platform complete
- Year 2 - 100 MH 480'S Parcel 1
- Year 3 Parcel 2 3 &4 keeping the pipe line going!
- Year 4 Sky is the Limit Supplying new Hosts Trained by us here.

Problems & Risks Going Forward

- How do we properly phase this project against its technical challenges, what will be the check points?
- Covering tooling costs .
  - That's what stock is for. I can leverage a project like this one to raise cash to pay for tooling.
  - Also manufacturing partners might want to own their own tools to lock in profits for them selves.
- All the technical challenges of course. Software, Robot Functionality, Collector Functionality, System Performance of all components.
- Permitting and other legal Issues.
- Underwriting UL and etc. This is 3rd year stuff. I don't believe its something to worry about in this phase since I'm the builder as well the customer.
- Supply Chain Issues especially with HCPV Cells, price of Platinum
- Other nuances of ramping up especially initial development priorities . i.e. we still have a profitable product initially even if the robots and Kiosk aren't ready. Of course there will be some what diminished performance. Until those robots come on line.

In the future our technology will keep making Green HYDROGREN

…that my partners, as well as my company, can profit from,

…and from which you can be built new self sustaining economical hydrogen farms through out the USA and the world!