

Solar Desiccant Air Conditioner



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Objectives

- Utilize renewable energy for Air Conditioning
- System size scalable from residential to a commercial size
- Environmentally friendly
 - Low electric consumption
 - Minimal CO₂ emissions
- Eliminate energy hungry components

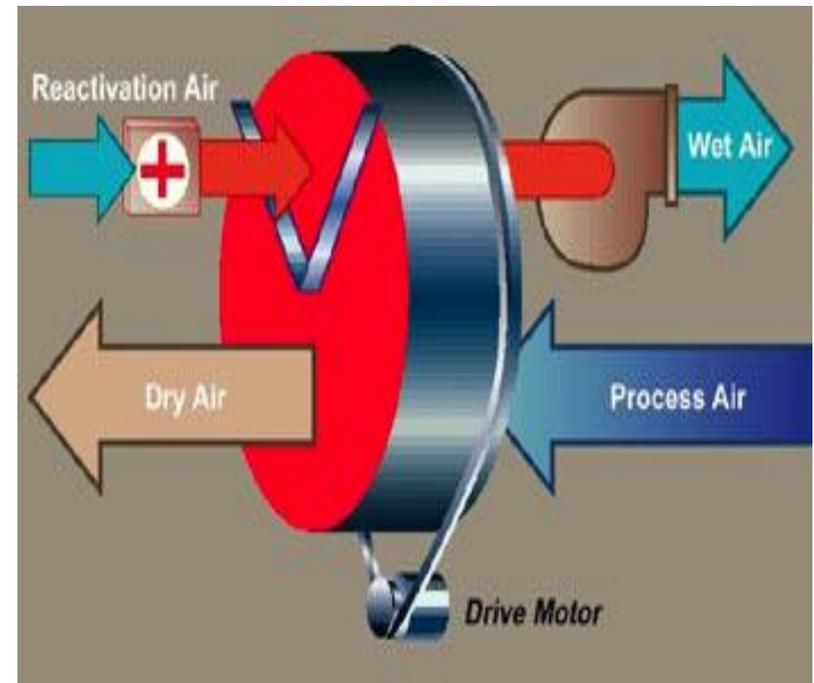


Cooling Air Process – How it works

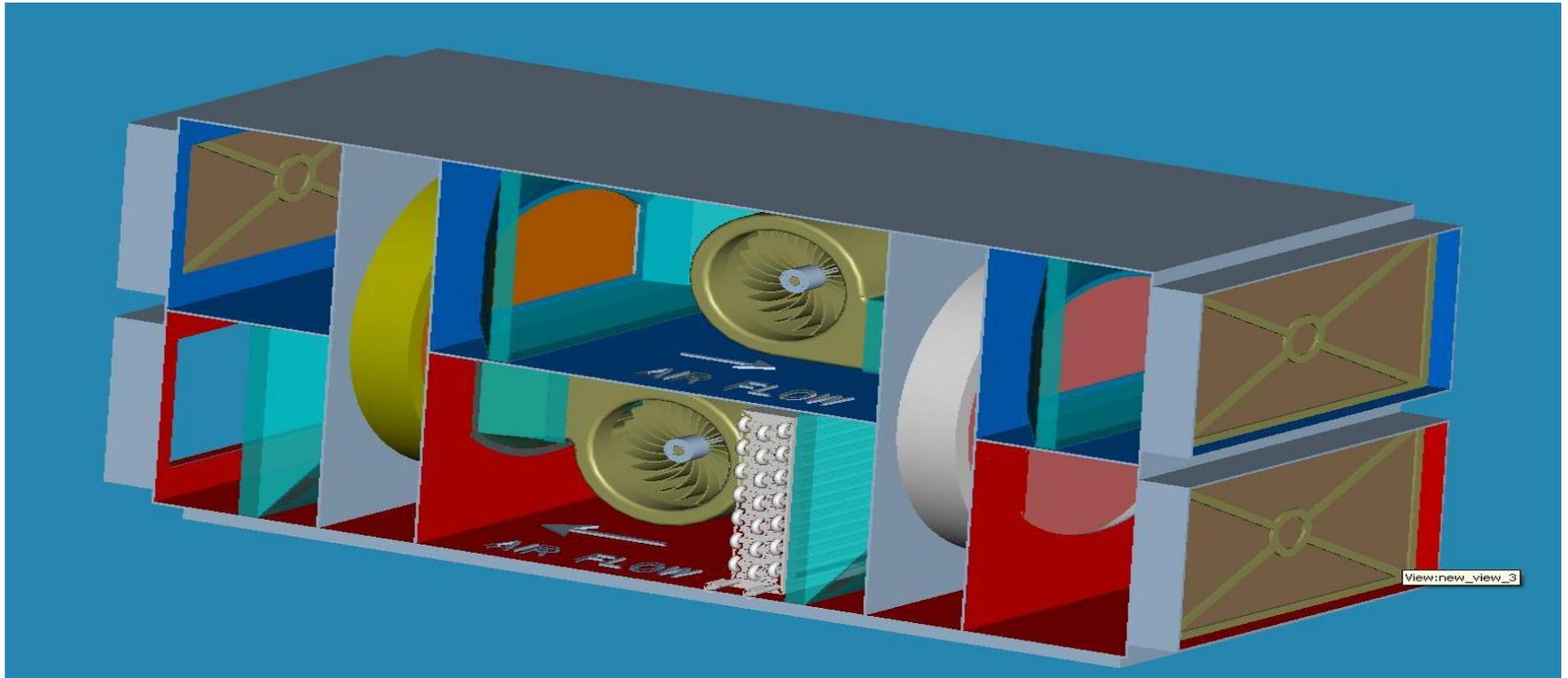
- Ambient air passes through desiccant wheel then delivered to heat recovery wheel.
- Desiccant wheel reduces the air's enthalpy and wet bulb temperature.
- Dry bulb temperature is increased through desiccant wheel. However decreased through recovery wheel.
- Desiccant wheel made up of silica gel pellets.
- Recovery wheel made up of aluminum fins.

Desiccant recovery cycle

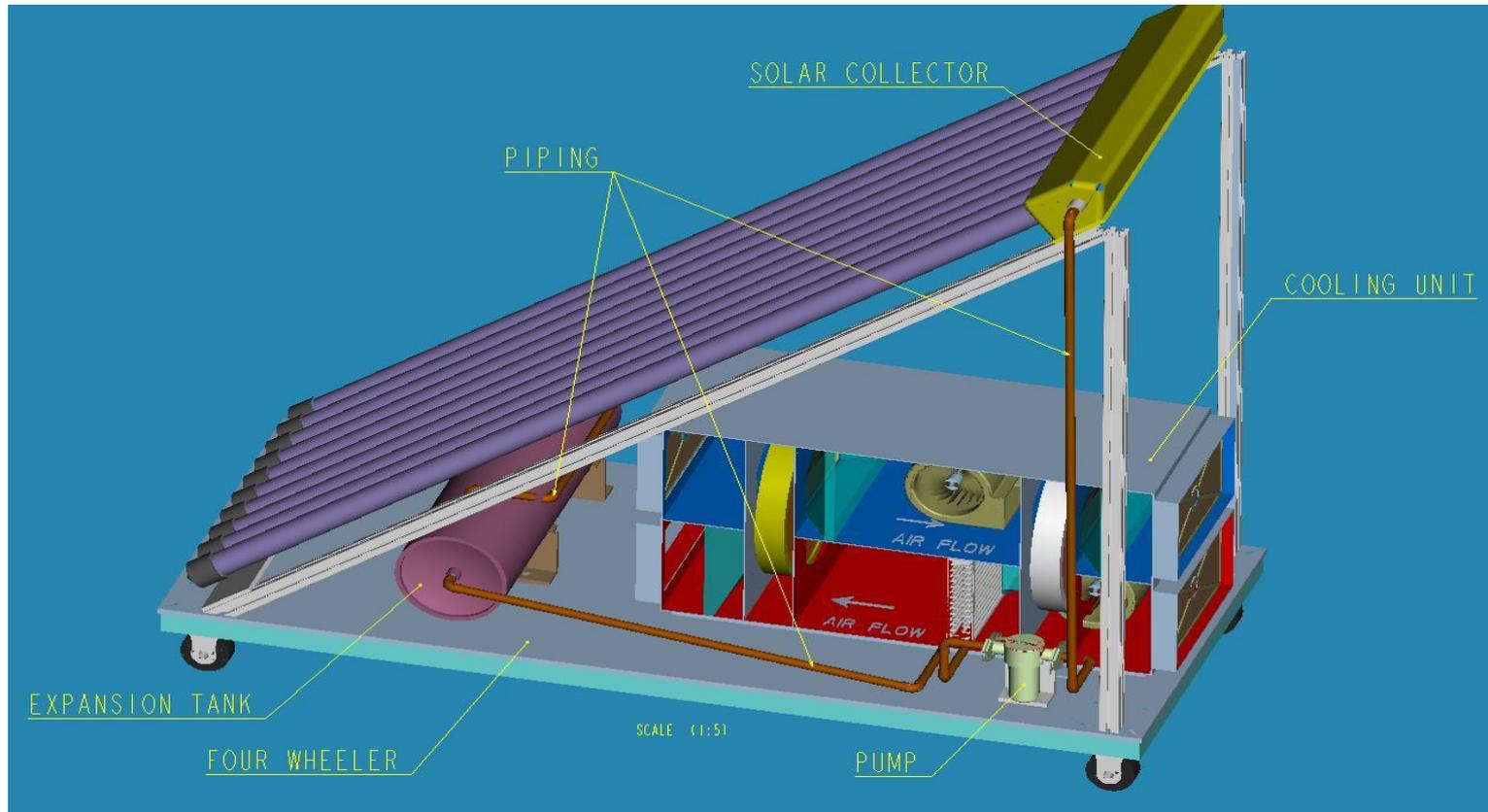
- Solar collector heats up water and transfers heat to air through heat exchanger.
- To recover the absorptive properties of the desiccant wheel; solar heated air is blown into a portion of the desiccant wheel.



Desiccant Cooling Design



Prototype Design and Testing



Hot Water Test Set-up



Set-up to test the attainable temperatures of water through the solar collector.



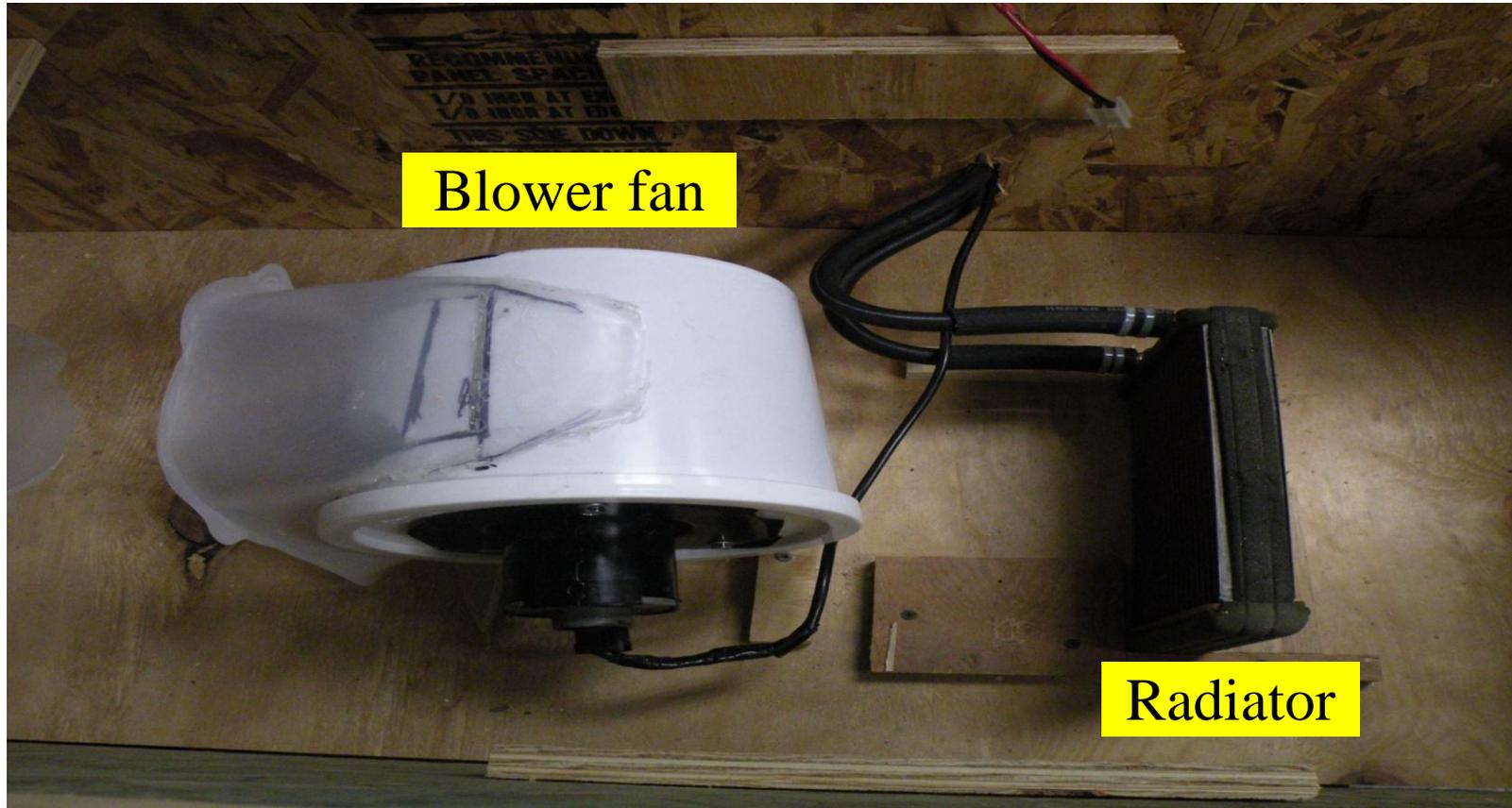
Building the Cooling System

The following are the components in the Box:

- 2 Blowers
- Radiator (water to air)
- Desiccant Wheel
- Cooling Wheel
- Ducts
- Styrofoam
- Wooden sheet for the partition.

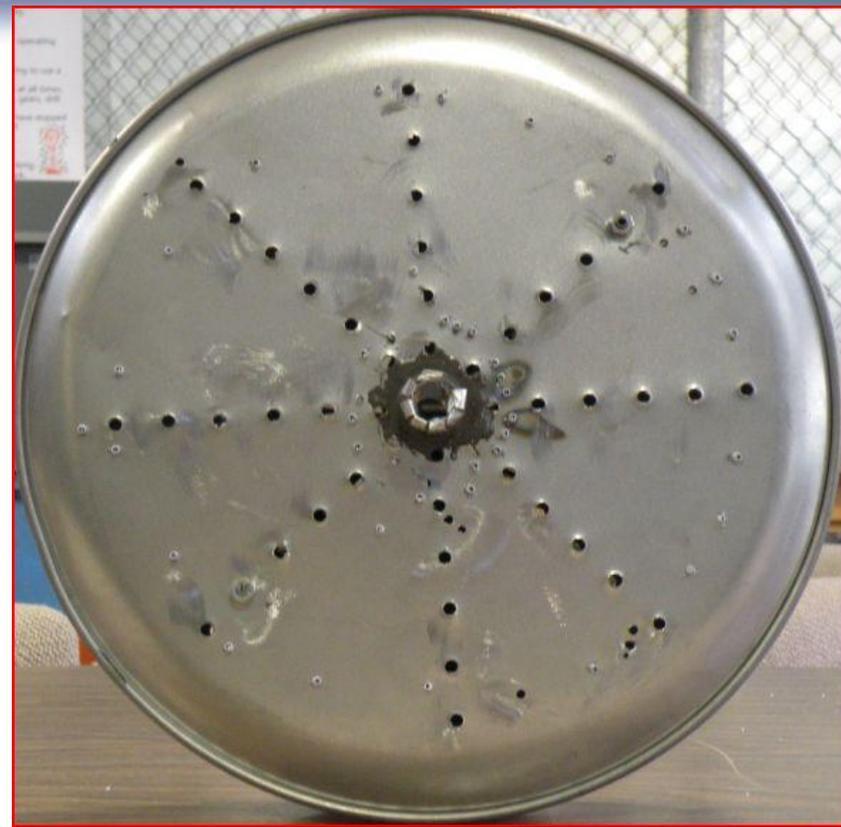
Box is partitioned in 2 parts for the regeneration of air.

Desiccant Recovery Cycle

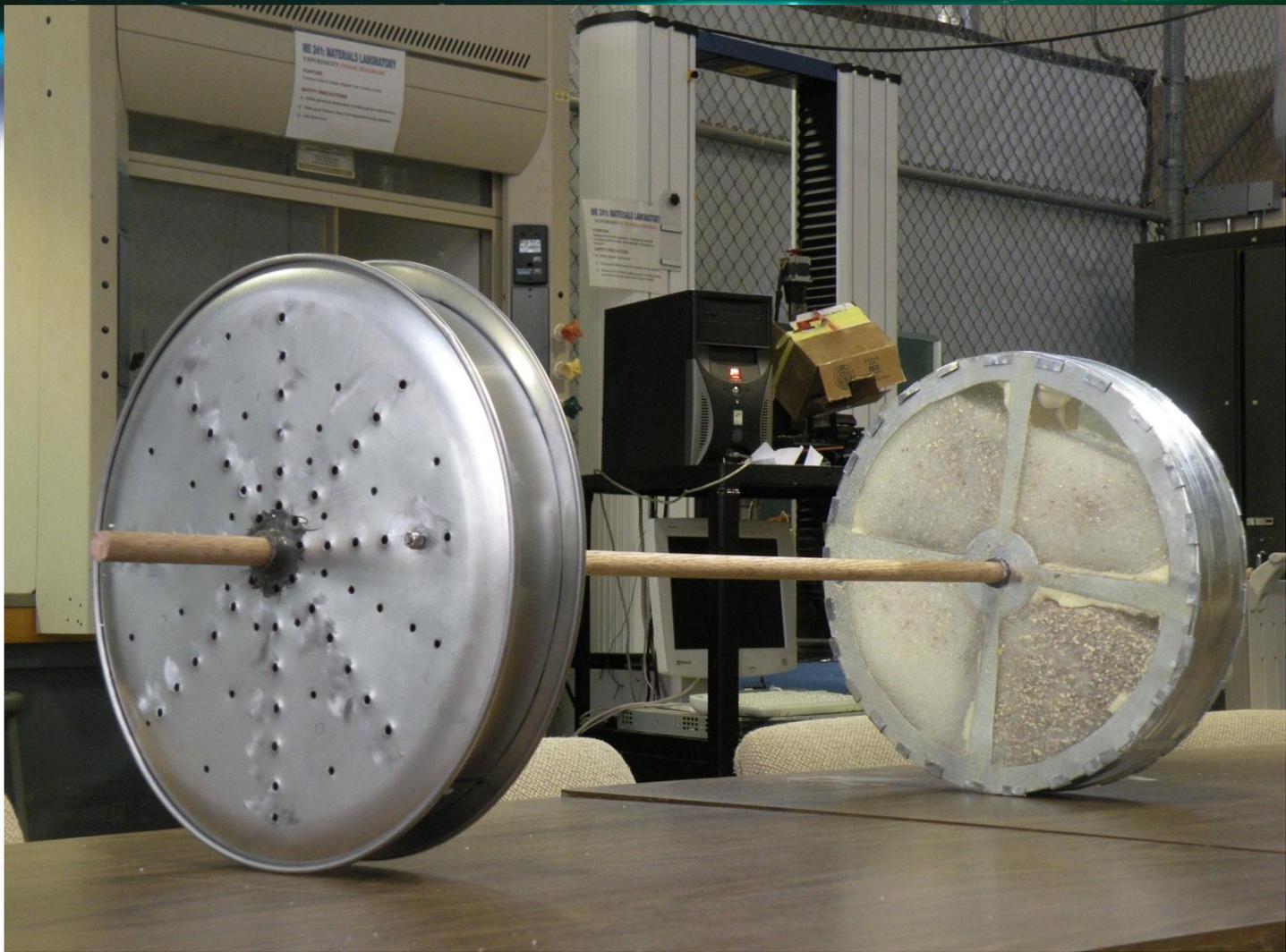




Desiccant Wheel filled up with Silica Gel.



Heat recovery Wheel with drilled holes for smooth flow rate.



A Spindle connects the 2 wheels inside the box.

Cooling Cycle

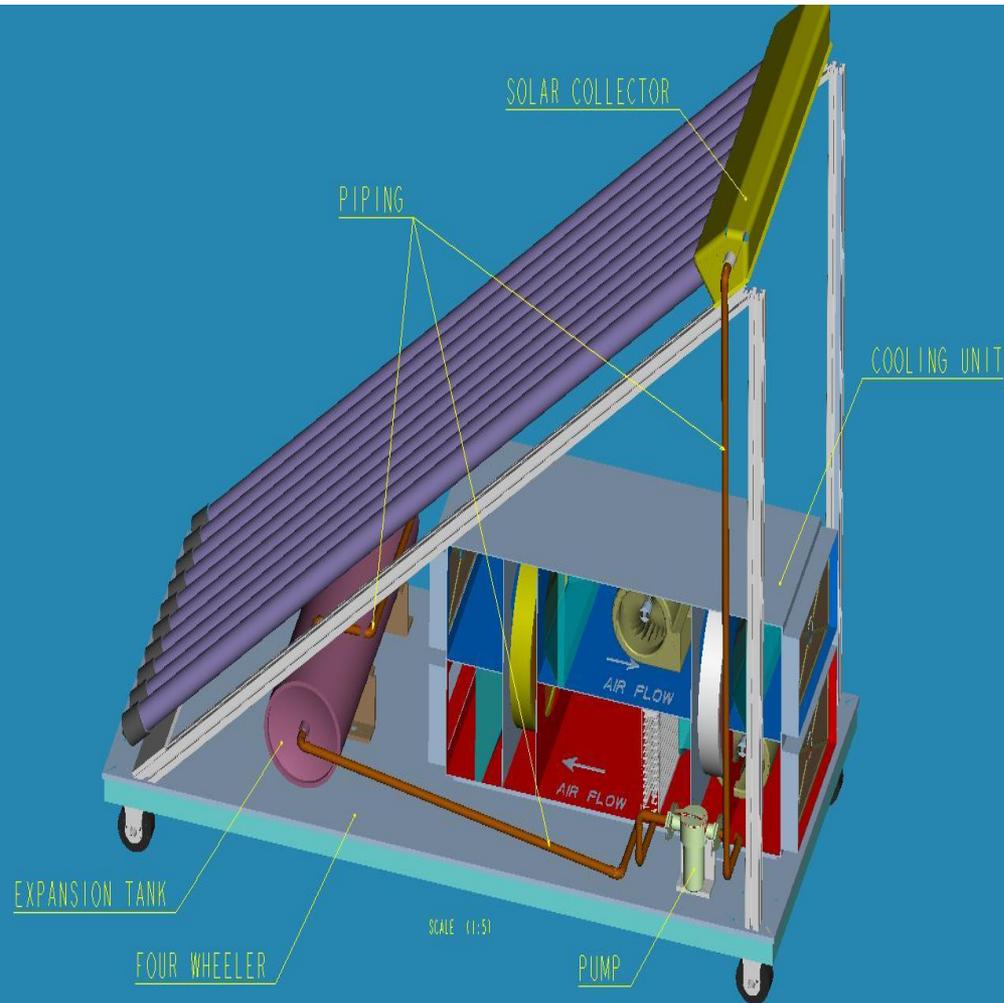
Desiccant
wheel

Blower fan

Heat recovery
wheel



Pro-E vs. Mechanical System





Aluminum sheets were added behind the tubes to maximize solar heating capacity.

Testing Results

Test	Water Temperature (deg F)	Humidity (%)	Air Temperature (deg F)
1	64	36	63.5 Inlet
		35	62.7 Outlet
2	70	32	64.0 Inlet
		30	63.2 Outlet
3	80	34	67.8 Inlet
		32	65.0 Outlet
4	86.6	32	64.8 Inlet
		30	62.2 Outlet
5	84.7	34	64.8 Inlet
		30	61.0 Outlet

Results Interpreted

- Expected air output cooler than air input
- Test performed during cloudy day
- Water temperature not able to reach expected value
 - >100 deg F
- Desiccant material not ideal type. (why not?)

Complete System Set Up

Side View



Switch made
for fans and
speed control.

Complete System Set Up

Front View



Bill of Materials



SAN DIEGO STATE
UNIVERSITY

COLLEGE OF ENGINEERING
Department of Mechanical Engineering

QTY	ITEM	SIZE	MATERIAL	COST	VENDOR	Price
1	Pump	1/20 HP	Bronze	\$155.90	McMaster-Carr	\$155.90
1	PVC Piping	10'x3/4"	PVC	\$1.43	Home Depot	\$1.43
1		10'x1"	PVC	\$2.20	Home Depot	\$2.20
1	Elbows	3/4"	PVC	\$0.25	Home Depot	\$0.25
2		1"	PVC	\$0.85	Home Depot	\$1.70
1	Female fitting	3/4"	PVC	\$0.62	Home Depot	\$0.62
1		1"		\$0.92	Home Depot	\$0.92
2	Male fitting	3/4"	PVC	\$0.64	Home Depot	\$1.28
1		1"	PVC	\$1.51	Home Depot	\$1.51
2	Ball Valve Fittings	1"	PVC	\$0.57	Home Depot	\$1.14
1	Ball Valve	1"	PVC	\$5.15	Home Depot	\$5.15
2	Hoses	1/2"	Rubber	\$14.95	Amazon	\$29.90
2		1"	Rubber	\$6.65	Home Depot	\$13.30
2	Plywood	4'x8'	Wood	\$19.87	Home Depot	\$39.74
2	Humidistat			\$19.33		\$38.66
1	Storage Tank	5 gal	Plastic	\$10.00	Home Depot	\$10.00
4	Caster Wheel	3"	Plastic, Metal	\$11.25		\$45.00
2	Desiccant Wheel (frame)	16" diam	Sheet metal	\$50.00		\$100.00
4	Desiccant (silica gel)	5-lb	Silica gel	\$18.00	SorbentSystems	\$72.00
1	Heat Recovery Wheel	16" diam	Aluminum	\$45.00	Walmart, HomeDepot	\$45.00
2	Blower Fans	Diameter: 5.65"	Plastic, Steel	\$14.00	Ecology Auto Parts	\$28.00
1	Radiator	10" * 7" * 1.3"	Copper	\$18.00	Ecology Auto Parts	\$18.00
1	Solar Panels	SunMaxx 10		\$700.00		\$700.00

Subtotal	1311.7
Tax	114.77
Total	1426.47



Conclusion

- Results obtained showed temperature drop.
- Constructed a system usable for one time investment.
- The system works best on a sunny day.
- The project taught us a lot about Project Management and working cohesively as a team.

Acknowledgements

Dr. Fletcher J Miller

Dr. Kee S Moon

Mr. Mike Lester

Silicon Solar Inc.

Thank you for all the help, ideas, and encouragement you gave us to complete our project.

The image features a large, semi-transparent green seal of San Diego State University in the background. The seal is circular and contains the text "SAN DIEGO STATE UNIVERSITY" around the perimeter and "1897" at the bottom. In the center of the seal is a depiction of a person standing in a landscape. The background of the slide is white with blue and green wavy borders at the top and bottom.

Thank you!

*One small degree in our results,
one giant leap in energy conservation*