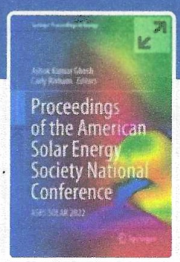

Proceedings of the American Solar Energy Society National Conference
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Solar Thermal Heating of Existing Buildings

Stephen R. Kenin

Conference paper | First Online: 19 June 2022

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Keywords

Passive solar · Solar thermal heating · Affordable solar heating for homeowners · Consumer absorption of passive solar retrofit · Bubble collector · Solar bubble

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Solar Thermal Heating of Existing Buildings

Stephen R. Kenin(✉)

PO Box 1377, Taos, NM 87571, USA
steve@stevekenin.com

Keywords: Passive solar · Solar thermal heating · Affordable solar heating for homeowners · Consumer absorption of passive solar retrofit · Bubble collector · Solar bubble

1 Introduction

Fifty Years of passive solar experience has resulted in my novel solar product patented in 2021, called **Universal Solar Thermal Cladding System.** When mounted on a sunny wall or roof it captures and circulates the heated air inside the building, enabling the building to substantially heat itself.

2 Materials and Methods

The Universal Solar Cladding System uses lightweight but structurally strong aluminum tubing that forms a framework mounted on the south, southeast and/or southwest sides of buildings. This framework supports two layers of 6 mil translucent polyethylene film that clips firmly into place against the building. A significantly more expensive clear film, ETFE is available. The film layers are then inflated using a low-wattage blower creating a tension structure. The resulting solar bubble collects thermal energy. The heated air is circulated into the buildings via windows, doors, or existing ductwork, often with the use of fans or blowers.

3 Results

ERDA, DOE and AIA awards and grants were received by my passive solar company in the 1970s. Passive solar was becoming popular until the 1985 demise of the Solar Tax Credit 1.0. www.solarroom.com - YouTube.

A. K. Ghosh and C. Rixham (Eds.): ASES SOLAR 2022, SPE, pp. 223–229, 2022.
https://doi.org/10.1007/978-3-031-08786-8_24

J. Douglas Balcomb, LANL's Solar Group Leader, was the DOE manager of our passive work. His 1992 book, Passive Solar Buildings, is the national survey. The engineering test data we generated and provided to Dr. Balcomb is still relevant. (Attachments Balcomb; Rogers).

(Fact Sheet below is the summary of the results of the DOE grants).

4 Discussion and Conclusions

Economic Justice vs Solar Availability: Affordability was a key requirement when developing our Universal Solar Thermal Cladding System. This "Solar Bubble" collector is made of high-tech, light weight, low-cost materials and is easily installed. The Bubble smiles at 80 mph winds. (Attachment Sears, Harr).

Challenges to passive solar adoption:

The first challenge is financial. I have had conversations with venture capitalists starting at the DOE's Venture Capitalist Conference in 1980. I was asked, "How do you monetize passive?" I was told, "Passive is Passé." Of course, DOE follows the money. Since the 1985 demise of Solar Tax Credits passive solar has survived only in up-scale home construction. Venture Capital tended to support Photovoltaics early on and later very expensive and ambitious Carbon Capture projects and Concentrating Solar Thermal power towers. All fine and good, but not a solution for the million of homeowners requiring an affordable carbon replacement option, or the millions of large warehouses and big box stores that could reduce carbon heating in cold seasons.

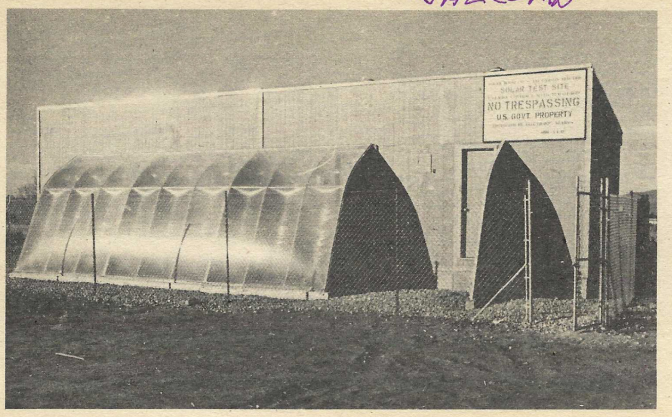
The second challenge is aesthetic: "Solar Bubbles" installed on homes and commercial buildings may not appeal to owners, but their heating effectiveness will.

Necessity Drives Invention: Today carbon replacement is an exponentially growing necessity. According to our and our patent attorney's research, ours is the only "Models and Tools" for the low-cost (passive) solar heating of homes and commercial buildings. (Passivesolarcladding.com – YouTube).

Appendix

Balcomb, Douglas

BALCOMB



SOLAR TEST SITE — The Solar Room test module is located near Ranchos de Taos on land donated by Kit Carson Electric Cooperative. Kit Carson also supplied the electrical power and meters for the solar test.

The Taos News
Thursday, December 29, 1977

Story and photos by Merilee Dannemann

Solar greenhouse tested

If you believe that a greenhouse solar heater will save energy and cut your heating bill, soon you'll be able to prove it.

The Solar Room Company of Ranchos de Taos is conducting a research project that will measure the effectiveness of Solar Room prefabricated greenhouses all through this winter season.

After about two weeks of operation, early results showed the greenhouse is way ahead in energy saving.

The project, which is federally funded and partly sponsored by Kit Carson Electric Cooperative, may be the first in the nation to monitor solar greenhouse performance in so scientific a manner. Los Alamos solar researcher Dr. J. Douglas Balcomb called it "one of the most significant passive research and development projects in the country."

Balcomb, who is official project monitor for the U.S. Energy Research and Development Administration, made his first inspection visit Dec. 15.

The experimental building, located near Ranchos, was built during the fall and started operation in late November.

It consists of four rooms of equal size, lined up next to each other. Each room has the same amount of exposure on the north and south sides. Unused storage rooms were built at both ends, so the two end rooms do not have more outdoor exposure than the others. Ordinary frame construction was used, except that double insulation was placed between each pair of rooms so they do not interfere with each other.

One room is the control, with no solar heater. A Solar Room greenhouse is stretched across the south side of the other three rooms.

One of those three is empty, with no heat storage. The second uses water storage, with water stored in quart jars under the floor. The last uses concrete slabs to simulate a massive concrete floor.

All four rooms have thermostats set to the same temperature. An electric heater turns itself on if the room temperature falls below a certain point. If the room gets too hot, a vent opens and an exhaust fan turns itself on — these actions simulate people in the house who would open a window if they were uncomfortable.

The electricity used for each room is recorded on a separate electric meter. The meter readings show exactly how much energy is used to maintain a constant temperature in each room.

After two weeks, the meters showed that the control unit required almost three times as much electricity as the solar heated room with water storage. When the meters were read Dec. 15, the control unit had used 164 kilowatt hours, the water-storage unit had used only 66 kwh. The solar unit without storage was in between at 97 kwh, and the concrete-block unit was close to it at 96 kwh.

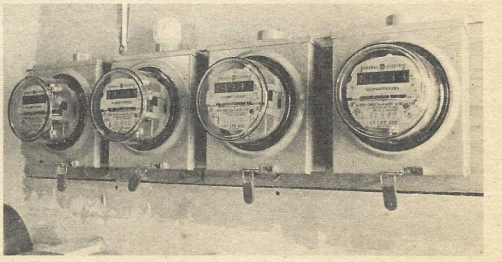
Solar Room Company president Stephen Kenin said he had expected the concrete-block unit to do better. He said he believed the problem was freshly poured and still curing — it is expected to hold heat better once it is thoroughly dried.

Dr. Benjamin T. Rogers of Rinconada, design engineer for the project, explained how heat storage helps the heat to be used more effectively.

The Solar Room is like a clear plastic bubble. If no windows or doors are open, it becomes quite hot in the daytime, just as a parked car becomes hot.

If a window or door into the house is kept open, the solar heat will warm the house in the daytime, but it could become too warm, depending on the size of the house. If it is too warm, the family will have to open a window to stay comfortable. Thus, part of the heat will escape to the outdoors and be wasted. But as soon as the sun goes down, the house will start to cool off. Heat from another source will be needed at night.

But if the hot air from the Solar Room flows past a storage medium, such as rock or water, some of the heat will be absorbed into the storage. When the air reaches the living space, it will be cooler because the storage has taken the heat. When the living space becomes cool at night, heat will radiate out of the storage, thus saving energy at night.



RESULTS — A row of electric meters tells the story of power consumption in the four test rooms.

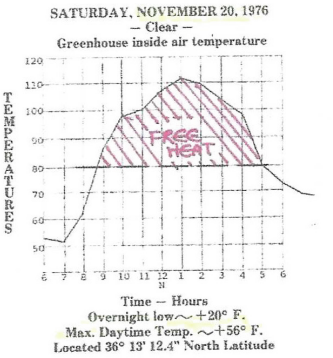
WHAT IS A GREENHOUSE SOLAR HEATER? — A SIMPLIFIED ENGINEERING APPROACH

by Benjamin T. Rogers

What is a solar greenhouse? After all, in a sense, any greenhouse is a solar greenhouse. So, just what is a "solar" greenhouse? In this page we will try to explain, in non-technical language as far as possible, the Solar Room concept of a solar greenhouse and how it works.

The Solar Room is manufactured in the mountain country of northern New Mexico. The area characteristically sees more than 6,000 heating degree days each year. For comparison, the ASHRAE tables give Chicago 5,882 (city data); Anchorage, Alaska 10,864; San Francisco 3,001; and Dallas 2,363. But the heating load is only part of the story. For a solar greenhouse to handle the heating load there must be a balance between the solar energy that it accepts and the heat that it loses to the cold outside environment. So, like any solar heating system, the Solar Room system is location specific. A conventional greenhouse will accept a lot of sun energy through the south facing glazing, a little through the east and west glazing, and very little through the north glazing. So in a sense, it has one collecting area, two partially effective collecting areas, and one big loss area (the north side). The Solar Room system, applied to the south side of an existing structure, avoids the large north side losses and, being linear in configuration, maximizes the south collection area and minimizes the end effects. It also serves to insulate the south wall of the structure.

We will now take a simplified analytical look at a solar greenhouse. When the sun is shining, high temperatures will be experienced in the greenhouse. However, after sundown experience has shown that, in our climate, the Solar Room will maintain a temperature about 30° F. above the outside air temperature. A typical temperature record for 11/20/76 is reproduced. This is the inside air temperature with no heat being taken from the greenhouse. The mass of material such as soil, plants, water tubs, etc., within the space was typical of a simple home greenhouse.



In this case, if we had started to remove heat by circulating it into the house to which it is attached and continued until 5 p.m., and done it in a manner so as to hold the greenhouse temperature at 80° F., we would have maintained the difference between the greenhouse and the outside air temperature at very close to 30° F., during the entire 24-hour period (i.e. Delta T = 30° F.).

Now we will show the performance of one square foot of Solar Room glazing that looks out in various directions and estimate the gains and losses in each case. This is an approximation to illustrate the principles; the elegant method involves a large computer and a bunch of hour-by-hour weather tapes.

Heat loss/sq. ft. of glazing per day = Q_L

U factor of double glazing = 0.65 BTU/hr., sq. ft., deg. F

Thus:

Q_L = U x Delta T x hrs/day
= 0.65 x 30 x 24
= 468 BTU/day loss/sq. ft.

We now tabulate the gains vs. the loss:

Direction	South	East	West	Roof
Gain BTU's	1437	454	454	772
(Loss) BTU's	(468)	(468)	(468)	(468)
Net	969	(14)	(14)	304

And our 30-foot long Solar Room would behave something like this:

South:	8 ft. x 30 ft. x 969 BTU's ...	232,560 BTU's PER DAY
East:	50 sq. ft. x (14) BTU's	(700)
West:	50 sq. ft. x (14) BTU's	(700)
Roof:	3 ft. x 30 ft. x 304 BTU's ...	27,360
	NET GAIN	258,520 BTU's per day

One of the reasons that a direct gain system such as the Solar Room is attractive involves its inherent efficiency. The efficiency of a typical flat plate solar collector drops off rapidly as the operating temperature rises, and high temperatures are frequently required to get usable heat to the point of utilization. The Solar Room operates at comparatively low temperature, and the heat is used at, or very near to, the point of collection. In one sense, the Solar Room is a solar collector that you get to live in.

Perhaps this little exercise has given you a better insight into how the Solar Room operates. We have kept the arithmetic simple and the results are very rough, clear day approximations.

We welcome requests for information. The more detailed the requests, the more detailed and technical our response will be.

Benjamin T. Rogers, engineer, was employed by Los Alamos Scientific Laboratories for 25 years. Recently retired, he is now consultant-engineer for LASA labs solar division, the Solar Room Company, and others. He is a director of the New Mexico Solar Energy Association.

SEARS, ROEBUCK AND CO.

ROBERT S. FEENY Store Manager

September 10, 1984

Mr Steve Kenin
Solar Resources, Inc
P O Box 1848
Taos, New Mexico 87571

Dear Steve,

Since I've had my "Solar Room" for three years, I thought it was time that I reported my complete satisfaction.

My wife and I are very happy since:

1. It has reduced winter heating bills by 60% (paid for itself the first year).
2. It has become a year-round hobby area (greenhouse). We have flowers all year.
3. It has added 312 sq ft of living area to our house.
4. It is delightful to be able to go out in December and sit in 80 degree temperature, when it is 25 degrees a few feet away.

The possibilities are as limited as the buyer's imagination, I can see it as a child's nursery, a hot tub enclosure, or just an area to read and/or relax.

My screen (for summer) is in excellent shape after three seasons. I am having to replace the plastic (also used three seasons) because icicles over the past three years, have punched many holes in the top and tape will no longer keep it air tight. The plastic has, otherwise, not deteriorated.

My Solar Room has been one of my best investments.

A very satisfied customer,

R. S. Feeny

RSF:dp

130 LINCOLN AVENUE SANTA FE, NM 505/983-6321

Harr, Kelvin S

July 16, 1982

HARR

Mr. Steve Kenin
Solar Resources
P. O. Box 1848
Taos, New Mexico 87571

Dear Mr. Kenin:

My two solar rooms have exceeded all expectations. They survived 80 mile an hour winds that blew down trees on my property. One unit keeps my two car garage shop useable all winter and the second unit provides significant heat input for the house. Last winter my heating bills were half that of anyone else in the neighborhood. I estimate my dollar savings to be in excess of $400 for the year.

I plan to relocate one of my solar rooms this fall to enclose a patio and hot tub. I expect no problems in moving the unit and am looking forward to a winter of hot tubbing. Also, tomatoes from the greenhouse have become a tradition for Christmas dinner.

Sincerely,

Kelvin S. Harr
Senior Research Engineer
Golden Colorado

KH:sk

GOLDEN JUL 16 '82 COLO.

Solar Energy Research Institute
1617 Cole Boulevard
Golden, Colorado 80401

Mr. Steve Kenin
Solar Resources
P. O. Box 1848
Taos, New Mexico 87571

Fact Sheet

Fact Sheet

BUILDINGS GENERATE 40% of CO_2. Heating is a significant percentage
Solar Bubbles initiate a new solar category:
Solar Thermal Retrofit

Universal Solar Thermal Cladding, or "Bubble Collectors" for short, introduce a novel passive approach: SOLAR THERMAL RETROFIT
Bubble Collectors are constructed of hi-tech, lightweight materials, inexpensive and strong. Bubble Collectors are designed to heat existing buildings. Mounted on sunny
walls or roofs they capture the solar radiation and circulate the heated air inside. Think
"Solar Tinker Toys." Bubble Collector Kits come ready to assemble and fit on your cabin, castle or big box store.

Bubble Collector Structure & Configurations
A double layered membrane of clear ETFE glazing film or translucent Polyethylene film
is stretched over a tubular aluminum structure configured to sunny wall or roof area(s). The membranes are then sealed at the building and inflated. The membranes become TENSION STRUCTURE BUBBLES.

This Solar Bubble Collector, 8'x30' = 240ft.^{2} was *DOE TESTED 11/20/76*
The following data is available from Buck Rogers, PE
232,560 BTU/day produced
969 BTU/1ft.^{2}/day
170 lbs. total weight of structure and polyethylene glazing
$600 direct costs
Utility Patent 2017, Universal Solar Thermal Retrofit:
PV space heating costs **10X** more than solar thermal space heating,
significant percentage.

Bubble Collector marketing is based on teaching passive solar to young activists.
Many of Greta Thunberg's "Blah, Blah, Blah" kids, thousands of smart, environmental activists, including debtor students, would accept "green work" that teaches "replacing CO_2 heating with solar heating." Each kid would be providing an important fraction of the gigatons of CO_2 removal necessary before **2030**. Solar Thermal sales can provide significant carbon footprint reductions. Solar Thermal systems must become ubiquitous by 2030.