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MULTI LEVEL COORDINATION
OF LOW COST COMMUNITY PRODUCED
PASSIVE SOLAR SYSTEMS
IN CRYSTAL CITY, TEXAS

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ABSTRACT

Small high poverty rural towns in South Texas are experiencing increasing difficulty in supplying energy sources at a price obtainable by their citizenry. Some of these towns are being forced to default on previous contracts to suppliers and have been or are being shut off. This occurrence has forced these towns to re-evaluate the basic assumptions upon which their original development plans were based where high degrees of coordination between labor, running capital, local and federal institutions, and their indigenous resources must now occur. This paper attempts to outline how passive solar technologies are an integral part of this redevelopment process and how innovative cross hybridization of appropriate technologies can make many of these attempts affordable where previously they were not.

1. INTRODUCTION

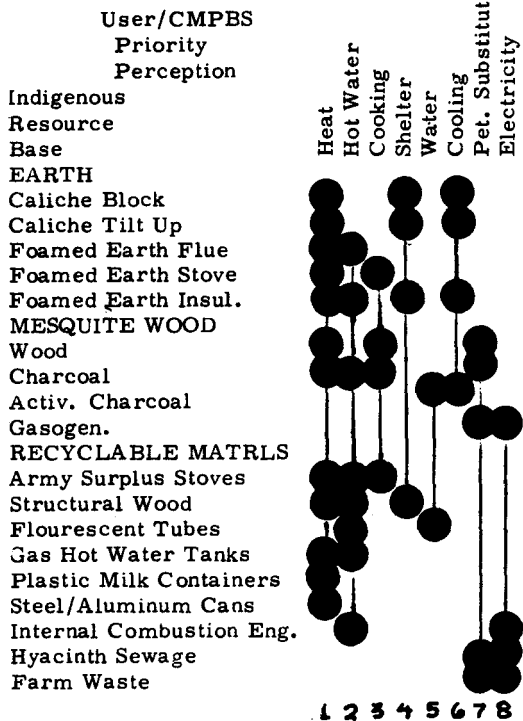
The common belief that solar technologies must by nature cost more than conventional utilities is an impossible condition under a high poverty situation (50-80% of the population being below poverty guidelines is common in south Texas especially during the winter season). One of the only possible solutions without massive government subsidy is a careful and gradual internal reorganization aimed toward self-sufficiency. This organization is internal and external in nature. Internally, it is not only a question of education, but one of convincing local agencies to coordinate in areas previously unheard of. It is also a relearning about indigenous resources and their use, many

of which have been thrown away in order to keep up with middle America. Internal organization is also a question of when and in what way should a municipal government become its own utility. How can the present government, from an internal political standpoint, throw out past planning policies that were set on growth. Programs that cost millions now suddenly becoming obsolete. External organization becomes a question of coordinating Federal agencies with grant funds to hinge around a highly regional cause which has very special attributes quite different from other regions. It involves rethinking of weatherization programs which rarely in their textbook form include indigenous resources or capabilities. This paper will present the beginnings of organizational techniques that can actually lower the cost of technologies such as passive solar collectors, greenhouses, dehumidification systems and many others. Not all the techniques to be mentioned in this paper are yet in progress, however, we have helped this small town of Crystal City, Texas (8,100 pop) to collect over 1000 cords of mesquite wood, and installed 1000 woodburning stoves. They will shortly have 150-200 solar hot water heaters. They have already gone through some substantial recycling efforts to reduce the cost of materials.

2. ORGANIZATIONAL PROCEDURE

Although an important step in organizing these towns is to convince those in power to subcontract a proper input/output analysis of materials, energy and money so that a

concrete priority system can be proposed the attempts so far have been crisis reactive on line planning that has had to respond to the users immediate needs. The following chart outlines various programs and their probable evolution.



- Participating Local & Federal Agencies:
- a) City of Crystal City 1 2 3 5 6 7 8
 - b) Migrant Housing Program 4 6
 - c) Zavala County Economic Develop. Prog. 1 2 3
 - d) Girl/Boy Scout Troop 1 2
 - e) CETA Program 1 2
 - f) U.S. D.A. Rural Extension Service 1
 - g) Urban Renewal 1 3 4
 - h) NCAT 2
 - i) C.M.P.B.S. 1 2 3 4 6

3. FINDINGS

Some technology integration points must be brought out in summary of these charts. First, it must be realized that when there is an extreme lack of basic comforts that heating is the highest priority to the user even in south Texas, and it was in response

to this factor that our approach was formulated. To pick one example of integration our Crystal City Passive Solar Collector illustrated at the end of this paper with flue pipe going up the middle and attached to a mesquite stove cannot practically take place unless one has a clean burning fuel such as charcoal otherwise there is too much buildup of tars in the flue of the recycled tank. The Crystal City Passive Solar Collector in turn cannot be really inexpensively produced unless recycling programs are going that include old gas hot water heater tanks and flourescent light tubes.

As we come down to individual components in this case within the Crystal City Solar Collector, the following cost reductions result from recycling. By utilizing recycled flour escent light tubes with an assumed recycle price of 23¢ each (which is high and includes labor) we find a 19% cost reduction compared to flat filon covered greenhouse plastic which does not perform as well as the flourescent tubes neither spectrally nor thermodynamically. By utilizing recycled tanks including labor for dismantling and acid cleaning we find a cost reduction of 68%. Over all the total savings of including installation of a simple passive collector is 33-34%. This brings the price well below a new electric hot water heater. Our collector was priced out at \$105 including labor.

The payback period as compared to the following conventional fuel systems using electricity:

| | |
|-------------|-----------|
| NUCLEAR | 6.5 years |
| COAL FIRED | 6.8 years |
| OIL | 3.5 years |
| PROPANE GAS | 4.4 years |

Too often such grassroots technology is not viewed by the scientific community as having too much relevance in advancing the field of solar energy. However, some important integrative aspects of the so-called soft technologies should be brought out. First, continuing on some of the design aspects of the same recycled Crystal City Collector, certain thermodynamic and spectral issues have been addressed rarely placed into production by the solar industry. Flourescent light tubes are not simply a replacement for glazing, but when placed on a north-south axis prismatically bend the

light during the days cycle. This technique was proven effective by Dr. Marshall Mariana during the ISES Conference in Los Angeles in 1974. Our system concentrically utilizes these tubes around the tank for best seal. As we compare performance on our system to plastic type glazing we find consistently better performance of from 5 to 15°F. Even under static conditions the Crystal City Collector averaged a 49% efficiency over a three day period. The D. O. E. sponsored Solar Data Center at Trinity University has found a 20 gal. model of this collector capable of producing about 12, 000 BTU daily or 50 gal of 110°F hot water.

There are findings of similar nature in the passive technologies category in relationship to attached solar greenhouses. Our framework is totally made up of recycled wood members placed in a rib truss formation. The rib truss is standard practice in the building industry for roofing members. However, there were two reasons for using this technology under present circumstances: 1) is the fact that truss plates replace toe nailing and thus circumvent the issue of old nail holes; 2) that ribs can be prefabricated at a city warehouse and delivered to the site thus reducing the time spent disrupting the family. Cost reduction of the total greenhouse is 28% (\$5.17/sq. ft. vs. \$3.72). It is important to note that to the user stress perception is also addressed where space is a most critical topic to a large low income family. It in effect could replace migrant housing efforts for a room addition while at the same time fulfilling the stress perception of needing heat. A greenhouse recently finished in Carrizo Springs, Texas also has a completely adaptable glazing system so that the greenhouse turns into a screen breeze porch during summer months. During the winter our greenhouse supplies all the 120 deg. days of heat requirement. It was found that various heat storage techniques used in these greenhouses cost out as follows:

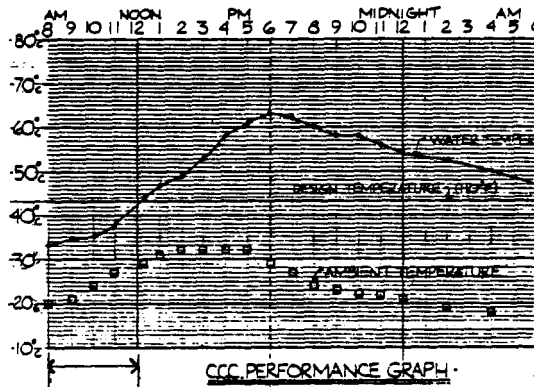
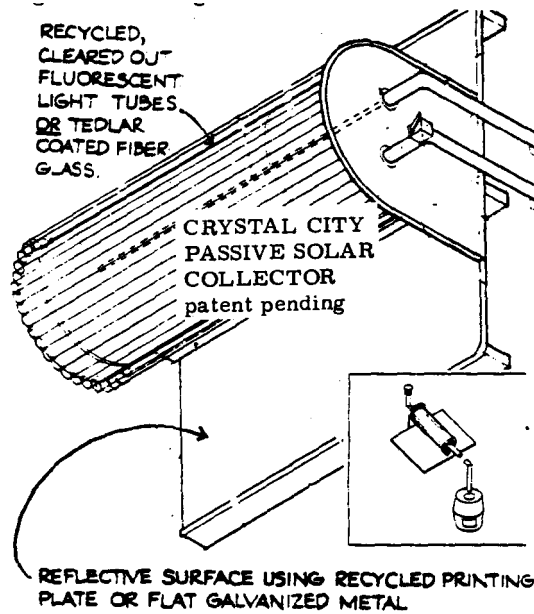
COST PER BTU OF VARIOUS HEAT STORAGE SYSTEMS

| | |
|--|-------------|
| \$43/yd. concrete, excluding labor & forms | \$.08/BTU |
| 8' Kalwall tube, 10" diam. | \$.233/BTU |
| Cattle storage tank, 320 gal. @ \$80, Sears | \$.03/BTU |

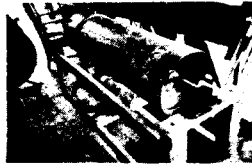
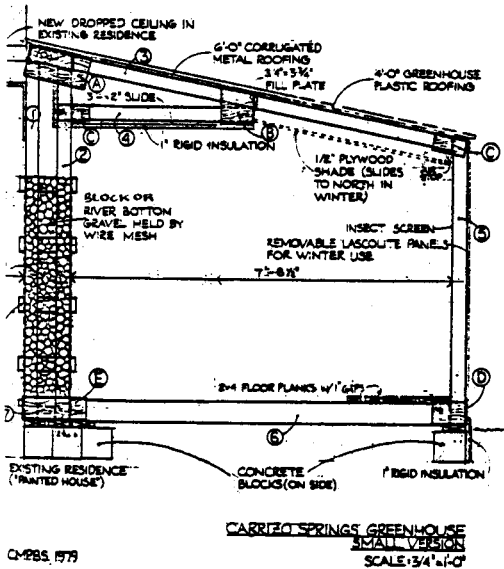
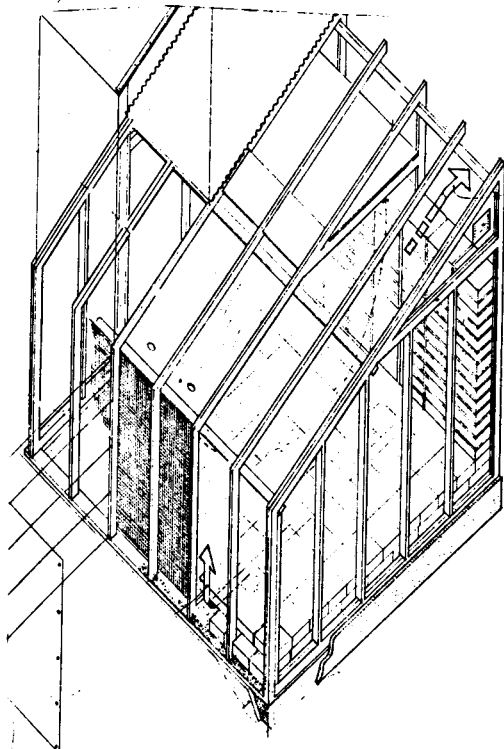
| | |
|---|-------------|
| Recycled 1 gal. plastic jug @ 5Q per bottle | \$.008/BTU |
| Soil cement @ 10% cement, includes all labor | \$.06/BTU |

4. CONCLUSION

Passive solar technologies, when responsive to the natural resources, labor and economics of the self-reliant community, may become our next stage in solar innovation. Cookbook approaches and indiscriminant borrowing of technologies is only one adolescent step in our progress. Many of these technologies must literally grow out of the total circumstances one finds in a given microregion.



RIB-TRUSS GREENHOUSE



Tank Recycling



C. C. Collector



Mesquite Stove



Mesquite Gathering



Structural Wood Recycling Pile



Rib-trusses for Greenhouse Stacked



Rib-truss Being Placed



Rib-truss Greenhouse



Foam Caliche Earth Insulation