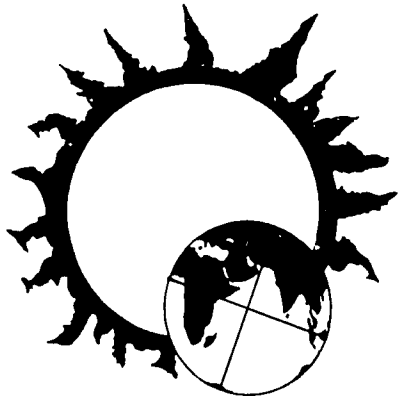

Training in Alternative Energy Technologies

A Cooperative Program of the
U.S. Agency for International Development
and the University of Florida

University of Florida

Gainesville, Florida

PDAA-717

THE TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM AT THE UNIVERSITY OF FLORIDA

FINAL PROGRAM REPORT

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A report to
Office of Energy
Bureau for Science and Technology
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Introduction

In September,1979, the US Agency for International Development, responding to an unsolicited proposal submitted by the University of Florida, entered into a Cooperative Agreement with the University to support a program in "Training in Alternative Energy Technology", (TAET). The principal investigator and administrator of the program was Dr. Erich Farber, Distinguished Service Professor of Mechanical Engineering, and Director of the Solar Energy and Energy Conversion Laboratory at the University of Florida. The project manager in USAID was Mr. Alan Jacobs, Director of the Office of Energy in the Bureau for Science and Technology

As stated in the Cooperative Agreement, the intention was to "make effective use of the broad experience and demonstrated competence of the University of Florida Solar Energy and Energy Conversion Laboratory in the field of alternative energy technology."

The specific objectives of the first Cooperative Agreement were defined as follows:

> (1) The development of LDC human and thus institutional and technical skills in small scale alternative energy technologies, specifically solar. This involves the conduct of an intensive training program for LDC participants by the recipient. The recipient would provide two training sessions of 15 weeks each year. These sessions would be open to 40 students per session of whom 30 would be LDC students supported under this program. The session would involve classroom and laboratory activities designed to provide participants with the skills and knowledge necessary to build, test and install small scale solar technologies-mechanisms which are inexpensive, safe and replicable and provide energy to meet basic needs of the rural and urban poor. The trainees would provide their LDCs with a nuclei of technically skilled persons capable of providing technical leadership and support in the development of a program of small scale solar technologies.
>
> (2) The application of these trained human and institutional skills to site and problem specific situations in the LDCs to provide energy to meet basic needs of the rural and urban poor. This involves consultation between recipient and the LDC government, the USAID Missions and the LDC participants on an on-going basis. This requires the establishment of continuing contact and support to these LDC participants and their LDC institutions to carry out in-country training by LDC participants and to construct, test, adopc and replicate the small scale solar technologies as rapidly and as widely as possible.

In keeping with the terms of the Cooperative Agreement, the University of Florida organized and presented the first 15-week training session in April 1980. Thirty-one participants from nineteen developing countries attended the session.

Over the next four years a further eight training sessions were conducted by the University. The chronology of events, including the dates of the three program reviews, are shown below.

Date	Activity
September 1, 1979	Cooperative Agreement begins
April 14 - July 25, 1980	Session 1
June 1980	Site Assessment
September 8 - December 19, 1980	Session 2
February 9 - May 22, 1981	Session 3
May 1981	Program Evaluation
August 8 - December 11, 1981	Session 4
December 1981	Curriculum review
February 22 - June 4, 1982	Session 5
August 23 - December 10, 1982	Session 6
February 21 - June 3, 1983	Session 7
August 22 - December 9, 1983	Session 8
February 21 - May 25, 1984	Session 9
June 30, 1984	TAET program ends

A total of 286 participants from 54 developing countries attended the training program; another 4 persons from the U.S. also participated. A list of participating countries, and the number of persons who attended from each one, is shown below. A complete listing of participants is given in Appendix 9.

Antigua	2	Guyana	2	Peru	1
Bangladesh	13	Haiti	3	Philippines	15
Barbados	2	Honduras	4	Portugal	1
Belize	1	India	23	Rwanda	6
Bolivia	6	Indonesia	11	St. Lucia	2
Brazil	2	Jamaica	13	Senegal	6
Burma	4	Jordan	5	Sierra Leone	2
Burundi	3	Kenya	4	Somalia	2
Cape Verde	1	Liberia	5	Sri Lanka	1
Costa Rica	6	Malawi	1	Sudan	32
Djibouti	1	Mali	1	Tanzania	8
Dominica	1	Mauritania	1	Thailand	22
Dominican Republic	11	Morocco	5	Togo	1
Ecuador	6	Nepal	5	Tunisia	2
Egypt	17	Nicaragua	1	Turkey	1
The Gambia	7	Nigeria	6	United States	4
Ghana	3	Panama	3	Venezuela	1
Guatemala	1	Papua New Guinea	1	Yemen	1
				Zaire	1

Course Structure

The first Cooperative Agreement between USAID and the University of Florida defined the purpose of the agreement in terms of the specific objectives outlined earlier. The objectives made it clear that the focus of the training program was to be small-scale solar technologies. Furthermore, the Cooperative Agreement gave examples of some of the technologies considered appropriate: solar energy technologies for "crop drying, fish drying, hot water, refrigeration and water purification."

The first session commenced on April 14, 1980, and ran for 15 weeks, ending on July 25, 1980. The program presented its course material to the 31 participants in the following sequence:

- Introduction (1 week)
  Orientation; course content and schedule; program philosophy; perspectives on energy technology.

- Availability of Alternative Energy Sources (2 weeks)
  Solar radiation; solar measurements; global energy resources--conventional and renewable; biomass resources; wind measurement; wind energy; hydropower, geothermal energy; ocean thermal energy conversion (OTEC); waste heat recovery.

- Harnessing of Renewable Sources of Energy (4 weeks)
  Principles of heat transfer; properties of materials; heat transfer coefficients; principles of fluid flow; flat plate solar collectors; thermosyphon systems; solar collector testing; solar air heaters; solar ponds; concentrating collectors; thermal energy storage; photovoltaic principles; silicon solar cells; energy conservation; "appropriate" technology.

- Applications of Alternative Energy Technologies (5 weeks)
  Domestic thermal energy loads; solar hot water systems; solar architecture; heat storage walls; refrigeration and air conditioning; thermoelectric cooling; energy use in the food system; crop drying, greenhouses, food preservation; solar distillation; solar stills; water desalination; mechanical power from alternative energy sources; Stirling engines; pumps and engines; solar thermal power plant; fuels from biomass; aquatic biomass; fuel alcohol; biogas technology.

- Socioeconomic Aspects (2 weeks)
  Transfer of appropriate technology; economic aspects of alternative energy systems; energy flows in developing countries; environmental limits on renewable energy developments; financing energy projects; sociological aspects of introducing energy technologies; appropriate technology and rural development.

The course included not just lectures and seminars, but also laboratory exercises, group project work, and field trips. The group also spent seven days visiting alternative energy systems, mainly solar technologies, in New Mexico and Arizona.

Site Assessment

During the week of June 9, 1980, about midway through the first training session, a four person team from USAID visited the University to review the new program. The Site Assessment report, issued by the review team in July, 1980, was for the most part favorable. The team found the course well-organized, and that the program was "administered in a manner that gives the appearance of having functioned for some time." The review team was clearly impressed by the motivation and qualifications of the participants. One member of the USAID group mentioned that he had "seldom observed a more satisfied group of participants."

The review team voiced a number of concerns pertaining to the operation and administration of the program, and made a number of recommendations to the University. Among these recommendations were the following suggestions.

- The curriculum should be subject to peer review either by a College of Engineering faculty committee or a university-wide interdepartmental or interdisciplinary panel. The inputs of such groups would be of much benefit in terms of assuring a balanced treatment of alternative energies, and the social and economic dimensions of utilizing these sources of energy in the LDCs.

- The University should add to the TAET faculty a qualified engineer or technical specialist who has lived in one or more developing countries and has been actively involved in the successful introduction and adaptation of alternative energy technologies.

- An effort should be made to describe alternative energy technologies introduced and adapted in developing countries. Case materials illustrating the social, cultural, economic and political considerations involved in technology choice and transfer in the new and renewable energy field should be made available and discussed.

- Sources of alternative energy other than direct solar merit more in-depth consideration than the cursory attention now given to them in one day by a single guest lecturer. This would include more intensive treatment for appropriate small-scale renewable energy technology subjects such as biogas and biomass, wind, and small hydropower.

- The socioeconomic aspects of each technology covered in the course should be discussed at the time that particular technology is taken up. Comparisons should be made in benefit-cost terms with other technologies that might be chosen to perform similar functions.

- There is an unusual emphasis and allocation of time for the purpose of involving participants who are managers and decisionmakers in hands-on fabrication of equipment. Their time might be more profitably invested in experimenting with the application of a wide variety of direct solar and other relevant alternative energy devices.

The majority of the recommendations made by the Site Assessment team were accepted by the University and incorporated into the organization of subsequent training sessions. However, the specific objectives outlined in the first Cooperative Agreement left no doubt that the emphasis of the TAET program was to be solar energy technologies; there is no mention in the Scope of Work of biomass, wind, or hydro. The review team recognized this problem when, after recommending that other alternative energy sources be included in the curriculum, they noted that "an amendment in the cooperative agreement may be called for in this connection."

Program Evaluation

A detailed evaluation of the TAET program was conducted by the firm of Arthur D. Little, Inc., in May 1981 during the last few weeks of the third training session. While finding that the TAET program made a "useful contribution to the understanding and utilization of a number of alternative energy technologies of importance in the range of developing countries from which the participants come"; and recommending that the training program be continued at the University of Florida, the ADL review team, nonetheless, recommended some significant changes to the program's structure and operation. The review team's recommendations are presented below:

1. The objectives of the training program should be more clearly defined. The overall objective should be to provide training to participants in renewable energy resource development which will help them make better decisions in allocating scarce manpower and financial resources for research and development, implementation, and commercialization activities.

2. More attention should be given to wind, small-scale hydro, and biomass systems with particular emphasis on their applications in the developing countries.

3. The participants should be provided with an overview of relevant activities in the US, and elsewhere, including the commercial status and availability of equipment.

4. The course should include a review of the cost structure of different equipment options, and approaches to estimating the costs of equipment and systems. Particular emphasis should be given to how the cost of systems divides among purchased materials, special processing, manufacturing, distribution, installation, and operation.

5. The course should show how economic performance characteristics of all systems should be evaluated, based on both present and projected cost structures. Approaches for comparing the economics of systems with both conventional and non-conventional options should be outlined.

6. The curriculum should include case studies of alternative energy systems in use in the developing countries. These studies should include the technical analysis, design constraints, installation issues, operating experience, and economic evaluations.

7. The course should introduce discussion of the socio-economic issues relevant to the developing countries which are associated with each technology option, including requirements for local manufacture, utility interface problems (for electric power systems), impacts on foreign exchange due to reduced oil imports, and installation and organization and management infrastructure requirements.

8. Socioeconomic issues should be an integral part of the discussion of each technology option and should not be solely addressed by short-term guest lecturers.

9. The design of course content in each technology must be done by TAET personnel if this content is to address adequately the special needs of the participants.

10. The University should add to the TAET teaching staff one or more staff members with in-depth knowledge of important non-thermal renewable energy technologies such as biomass and wind energy utilization.

11. Included in the teaching staff should be individuals with an overall technology evaluation orientation including economic analysis and national socioeconomic assessment; staff should also have experience in the developing countries.

12. The administrative organization of the program should be restructured so as to:
    - reduce the administrative costs associated with the program
    - increase the breadth of academic input into the program
    - clarify lines of responsibility and increase the amount of delegation of authority and responsibility.

13. Greater authority and responsibility should be given to the Advisory Committee. This committee should include a wider diversity of individuals with expertise in economic analysis and familiarity with sociological issues. There should be greater representation from individuals with developing country experience.

Selected material from the review team's report, including the program review, executive summary, and recommendations, is given in Appendix 2.

The Revised Agreement

The Cooperative Agreement between USAID and the University of Florida was extended in September 1981. However, the Scope of Work appended to the Agreement now showed a number of significant changes when compared to the original Cooperative Agreement. These amendments to the contract included many of the changes recommended by the Site Assessment and the Program Evaluation review teams.

For example, whereas in the first agreement it was stated that the purpose of the agreement was to utilize the experience and competence of the University of Florida in the field of alternative energy technology "specifically, small scale solar technology," in the revised agreement the experience and competence of the University was now recognized as encompassing solar energy, wind power, hydropower, and the biomass energy technologies.

But the most significant changes occured in the definition of the specific objectives. In the original agreement the objectives had been only loosely defined, in language that was not entirely clear. The revised Cooperative Agreement defined four specific objectives.

(1) To instruct technically oriented LDC participants on the analysis and operation of applicable technology options.

(2) To provide participants with up-to-date information on technology status in the U.S. (and elsewhere) and to identify potential sources of goods and services which individual LDCs might contact to assist in their R & D and implementation activities.

(3) To instruct participants in how to evaluate the technical and economic performance of systems when serving both small and larger scale applications identified as being of importance in LDCs.

(4) To provide the participant with sufficient knowledge in alternative energy technologies in order that he can participate in establishing realistic national alternative energy programs for his country.

The new Scope of Work even indicated the time that was to be allocated to each subject area:

> Each session would be structured to provide two weeks at the beginning of the program for general training in alternative energy technologies followed by four weeks in solar, two weeks in biomass, one and a half weeks each in hydro and wind energy systems. These sessions would include classroom and laboratory activities designed to provide participants with the skills and knowledge necessary to meet the specific objectives as outlined above. The remaining weeks will be used to continue laboratory projects, treat the socio-economic aspects of alternative energy in developing countries, visit alternative energy facilities, and consult with private sector representatives. These remaining weeks may be interwoven into the earlier portions of the program as appropriate.

It was clear that the intention was that the training program should give more emphasis to hydropower, wind energy, and the biomass energy technologies. Moreover, the focus on "small scale" technologies designed to provide energy to meet the "basic needs of the rural and urban poor"--a focus clearly defined in the first Scope of Work--had now been dropped.

Curriculum Review

In November, 1981, the consulting firm of Development Sciences Inc., (DSI) was asked by the Office of Energy at USAID to review the TAET curriculum and to make suggestions for revising it to meet USAID objectives. The DSI team subsequently developed a revised curriculum which was approved by the Office of Energy and accepted by the University of Florida.

In their brief report, the DSI team made a number of specific suggestions which they recommended be implemented before the start of the next session (session 5) of the training program. These recommendations are listed below:

- Continue, but diminish, the emphasis in the 15-week course on small scale renewable energy technologies and applications and add consideration and comparison of larger scale and more sophisticated renewable technologies.

- Integrate social, economic and national renewable energy issues and analysis procedures into existing lecture presentations by permanent staff. Include more emphasis on social, economic, environmental, etc., criteria for technology selection.

- Expand the two week overview course to emphasize technology systems tradeoff and decision making as it applies to LDC's. An approach starting with end uses and moving to resources and transformation technologies should be adopted. The total energy technology selection process should be discussed.

- Form a teaching team for at least the two week overview and introduction to the 15-week course. This team should be composed of Dr. Farber, Dr. Pagano and a third person. The third person should have extensive LDC experience in renewable energy technology and systems tradeoff. During the upcoming session (session 5), the third person should come from outside the existing permanent staff. For following sessions, a senior permanent staff position should be considered and possibly an existing staff member could fill this position.

- Increase the formal student-teacher contact time and add more emphasis on LDC applications and experience. Be sure that this emphasis is integrated into the overall course. If classes are given by guest lecturers, more notes, handouts and preparation should be included and the guest lecturers should be provided with a course syllabus and given time to discuss their presentations with the teaching staff.

- Decentralize administration to free-up technical staff for more substantive and teaching involvement.

- Produce a lecture notebook similar to the existing laboratory notebook. This notebook should be given to students at the beginning of the course.

- Continue the student project element, but augment and strengthen this effort with an intensive week's work with permanent staff and selected visiting experts.

- Continue the acquisition and expansion of laboratory equipment and capabilities emphasizing small hydro, wind and biomass. Increase scale/size of demonstration technologies to provide examples of village/commercial size systems.

The course content and format of the fifth training session was restructured following the review team's evaluation, and the curriculum recommended by DSI was closely followed. The most significant innovation was the introduction of a short course or "overview session", scheduled for the first two weeks of the 15-week session. This "mini-course" was a self-contained unit, and was designed to attract developing country personnel who could not spare 4 months to attend the full session.

The DSI team recommended that the 2-week overview session should follow the conceptual structure outlined below:

Unit 1 Basic Concepts

- The overview of the course and its objectives
- Taking first steps to create energy programs

Unit 2 Design Criteria

- End use analysis
- Energy for what?
- Criteria for technology selection and design parameters
- Examples of technologies suited to end uses

Unit 3 Practical Factors of Success

- Making technologies work
- Laboratory program description
- Manpower skills required to support technology applications
- Program, project, institutional context
- The concept of system design

Unit 4 Defining the First Step to Meet End Use Needs

- Defining a resource
- Competition for resource use
- Assessing a resource

Unit 5 Familiarization with Technologies and Their Appropriateness

- The primary conversion technologies (solar, biomass, wind, hydro)
- Why these sources--the methodology of selection
- How and where they compete with conventional energy
- The question of scale
- The emphasis on rural applications

Unit 6 Reality Consciousness Raising

- Laboratory demonstration of selected previous technology projects
- Technology projects
- Site visits to demonstration projects

Unit 7 Incentives

- Developing country applications--a history of successful projects

Unit 8 Understanding the Commitment Needed

- Providing the preconditions for introducing renewable energy

Unit 9 Framework and Priorities

- Round table discussion for problem definition in each country with commentary by faculty

The DSI team's recommended curriculum for the 13-week main session following the short course was arranged in a conceptually similar manner.

Unit 1 The Analytical Framework to Supply End Uses

Unit 2 Basic Technological Features

- Heat transfer
- Fluid flow
- Combustion
- Mechanical transformation
- Materials
- Biochemical processes
- Electricity
- Instrumentation
- Energy Storage

Unit 3 Basic Non-Technical Features

- Economic analysis
- Financial analysis
- Sociological analysis
- Institutional analysis
- Management analysis
- Project design and integration

Unit 4 Sources and Their Measurement

- Solar
- Wind
- Hydro
- Biomass
- Geothermal
- Ocean thermal
- Tidal

Unit 5 Conversion Technologies

- Thermal
- Mechanical
- Biochemical
- Electrical

Unit 6 Matching Technologies to End Uses

- Criteria
- Methodologies

Unit 7 Group Project Work

- Technology construction

Unit 8 Technology Generation and Transfer

- Creating the conditions for introducing renewable energy to meet economic goals

Curriculum Development

It is clear from the preceeding discussions concerning the structure and organization of the TAET program, and the recommendations of the three review teams, that two persistently strong recommendations to the University were that first, the course should give more time to the other alternative energy technologies besides solar; and that second, the course should do a better job of presenting the socioeconomic material and relating it the transfer, adoption, and dissemination of the alternative energy technologies in the developing countries.

With regard to the inclusion in the training course of the other alternative energy technologies--mainly, biomass, wind, and hydropower--it has been suggested that the principal barrier to the inclusion of these subjects into the teaching curriculum was the emphasis of the specific objectives articulated in the first Cooperative Agreement. The objectives made it clear that the major part of the curriculum was to be devoted to the teaching of the solar energy technologies.

The contractual obligations imposed by the first Cooperative Agreement were in effect from September 1979 until September 1981, during which time three training sessions were conducted, and a fourth was in progress. The TAET course content changed very little during this period. Approximately 40 percent of the course time was scheduled for training related to the solar thermal technologies. The time allocated to biomass, wind, hydropower, and photovoltaics increased only marginally during the first four training sessions; the time set aside for these technologies as a whole was still less than that taken up by solar.

Table 1, overleaf, compares the time allocated to each broad subject classification as a percentage of total teaching time, over the nine sessions. It can be seen that the emphasis and focus of the program remained essentially unchanged during the first four sessions.

Some change in emphasis is apparent in session 4: more time is devoted to the biomass energy technologies and the time taken up in teaching the basic technical principles is somewhat reduced. Solar thermal energy technologies, however, continue to dominate the course. The first four training sessions were organized and conducted in a manner which did not significantly differ from that of the first session--the outline of which is shown on page 2.

However, following the publication of the Curriculum Review in December, 1981, session 5 of the TAET program was substantially restructured in keeping with the recommendations made by the DSI review team. The first two weeks of the session were reorganized into a self-contained overview course, called the "short course"; the remainder of the session was also restructured. The curriculum of the training program also changed. As Table 1 clearly shows, session 5 marked the beginning of a trend that saw an increasing amount of time gradually being allocated to the other energy technologies besides solar.

Table 1

Comparative Time Allocation by Subject Area - Percent

Subject Area	Session								
	1	2	3	4	5	6	7	8	9
1. Solar thermal (1)	41	38	36	39	24	25	29	26	25
2. Basic principles (2)	20	21	18	12	10	11	10	11	13
3. Biomass energy	13	15	16	19	18	22	19	15	16
4. Socioeconomics	13	9	13	12	23	17	16	19	17
5. Photovoltaics	4	7	4	5	6	5	7	6	7
6. Energy conservation (3)	4	3	3	3	1	2	1	1	1
7. Wind energy	3	4	5	5	9	7	6	10	9
8. Hydropower	1	1	2	2	5	7	8	9	8
9. Geothermal & OTEC	1	2	3	3	4	4	4	3	4

Notes: 1) Solar radiation, solar collectors, solar ponds, stills, dryers, systems.
2) Heat transfer and storage, fluid flow, electrical generation, refrigeration, thermomechanical conversion.
3) Including passive solar and waste heat recovery.

The format and curriculum for the short course of the fifth session is shown on pages 16 and 17. The structure of the main session, weeks 3 through 15, is shown in plan form on page 18.

The course format indicated in these charts was followed, with only minor changes, during session 6 through 9. A detailed schedule for the last training session, conducted in the spring of 1984, is given in Appendix 1.

The second point consistently made by the review teams related to the teaching of the theory and practice of social, economic, financial, and other forms of project analysis, and the opinion expressed by the reviewers that these concepts were not being effectively addressed in the training program.

The University had attempted to respond to these criticisms but had found it difficult to find professors or researchers at the University who were familiar with both the methods of socioeconomic analysis and the alternative energy technologies. There were many people with a great deal of experience in either one field or the other--but almost none with experience in both.

People were brought in from outside the University to lecture to the TAET participants in these subject areas, but this approach did not lend itself to an integrated or systematic exposition of the subject material--a problem recognized by the review teams. This situation improved considerably at the beginning of 1982 when the University asked Dr. Clyde Kiker to arrange and coordinate this part of the training program curriculum. Dr. Kiker is an Associate Professor in the Institute of Food and Agricultural Sciences, Department of Food and Resource Economics, with experience in both engineering and economics.

TAET SESSION 5 — SHORT COURSE WEEK 1

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
FORMAL OPENING	INTRODUCTION	DESIGN CRITERIA	RESOURCE ANALYSIS	ALTERNATIVE ENERGY TECHNOLOGIES
• Welcoming Address. U.S.A.I.D., University & T.A.E.T. Staff Tour of laboratory and shop facilities	• Overview of the course and program objectives.	• How societies use energy. • Energy for what? • Criteria for technology selection	• Defining a resource • Resource allocation	• HYDROPOWER • Resource potential, technologies, systems, and issues.
PARTICIPANTS' INTRODUCTION	INTRODUCTION	DESIGN CRITERIA	ALTERNATIVE ENERGY TECHNOLOGIES	ALTERNATIVE ENERGY TECHNOLOGIES
• Participants' introduction and individual presentations.	• Introductory basic concepts Tour of alternative energy installations in Gainesville.	• Methodologies of technology selection • Systems analysis • Trade-offs	• WIND ENERGY • Resource potential technologies, systems, and issues.	• BIOMASS • Resource potential technologies, systems, and issues.

TAET SESSION 5		SHORT COURSE WEEK 2		
MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
ALTERNATIVE ENERGY TECHNOLOGIES	ENERGY TECHNOLOGIES IN PERSPECTIVE	ENSURING SUCCESS	TECHNOLOGY DEMONSTRATION	SUMMARY DISCUSSION
• SOLAR ENERGY • Resource potential, technologies, systems, and issues.	• Resources to end-use • End-use matching • Scale and economies of scale	• The role of the institution. • Competition for development resources. • Information needs	• Criteria for laboratory organization. • Laboratory demonstration of operating systems.	• Participant presentations and analysis.
ENERGY TECHNOLOGIES IN PERSPECTIVE	ENSURING SUCCESS	PROJECT DEVELOPMENT	TECHNOLOGY DEMONSTRATION	
• Framework for choosing among options • Competing with conventional technologies • Short term/long term needs.	• Making technology work. • Practical considerations and examples.	• Creating Infrastructure • Financing • Management	• Developing country case studies and analysis.	
	Tour of alternative energy installations in Gainesville.			

UNIT PLAN FOR MAIN SESSION

WEEK	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
1.	PART 1 SHORT COURSE (See detailed outline)				
2.					
3.	UNIT 1: ALTERNATE ENERGY SOURCES AND THEIR MEASUREMENT: Biomass, Wind energy, Hydropower, Geothermal, Ocean Thermal, Solar Energy.				FIELD TRIP 1
4.					
5.	UNIT 2: ALTERNATE ENERGY TECHNOLOGIES -- TECHNICAL ASPECTS:				FIELD TRIP 2
6.	Heat transfer, Solar thermal, Fluid flow, Refrigeration, Electrical energy, Photovoltaic conversion, Wind energy, Hydropower.				
7.	UNIT 3: ALTERNATE ENERGY TECHNOLOGIES -- NON-TECHNICAL ASPECTS: Program planning, Financial analysis, Economic analysis, Institutional analysis, Project management; Project design and integration.				
8.	UNIT 4: ENERGY CONVERSION SYSTEMS:				
9.	Flat plate collectors, Heat storage, system design and economics, Solar air heating systems, Refrigeration and air conditioning, Thermomechanical systems, Stirling engines, Low delta-T systems, Wind systems, Hydro systems, Photovoltaic systems, Solar thermal electric systems, Biomass conversion technologies,				
10.	Biogas systems and economics.				FIELD TRIP 3
11.	UNIT 5: GROUP PROJECT WORK				
12.	UNIT 4: (Continued) Fuel alcohol production, Woody biomass, Biomass system economics.			FIELD TRIPS 4 & 5	
13.	UNIT 6: END USE MATCHING: Stoves and cookers, Crop drying and food preservation, Integrated farm systems.		UNIT 7: TECHNOLOGY GENERATION & TRANSFER Appropriate technology, Project facilitation and technology transfer.		UNIT 5: REPORT PRESENTATION
14.	F I E L D T R I P				
15.		UNIT 5: REPORT PRESENTATION	SUMMARY DISCUSSION		

Program Administration and Personnel

The TAET program since its inception was under the overall supervision of Dr. E.A. Farber, Distinguished Service Professor in the Department of Mechanical Engineering, and Director of the Solar Energy and Energy Conversion Laboratory at the University of Florida.

After the Cooperative Agreement became effective in September, 1979, the University appointed a number of full time personnel to the training program. At the beginning of the first session in April, 1980, the full-time TAET staff consisted of the following persons:

Dr. Roberto Pagano	Technical Director
George Shipp	Program Administrator
Dr. Anil Rajvanshi	Instructor
Leonard Laketek	Instructor
Ms. Dianne Wright	Staff Assistant

Support staff of three technicians, two secretaries, an information specialist and a fiscal assistant were also hired.

In June, 1981, Dr. Rajvanshi left the program and returned to India. Dr. Martin Bush joined the program as an instructor. Dr. Bush had been an Assistant Professor in the Department of Mechanical Engineering at the University of Calgary in Canada.

At the inception of the training program in September, 1979, the TAET project manager in the Office of Energy at USAID was Mr. Alan B. Jacobs. In July, 1981, this position was taken over by Ms. Shirley A. Toth, who remained as project manager until the end of the program in June, 1984.

Mr. George Shipp left the program at the end of 1981. His administrative responsibilities were taken over by Ms. Dianne Wright, Staff Assistant to the program. The information specialist, Ms. Mary Green, left the program at the end of 1982.

In July, 1983, Dr. Bush was appointed Administrative Director of the TAET program. His responsibilities included:

- maintaining direct communication with the USAID project manager
- supervising all program administrative and non-technical personnel
- Preparation of all documentation related to program planning, budgeting, and execution

Dr. R. Pagano continued as Technical Director of the program with broad responsibility for the supervision of the laboratory work, technical lectures, field trips, and group project activities.

At the end of 1983 the program's fiscal assistant, Ms. Jackie Smith, left the program. At this time the full-time TAET staff consisted of:

Dr. Martin Bush	Administrative Director
Dr. Roberto Pagano	Technical Director
Leonard Laketek	Instructor
Ms. Dianne Wright	Staff Assistant

The support staff comprised three technicians and two secretaries.

In January, 1984, Dr. Bush was given responsibility for all matters related to the administration of the program, including the supervision of all TAET program personnel.

Discussion

At the end of any instructional program intended to teach people certain skills, and to train them to work more productively and effectively, it is necessary to ask a number of questions concerning the effectiveness and usefulness of the program. At the very least, one would like to know:

1. To what degree were the objectives of the program attained?

2. Assuming the program met its objectives, was the program cost-effective?

3. What lessons, if any, have been learned by the organizers of the program, and what advice would they offer to those who may be considering setting up similar programs?

The first of these questions, perhaps the most important, is unfortunately the most difficult to answer. As indicated in the previous sections of this report, the specific objectives of the TAET program changed quite substantially over the course of the 5-year training program. The first version of the program objectives is given on page 1; the second version, defined in September, 1981, is given on page 8.

However, the objectives were revised yet again in February, 1982. The objectives were reduced to two:

1. To acquaint participants with renewable energy technologies; and,

2. To provide the participants with sufficient knowledge to determine the natural renewable energy resources of his/her country and the best possible technological way to utilize these resources so that he/she can participate in establishing realistic national renewable energy programs for his/her country.

Four months later, a third objective was added:

3. To equip technically trained people with the knowledge to make energy technology selection and application.

These three principal objectives remained in effect until the end of the program in June, 1984.

The fact that the objectives of the TAET program changed so many times during the course of the program complicates any attempt to evaluate the extent to which the program met its objectives.

But a more fundamental criticism concerns the formulation of the objectives themselves. The specific objectives of the training program, no matter which version is considered, were never defined sufficiently explicitly to permit a quantitative evaluation of whether the objectives were attained.*

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* See, for example, the discussion of "Logical Framework Elements" in "Design and Evaluation of AID-Assisted Projects", Training and Development Division, Office of Personnel Management, USAID, November 1980.

However, it is interesting to note the response of the training program participants when they were asked to evaluate the program. At the end of each session, the participants were asked to complete a brief evaluation form (see Appendix 5). The first question on the form asked the participants whether they felt that the objectives of the training program had been attained. The degree of attainment was indicated by a score of 1 to 5; where a low score indicated an objective had not been achieved, and a high score indicated an objective that had been achieved.

For the last two sessions of the program--sessions 8 and 9--the objectives in effect were the three listed above. Taking the two sessions together, 76 percent of the participants considered that the first objective had been attained--they judged themselves acquainted with the alternative energy technologies (a score of 5). Ninety eight percent of the participants responded with a mark of 4 or above.

The second objective, in the opinion of the majority of participants, had not been attained: only 32 percent of them felt that they possessed sufficient knowledge to assess the natural energy resources of their country and to determine the best possible technological options to utilize these resources (a score of 5). However, if a mark of 4 is considered to indicate an objective "nearly attained", then 76 percent of the group felt that this second objective was either nearly attained or fully attained (scores of 4 and 5 respectively).

The last objective was judged to have been attained by 45 percent of the participants: almost half the group felt that they now had the knowledge to select among technological options and could identify the most appropriate applications of the alternative energy technologies (a score of 5). Eighty two percent of the participants scored the question with a mark of 4 or higher.

The second question posed above: Was the program cost effective?, remains an open question in the light of the preceeding discussion concerning the program objectives. The total cost of the training program was just over $3.9 million, which leads to an estimate of a little under $3800 per participant-month of training. These costs are within the guidelines established by USAID.

The final question posed in this section of the report asks what lessons have been learned by the program organizers, and what recommendations would they make to those engaged in designing training programs similar to the TAET program.

These recommendations are as follows:

- Program goals should be clearly stated; this avoids ambivalence and ambiguity, and helps to prevent differences of opinion and interpretation that can sometimes lead to problems with the effective administration and management of a program.

- The specific objectives should be precisely defined, and should be formulated in a manner that permits the quantitative evaluation of a program's effectiveness.

- If the project goals and objectives are revised during the course of a training program, it is important that the program staff fully understand and support the program's new focus and direction. Failure to ensure a consensus at all levels of program administration and organization will inevitably lead to problems with the administration and supervision of the program.

- There is a limit to what a training program--any training program--can accomplish. If the curriculum is to be broad-based, as the curriculum of the TAET program gradually became, then advanced training in one particular area of technology will not be possible--certainly not in a 15-week course. This limitation should be recognized from the outset, and if detailed training in one or two specific technologies is what is really required, then consideration should be given to developing a program format that permits such specialized training.

- The TAET program taught the practice as well as the theory. In addition to conventional lectures and seminars, the curriculum included group project work, laboratory experiments and exercises, and field trips to view full-scale operating systems. This approach to technical training was found to be very effective, and has much to recommend it. However, the practice of the technologies cannot be properly taught without having available a set of operating systems--machines, engines, generators, and other energy conversion devices--that enable the trainees to become familiar with the operation and maintenance of real systems. If possible, these systems should be full-size, commercially available, and fully operational. While models are useful to demonstrate basic principles and theory, there is no substitute for having program participants work with real systems. Program budgets should provide for the procurement and operation of such systems.

- It is essential that all participants are provided with a comprehensive set of reference material and lecture notes. The format and content of this supplementary teaching material and technical literature should be agreed upon and organized before the program commences.

- It should be recognized that a great deal of information is exchanged between lecturers and participants, and among participants themselves, outside of formal training activities. Social interaction is essential if this informal learning is to be facilitated. Training program schedules should therefore include evening events, weekend field trips, and other informal gatherings, in order to give program staff and participants time to get to know each other, and an opportunity to discuss ideas, concepts, and experiences related to the topics being addressed in the training program.

- It became clear during the training sessions that the field trips were a particularly highly valued aspect of the TAET program. Few people from the developing countries have seen, or are even aware of, the comprehensive array of alternative and renewable energy technologies that are in operation in the U.S. Showing these energy systems to developing country personnel not only demonstrates the technical feasibility of the system concept, but confirms the commitment of the U.S. to the development of these new technologies. Visits to full-scale operating energy systems and installations should be an integral part of training programs in alternative energy technology.

- The developing countries have great difficulty keeping up to date with research and development in all areas of technology, and the renewable energy technologies are no exception. Training program participants should have access to literature searches, information retrieval systems, and other database systems, so that they may become familiar with the latest developments in specialized areas of energy science and technology that hold particular promise for their countries.

ÍNDICES

Appendix 1.

PROGRAM SCHEDULE
TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1984 SESSION 9 WEEK 1

REMINDER: DAILY PICKUP TIMES AT THE DAYS INN ARE 0815 AND 1315, EXCEPT WHERE NOTED OTHERWISE

MONDAY February 13	0830-1130	**Participant's Introduction** Each participant is invited to introduce himself, to talk briefly about his work and interests, and to tell us a little about his country's energy situation.
	1130-1330	**Lunch Break**
	1330-1415	**Course Outline** Dr. Bush
	1430-1500	**Group Photograph**
	1500-1600	**OPENING CEREMONY** Welcoming addresses by representatives of the U.S. Government, the University of Florida, and the City of Gainesville.
	1600-1700	**RECEPTION**
TUESDAY February 14	0830-0930	LECTURE: **Introduction to the Renewable Energy Technologies** Dr. Bush
	1000-1130	LECTURE: **Social and Economic Context of Energy Technology** Dr. Kiker
	1330-1630	**Demonstration of Alternative Energy Technologies** Dr. Pagano, Dr. Bush, Mr. Laketek
WEDNESDAY February 15	0830-1130	LECTURE: **An Overview of Alternative Energy Resources** Dr. Pagano
	1330-1630	PROJECTS: **Selection of Group Projects**
THURSDAY February 16	0830-1130 and 1330-1630	LECTURE: **Solar Energy** Dr. Farber
FRIDAY February 17	0830-1130 and 1330-1630	LECTURE: **Biomass Energy** Gerald Foley, Earthscan, U.K.
SATURDAY February 18	COCKTAIL PARTY	Dr. Robert B. Gaither, Chairman of the Department of Mechanical Engineering, will host a cocktail party at his home in Gainesville. Pickup at the Days Inn will be at 6:15 p.m.

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PROGRAM SCHEDULE
TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1984 SESSION 9 WEEK 2

THE LECTURE ON MONDAY WILL BE IN ROOM 349 OF THE REITZ UNION ON THE UNIVERSITY CAMPUS. THERE WILL BE NO LUNCHTIME TRANSPORTATION TO THE DAYS INN ON THIS DAY.

MONDAY February 20	0830-1130 and 1330-1630	LECTURE:	**Wind Energy** Dr. V. Roan
TUESDAY February 21	0830-1130 and 1330-1630	LECTURE:	**Hydropower Technology** Mike Johnson, Little Spokane Hydroelectric Bard Jackson, National Rural Electric Cooperative Association
	1130	BANK RUN	
	1630	SHOPPING RUN	
WEDNESDAY February 22	0830-0945	LECTURE:	**End-Use Matching** Dr. Bush
	1015-1130	LECTURE:	**Framework for Choice** Dr. Kiker
	1330-1400	PROJECTS:	**Organization of group projects and project proposals**
	1400-1630	TOUR	**Energy Research and Education Park University of Florida**
THURSDAY February 23	0830-1130	LECTURE:	**Social and Economic Analysis** Dr. Kiker
	1330-1630	LECTURE:	**Making Technology Work** Dr. Farber
FRIDAY February 24	0830-1130	LECTURE:	**Review of Alternative Energy Technologies** Dr. Pagano
	1330-1630	TOUR	**Alternative Energy Installations in Gainesville**

PROGRAM SCHEDULE
TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1984 SESSION 9 WEEK 3

RESOURCE ASSESSMENT

MONDAY February 27	0830-1130	GROUP PROJECTS	
	1130	BANK RUN	
	1330-1630	LABORATORY:	**Introductory Session** Leonard Laketek
	1630	SHOPPING RUN	
TUESDAY February 28	0830-1130	LECTURE:	**Solar Energy** Dr. Farber
	1330-1430	LECTURE:	**The STAC Information System** Professor Hal Ingman
	1500-1630	GROUP PROJECTS	
		EVENING	MOVIE RUN
WEDNESDAY February 29	0830-1130 and 1330-1630	LECTURE:	**Solar Energy Characteristics** Dr. Pagano
THURSDAY March 1	0830-1130	LECTURE:	**Solar Energy Characteristics (continued)** Dr. Pagano
	1330-1630	LABORATORY:	**Solar Radiation Measurement** Dr. Pagano
FRIDAY March 2	0815-1730	FIELD TRIP	Details of the field trip are given overleaf

FIELD TRIP: JACKSONVILLE, FLORIDA

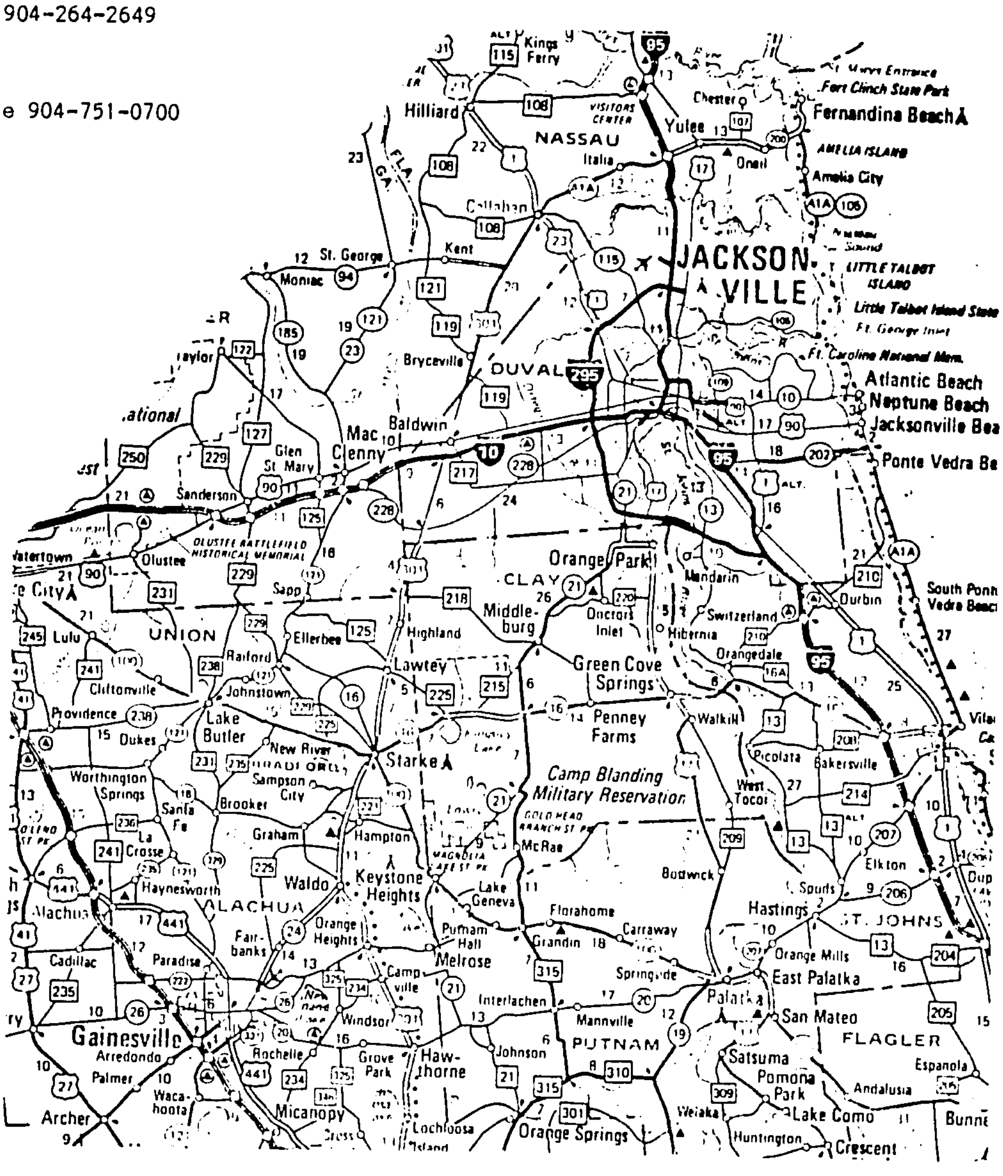
We will travel to Jacksonville, located approximately 70 miles (110 kilometers) from Gainesville, to visit the Morning Star Corporation, a manufacturer of solar flat plate collectors, and the Anheuser-Busch Brewery. At the brewery, we will inspect a solar system comprising evacuated tube collectors and a phase-change heat storage medium designed to provide hot water for pasteurizing beer.

SCHEDULE:		
	0815	Leave Days Inn
	1000-1100	Tour of Morning Star
	1130-1400	Lunch break in downtown Jacksonville
	1430-1600	Tour of Anheuser-Busch
	1730	Return at Days Inn

CONTACTS:

Dick Joyce
Morning Star, phone 904-264-2649

Alva Hogan
Anheuser-Busch, phone 904-751-0700



PROGRAM SCHEDULE
TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1983 SESSION 9 WEEK 4

RESOURCE ASSESSMENT

MONDAY March 5	0830-1130	LECTURE:	**Biomass Resources** Dr. G. Bowes Department of Botany
	1130	BANK RUN	
	1330-1630	LECTURE:	**Assessing the Wind Resource** Dr. V. Roan
	1630	SHOPPING RUN	
TUESDAY March 6	0830-1130	LECTURE:	**Principles of Photovoltaic Conversion** Dr. A. Neugroschel Department of Electrical Engineering
	1330-1630	LABORATORY:	**Fabrication Techniques** Leonard Laketek
	EVENING	MOVIE RUN	
WEDNESDAY March 7	0830-1130	LECTURE:	**Wind Data Analysis** Dr. Bush
	1330-1630	GROUP PROJECTS	
THURSDAY March 8	0830-1130 and 1330-1630	LECTURE:	**Solar Thermal Processes** Dr. Farber
FRIDAY March 9	0830-1130	LECTURE:	**Wind Data Applications** Dr. Bush
	1330-1630	LECTURE:	**Solar Thermal Processes (continued)** Dr. Farber
	6:30 pm	PARTY AT DAYS INN (DETAILS WILL BE ANNOUNCED LATER)	

PROGRAM SCHEDULE
TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1984 SESSION 9 WEEK 5

TECHNICAL PRINCIPLES

MONDAY March 12	0830-1130	LECTURE:	**Geothermal Energy** Dr. Marshall Reed Berkeley Group Inc.
	1130	BANK RUN	
	1330-1630	LECTURE:	**Geothermal Energy (continued)** Dr. Marshall Reed Berkeley Group Inc.
	1630	SHOPPING RUN	
TUESDAY March 13	0830-1130	LECTURE:	**Analysis of Flat Plate Collectors** Dr. Bush
	1330-1630	LABORATORY:	**Flat Plate Collector Performance** Dr. Pagano
	EVENING	MOVIE RUN	
WEDNESDAY March 14	0830-0930	LECTURE:	**Analysis of Laboratory Data** Dr. Pagano
	1000-1130	LECTURE:	**Principles of Fluid Flow** Mr. Laketek
	1330-1630	GROUP PROJECTS	
THURSDAY March 15 to March 17	3-DAY FIELD TRIP		Details of the field trip are given overleaf

FIELD TRIP: BROOKSVILLE-CLEARWATER-ORLANDO

We will leave Gainesville on Thursday morning and travel approximately 100 miles (160 kilometers) southwest to Brooksville where we will visit a fuel alcohol plant. This plant, operated by Biochemical Energy Limited, produces about one million gallons of anhydrous ethanol a year from molasses. From Brooksville, we will travel to Clearwater, stopping for lunch on the way. In Clearwater, we will visit the Clearwater Times building which incorporates several interesting energy conserving features, as well as a large solar hot water system and a 30-kilowatt Darrieus wind machine. Following this visit we will travel approximately 100 miles (160 kilometers) to the Orlando area where we will spend the nights of Thursday and Friday at the Quality Inn Motel.

On Friday we will have the opportunity to visit Disney World's Magic Kingdom.

On Saturday we will visit the Experimental Prototype Community of Tomorrow (EPCOT) Center which encompasses Future World and World Showcase. Future World contains several interesting exhibits, including the Universe of Energy, the World of Motion and The Land. In the World Showcase there are pavilions of a number of nations of the world. Typical restaurants and stores are available in many of the pavilions.

SCHEDULE:

THURSDAY	0815	Leave Days Inn
March 15	1000-1100	Visit Fuel Alcohol Plant
	1430-1530	Visit Clearwater Times Building
	1800	Arrive at Quality Inn Motel
FRIDAY	0815	Leave Quality Inn
March 16	0900-2200	Visit the Magic Kingdom
	2230	Arrive at Quality Inn
SATURDAY	0815	Check out of Quality Inn
March 17		PLEASE TAKE ALL LUGGAGE TO VANS AND LEAVE KEYS IN ROOMS.
	0900-1800	Visit EPCOT Center
	1800	Leave Orlando Area
	2100	Arrive at Days Inn, Gainesville

CONTACTS:

Ron Buening - 813-785-8844
Biochemical Energy Limited

Gary Wilson - 813-461-7575
Clearwater Times

Quality Inn Motel - 305-351-1600
7600 International Drive, Orlando

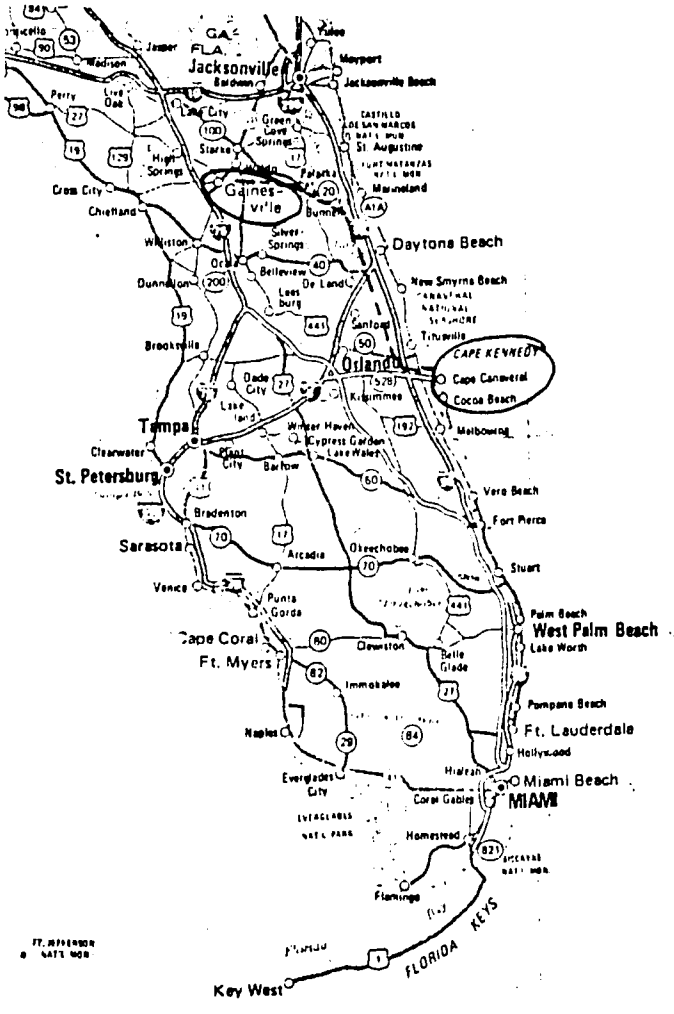
PROGRAM SCHEDULE
TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1984 SESSION 9 WEEK 6

BASIC PRINCIPLES

MONDAY March 19	0830-1130	LECTURE:	**Biomass Energy Conversion: Biochemical Options** Dr. J. T. Mullins Department of Botany
	1130	BANK RUN	
	1330-1400	SEMINAR:	**Solar Refrigeration** Mr. Daga
	1400-1630	LECTURE:	**Anaerobic Digestion and Biogas Technology** Dr. Bush
	1630	SHOPPING RUN	
TUESDAY March 20	0830-1130	LECTURE:	**Assessing the Hydro Resource** Dr. Bent A. Christensen Department of Civil Engineering
	1330-1630	GROUP PROJECTS	
WEDNESDAY March 21	ALL DAY	FIELD TRIP:	**Assessing the Hydro Resource** Dr. Christensen We will visit the hydraulics lab on campus from 0830 to 1030. Following this visit, we will travel approximately one hour to the Suwannee River at Fanning Springs and spend the afternoon measuring the flow of the river. Please bring your own picnic lunch and drinks with you as there are no convenient restaurants or shopping facilities in the area. Ice for cold drinks will be available in the vans.
THURSDAY March 22	0830-1130	LECTURE:	**Biomass Gasification** Dr. Pagano
	1330-1630	LECTURE:	**Biomass Gasification** Dr. K. Eoff, Department of Geography
FRIDAY March 23	ALL DAY	FIELD TRIP:	**Florida Solar Energy Center** **Cape Canaveral, Florida** Details of this field trip are given overleaf.

FIELD TRIP: FLORIDA SOLAR ENERGY CENTER

In the course of this field trip, we will visit the Florida Solar Energy Center, an entity within the State University System of Florida, dedicated to research and development, to educational information services and to other developmental and demonstration activies related to solar energy. Among the facilities we will be inspecting are in all-electric residence equipped with a photovoltaic system, a solar-powered lithium bromide-water air conditioning system, a passive heating and cooling test facility, several collector testing systems and a small wind turbine. While in the Cape Canaveral area, we will have the opportunity to visit the Kennedy Space Center where an optional 2-hour bus tour will be available at a charge of $4.00 per person. A museum, which houses an interesting collection highlighting the United States' achievements in the exploration of space, is located at the space center and may be visited free of charge. We will leave Gainesville, early in the morning and travel a total of approximately 350 miles (600 kilometers) before returning home late in the evening, making this a long but interesting and enjoyable day.



SCHEDULE

0530	Leave Days Inn
0930	Arrive at the Kennedy Space Center
1000	Optional Bus Tour
	Lunch Available at the Space Center
1300	Leave Space Center
1330	Arrive at Florida Solar Energy Center
1700	Leave Florida Solar Energy Center
2030	Return at Days Inn

CONTACT: Dr. Subrato Chandra
Florida Solar Energy Center
Cape Canaveral, Florida
305-783-0300

PROGRAM SCHEDULE
TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1984 SESSION 9 WEEK 7

PRINCIPLES OF SOCIO-ECONOMIC ANALYSIS

MONDAY March 26	0830-1130	LECTURE:	**Institutional Analysis** Dr. Kiker
	1130	BANK RUN	
	1330-1630	LECTURE:	**Social Analysis** Dr. Kiker
	1630	SHOPPING RUN	
TUESDAY March 27	0830-1130	LECTURE:	**Energy Analysis of Alternative Energy Technologies: Concepts** Dr. Kiker
	1330-1630	LECTURE:	**Energy Analysis of Alternative Energy Technologies: Methods and Cases** Dr. Kiker
WEDNESDAY March 28	0830-1130	LECTURE:	**Economic and Financial Analysis: Concepts** Dr. Kiker
	1330-1630	GROUP PROJECTS	
THURSDAY March 29	0830-1130	LECTURE:	**Economic and Financial Analysis: Concepts** Dr. Kiker
	1330-1630	LECTURE:	**Economic and Financial Analysis Applications and Cases** Dr. Kiker
FRIDAY March 30	0830-1130 and 1330-1630	LECTURE:	**Hydroelectric Systems** Mr. Howard Mayo, Jr. Allis-Chalmers Corporation

FRIDAY EVENING: TAET PARTY - DETAILS W'LL BE ANNOUNCED LATER

PROGRAM SCHEDULE
TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1984 SESSION 9 WEEK 8

ALTERNATIVE ENERGY SYSTEMS

MONDAY April 2	0830-1130	LECTURE:	**Solar Thermal Systems** Dr. Bush
	1130	BANK RUN	
	1330-1630	LECTURE:	**PV Systems: The Photovoltaic Process** William Bifano NASA-Lewis Research Center Cleveland, Ohio
	1630	SHOPPING RUN	
TUESDAY April 3	0830-1130 and 1330-1630	LECTURE:	**PV Systems: Applications and Field Demonstration** William Bifano
WEDNESDAY April 4	0830-1130 and 1330-1630	LECTURE:	**PV Systems: System Design and Installation** Richard DeLombard NASA-Lewis Research Center
THURSDAY April 5	0830-1130	LABORATORY:	**Photovoltaic Systems** Mr. Laketek
	1330-1630	GROUP PROJECTS	
FRIDAY April 6	0830-1130 and 1330-1630	LECTURE:	**Thermomechanical Systems** **Low Temperature - Difference Technologies** Mr. Ben Dambly J. Hilbert Anderson Company York, Pennsylvania

TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1984 SESSION 9 WEEK 9

ALTERNATIVE ENERGY SYSTEMS

MONDAY April 9	0815-1130	FIELD TRIP:	**Visit to US Solar Corporation in Hampton, Florida, a manufacturer of flat plate collectors.**
	1130	BANK RUN	
	1330-1630	GROUP PROJECTS:	
	1630	SHOPPING RUN	
TUESDAY April 10	0830-1130 and 1330-1630	LECTURE:	**Refrigeration Technology** Dr. Farber
WEDNESDAY April 11	0830-1130	LECTURE:	**Alcohol Production Processes** Dr. J.T. Mullins
	1330-1630	DEMONSTRATION:	**Refrigeration Systems** Dr. Pagano
THURSDAY April 12	0830-1130	LECTURE:	**Concentrating Solar Systems** Dr. Pagano and Dr. Bush
	1330-1630	LABORATORY:	**Air Heaters and Rock Bed Thermal Storage Systems** Dr. Pagano
FRIDAY April 13	0815-1700	FIELD TRIP:	**Biomass Technologies in the Ocala and Orlando area**

Details of this field trip are given overleaf.

FIELD TRIP: OCALA AND ORLANDO, FLORIDA

We will travel from Gainesville to Ocala to inspect a charcoal-making factory operated by Husky Industries. At this factory, charcoal is produced from wood wastes in a Herreshoff multiple hearth furnace and briquetted at the rate of 50 tons per day. From Ocala we will travel to the Orlando area stopping for lunch on the way. We will then inspect a research project dealing with water hyacinths and other freshwater aquatic plants. These plants are being studied as potential means of simultaneously producing biomass and purifying agricultural runoff.

SCHEDULE:

Friday	0815	Leave Days Inn
April 13	0900-1030	Inspection of the Charcoal Plant
	1030-1330	Travel to Orlando, with lunch stop on the way
	1330-1500	Inspection of Aquatic Biomass Research Project
	1700	Return at Days Inn

CONTACTS:

Mr. Dan Swearinger
Husky Industries
Ocala, Florida
Phone: 904-732-0005

Dr. K. R. Reddy
Zellwood Experimentation Station
Sanford AREC
Phone: 305-322-4134

PROGRAM SCHEDULE
TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1984 SESSION 9 WEEK 10

ALTERNATIVE ENERGY SYSTEMS

MONDAY April 16	0830-1130	LECTURE:	**Wind Energy Systems** Leonard Laketek
	1130	BANK RUN	
	1330-1630	LECTURE:	**Wind Energy Systems (continued)** Leonard Laketek
	1630	SHOPPING RUN	
TUESDAY April 17	0830-1130 and 1330-1630	LECTURE:	**Thermomechanical Systems** Dr. Farber
WEDNESDAY April 18	0830-0900	SEMINAR:	**Land Use Patterns in Fuel Wood Production** Mr. Abdel Salaam
	0900-1630	GROUP PROJECTS:	
THURSDAY April 19	0830-1130	LECTURE:	**Engine Performance of Biofuels** Dr. Lawrance Shaw
	1330-1630	LABORATORY:	**Hydropower and Wind Power** Leonard Laketek
FRIDAY April 20	0830-1130 and 1330-1630	LECTURE:	**Energy Conservation** Dr. Skip Ingley
	6:30pm	**PARTY AT DAYS INN** (Details will be announced later)	

PROGRAM SCHEDULE
TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1984 SESSION 9 WEEK 11

NOTE THAT THE LECTURE ON TUESDAY IS IN THE BASEMENT OF THE REITZ UNION BUILDING

MONDAY April 23	0830-1130	LECTURE:	**Economic and Social Analysis: Case Studies** Dr. Kiker
	1130	BANK RUN	
	1330-1630	LECTURE:	**Economic and Social Analysis (Continued)** Dr. Kiker
	1630	SHOPPING RUN	
TUESDAY April 24	0830-1130 and 1330-1630	LECTURE:	**Economic and Social Analysis: Case Studies** Dr. Kiker, Room 873 Reitz Union
WEDNESDAY April 25	ALL DAY 0830-0945	LECTURE:	**INTEGRATED FARM SYSTEMS** **Anaerobic Digestion** Dr. R. Nordstedt
	1015-1130	LECTURE:	**Integrated Microalgae Systems** Dr. E. Lincoln
	1330-1445	LECTURE:	**Harvesting, Processing, and Digestion of Aquatic Biomass** Dr. L. Bagnall
	1500-1630	TOUR	**Farm Systems at EREP**
THURSDAY April 26	0830-1130 and 1330-1630	LECTURE:	**Gasifier Technology: Fabrication, Installation, Operation, and Maintenance** Mr. R. Hargrave
FRIDAY April 27	0830-1130 and 1330-1630	GROUP PROJECTS	

PROGRAM SCHEDULE
TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1984 SESSION 9 WEEK 12

NOTE THAT THE LECTURE ON WEDNESDAY IS IN THE REITZ UNION

MONDAY April 30	0830-1130	LECTURE:	**Alternative Food Processing Technologies** Dr. R. Bates
	1130	BANK RUN	
	1330-1630	LECTURE:	**Solar Grain Drying** Dr. Khe Van Chau
	1630	SHOPPING RUN	
TUESDAY May 1	0830-1130 and 1330-1630	LECTURE:	**Energy Conversion** Dr. Farber
WEDNESDAY May 2	0830-1000 Room 355 Reitz Union	SEMINAR:	**Evaluation of Wind and Solar Energy: The Case of Senegal** Mr. Bocar Sada Sy
	1030-1130		**Field trip Preview** Dr. Bush
	1330-1630	LECTURE:	**End-Use Matching and Renewable Energy Costs** Dr. Bush
THURSDAY May 3	0830-1130	LECTURE:	**Wind Powered Water Pumping** Mr. Laketek
	1330-1630	LECTURE:	**Energy Conversion (Continued)** Dr. Farber
FRIDAY May 4	0830-0900	SEMINAR:	**The Design of a Portable Solar Dryer** Mr. Audace Ndayizeye
	0900-1130	GROUP PROJECTS	
	1130	BANK RUN	
	1330-1630	GROUP PROJECTS	
	6:30 pm	**INTERNATIONAL DINNER PARTY AT THE TREEO CENTER** Pick up at Days Inn will be at 6:15 pm	

TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1984 SESSION 9 WEEK 13

WESTERN FIELD TRIP

SUNDAY	0530	Pickup at Days Inn
May 6	0700	Leave Gainesville for Atlanta on EA 104
	0925	Leave Atlanta for Los Angeles on EA 81
	1107	Arrive Los Angeles
		Drive to El Centro
		Route: I-405 to Laguna Beach, US1
		to I-5, I-805, I-8 to El Centro (216 Miles)
		Stay: Holiday Inn
		1455 Ocotillo Drive, El Centro
MONDAY	0800	Leave Holiday Inn
May 7	0900	Arrive Magma Geothermal Plant
	1030	Depart
	1100	Arrive Imperial Hydro Plant
	1230	Depart
	1300	Lunch in El Centro
		Drive to San Bernadino
		Route: US86, I-10 (163 miles)
		Stay: San Bernadino Hilton
		I-10 at Waterman Avenue
TUESDAY	0830	Leave hotel
May 8	0930	Arrive Hesperia PV Plant
	1100	Depart
	1200	Lunch in Barstow
	1300	Arrive Solar One
	1500	Depart
		Drive to Bakersfield
		Route: US58 (121 miles)
		Stay: Hilton Inn
		3535 Rosedale Highway

CONTINUED OVERLEAF

WEDNESDAY	0830	Leave hotel
May 9		Drive to San Luis Obispo
		Route: US58 (123 miles)
	1200	Lunch
	1300	Drive to San Francisco
		Route: US1, (223 miles)
		Stay: Ramada Inn
		Fisherman's Wharf
		590 Bay Street
THURSDAY	0800	Pickup at hotel
May 10	1100	Arrive Geysers Geothermal
		Return to Ramada Inn
FRIDAY	0800	Pickup at hotel
May 11		Visit Solano Wind Turbine
		Lunch in Pleasanton
		Visit Altamont Pass Wind Farm
SATURDAY		No scheduled activities
May 12		
Sunday	0645	Leave hotel
May 13	0830	Leave San Francisco for Atlanta on EA 70
	1600	Arrive Atlanta
	1655	Leave Atlanta for Gainesville on EA 101
	1840	Arrive Gainesville

TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1984 SESSION 9 WEEK 14

GROUP PROJECTS

MONDAY May 14	0830-1130	GROUP PROJECTS
	1130	BANK RUN
	1330-1630	GROUP PROJECTS
	1630	SHOPPING RUN
TUESDAY May 15	ALL DAY	GROUP PROJECTS
WEDNESDAY May 16	ALL DAY	GROUP PROJECTS
THURSDAY May 17	ALL DAY	GROUP PROJECTS
FRIDAY May 18	0830-0900	**Scheduling of Group Project Presentations** Dr. Bush
	0900-1130 and 1330-1630	GROUP PROJECTS

TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES PROGRAM
1984 SESSION 9 WEEK 15

CONCLUDING WEEK
GROUP PROJECT PRESENTATIONS

MONDAY May 21			GROUP PROJECT PRESENTATIONS
	0830-0915		**Gasification Technology** Mr. Edmond Zowulu, et.al
	0915-1000		**Biogas Project** Mr. Melvin Smith, et.al
	1030-1115		**Energy Use in Thailand** Mr. Songkeat Limsiri
	1130	BANK RUN	
	1330-1415		**Low Grade Heat** Mr. Lalit Shingal
	1415-1500		**Solar Radiation Measurement** Mr. Osman and Mr. Namprakai
	1530-1615		**Lime Battery Project** Mr. Omar Sallah
TUESDAY May 22	0830-0915	SEMINAR	**a) Solar Energy Research & Development at Projects Development Institute (PRODA), Enugu, Nigeria** **b) Time Zone Characteristics of Continental Africa** Mr. Chukwubueze Odunukwe
			GROUP PROJECTS PRESENTATIONS
	0915-1000		**Photovoltaic Project** Mr. Audace Ndayizeye, et.al.
	1030-1115		**Solar Ovens** Mr. Omar Sallah, et.al.

	1330-1415	**Ammonia-Water Refrigeration** Mr. Bocar Sy
	1415-1500	**Wind Data Analysis** Mr. Shalabi Shelbya
	1530-1615	**Solar Drying** Mr. Chukwubueze Odunukwe and Mr. Dagoberto Vega Aragon
WEDNESDAY May 23	0830-1000	**Field Trip Review** Dr. Bush
	1030-1130	**Summary Discussion** Dr. Farber
	1330-1500	**Course Evaluation**
THURSDAY May 24	0830	**GROUP DISCUSSION** "The Role of the Renewable Sources of Energy in National Energy Planning" Each participant is invited to make a brief statement on the above topic with reference to his or her home country. It is suggested that the format of the statement be the following: a. Energy Problems, Prospects and Policy b. National Energy Plan c. The Pole of Renewable Sources of Energy Anyone who wishes to comment on the presentations or engage in informal discussion is encouraged to do so. Where there is more than one participant from a paticular country, each participant may choose to make a individual presentation, or, alternatively, a spokesman may make a single presentation on behalf of the group.
	6:00 pm	**BANQUET AND AWARDS CEREMONIES** **HILTON HOTEL** Pick up at 5:30 pm.
FRIDAY May 25	ALL DAY	**No Scheduled Activities**

HAVE A SAFE AND PLEASANT JOURNEY HOME!

Appendix 2. Selected Material from the 1981 Program Evaluation

A. INTRODUCTION

The purpose of this report* is to present our evaluation of the Training in Alternative Energy Technologies (TAET) Program at the University of Florida. While the evaluation concerns a wide range of questions, it focuses on two basic areas:

- To what extent has the program been successful in delivering training that is responsive to the needs of the LDC participants?
- To what extent has the University of Florida been in compliance with the cooperative agreement with USAID?

The findings in this report are based on intensive interviews with TAET participants, faculty and administrators, a review of course materials, and examination of the course outline. In addition, our findings reflect the review team's experience and background in the areas of economic development, alternative energy technology, and education.

Your contract specified that our report should include an analysis of the following:

- The attitudes and perceptions of past and current participants.
- A program review that considered objectives, curriculum, faculty, administration, participant life and University oversight.
- Costs associated with the TAET Program.
- University of Florida compliance with the cooperative agreement.
- Review of the 1980 AID Management Review Team's report.
- The relevance of the TAET Program to the needs and interests of the LDC participants.

Compliance with these specific contract requirements produced a series of reports that all focus on essentially the same issues and come to similar conclusions. In order to avoid possible redundancy in the body of this report, we have therefore put the detailed analyses required by the contract into a series of appendices.

B. GENERAL FINDINGS

1. Overall Evaluation

While we believe that substantial changes in many aspects of the TAET Program at the University of Florida are warranted, we find that the program makes a useful contribution to the understanding and utilization of a number (but not all) alternative energy technologies of importance in the range of developing countries from which the participants come. The

* An Evaluation of the University of Florida Training Program in Alternative Energy Technology, prepared for USAID by Arthur D Little, Inc, Contract No. AID/SOD/PDC-C-0390, August 7, 1981.

program operates in compliance with contract requirements and within cost parameters that are consistent with USAID guidelines and is taught for the most part with skill and enthusiasm. Participants generally express satisfaction and many of them are attempting to apply their technological training to projects in their own countries. While this report does not spare the program from criticism and makes a number of suggestions for improvement, we recommend that it be continued at the University of Florida.

With respect to the requirement of our contract that we "recommend whether introducing contract competition for the continuation of this program will result in an improvement of the type and quality of training", we are of the opinion that it will be more cost-effective at this time to make such improvements through moving toward adopting the recommendations of this report and that seeking competitive offers should be held in abeyance until sufficient time has gone by to provide a basis for observing the response of the University and TAET management. This recommendation obviates the need for meeting the related requirement of our contract that we "indicate other academic institutions that might offer all or part of this training under AID financing"; although we are in a position to do so on request.

2. Participant Opinions

In general the participants whom we interviewed at the University during the final week of Program III expressed satisfaction with the course and stated that it is a worthwhile undertaking. Special importance was attributed by the participants to the dedication and enthusiasm of the TAET teaching and support staffs.

On the other hand participants were critical of various aspects of the program. The most significant of these criticisms, in our opinion, are:

- That excessive attention is given to small-scale solar thermal technologies leading to relatively limited emphasis on wind, biomass, and small-scale hydro technologies which are of particular interest in many LDCs;
- That insufficient emphasis is given to overall applications analysis, including socio-economic evaluations of systems relevant to LDC needs;
- That there is a lack of emphasis on reviewing the overall status of the technology including commercial availability in the U.S. and elsewhere of systems, components, and special materials;
- That there is inadequate preparation of guest speakers and a general lack of experience in the LDCs and with LDC energy problems on the part of TAET staff other than the Program Director;
- That there is need for more laboratory equipment, covering a broader range of technologies;
- That the selection of site visits could be improved, especially by including a wider exposure to successfully operating systems of relevance to LDCs.

We also interviewed ten former participants through telephone conversations. These former participants had opinions which were very similar to those of participants in Program III.

3. Program Review

- Goals and Objectives

There appears to be a lack of full consensus between USAID and the University of Florida about the goals and objectives of the TAET Program. This lack of fully agreed upon goals and objectives complicates the tasks of conducting and of evaluating the success of the course.

- Curriculum

Solar thermal technology plays a predominant role in the TAET Program. Exposure to a number of non-solar thermal technologies is incomplete, spasmodic, and often provided by outside lecturers with little awareness of participant interests or needs. There is bias towards small-scale rural applications to the point where discussions related to technologies that could more significantly affect a country's energy balance are not covered adequately.

The strong focus on technology tends to limit discussions of important socio-economic factors associated with the implementation of alternative energy technologies. Of particular concern is the fact that most discussions of socio-economic issues are presented by guest lecturers and are not integrated into the technology discussions.

Laboratory work could be improved by greater emphasis on evaluating a broader range of commercially ready systems in alternative configurations or those using competing equipment or technologies.

The field trips are considered an important program activity by the participants and several sites displaying operational equipment to advantage are visited as part of the program. A number of the demonstration systems visited, however, were non-operational or, in some cases, not particularly relevant to the needs of the developing countries. The field trip schedule should be reviewed and modified to expose participants to a larger number of successful systems employing a broader range of commercially available technologies of specific interest in the developing countries.

- Faculty

Our overall impression of the faculty is that it lacks the background to cover material outside the area of solar-thermal technology. The primary experience of all of the tenured and non-tenured TAET faculty is technological with the result that socio-economic areas receive limited attention.

The new faculty proposed to date do not appear to be in a position to deal effectively with the above issues.

Guest speakers are a concern because of the uneven focus and structure of their presentations and because of their very significant role in the TAET Program. In particular, it appears that many guest lecturers are not prepared to address subject areas relevant to participant needs.

Teaching loads for the TAET faculty seem low by comparison with those in other academic institutions and with those in traditional teaching environments. The TAET administration defends the relatively light formal teaching loads because faculty are expected to spend a large number of non-classroom hours with the participants. Because of the time frame in which we performed our evaluation, we were unable to fully evaluate this issue.

- Teaching Materials

Our general impression is that there is room for improvement in the quality and assortment of teaching material provided to the participants. Handout materials are not well organized and do not include the wealth of material that is available and is directly relevant to LDC problems in this field.

- Administrative Staff

Two areas of the administrative structure are of some concern. There do not appear to be clearly defined lines of responsibility within the administrative staff, a condition which can lead to inefficient use of resources. Partly as a consequence, there is an apparent excess of administrative personnel.

- Participant Selection and Life

The TAET Program has some difficulties in dealing with the heterogeneity of its participants. This is a problem, common to similar programs, which probably can be mitigated by careful planning of the curriculum.

Many participants reported that they felt isolated from the University and the people of Gainesville, a condition that would be difficult to ameliorate because of limitations imposed by the physical location of available facilities. It can be argued that there are compensating advantages.

- University Advisory Committee

All but one member of the University Advisory Committee have primarily technological backgrounds. As a result, the Committee as now constituted may not be well positioned to advise the TAET management on the range of non-technical issues which may be important factors in evolving a broader-based course responsive to LDC needs. It is also not clear that the Advisory Committee has to date played an active role in critical evaluation of the program.

4. Compliance With the Cooperative Agreement

The University of Florida is in compliance with the terms of the cooperative agreement and a program of the type being offered is clearly within its scope. The few minor departures from literal requirements appear to flow primarily from ambiguity or differences in interpretation.

5. Program Costs

Per participant, monthly costs appear to be within USAID cost guidelines. There are, however, a number of areas where cost control measures could be considered with possible savings up to $100,000 a year.

6. Review of 1980 AID Management Review Report

Many of the issues raised in the 1980 AID Management Review Report ("Site Assessment") of the TAET Program remain as issues of concern to the Arthur D. Little evaluation team. Specifically these "carryover" issues are:

- The extent of emphasis on solar thermal technology,
- Inadequate attention to non-technology areas; e.g., economics,
- Organization and content of course reading materials,
- Background and LDC experience of the faculty,
- Uneven quality of guest speakers, and
- Size of administrative staff.

7. Relevance of the TAET Program to Developing Country Needs

There are questions meriting consideration about the TAET Program's relavance to developing country needs as represented by participants:

- Does the course contribute to the capability of technically oriented decision-makers to identify which technologies merit R&D to adapt them for use and manufacture in-country?
- Does the course provide planners with an approach for determining which Renewable Energy Resources (RER) systems merit consideration for widespread use?
- Does the course sufficiently expose the participants to equipment status and development on a worldwide basis so as to discourage excessive duplication of effort.
- Is the relative emphasis among technology options appropriate?

C. RECOMMENDATIONS

1. Program Objectives

One of the difficulties encountered in evaluating the TAET course is that, despite the general language about goals and objectives which appears in the cooperative agreement (see Appendix IV), it is not entirely clear what the objectives of the course in fact are and how these objectives address major issues of interest to USAID and the LDCs.

Future efforts to improve and modify the TAET course should therefore be carried out against a background of renegotiated and explicit overall goals and objectives which have been mutually agreed upon by TAET management and USAID. If this is done, course activities can be measured in terms of how they contribute to meeting such objectives and goals. Corrective action can then be taken as appropriate. We give, below, examples of what such a statement might cover.

a. Issues To Be Addressed

The TAET course should address specific issues which are common to many LDCs and be aligned with the overall policy directions of USAID's energy development programs.

Major issues include the following:

- Technical Capability

  In many LDCs there is a lack of analytical and experimental capability relative to RER systems. This deficiency manifests itself in poorly conceived R&D projects which are often not well implemented. Such poorly executed projects often take up most of the scarce R&D resources available to these countries, with obvious negative implications. It is this aspect of LDC needs which has been emphasized by Dr. Farber in describing the benefits of the TAET Program.

- Technical Awareness

  It is very difficult for technical and management staff in LDCs to maintain adequate cognizance of developments in the industrialized nations, including the United States. As a result, many decisions to undertake R&D projects, develop energy policies, etc., are made without knowing all the technology options available. This results in extensive duplication of effort, large amounts of time being lost in project formulation, and many potentially useful activities not being initiated at all.

- Application Opportunities and Economics

  In many LDCs there is only very limited understanding of the issues affecting the use of systems (capacity factors, operation and maintenance requirements, etc.) and the resultant system economics. Experience in LDCs indicates that even highly-skilled technical people

will undertake programs in high technology systems (for example, solar thermal power) with only a vague notion of how much they are likely to cost or their potential use.

As a result, much of the research, development, and demonstration activity in LDCs is inappropriate since even technical success does not lead to useful output.

- National Impact

It is possible for systems to be technically successful and have acceptable cost while still being of minimal utility to a country due to a limited number of applications.

Conversely, the benefits of implementing RER systems can include increased employment opportunities, decreased foreign exchange drains, and rural development. These benefits would not normally be quantified in the evaluation of individual systems, but could be critical in determining the overall merits of the technology on a national basis.

Most participants in RER development in LDCs are not inclined by training to consider the full range of national impacts when considering different technology research and development programs. Again, this tends to result in poor evaluations of technology options and subsequent poor use of resources.

b. Course Objectives

The overall objective of an RER course funded by USAID should be to provide training to participants in RER development which will help them make better decisions in allocating scarce manpower and financial resources for R&D, implementation, and commercialization activities.

An effort to achieve this overall objective should address the specific issues referred to previously. As such, it is suggested that the course have the following mutually supporting objectives:

- Objective 1

To instruct technically-oriented LDC participants on the analysis and operation of applicable technology options.

- Objective 2

To provide participants with up-to-date information on technology status in the U.S. (and elsewhere) and to identify potential sources of goods and services which individual LDCs might contact to assist in their R&D and implementation activities.

- Objective 3

  To instruct participants in how to evaluate the technical and economic performance of systems when serving both small and larger scale applications identified as being of importance in LDCs.

- Objective 4

  To outline the methodologies by which the overall national impacts of RER systems can be assessed and, thereby, provide the required information for allocating manpower and financial resources.

Only the first of these objectives is now addressed in any detail within the course and then primarily for solar thermal technologies. Limited attention is also given to Objectives 2 and 3 although not on any consistent basis between technologies.

At present very little attention is given to Objective 4 which may well be the single most important objective of a program aimed at furthering USAID's policy of assisting LDCs to become more energy self-sufficient.

2. Academic Changes

The evaluation team believes that the effectiveness of the TAET course could be improved if significant modifications were made in subject matter emphasis. The recommendations made reflect the opinions of the evaluation team that meeting the course objectives stated above requires a broader overview of the technical/economic implications of RER development than is now the case. Specific recommendations relative to academic changes are divided into two areas:

- Changes in course content and emphasis to better meet overall objectives, and
- Changes in composition of teaching staff (including guest lecturers) required to effectively implement the recommended course modifications.

a. Course Content

One of the most serious concerns of the evaluation team is the lack of consistent presentation of technology alternatives and an over-emphasis on engineering detail at the expense of applications analysis (including the full range of socio-economic factors involved in such an analysis). Although progress has been made in this area, additional efforts should be made to give the course better balance. Appendix X presents a preliminary outline of how a revised course might be structured to meet these criteria. Specific recommendations consistent with the suggested course outline include:

- Give more attention to wind, small-scale hydro, and biomass systems with particular emphasis on their application in LDCs. These technologies were consistently referred to by participants as being of

particular relevance in their countries and as having been treated ineffectually in the course.

- Provide participants with an overview of relevant activities in the United States (and elsewhere), including the commercial status and availability of equipment. This would tend to stimulate future contacts between LDC interests and U.S. manufacturers, thereby serving a number of general foreign policy objectives. It might help LDCs reduce costly duplication of effort in system development and better ensure that their efforts are preferentially directed to areas where they can efficiently add to the value of systems.

- Review the cost structure of different equipment options now available and study approaches to estimating the costs of equipment and systems. Particular emphasis should be given to how the cost of systems divides among purchased materials, special processing, manufacturing, distribution, installation, and operation. This will help participants better evaluate system options and identify those systems which can most economically be manufactured and used in their countries.

- Show how the economic performance characteristics of all systems should be evaluated, based on both present and projected cost structures. Approaches for comparing the economics of systems with both conventional and non-conventional options should be outlined. This evaluation process should be integrated within the discussion of each technology and should not be relegated as a special (almost irrelevant) subject to be addressed by a guest lecturer as is now the case.

- Present and involve participants in the analysis of case studies of how such systems have been and could be used within LDCs. These studies should include the technical analysis, design constraints, installation issues, operating experience review, and economic evaluations. Such case studies would provide participants with a better perspective on all the issues associated with the RER option under consideration.

- Discuss the numerous socio-economic issues relevant to LDCs which are associated with each technology option. These issues include the requirements for local manufacture, utility interface problems (for electric power systems), impacts on foreign exchange due to reduced oil imports, and installation and organization and management infrastructure requirements.

In response to the comments of the first review team, which made suggestions similar to those just presented, TAET course management made certain course modifications. These included the use of University of Florida guest lecturers to address biomass and wind power technologies and short seminars on methods of economic evaluation. In our view, these measures are not sufficient. Specifically we believe strongly that the socio-economic issues should be an integral part of the discussion of each technology option and that these important issues cannot be effectively treated by short-term guest lecturers.

Also, the design of course content in each technology must be done by TAET personnel if this content is to address adequately the rather special needs of the LDC participants. This does not preclude the use of guest lecturers. It would ensure that such lecturers, when properly prepared, are addressing issues pertinent to and integral with overall course objectives.

b. Teaching Staff Requirements

Presently the staff is intellectually dominated by Dr. Farber, who has many years of experience in solar thermal technologies and is a well-known expert in this field. The other TAET staff members also have a solar thermal technology orientation. Two new staff slated to teach in Program IV have very limited experience in RER and are also from primarily technological backgrounds. In short, it does not appear to us that the present staff mix can effectively undertake the recommended course content modifications.

We therefore recommend that the TAET course teaching staff be modified so that it includes:

- One or more staff members with an in-depth knowledge of important non-thermal RER technologies such as biomass (with particular emphasis in LDC applications) and wind energy utilization.
- Individuals with an overall technology-evaluation orientation including economic analysis and national socio-economic assessments.

A further recommendation is that staff with these backgrounds should also have experience in the LDCs. Most of the participants noted that the staff has not had LDC experience and that his was evident from their course presentations.

It appears, therefore, that in order to give the appropriate re-direction a new senior staff person is required, a person who has a broad view of technologies and their application in the LDCs. This should be accompanied by a review of the backgrounds of present and new staff members to determine whether other changes are needed.

3. Administrative Changes

The recommendations in this subsection on administration are aimed at the following goals:

- Reducing the administrative costs associated with the TAET Program
- Increasing the breadth of academic input into the program
- Clarifying lines of responsibility and increasing the amount of delegation of authority and responsibility

We believe that the TAET Program could run efficiently and effectively with an administrative staff performing the following broadly outlined duties:

Program Director	This individual would be totally responsible for the TAET Program. It would be a full-time position in which the person managed both the academic and administrative affairs of the TAET Program. The person in this position should be a fully-qualified academic with wide experience in the full range of topics to be covered in the program.
Program Administrator	This is a full-time position in which the individual would be responsible for the academic and fiscal administration of the TAET Program. Duties would include program scheduling, cost planing and control, interfacing with faculty, ordering books and coordinting handouts of teaching material.
Participant Affairs Coordinator	This is a full-time position with the individual having responsibility for those activities which have direct interface with participants; i.e., housing, transportation, admissions, insurance, social activities.
Budget Clerk	This is a full-time position with the individual having responsibility for maintaining the TAET Program financial records.
Secretary	Full-time, general secretarial functions.
Word Processor Operator	Full-time, general secretary and word processor operator.

Figure 1 shows this streamlined organization in the form of a traditional organization chart. To complete the picture we have added Faculty and Advisory Committee to the chart.

This new organization is designed to give greater authority and responsibility to the University Advisory Committee. We believe that this group should have a more significant role in the overall running of the TAET Program.

The Committee should include a wider diversity of individuals. There should be representation from individuals who can contribute expertise on economic analysis and on the sociological issues. There should be greater representation from individuals with LDC experience.

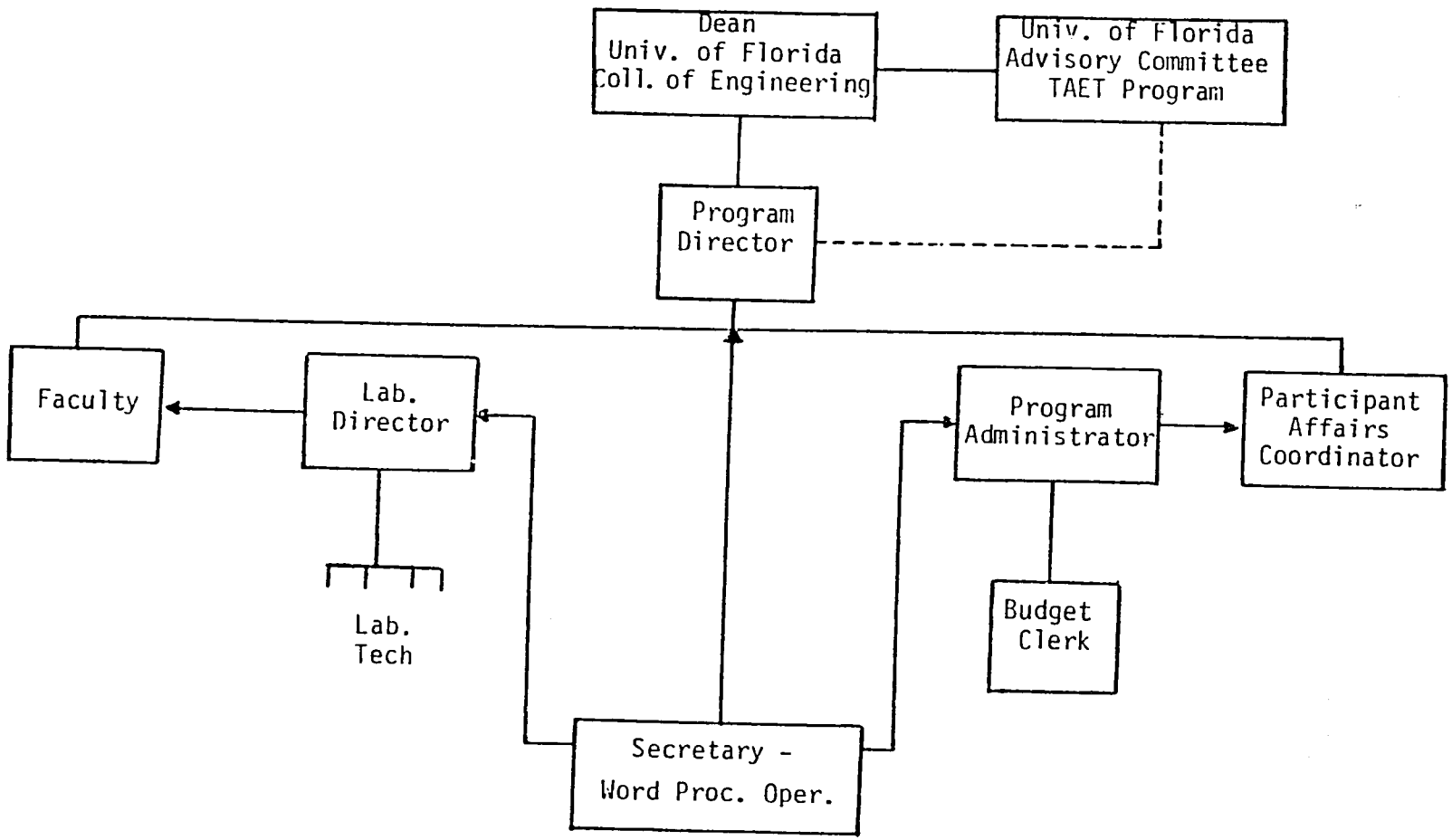


FIGURE 1: RECOMMENDED TAET ADMINISTRATIVE STRUCTURE

We believe that success in making the improvements that these recommendations suggest will require active participation by USAID DS/EY with TAET program management, especially in bringing course goals and objectives fully into line with evolving USAID objectives and AID Mission needs as well as assuring that there is full consensus on the translation of these into program structure, staffing and management.

PROGRAM REVIEW

In this Appendix we review the following elements of the TAET Program: general program structure, goals and objectives, curriculum, faculty, administrative staff and services, participant selection and participant life, and the University Review Committee. We briefly describe the situation as we found it and then provide our reactions. It should be kept in mind that we did not have an opportunity, due to the scheduling of this evaluation effort, to actually audit classes in session; our data sources were therefore review of written material, interviews with participants, and interviews with faculty and staff.

A. GENERAL PROGRAM STRUCTURE

The academic structure of the program being offered is divided into three distinct parts:

1. General lectures
2. Seminars
3. Laboratory work

General lectures were typically conducted by TAET full-time academic staff or University of Florida full-time faculty. These were most often three-hour seminars conducted in the mornings.

Seminars were most often conducted by guest lecturers. They were held in the afternoon and were typically three hours in length. Seminars were designed to offer the participants the opportunity to discuss the subject under consideration.

Laboratory work was conducted on those days when seminars were not scheduled in the afternoon. Early in the program the laboratory work was devoted to general issues. During the second phase of the program the laboratory time was devoted to working on the participants' projects.

In addition to these three basic elements the TAET Program includes a number of one-day field trips and a one-week field trip. There are also periods of time devoted to presentations made by the participants.

A detailed daily schedule is provided as Appendix V. The remainder of this discussion analyzes the elements of the program.

B. GOALS AND OBJECTIVES

The Program Description included in the cooperative agreement between the University of Florida and USAID describes the purpose of the arrangement in the following terms:

> "The purpose of this agreement is to make effective use of the broad experience and demonstrated competence of the University of Florida (UF) Solar Energy and Energy Conversion Laboratory in the field of

alternative energy technology, specifically, small-scale solar technology. It is to enable the UF to enhance its ability to train LDC participants in the theory of alternative energy technologies, the machine shop and construction aspects of building low-cost mechanisms based on small-scale solar energy technologies to provide energy for such purposes as crop drying, fish drying, hot water, refrigeration and water purification...The recipient will, to the extent possible, tailor its training to the special needs of the individual LDC participant and will provide training in the social, financial and cultural implications of the transfer of small-scale alternative energy technologies to the rural and urban poor."

The "specific objectives" are then presented as follows:

"(1) The development of LDC human and thus institutional technical skills in small-scale alternative energy technologies, specifically solar [underlining added]. This involves the conduct of an intensive training program for LDC participants by the recipient. The recipient would provide two training sessions of 15 weeks each year. These sessions would be open to 40 students per session of whom 30 would be LDC students supported under this program. The session would involve classroom and laboratory activities designed to provide participants with the skills and knowledge necessary to build, test and install small-scale solar technologies-mechanisms which are inexpensive, safe and replicable and provide energy to meet basic needs of the rural and urban poor. The trainees would provide their LDCs with a nuclei of technically skilled persons capable of providing technical leadership and support in the development of a program of small-scale solar technologies.

"(2) The application of these trained human and institutional skills to site and problem specific situations in the LDCs to provide energy to meet basic needs of the rural and urban poor [underlining added]. This involves consultation between recipient and the LDC government, the USAID Missions and the LDC participants on an on-going basis. This requires the establishment of continuing contact and support to these LDC participants and their LDC institutions to carry out in-country training by LDC participants and to construct, test, adopt and replicate the small-scale solar technologies as rapidly and as widely as possible."

In the recommendations of the report we outline and describe what we believe would be a different and more meaningful set of overall goals and specific objectives for the TAET Program which, if accepted, would require changes in both the contract and the program.

Over the two years the TAET Program has been in existence there has continued to be a lack of consensus about basic program goals and objectives. Dr. Farber and his staff seem to have one set of goals in mind while USAID appears to have another set - and these not necessarily themselves consistent with the contract language. This is most apparent when one reviews the report of USAID's first review team. The University of Florida has, perhaps quite properly, taken a very literal interpretation of

its contract as a goal statement. We believe that the first review team (and possibly USAID management) wanted these goals and objectives modifi although no formal action has been taken to do so. Moreover our interviews lead us to believe that Dr. Farber, his faculty and staff also maintain concepts about program goals that display a fair amount of variance among themselves and that are not necessarily consistent with the goal concepts of the contract, or those of USAID as expressed in the first review team report.

This lack of consensus about goals has contributed to some participant disappointment and to the feeling of some participants that they have received what they felt to be inappropriate training.

An additional difficulty arises from this situation; the goals and objectives of the TAET Program are not defined clearly enough to be used as a measure of success.

C. CURRICULUM

Our review of the TAET curriculum is divided into the following sections: Technology, Socio-Economic Focus, Balance Within and Between Technology Presentations, Laboratory Work and Projects, Field Trips and Industrial Exposure.

1. Technology

We found that there were attempts to cover all of the relevant alternativ energy technologies at some point in the program. Our interviews indicated that there was a significant amount of learning taking place. Participants were able to converse on a fairly sophisticated level about the technological aspects of the various alternative energy technologies that were discussed during the program. Those individuals who came to the program without formal training in alternative energy engineering were exposed to and learned an impressive amount of engineering detail on this subject.

The amount of technological learning that was achieved by those with an energy engineering background seemed to be satisfactory. Several of the PhDs in the program said they picked up a good deal of useful technological detail.

The role of solar-thermal technology plays a dominating and perhaps overriding place in the TAET Program. This is evidenced by the very limited amount of time devoted to biomass, wind, hydro and other non-solar thermal technology. See Table 1 for the allocation of classroom time by subject matter as shown in the formal schedule. More importantly, the full-time academic staff associated with this program are specialists in solar thermal technology. The training in the other alternative energy sources is provided by other University of Florida faculty or non-University of Florida guest speakers. These individuals, who have only limited contact with the TAET Program, do not have the opportunity and perhaps the inclination to have a major impact upon the program.

Exposure to a number of the non-solar thermal technologies was incomplete and spasmodic. For example, there was very little, if any, information provided on small-scale hydro.

TABLE 1

APPROXIMATE DISTRIBUTION OF CLASSROOM TIME
AS SHOWN IN ACADEMIC SCHEDULE

	Percent	Hours
Overview Material	10.0	21
Theory of Solar Radiation and Heat Transfer, etc.	22.5	48
Solar Thermal Applications	29.5	63
Hydro	3.0	6
Wind	5.5	12
Geothermal	1.5	3
Photovoltaic	3.5	12
Biomass	7.0	15
Ethanol	4.0	9
Economics/Sociology	11.4	24

Does not account for field trips and student presentations.

The TAET Program is planning to bring in two new instructors for the coming year. One of these individuals has a limited and narrowly focused background in solar technology; the other is an individual with a more general background and has some interest in non-solar thermal applications. Neither of these two individuals will be strong enough nor do they have the background necessary to change the balance of the TAET Program.

Dr. Farber reported that one of the individuals he hopes to hire may not join the faculty. If this happens and it is felt necessary to hire another full-time faculty member, then this individual should have a non-solar technology specialty or the individual might be looked on to bring a strong economics or social science influence.

The TAET Program focuses much of its attention on alternative energy for small-scale rural utilization. The focus seems to be on the individual family or very small unit. There is a very conscious focus on the utilization of local materials in locally manufactured products. This focus does not deal with those items that can have significant impact on a country's energy balance.

Many participants are from newly industrialized LDCs such as India and Brazil. There is no reason why renewable energy resources should not be considered a potential major resource in such countries for process heating, grid-connected wind, etc. Countries such as Brazil already have several companies manufacturing such equipment. Argentina makes more wind pumps than the United States. The narrower view which dominates TAET instruction helps perpetuate an unfortunate bias in some LDCs that renewable energy resources are unimportant in a national energy supply context and therefore do not merit serious consideration in national planning activities.

There is also an implicit assumption that imported goods are always more expensive than locally manufactured goods. This assumption is consistent with the overall lack of sophisticated economic analysis in the program. Participants do not learn how to approach the make or buy decision from a purely financial basis or from a social cost/benefit analysis. The assumption seems to be that the shadow price of local research and development is zero. This is obviously not true.

The TAET's focus on small-scale rural applications with a special emphasis on showing how these devices can be fabricated from locally available materials is not without merit (and it certainly is consistent with the statement of goals and objectives in the cooperative agreement). Many LDCs are not in a position to take advantage of more sophisticated technologies and therefore the issues of small-scale rural application have a place in the curriculum. It is only the emphasis that we question.

2. Socio-Economic Focus

The TAET Program has as its primary focus the technological considerations associated with small-scale alternative energy resources for rural areas in the LDCs. We take issue with the heavy emphasis on technological

considerations. This technological bias leads to a diminished and unsatisfactory treatment of many other dimensions of the alternative energy problem in an LDC. Our interviews indicated that participants did not view alternative energy programs as systems with economic, social and very real implementation problems.

Participants developed fairly good skills in understanding the engineering of an alternative energy device, but they could not then analyze that device for its impact on the society where it was to be installed. We believe that concepts of social cost/benefit analysis are not covered adequately although they apparently are referred to. Few participants appeared to us to be in a position to assess the impact of a suggested technology on a country's energy balance.

As far as we could tell, the subjects of economic and social analysis were separated from the treatment of each technology. There were a limited number of separate classes on economic analysis and/or social analysis. We feel this type of treatment relegates economic and social issues to a lower level of importance.

It would appear that the participants were primarily involved in learning how to solve engineering problems rather than in identifying the appropriate questions to ask when evaluating the potential for a technology in a particular situation or country.

3. Balance Within and Between Technology Presentations

One of the most serious concerns we have about the TAET course is the lack of a consistent presentation between the various technology alternatives and an over-emphasis on engineering detail at the expense of applications analysis. In Appendix X we present an outline for a wind power course to illustrate an alternative approach which could better ensure a balanced and complete discussion within each technology area.

The present course approach focuses on information relative to resource characteristics (i.e., wind availability) and performance characteristics. However, relatively little emphasis is given to overall system design issues, cost structure of equipment and systems, how to evaluate system economics, availability of equipment in the U.S. and elsewhere, how the equipment can be applied in LDC applications, and socio-economic issues associated with widespread use.

In the course approach suggested in Appendix X the socio-economic issues are considered as an integral part of the technology option discussion. Both review teams agree that this is preferable to having these issues treated separately by guest lecturers.

The outline presented is specifically for wind power. It is considered that each technology area could be treated according to a common format similar to that indicated, so that participants can learn how to compare alternatives and thereby improve their decision-making capabilities when they return home.

Having all the technologies presented in a similar format will help ensure that a reasonable balance is provided between the technologies.

Also, such an integrated curriculum will help guide the presentations made by guest lecturers by explicitly providing them with the context within which their presentations will be made, adding to the breadth and scope of the course.

An additional advantage of a standardized format is that it will assist TAET staff in preparing a coherent set of handouts for the participants - a lack noted during the participant interviews and by several of the AID Missions.

4. Laboratory Work and Projects

In line with the cooperative agreement between USAID and the University of Florida, the TAET Program provides extensive hands-on experience in building alternative energy devices. Each participant is given the opportunity to participate in one or more projects. These projects are devoted to building items such as solar crop dryers, wood gassifiers and solar hot water heaters. This experience exposes many participants for the first time to the realities of hardware assembly and proper experimental procedures. This will help the technical people better plan their own experimental programs and provide planners with additional insights into system construction and operations.

We fully agree that some experience of this nature is desirable. The question we raise relates, rather, to the balance between "hands on" experience and learning about the operation and evaluation of commercially available hardware. It appears to the review team that more emphasis should be given to operating and evaluating commercially ready equipment (waste heaters of various designs, distillation systems, photovoltaic coolers, etc.) so that participants are exposed to a wide variety of system options .

The laboratory equipment was adequate for current purposes but fell short of being able to respond to more than the relatively unsophisticated needs of the current laboratory philosophy. The laboratories could not provide the participant with a chance to evaluate usable systems in alternative configurations or those utilizing competing equipment or technologies.

At times, we understand, there were shortages of laboratory personnel, but this problem may be susceptible to a solution through improved scheduling.

Not every participant chose a special project that required building a piece of hardware. Participants could choose to do an economics-oriented project. This flexibility was a useful feature in the TAET Program.

5. Field Trips and Industrial Exposure

Participants go on several local field trips and one extended one-week field trip that includes, among others, visits to Sandia Laboratories, Schuchuli Village, and the Gila Bend Irrigation System. The composition of the field trip conducted in week 14 of the program raised some questions in the minds of the evaluation team. There appears to be an emphasis on showing the participants some large-scale sophisticated U.S.

failures in the area of alternative energy. The focus on failures is to drive home the need for appropriate technology. We find no serious fault with the concept of ensuring that participants do not repeat U.S. mistakes. We do, however, believe that the emphasis on failures may be a bit overdone. Greater exposure to well-planned, working systems would appear also to be a valuable learning experience. Such systems exist in the U.S. and could be visited within the framework of the one-week field trip

In general, there was very little attempt to expose participants to U.S. industrial practice. One trip to a flat plate collector manufacturer is made during the course of the program. It would seem that many U.S. manufacturers would be happy to have participants visit their facilities. This would provide the participants with a much better feel for what would be involved if their countries were to become serious about local manufacture. It would also provide greater exposure to the range of already available commercial devices. It might even provide a sales lead for a U.S. company.

D. FACULTY

In this section we look at each of the following issues: Faculty Background and Functions, Teaching Loads, Teaching Materials, and Guest Speakers.

Faculty Background and Functions

The faculty for the TAET Program is comprised of three groups: members of the University of Florida full-time tenure-track faculty, full-time faculty hired for the TAET Program and not within the University tenure systems, and guest speakers not associated with the University of Florida.

Full-Time Tenured Faculty

The two faculty members in this category are Dr. Erich A. Farber and Dr. Herbert Ingley. Dr. Farber is a highly qualified, world-recognized expert in the area of solar thermal technology. He is also highly qualified as a teacher and director of the TAET Program. His developing world experience makes his contribution to the program invaluable.

Dr. Farber is the intellectual father of this program. It was his conception, and his input continues to dominate all areas of the academic program. He also has major administrative responsibility for the TAET Program. It was apparent that Dr. Farber also controls the administrative decision-making structure of the TAET Program.

Dr. Ingley is a member of the Mechanical Engineering Department of the University of Florida. He is assigned to teach on the TAET Program and the program picks up 20 percent of his salary costs. He received his Ph.D. from the University of Florida in 1971. His specializations are air pollution technology, solar heating and cooling, low-temperature solar air-conditioning and a number of other related areas. Within the TAET Program Dr. Ingley is responsible for the solar cooling and air-conditioning material. The

review team sees him as a qualified engineer with technical expertise in the area of his responsibility. We noted, however, Dr. Ingley's lack of developing country experience and the highly technical focus he brought to his teaching.

Non-Tenure-Track Faculty

The most senior non-tenure-track faculty member associated with the TAET Program is Dr. Roberto Pagano. Dr. Pagano acts as the academic administrator for the program and has responsibilities for teaching in the area of solar radiation. He has a relatively limited academi and research background in the renewable energy field other than with solar radiation. His specialization prior to coming to the TAET Program was nuclear reactors and their associated problems. He also has extensive experience in assessing the environmental impact of energy developments.

The review team found Dr. Pagano to be a hard-working, enthusiastic individual. We were, however, somewhat concerned with his lack of experience outside the solar radiation field which militates against his being in a position to provide broad academic leadership throughout the TAET Program.

Dr. Anil Rajvanshi has just left the TAET Program. His area of interest was in the solar thermal area. He studied for his Ph.D. under Dr. Farber. During our interviews it became obvious that Dr. Rajvanshi was a well-liked member of the faculty. Being a junior member, however, made it very difficult for him to have a substantive impact on the direction of the TAET Program.

Leonard Laketek is in charge of the laboratory work for the TAET Program. He seems well qualified for this work. The participants felt he was very supportive of their efforts. Mr. Laketek also completed his studies at the University of Florida.

Dr. Farber has made offers to two individuals to join the teaching faculty this coming September. One of the individuals, Dr. Agarwal, is a physicist with what appears to be a fine theoretical background. The review team notes, however, that Dr. Agarwal does not bring significant experience in the application of renewable energy resources in the developing world. He does not fulfill the need for a faculty member who has a background in areas other than solar thermal technology.

The other individual Dr. Farber hopes to hire is Dr. Martin Bush. Dr. Bush is a well-trained chemical engineer. Again, we note this individual's lack of experience in renewable energy.

Our general observation about non-tenure-track faculty associated with the TAET Program has to be that there is a noticeable lack of depth and breadth. While Dr. Farber is an acknowledged expert in his field, the other faculty (tenure-track, both current and anticipated) lack the practical experience to bring relevance to their teaching in this particular curriculum. They also lack the skills

required to complement those of Dr. Farber. There do not seem to be faculty who can bring relevant non-solar thermal expertise to bear nor do they provide expertise in the non-technology issues.

Guest Speakers

A wide variety of guest speakers is used throughout the TAET Program. Technical experts from the University of Florida and from government and industry are brought in for periods of one-half to two days. The use of guest speakers has some very real potential benefits.

We see several problems in the way the TAET program utilizes guest speakers. The most significant problem is associated with the appropriateness of the technology being discussed. A second problem relates to the adequacy of the briefing given to guests and the thoroughness of preparation by guest speakers themselves.

In more than a few instances guest speakers, typically non-University of Florida faculty, were only prepared to talk about U.S. technology and very large sophisticated systems. This was unfortunately true in the non-solar thermal area where strong presentations of relevance to the LDCs would be most important.

It was apparent to participants that many of the guest speakers had been inadequately briefed on their talks. They had very little knowledge of the TAET Program, its students or the goals of the program. This was true both of non-University of Florida guest speakers and University of Florida faculty.

Participants commented that several of the guest speakers had not adequately prepared for their sessions. This could be a function of the amount of preparation time being paid for, or it could be a function of faculty interest and dedication. Guest lecturers were provided somewhere between two and three days of consulting fees to prepare and present a three-hour seminar. This is very limited compensation for what could be a major task. Guest speakers cannot look to the TAET Program for a consulting fee that fully compensates for the work being done but the program should be sure that the amount is not so small as to discourage adequate preparation.

A serious problem with guest speakers is associated with the fact that there is no consistent format for treating the technology options. Each speaker was free to choose his own format and area of coverage. This led to widely varying approaches that made it very difficult for the participants to compare the technologies covered by the various guest speakers.

Perhaps the most serious problem with guest speakers was that in certain areas they provided all or the vast majority of the subject treatment for a particular energy alternative. This left the participants with little opportunity to follow up on subjects covered by a guest speaker. This was particularly true in the areas of

wind, hydro, geothermal and economics. If we consider non-full-time TAET faculty as guests, then we would have to add the biomass and thermal areas to this list.

As one analyzes the teaching load for regular classes, excluding laboratory sessions, it would appear that about one-third of the sessions are covered by full-time TAET faculty, one-third by other University of Florida faculty and one-third by outside guest speakers. There are the equivalent of 20 sessions covered by each group of instructors.

The problems associated with coordinating close to 20 outside lecturers in the time available make it unrealistic to assume there will be any consistency in approach or quality of presentation.

2. Teaching Loads

A review of the daily schedule for Program III shows that there is very limited classroom utilization of Drs. Pagano and Rajvanshi. Both of these individuals are full-time employees of TAET and had four classroom contacts of three hours each. This 12 hours total teaching in a 15-week period seems less than full utilization of resources.

Dr. Pagano has other responsibilities, being the Technical Director of the program, but that would not seem to require 95 percent of the work time available.

Dr. Rajvanshi worked closely with the students on their projects, and this undoubtedly used up a significant amount of his time. One wonders, however, if 12 hours of formal teaching and project supervision over the entire 15-week period is appropriate utilization of this resource.

Dr. Ingley, who has 20 percent of his time charged to the TAET Program, also carried a teaching load of 12 hours during a 15-week program.

In the forthcoming year, the TAET Program has hired two full-time instructors while only Dr. Rajvanshi will be leaving. Unless this leads to a significant reduction in the utilization of outside guests, one must be concerned about work loads.

Dr. Farber carried the heaviest teaching load in the TAET Program. He teaches nine separate three-hour sessions over a 15-week period. This 27-hour teaching load may be a bit high when Dr. Farber is also expected to provide administrative guidance and supervision. The TAET Program picks up 25 percent of Dr. Farber's salary.

Dr. Farber explained the relatively light formal teaching loads for his faculty on the basis of the need for very significant student contact outside of normal classes. We were not able to observe this non-classroom activity because our review took place after formal classes had ended. We had no reason to doubt that Drs. Pagano, Rajvanshi, and Ingley spent a considerable amount of time in contact with participants. One might still debate whether that is the most effective utilization of faculty time.

3. Teaching Materials

Each participant is provided with several textbooks and a large amount of printed material. After inspecting the non-textbook materials provided to each participant, we have some serious concerns. One major handout is composed of articles written by Dr. Farber. These articles range from fairly recent to some of relatively old vintage. There does not appear to be an attempt to provide a balanced picture of the technologies covered in this major handout. The focus of most of the material in this handout is solar thermal.

Many of the papers in the large handout are not relevant to LDC applications or technology choices. No use is made of the wealth of papers written especially for LDC applications available from or through USAID, the World Bank, the U.N., and many other channels.

In the non-solar thermal area there is no systematic handout of materials. Some guest speakers provided material for all participants - usually just reports - not really course materials. In other situations participants were told to inspect materials and identify those they would like copied. This approach seems less than satisfactory.

There is no consistent set of handout or course material, background reading, or data on product availability. A brief review of the materials provided on the non-solar thermal technology also demonstrated weaknesses. Much of the material was U.S. in its orientation. There was little or no emphasis on implementation problems in the LDCs.

The organization and presentation of handout material was not in a format that would maximize utility to the participants.

The participants felt that it would have been useful to have more exposure to information on commercially available equipment (company profiles, costs, performance characteristics, etc.). The TAET management indicates that such information is available in the reading room and is copied, on request. As a practical matter, however, it appears that the fact that this information is not presented formally and in an organized way to the participants makes it difficult for them to get a balanced overview of commercial availability. More emphasis, we believe, should be placed on taking the initiative to provide participants with commercial information in the form of company catalogues, product data sheets, etc., which can be useful additions to their libraries.

This treatment of commercial data highlights another problem. Participants had very little feeling for nor understanding of what is available in the way of U.S. or foreign technology. The focus on using locally available materials seems to weigh unnecessarily against the identification of commercially available and economically justifiable off-the-shelf technology.

E. ADMINISTRATIVE STAFF AND SERVICES

The TAET Program runs smoothly and the administration seems to have developed a system that works. The administrators appear to have all aspects of the program under control. The recruiting, admissions, housing and other nonacademic matters are handled in a very satisfactory manner.

The academic administration works well. Schedules are prepared and followed. People seem to know what is going on and are able to anticipate problems.

Two areas of the administrative structure, however, cause us concern. First is the lack of delegation of authority and the second is an apparent excess of administrators.

The administration of the TAET Program is highly centralized. Few, if any, decisions can be made by anyone other than Dr. Farber. This situation seems to be impeding the staff's willingness to innovate and be responsive to the changing needs of participants.

This lack of decentralization or delegation is creating some obvious weak spots in academic administration. With Dr. Farber's other activities outside of TAET he does not have time to get sufficiently involved in all aspects of academic administration. This has left areas such as classroom notes, handouts, quality control over guest lecturers and briefing of lecturers in relatively poor condition. Flexibility in classroom scheduling, changes in weekly sequencing of material and possible changes in course content are discouraged, if not made very difficult, because of the highly centralized management system.

There also appears to be an excessive number of administrators for the amount of work to be done. A careful re-evaluation of job duties and assignments might show that as many as two administrative staff could be eliminated.

The impression one got during interviews was that at least one administrator had few, if any, real responsibilities and that at least one or two others had less than full-time jobs. It also seemed plausible that the current staff could fairly easily handle a sequence of three training sessions per year.

The following positions currently make up the administrative (non-teaching) structure of the TAET Program:

Program Director	Dr. Farber - in overall charge reporting to the Dean of the School of Engineering.
Technical Director	Reports to Dr. Farber and has basic responsibilities for classroom activities.
Program Administrator	Unclear reporting relationship. Seems to prepare budgets and write reports. Little contact with daily program routine or students.
Staff Assistant	Reports to Program Administrator. Performs wide variety of functions from admissions to traditional student affairs activity. Key member of administrative staff.

Information Specialist	Reports to Staff Assistant. Takes pictures, arranges public relations, plans student parties.
Fiscal Assistant	Reports to Staff Assistant. Keeps financial records of program.
Librarian	Unclear reporting relationship. Orders books for students and is building library.
Secretary	Reports to Staff Assistant. Performs general secretarial duties for everyone.
Word Processing Operator	Reports to Staff Assistant. Operates word processor.
Laboratory Manager	Reports to Technical Director, supervises laboratory activities.

F. PARTICIPANT SELECTION

The process for selecting participants to attend the TAET Program seems to be fairly well organized. Nominations come from AID Missions to the University. The TAET administration reviews these nominations and passes their recommendations on to USAID in Washington.

One issue in the area of participant selection caused the review team some concern. Participants have widely varying backgrounds and reasons for attending the TAET Program. Qualifications range from Ph.D.s in some areas of alternative energy to undergraduate engineering or economics degrees. This heterogeneity makes it very difficult to focus a course or to identify the appropriate level at which to teach the technological subjects. Conversely, it is not clear that a homogeneous group of participants would be a desirable program attribute. Greater attention to the issue of heterogeneity would most likely resolve this issue to the extent that one can solve the problem. A number of possible avenues are open to deal with the problem. One would be a series of seminars near the end of the program for those individuals with special interests. Another would be to conduct laboratory sessions on two levels - one for generalists and the other for specialists.

G. PARTICIPANT LIFE

One measure of the program's success must always be the level of participant satisfaction. By this measure the TAET Program is doing very well. Almost all participants were enthusiastic about the program. Individual problems did not override the participants' general level of satisfaction. Participants were enthusiastic about recommending the program to their colleagues.

The largest single complaint voiced by the participants was their sense of isolation from the main University campus. The Days Inn location was

neither near the TREEO Center nor the main campus. Participants found it difficult to utilize the resources available on the main campus, and because of transport limitations, they could not stay at the TREEO Center late into the day if they wanted to continue work there.

Most participants claimed that they had very serious problems trying to set up appointments with non-TAET faculty on the main University campus. The difficulty in setting up the meetings quickly discouraged those individuals who would have benefited.

There was, in addition, a feeling of isolation from the mainstream of community life. Living in a motel that is not centrally located prohibits participants from gaining any real sense of Gainesville and its people.

Balancing this sense of isolation is the fact that the participants get to meet a wide cross-section of the American community, particularly since the TAET Program makes very extensive use of outside guest lecturers. These individuals represent a wide variety of institutions and this variety of exposure is valuable to the participants. From this variety of individuals the participants see that there are no simple or absolute answers to an energy problem and they get different perspectives on the entire subject of alternative energy. The participants also come into contact with a wide variety of individuals on their field trips and site visits.

H. UNIVERSITY REVIEW COMMITTEE

After the visit of USAID's first review team, the University of Florida established an Advisory Committee for the TAET Program. The Committee expressed some degree of satisfaction in gaining acceptance from TAET Program management of some of the ideas in the first review team's report.

We are, however, not overly confident of the Advisory Committee's abilities to get others of its suggestions implemented under present circumstances. The process of negotiating change in the TAET Program is slow and very much constrained by the tradition of non-interference in the academic prerogatives of colleagues. Perhaps a more serious problem is that the Advisory Committee does not have in its membership anyone who has comprehensive understanding of the issues that need to be faced in the TAET Program. Members of the Committee are technologically competent and are experienced in University teaching and administration. Sensitivity to and experience in applying the total system approach to RER development which we feel is so necessary does not appear to be a major strength of this Committee.

We also have the impression that the Committee has not as yet been very active and does not have an agenda involving rigorous review of the TAET Program with adequate staff support.

Appendix 3 Participating University of Florida Faculty

Name	Department	Subject(s)
Dr. L.O. Bagnall	Agricultural Engineering	Anaerobic digestion of aquatic biomass
Dr. C.D. Baird	Agricultural Engineering	Solar applications in agriculture
Dr. R.P. Bates	Food Service and Human Nutrition	Food Preservation
Dr. P.S. Bourgeron	Forest Resources and Conservation	Economics of woody biomass
Dr. G.F. Bowes	Botany	Photosynthesis, biomass energy
(1) Dr. M.J. Bush	Mechanical Engineering	Heat transfer, fluid flow, solar thermal systems, biogas, wind energy, energy conservation, energy & agriculture, energy economics
Dr. K.V. Chau	Agricultural Engineering	Solar crop drying
Dr. B.A. Christensen	Civil Engineering	Hydropower principles
Dr. C.W. Cormer	Forest Resources and Conservation	Woody biomass
Dr. B. Dehgan	Ornamental Horticulture	Plant hydrocarbons
Dr. D. Dippon	Forest Resources and Conservation	Economics of woody biomass
Ms. M. Dowd	Center for Biomass Energy Systems	Biomass energy
Dr. K.M. Eoff	Geography	Gasification
Dr. K.C. Ewel	Forest Resources and Conservation	Woody biomass economics

(1) Administrative Director, TAET Program

Name	Department	Subjects(s)
(1) Dr. E.A. Farber	Mechanical Engineering	Solar energy, energy conversion, heat transfer, refrigeration, Stirling engines.
Dr. R.F. Fisher	Forest Resources and Conservation	Woody biomass production, plantation management
Dr. R.C. Fluck	Agricultural Engineering	Energy analysis
Dr. J.G. Fossum	Electrical Engineering	Silicon solar cells
Dr. R.B. Gaither	Mechanical Engineering	Energy technology
Dr. C.H. Gladwin	Food and Resource Economics	Social analysis
Dr. D.A. Graetz	Soil Science	Environmental impact of biomass energy systems
Mr. J. Gressel	Food and Resource Economics	Economic analysis of biomass energy systems
Mr. L.H. Halsey	Agricultural Extension Services	Energy from root crops
Dr. P.E. Hilderbrand	Food and Resource Economics	Farms systems
(2) Dr. H.A. Ingley	Mechanical Engineering	Refrigeration and air-conditioning, thermal loads, thermal storage
Mr. H.M. Ingman	Mechanical Engineering	Information systems
Dr. C.F. Kiker	Food and Resource Economics	Economic and financial analysis, project planning and appraisal

(1) Principal Investigator, TAET Program

(2) Part-time Lecturer, TAET Program

Name	Department	Subject(s)
(1) Mr. L. Laketek	Mechanical Engineering	Fluid flow, wind energy, heat transfer, laboratory practice
Dr. R.S. Leavenworth	Industrial and Systems Engineering	Engineering economics
Dr. E.P. Lincoln	Institute of Food and Agricultural Sciences	Algae production
Dr. F.A. Lindholm	Electrical Engineering	Silicon solar cells
Dr. J.W. Mishoe	Agricultural Engineering	Biomass production systems
Dr. J.T. Mullins	Botany	Biochemical conversion, fuel alcohol production
Dr. A. Neugroschel	Electrical Engineering	Photovoltaic principles
Dr. R.A. Nordstedt	Agricultural Engineering	Anaerobic digestion
Dr. S.K. Ohair	Institute of Food and Agricultural Sciences	Biomass systems
Dr. L.A. Paganini	Geography	Resource utilization
(2) Dr. R. Pagano	Mechanical Engineering	Solar radiation measurement, concentrating collectors
Dr. H.L. Popenoe	Institute of Food and Agricultural Sciences	Energy and agriculture
Mr. D.M. Post	Forestry	Gasification
Dr. E.S. Priem	Electrical Engineering	Electrical power generation
Dr. G.M. Prine	Agronomy	Energy from forages
Dr. J. Richardson	Forest Resources and Conservation	Economics of woody biomass
Dr. G.D. Ridgdill	College of Architecture	Energy conservation in architecture

(1) Instructor, TAET Program

(2) Technical Director, TAET Program

Technical Director, TAET Program

Name	Department	Subject(s)
Dr. H. Riekerk	Forest Resources and Conservation	Woody biomass--environmental impact
Dr. V.P. Roan	Mechanical Engineering	Wind assessment, windpower technology energy storage
Dr. D.L. Rockwood	Forest Resources and Conservation	Woody biomass production
Dr. H. Rubin	Civil Engineering	Solar ponds
Dr. D.O. Shah	Chemical Engineering	Coal technology, enhanced oil recovery
Dr. L.N. Shaw	Agricultural Engineering	Gasification biofuels
Dr. A. Shiralipour	Microbiology	Aquatic biomass
Dr. N.J. Smith	Geography	Forests and fuelwood
Dr. P.H. Smith	Microbiology and Cell Sciences	Anaerobic digestion
Dr. W.H. Smith	Center for Biomass Energy Systems	Biomass energy
Dr. K. Soderstrom	Mechanical Engineering	Solar energy, wind energy technology
Dr. R.L. Sullivan	Electrical Engineering	Windpower system planning
Ms. K.H. Taylor	Statistics	Biomass production & supply systems
Dr. T.K. Van	Institute of Food and Agricultural Sciences	Aquatic biomass
Dr. S-C Wang	Forest Resources and Conservation	Woody biomass production
Dr. W. Woodruff	History	Economic development

(1) Visiting Professor, TAET Program

Appendix 4 Visiting Lecturers

Name and Affiliation	Session	Subject Area
A.G. Alexander University of Puerto Rico Rio Piedras, Puerto Rico	1, 2	Tropical Grasses and Renewable Sources of Energy
James H. Anderson J. Hilbert Anderson, Inc. York, Pennsylvania	1, 2, 3	Geothermal Energy, Ocean Thermal Energy, Waste Heat Recovery
Roger Arndt St. Anthony Falls Hydraulics Lab Minneapolis, Minnesota	8	Hydropower Technology
W. Richard Barchet Pacific Northwest Laboratory Battelle Memorial Insitutute Richland, Washington	5	Wind Energy Resources
Seymour Baron Burns and Roe Oradell, New Jersey	1, 2, 3, 4	Economic Aspects of Alternative Energy Systems
William T. Beale Sunpower, Inc. Athens, Ohio	1, 2, 3, 4, 5, 6	Stirling Engines
William Bifano NASA/Lewis Research Center Cleveland, Ohio	5, 6, 7, 8, 9	Photovoltaic Systems
Chuck Bufe US Geological Survey Washington, D.C.	3, 4, 6, 7, 8	Geothermal Energy
O.K. Burros CH2M Hill Inc. Gainesville, Florida	1, 2	Water Desalination and Management
John J. Cassidy Bechtel Civil and Minerals, Inc. San Francisco, California	4, 5	Hydro Systems and Economics
Ms. Elizabeth Cecelski Volunteers in Technical Assistance Washington, D.C.	2, 3, 4	Social & Economic Aspects of Renewable Energy Technology Transfer
Paul R. Clark National Rural Electric Cooperative Association Washington, D.C.	7	Economics of Hydropower

Name and Affiliation	Session	Subject Area
Ben Dambly J. Hilbert Anderson, Inc. York, Pennsylvania	4, 5, 6, 7, 8, 9	Geothermal Energy, Ocean Thermal Energy, & Waste Heat Recovery
Richard DeLombard NASA/Lewis Research Center Cleveland, Ohio	7, 9	Photovoltaic Systems
Daniel C. Dunham Columbia University New York, New York	1, 2, 4	Sociological Aspects of Introduction of Alternative Technologies in Developing Countries
D.L. Elliott Pacific Northwest Laboratories Battelle Memorial Institute Richland, Washington	3	Wind Energy
Mr. David Etherton ARIBA New York	1	Solar Architecture
Gerald Foley Earthscan London, England	9	Biomass Technologies
John S. Gladwell Idaho Water Resources Institute Moscow, Idaho	1	Hydropower Technology an Alternative Source of
Richard S. Greeley The MITRE Corporation McLean, Virginia	1	Global Energy Resources
Robert Hargrave Rocky Creek Gasifiers Lacrosse, Florida	9	Gasification Technology
James W. Howe Solar Energy Research Institute Golden, Colorado	2, 4	Transfer of Appropriate Technology & International Programs at SERI
Robert E. Inman Solar Energy Research Institute Golden, Colorado	1, 2	Fuels from Biomass
Allen R. Inversin National Rural Electric Cooperative Association Washington, D.C.	7, 8	Small Hydropower Technology

Name and Affiliation	Session	Subject Area
Bard Jackson National Rural Electric Cooperative Association Washington, D.C.	7, 8, 9	Small Hydropower Technology
Willis E. Jacobsen The MITRE Corporation	2	Small Hydropower Technology
William J. Jewell Cornell University Ithaca, New York	2	Biological Conversion of Biomass to Methane
C.G. Justus Georgia Institute of Technology Atlanta, Georgia	1, 2	Wind Energy
John Kentfield University of Calgary Calgary, Alberta, Canada	8	Wind Powered Water Pumping
Irving Kuczynsky World Bank	2	Financing Energy Projects in Developing Countries
Thomas Lawand Brace Research Institute McGill University Montreal, Quebec, Canada	1, 2, 3, 4, 5, 6, 8, 9	Appropriate Technology and Renewable Energy Development
Edward S. Lipinsky Battelle Columbus Laboratories	1	Production and Utilization of Ethanol as Fuel
Joseph J. Loferski Brown University Providence, Rhode Island	1, 2, 3, 4	Photovoltaics--An Overview of Developments & Applications
George O. Lof Solaron Corporation Englewood, Colorado	2, 3, 4	Solar Air Heating Systems
James F. Lowry Booz Allen and Hamilton, Inc.	1	Energy Conservation
James R. Lowry Hagler, Bailly and Co. Washington, D.C.	2, 3	Conservation of Energy and Criticial Resources
Howard A. Mayo, Jr. Allis-Chalmers Corporation York, Pennsylvania	6, 7, 8, 9	Hydroelectric Systems

Name and Affiliation	Session	Subject Area
Richard J. McDonald Institute for Water Resources Corps of Engineers	2, 3	Hydropower Resource Assessment
Robert Nathans State University of New York at Stony Brook Stony Brook, New York	1	Energy Planning and Policy
William H.N. Paton Brandon University Brandon, Manitoba, Canada	3, 5	Fuel Alcohol Production
William T. Pennell Pacific Northwest Laboratory Battelle Memorial Institute Richland, Washington	3, 4	Wind Resource Assessment
Harry Perry Resources for the Future Washington, D.C.	2, 3	Global Energy Resources
John T. Pfeffer University of Illinois Urbana, Illinois	1	Biological Conversion of Biomass to Methane
David Pimentel Cornell University Ithaca, New York	1, 2, 3, 4	Energy Use in the Food System
Marshall Reed U.S. Geological Survey Menlo Park, California	5, 9	Geothermal Energy Resources
Isaac Sam World Bank	3	Financing Biomass Energy Projects
Gene Shove University of Illinois Urbana, Illinois	1, 2	Solar Crop Drying and Food Preservation
Vaclav Smil University of Manitoba Manitoba, Canada	1	Energy Flows in the Developing World
Klaus Steinbeck University of Georgia Athens, Georgia	1, 2	Forest Biomass as a Source of Energy

Name and Affiliation	Session	Subject Area
Gabor Strasser Strasser Associates	1	Transfer of Alternative Energy Technologies
George t. Tsao Purdue University Lafayette, Indiana	2	Advances in the Production of Ethanol from Biomass
H. Gus Waldren U.S. Dept. of Agriculture	4	Fuels from Biomass
James D. Westfield Development Sciences, Inc. Sagamore, Massachusetts	6	Contracts, Design & Specifications for Equipment and Services
Prof. John I. Yellott John Yellott Engineering Assoc., Inc. Phoenix, Arizona	2, 3, 4	History of Solar Energy

Appendix 5 Program Evaluation by Participants

Starting with session 2, at the end of each session of the training program the participants were asked to complete a program evaluation form. The results of these evaluations are presented below together with the questions as they appeared on the form. It should be noted that more questions were added to the form from time to time; this explains the absence of data from the early sessions in the responses to some of the questions. There are nine questions:

1. OBJECTIVES

The aims of the program are set out below. Please indicate to what degree you feel these objectives have been attained.

(1) To acquaint the participants with the alternative energy technologies.

(2) To provide the participants with sufficient knowledge to assess the natural energy resources of the participant's country and to determine the best possible technological options to utilize those resources so that the participant can provide input in establishing realistic national alternative energy programs for the participant's country.

(3) To provide technically trained people with knowledge to select among technological options and to identify their most appropriate applications.

Objective	Achieved				Not Achieved
#1	5	4	3	2	1
#2	5	4	3	2	1
#3	5	4	3	2	1

Response: mean score:

#1	4.6
#2	3.9
#3	4.4

Trend:

Session	Range
2	3.9 - 4.2
3	3.5 - 4.1
4	3.6 - 3.9
5	3.3 - 3.9
6	4.4 - 4.7
7	3.8 - 4.7
8	4.0 - 4.8
9	3.9 - 4.6

2. How do you rate the overall usefulness of the program to you?

Very Useful	More than Useful	Useful	Fair	Not Useful
5	4	3	2	1

Response: mean score 4.1

Trend:

Session	Score
2	4.6
3	4.4
4	4.1
5	3.9
6	4.4
7	4.0
8	4.4
9	4.1

3. One of the objectives of the short course (the first two weeks of the program) is as follows:

"It serves as a thorough introduction to the main course and establishes the framework in which the alternative energies are examined in detail during the subsequent portion of the training session."

Please indicate to what degree you feel this objective was achieved.

Achieved				Not achieved
5	4	3	2	1

Response: mean score 4.2

Trend:

Session	Score
5	3.1
6	4.1
7	3.9
8	4.0
9	4.2

4. SUBJECT AREAS I

How adequate is the coverage of the topics below in terms of content?

	Excellent	Good	Adequate	Fair	Poor
Biomass energy	5	4	3	2	1
Geothermal energy	5	4	3	2	1
Hydroelectric power	5	4	3	2	1
Photovoltaics	5	4	3	2	1
Socio-economics analysis	5	4	3	2	1
Solar thermal	5	4	3	2	1
Wind energy	5	4	3	2	1

Response: Mean scores and trend:

Topic:	Session:	5	6	7	8	9
Biomass		3.7	4.4	3.9	4.2	3.3
Geothermal		3.1	3.6	3.5	3.3	3.5
Hydropower		3.2	3.8	3.7	4.3	3.7
Photovoltaics		3.1	3.2	2.9	3.4	3.6
Socio-economic analysis		2.9	3.9	3.9	3.9	3.7
Solar thermal		4.6	4.6	4.3	4.7	4.1
Wind energy		3.5	3.9	3.6	4.1	4.4

5. SUBJECT AREAS II

How adequate is the coverage of the topics below in terms of time?

	Too Much		About Right		Not Enough
Biomass energy	5	4	3	2	1
Geothermal energy	5	4	3	2	1
Hydroelectric power	5	4	3	2	1
Photovoltaics	5	4	3	2	1
Socio-economics analysis	5	4	3	2	1
Solar thermal	5	4	3	2	1

Response: Mean score:

Topic	Session 8	Session 9
Biomass	3.4	3.4
Geothermal	2.9	2.7
Hydropower	3.5	2.9
Photovoltaics	2.8	3.2
Socio-economics	4.1	3.9
Solar thermal	3.6	3.8
Wind energy	3.1	3.1

6. **Please evaluate the adequacy of the written material (hand outs) that accompanies the lectures.**

Excellent				Poor
5	4	3	2	1

Response: Mean score 4.2

Trend:

Session	Score
5	4.3
6	4.3
7	4.2
8	4.2
9	4.2

7. PROGRAM COMPONENTS

The TAET program consists of the four components identified below. Indicate the usefulness of each of these components.

	Very Useful				Not Useful
Lectures	5	4	3	2	1
Lab. work	5	4	3	2	1
Group projects	5	4	3	2	1
Field trips	5	4	3	2	1

		Session 7	Session 8	Session 9
Response:	Lectures	4.1	4.5	4.2
	Lab. work	3.7	3.8	3.4
	Group projects	4.2	4.1	4.3
	Field trips	4.3	3.8	4.6

8. Please evaluate the field trips in terms of their overall usefulness:

Excellent				Poor
5	4	3	2	1

Response: mean score 4.6

Trend:

Session 6	4.6
Session 7	4.3
Session 8	4.1
Session 9	4.6

9. FACILITIES AND SERVICES

Please evaluate the adequacy of the facilities and services listed below.

Excellent				Poor
5	4	3	2	1

Response:	Session 7	Session 8	Session 9
TREEO Centre	4.5	4.2	4.5
Lab. facilities	4.0	3.8	4.1
Workshop facilities	4.0	3.4	4.1
Housing	4.5	4.6	4.1
Transportation	4.5	4.5	4.3
Access to library	3.9	4.0	4.0
Photocopying	4.2	3.6	4.6
Typing & secretarial	4.5	4.9	4.4
Social activities	4.5	4.2	3.4
Administration	---	4.8	4.8

Appendix 6 Course Materials

The course materials given to the program participants were gradually compiled and organized over the course of the nine sessions of the training program. The notebooks, texts, and review material made available to participants during the ninth training session are listed below.

1. **Selected Topics in Alternative Energy Technologies for Developing Countries**

   This technical notebook of over 400 pages was written by Dr. Martin Bush. The text presents the technical principles and applications of many of the alternative energy technologies. Topics addressed in this notebook include: fluid flow, heat transfer, flat plate solar collectors, solar thermal systems, solar thermal electric systems, wind power, biogas technology, improved stoves and solar cookers, energy use in agriculture, end-use matching and renewable energy costs.

2. **Solar and Ancillary Measurement Equipment**

   This 460-page manual is a listing of the technical specifications of over 30 instruments that were routinely in use during the laboratory experiments and the group project work. The material was compiled by Mr. Leonard Laketek, TAET Laboratory Manager.

3. **Readings in Alternative Energy Technologies**

   This notebook is a compilation of 32 technical articles on all kinds of alternative energy technologies and systems. The material was compiled by Dr. Martin Bush. The notebook includes a list of manufacturers and suppliers for gasifiers, hydroelectric systems, photovoltaic systems, wind energy conversion systems, and solar collectors.

4. **Readings in Biomass Energy Systems and Agricultural End-Uses**

   This document is a compilation of 46 technical articles that discuss the use of biomass as a source of energy. Topics addressed in this 560 page text include: resource assessment and production, alcohol production, biogas and methane, producer gas and charcoal, environmental considerations, and alternative energy technologies in agriculture. The collection was compiled by Ms. Marybruce Dowd and Dr. Wayne Smith at the Center for Biomass Energy Systems, Institute for Food and Agricultural Sciences, at the University.

5. **Bioenergy Systems Reports**

   This book contains the series of reports compiled and written between March, 1982, and June, 1983, by Dean B. Mahin, of International Energy Projects (Front Royal, Virginia) unde a contract with the U.S. Department of Agriculture, funded through the Bioenergy Systems Projects of the Office of Energy in USAID. The six reports in this collection examine biogas technology, thermochemical conversion of biomass, biomass fuels for vehicles, forestry and wood fuels, bioenergy for agriculture, and bioenergy for electric power generation. Each one of the six technical reports is 24 pages long.

In addition to these documents, all of which were compiled by TAET or University of Florida faculty, a number of other books were provided to the program participants. These books were made available to the TAET program free of charge by the National Academy of Sciences, Board on Science and Technology for International Development.

These texts are listed below.

1. Energy for Rural Development: Renewable Resources and Alternative Technologies for Developing Countries, NAS 1976.

2. Supplement to the above, NAS 1981.

3. Methane Generation from Human, Animal, and Agricultural Wastes, NAS 1977.

4. Food, Fuel, and Fertilizer from Organic Wastes, NAS 1981.

5. Proceedings of the International Workshop on Energy Survey Methodologies for Developing Countries (held at Jekyll Island Georgia in January, 1980), NAS 1980.

6. Microbial Processes: Promising Technologies for Developing Countries, NAS 1979.

7. Firewood Crops: Shrub and Tree Species for Energy Production, NAS 1980.

8. Making Aquatic Weeds Useful: Some Perspectives for Developing Countires, NAS 1976.

9. Producer Gas: Another Fuel for Motor Transport, NAS 1983.

10. Alcohol Fuels: Options for Developing Countries, NAS 1983.

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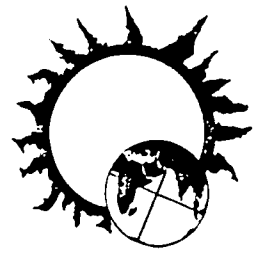


The Biannual Newsletter of the Training in Alternative Energy Technologies Program

USAID Renews TAET Contract through 1983 as Former TAET Participants Share Experiences

Continuing a three-year-old commitment to train representatives of developing nations in alternative energy technologies, USAID/Washington has announced the renewal of its contract with the University of Florida to sponsor the Training in Alternative Energy Technologies program. This 18-month contract renewal provides funding for two training sessions in 1983, as well as the program's sixth session which ended in December 1982.

USAID/Washington and the University of Florida entered into the original cooperative agreement to establish the program in September 1979. Since that time one-hundred and ninety-nine (199) participants from 48 countries have participated in TAET, beginning with the April 1980 inaugural session. As the TAET staff makes plans for future sessions, it has been able to measure the effectiveness of past efforts by communicating with former TAET participants. Many of these alumni have documented the success of, and need for, such a program through reports of their activities since attending TAET.

The following list contains information on the activities of former participants:

SESSION I

Mrs. Afiya Mahtab, Bangladesh is working at the Institute of Fuel Research and Development on projects in the solar energy field, including intensity measurement, solar hot boxes and solar cookers. The solar cooker she has been working with is now being manufactured commercially in Bangladesh.

Gil Manuel Canario is working as Assistant to the Executive Secretary of the Dominican Republic's National Commission for Energy Policy, where he is in charge of the Energy Conservation and Savings Division.

He is in the process of organizing a four-year energy conservation program for the Dominican Republic's industrial sector. Financed by a $13 million loan from USAID, the program's goal is to achieve an energy savings of 40%.

Since his return to India, **Veeraswamy Geethaguru** has been working on a conical solar still project. The conical still is "new in design and efficient in performance," according to Geethaguru.

He was honored by **Technology,** a monthly magazine of the U.S.-based Technology Information Corporation, for his work on water-pumping windmills. The publication named him on its list of 100 key achievers around the world "without whom some important technical advances during 1981 would not have occured."

He was also awarded a gold medal for his work by WIPO, a United Nations organization.

Ahmed Abasaeed worked for six months on the design and operation of a biomass reactor after returning to Sudan. He also assisted in the erection and operation of solar cell panels for pumping water, a United Nations Development Program project.

He returned to the University of Florida and completed a M.S. in chemical engineering (biomass conversion) in May 1982. He is currently working towards his Ph.D. in the same field at UF. *(continued on page 2)*

In This Issue

TAET Biogas Unit in Operation

In an effort to offer program participants the opportunity to view biogas technology in operation, the TAET staff has designed and constructed a biogas unit at the Training, Research and Education in Environmental Occupations (TREEO) Center, site of the training program.

It is the first time the program has had a biogas system in continuous operation.

According to Dr. Martin Bush, who designed the unit with Dr. Roberto Pagano, the objectives of having the unit are: (1) to demonstrate biogas technology, (2) to run a small, modified gasoline engine on the gas produced, and (3) to examine the power characteristics of the engine.

The unit is constructed from two oil drums, with a pit volume of 180 litres and a gas holder volume of approximately 100 litres. The feed is three litres of dung per day mixed with an equal volume of water.

Dung for the biogas unit is being provided by "Bruiser," a 10-year-old beef steer owned by the University of Florida's Institute of Food and Agricultural Sciences (IFAS). The research animal is being studied by IFAS as a "walking anaerobic digester."

A lab-scale biogas system is also being assembled at the TREEO Center to examine the temperature dependence of the process and the effects of other operational parameters on gas production.

Participant Update (continued from page 1)

SESSION II

On his return from the TAET program, **Mohammed Quaiyum** was responsible for organizing the first Bangladesh National Seminar on Energy for Development (May 24-25, 1981).

He is currently working with flat plate solar water heaters at the Bangladesh University of Engineering Technology's Mechanical Engineering Department.

Jerome O.R. Singh is serving as Senior Technical Assistant of the Caribbean Development Bank's Technology and Energy Unit.

"We in the operation side of activity in the Caribbean cannot be specialists, but rather generalists, so as to serve the needs of 5 million people in 17 self-governing territories with populations from 13,000 to 2 million," Singh said.

The Bank's projects involve countries from Antigua to Guyana and range in diversity from the promotion of simple domestic solar food dryers to the testing and demonstration of solar-powered photovoltaic systems for irrigation.

Singh and his colleagues were recently able to influence seven new hotel/-holiday cottage developments to incorporate solar water heating.

Donald Peterson has been joined by **Eduardo Sibaja** at the Instituto Tecnologico de Costa Rica where the emphasis in applications of renewable energy resources. Peterson said, has gradually moved from solar energy studies to biomass energy.

The Tecnologico has just completed a project with Citizen's Energy Corporation which examined the various technologies that utilize biomass energy. The project included studies on the production of charcoal from forest residues, the application of biodigesters in Costa Rica and a project on coffee drying.

Suresh Chandra is responsible for the coordination of the Non-Conventional Energy Resources program of Bharat Heavy Electricals, Ltd. in India. The company's areas of research and development include solar water heating systems, solar power generation, solar water pumping, solar cooling, solar thermal energy storage, wind power and biogas.

Federico "Fred" Santos, Jr. is serving as Development Coordinator of the Special Projects Division of San Miguel Corporation. He has been gathering data on a project involving the use of solar water heating for industrial use.

Santos said the company is examining the potential for solar drying of cattle feed at its cattle farm and has consulted with the University of the Philippines at Los Banos on the project, a pilot installation.

The company is also awaiting the completion of a biogas plant in the hog farm of one of San Miguel's subsidiary companies.

Dr. Kamal Abdalla, Sudan, has supervised University of Khartoum students working on the design of a solar refrigeration unit and a solar collector. His department (mechanical engineering) is also conducting a project on a solid absorbant solar refrigeration system in collaboration with the Danish government.

"I am personally amazed at the many things I can do now and how other people believe in my suggestions just because I have gone through the TAET training."

—RACHEL POLESTICO
SESSION IV PARTICIPANT

Since his return to Sudan, **Dr. Ahmed Ibrahim Elhag** has been involved in studies and research on the development of solar refrigeration, solar water pumping and small-scale hydropower in Sudan.

He said the University of Khartoum Mechanical Engineering faculty, of which he is a member, is in the process of establishing an Energy Research Group.

Chaya Jivacate was recently assigned by the National Research Council to form a working group to give advice and guidance to his government concerning the research, development, demonstration, testing and evaluation of photovoltaics in Thailand. The group will be composed of members from both the government and private sectors.

Dr. Emerson F. Jaguaribe is conducting post-doctoral research at the University of Michigan in the diffusion of heat in a porous medium. He said he is planning to use the results of his study in solar applications in Brazil.

SESSION III

Benjamin Lartey was recently selected by the Commonwealth Science Council (London) to be Ghana's National Coordinator of solar crop drying and solar systems for the Council's African Energy Program.

J.R. Meena, India reports that his present activities as Senior Scientific Officer at the Commission for Additional Sources of Energy include program planning and evaluation of research, development and demonstration projects sponsored by the Commission in conjunction with various organizations in the field of new and renewable energy sources

Rashad Aburas is currently head of the Energy Section of the Jordan Electricity Authority. He has participated with the World Bank in carrying out a comprehensive study on the energy sector in Jordan. He has also conducted a study for improving energy utilization in Jordanian thermal power stations.

Juan "Pancho" Lara has been working with a private cement plant in Panama in a puzzolane drying project designed to produce low-cost cement by combining active and passive solar systems to dry the material.

Shortly after his return to Panama, **Lynn Sheldon** was transferred to Sudan to serve as Chief Engineer of the USAID/Sudan Mission. He was previously project manager for the USAID Alternative Energy Sources Project in Panama.

Lynn and his wife, Karen, are celebrating the September birth of their second son, Jason Andrew.

Concepcion "Sony" Inductivo's work at the Philippines National Oil Company's Energy Research and Development Center is geared towards the commercialization of selected non-conventional/conventional energy

(continued on page 3)

(continued from page 2)

systems. She is working specifically with industrial-scale applications of biogas technology.

As a continuous undertaking, she has been assessing and/or evaluating completed projects implemented by both private and public institutions under the assistance of the Ministry of Energy.

In his position as head of the Sri Lankan National Engineering Research and Development Center's Solar Energy Department, **Don B.J. Ranatunga** is supervising a variety of solar projects, including the operation of a solar water heater in a chemical factory, where it is used to preheat boiler feed water.

In addition to his solar energy activities with the Center, he has developed a wind-powered battery charger, a three-bladed, 12-foot high-speed wind turbine.

Also, he is serving as adviser to the Ministry of Industries and Scientific Affairs on energy conservation projects.

SESSION IV

At the Centro de Tecnologia Petrolera in Bolivia, **Marcelo Urquidi Moore** and his colleagues are trying to finance a Laboratory of Energy Research. Tentative plans for the laboratory include the testing of the performance of internal combustion engines using alternative hybrid fuels.

At Dominica's Ministry of Communications and Works, **Petronald Green** has been involved with the establishment of an energy unit to coordinate all energy-related matters.

The Ministry is planning the construction of a mini-hydro plant in one of the country's non-electrified villages, a project that Green is coordinating.

He is also serving as coordinator for a Human Settlements and Energy Project. The objective of the program, Green reported, is to make use of funding from the Organization of American States to set up various appropriate energy-related pilot projects in participating countries.

R. Emile Rhinelander was recently promoted to the newly-created position of Appropriate Energy Technologist with Liberia's Ministry of Lands and Mines. He is responsible for the design, construction and fabrication of alternative energy installations in his country.

Along with fellow Session IV participant **Jacob Sandikie,** Rhinelander also is working with a team of U.S. workers in assessing the energy resources of Liberia. The USAID-sponsored project is the result of a cooperative effort between the governments of the Liberia and the United States and involves representatives of the Liberian Bureau of Hydrocarbon and the Oak Ridge National Laboratory (Tennessee state).

Chandra Joshi is working on the development of micro-hydro power in Nepal.

Nora Dicioco, the Philippines, has been assisting the National Engineering Center in conducting alternative energy short courses for engineering teachers and is currently preparing a seminar for chemical engineering teachers on biomass systems.

She has also been assisting a number of people making studies on solar distillers, solar cookers and solar concentrating devices.

Dicioco reports the Center is considering joining in the newly-created program on energy management at the University of the Philippines' College of Engineering.

"It is worth noting that the Philippines Government is really bent on the idea of harnessing indigenous and renewable sources of energy, particularly geothermal, solar and biomass resources," Dicioco said. "There is an increased drive to develop our hot springs and energy plantations as well as disperse biogas technology in the rural areas."

Session I participant Veeraswamy Geethaguru inspects the conical solar still he developed after his participation in the TAET program. Information on the still was published in three languages as a "do-it-yourself" booklet. He has been honored by **Technology,** *a UF-based magazine and WITO, a United Nations organization, for his work on water-pumping windmills.*

In the Philippines, **Rachel Polestico** has been passing on the knowledge she gained as a TAET participant. She recently trained 37 participants of the Southeast Asian Rural Society Leadership Institute at Xavier University on alternative energy and appropriate technology. She also compressed the TAET training into a 10-hour mini-course, which she presented during a physics convention for the southern Philippines.

Polestico has joined the Xavier University Extension Service as a biogas project officer, where her services are in demand in villages to design and install biogas generators. "I have made several designs patterned from those I learned in Florida," Polestico reported.

"I am personally amazed at the many things I can do now and how other people believe in my suggestions just because I have gone through the TAET training," she added.

Editor's Note:

Former participants are asked to send news and photographs of their activities since attending the TAET program. Participants are also encouraged to send their comments regarding the TAET program and how it can be improved.

All correspondence should be sent to: Editor, **TAET Transfer,** Training in Alternative Energy Technologies program, University of Florida, 3900 S.W. 63rd Blvd., Gainesville, Florida 32608.

Plan On It

WIND WORKSHOP VI, June 1-3, 1983, Minneapolis, Minnesota. Sponsored by the Wind Energy Division of the American Solar Energy Society (ASES). Contact: ASES, 1230 Grandview, Boulder, CO 80302.

THIRD INTERNATIONAL CONFERENCE ON ENERGY FOR RURAL AND ISLAND COMMUNITIES, September 12-16, 1983. Inverness, Scotland. Papers are now being requested for this third annual conference on meeting the energy needs of remote communities. Emphasis will be on "end-use experiences." Contact: W. Grainger, J.W. Twidell, Department of Applied Physics, University of Strathclyde, John Anderson Bldg., Glasgow, G4 ONG, UK.

1983 THIRD ANNUAL TRADE FAIR, TECHNOLOGY FOR THE PEOPLE, November 21-27, 1983. Manila, Philippines. Contact: TFTP/PHILCITE, P.O. Box-P.A., 473, Roxas Blvd., Manila, Philippines.

Greetings from Dean Chen

GREETINGS!

With this first issue of the TAET NEWSLETTER, we are very pleased and proud to send out this global message, offering greetings and say hello to all our friends and TAET alumni who are scattered throughout the world. HI, HOW ARE YOU?

TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES (TAET) is a *unique* program. With the rapid depletion of petroleum recources, alternative energy technologies are vital complementary means to sustain and satisfy the energy need throughout the world. Thanks to the vision of the U.S. Agency for International Development (AID), the TAET program was born and the University of Florida is privileged to organize and conduct this TAET program since its inception in early 1980.

For the graduates of the past five sessions, I feel fortunate and privileged to have greeted every one of you at the graduation ceremony as well as at the opening ceremony and other occasions. We appreciated your participation in the program, and are thankful for your continued dedication, hard work and leadership role in applying alternative energy technologies in your own country and for the well being of the world.

Few educational programs have as much impact as TAET does. Its goal directly impacts the welfare of the people on a global basis, and the TAET participants as a training class resemble a "United Nations" assembly with their fruitful technical pursuit in a friendly, harmonious atmosphere.

For the success of the TAET program, I wish to record our collective gratitude to: Mr. Alan Jacobs, Director, Office of Energy, and Ms. Shirley Toth, Program Manager, both of the U.S. AID, for their leadership roles, with Mr. Jacobs as the visionary and creator of TAET; Dr. Erich Farber, other faculty and staff members, for their leadership and substantial contributions in instruction and all aspects of TAET operations; Dr. Jack Ohanian and other members of the TAET Advisory Committee, for their valuable reviews and deliberations to ensure that the objectives of the TAET program are met in the curriculum and instructional activities.

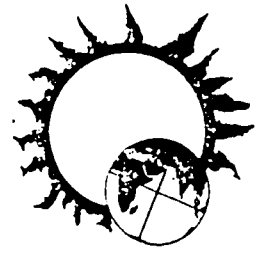
During each of the graduation ceremonies, Dr. Farber always repeated his message, "You as graduates of the TAET program have an important mission to contribute to your own country and the world. Collectively, you form an *international network* of expertise in alternate energy technologies; and it is important that we keep in touch to exchange ideas, share experiences, and provide constructive suggestions (to the TAET program and to each other)." As the Founding Director of TAET, Dr. Farber is, of course, the focal point of communication for this network. I know that many of you have written letters to Dr. Farber reviewing and discussing your perspectives and experiences. (And we appreciate very much your kind words about the TAET program.) With the new *TAET NEWSLETTER,* we shall now have a new instrument and a new dimension in our communication.

Dr. Erich Farber and all faculty and staff members in TAET join me in sending our warmest personal regards.

Wayne Chen

Wayne H. Chen, Dean
UF College of Engineering

A Letter from TAET



Dear Alumni of TAET,

It is such a pleasure to receive the many letters, Christmas and birthday cards from you and to hear what you are doing and how you are using the information which we provided for you in the Training on Alternative energy Technology. It was like a reunion when I met fifteen of you in Africa last summer during the United Nations Energy meeting in Nairobi, as well as fifteen of my former students who received their advanced degrees in our Laboratory.

This summer I had the same experience by having been invited to Honduras as the keynote speaker for the Central America Engineering Societies Congress, meetings in Venezuela, the Pan American Engineering Association Congress in Puerto Rico and some meetings in Mexico.

At all places I met former TAET participants, former students or associates, or associates of both. This provided, in addition to the many letters, information on what all of you are doing.

I hear many success stories, promotions you received because of your work, and satisfaction with your work and I am proud of you and happy that we could contribute to this.

We hope to hear from you in the future as we have in the past and wish you the best in your field of work.

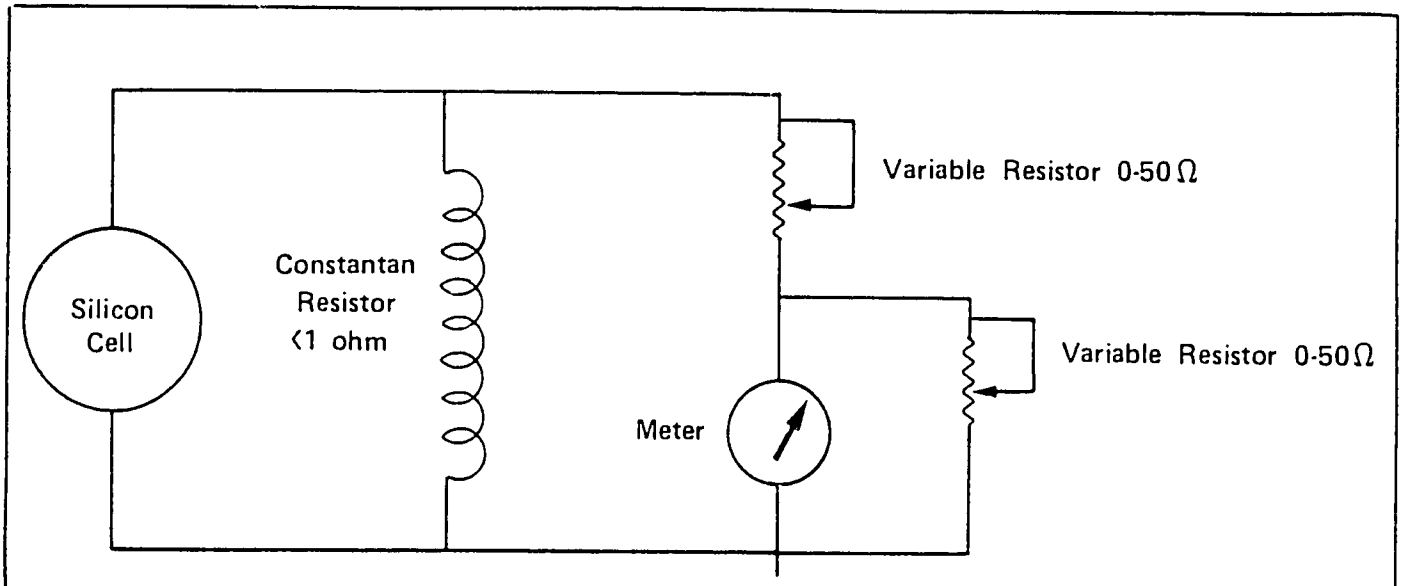
With best wishes, I remain

Erich A. Farber

Erich A. Farber, Ph.D., P.E.
Distinguished Service Professor
Director, Solar Energy &
Energy Conservation Lab

P.S. If there is anything we can do to help you, we hope that you'll let us know.

Technical Topics: The Silicon Solar Cell Pyranometer



Wiring Diagram for Silicon Solar Cell Pyranometer

by Leonard Laketek

Many technical people are aware that one of the most useful instruments in the measurement of the solar resource is the pyranometer. The classic example of a first-order world-class instrument is the Eppley PSP. This instrument is found in most laboratories involved with the design of systems which will employ the sun as an energy source.

There are two basic disadvantages of this system. First, the cost, which is more than $1,200 and the second, the need for a costly support voltmeter. The PSP needs a digital voltmeter to accurately measure the electromotive force produced by the PSP when exposed to solar radiation. The PSP voltmeter system can easily cost more than $1,900. This system has the additional disadvantage of not being extremely rugged or portable for use in the field, away from the laboratory environment.

The need for a small, portable pyranometer has been satisfied by instruments designed around a small silicon cell in conjunction with a standard D'Arsonval movement. Commercial examples of this system in the TAET laboratory are the Dodge Model 776 and the Matrix Mark 6 hand-held pyranometer. Their respective costs are approximately $110 and $300.

The TAET photovoltaic lab has recently been modified to allow participants to fabricate their own silicon cell pyranometer from components supplied in the lab. These units are calibrated using the TAET Eppley PSP pyranometer as a reference standard. Each unit is studied to determine its response to different light sources and various weather conditions. Participants establish a calibration curve for their pyranometer and learn to recognize the advantages and disadvantages of the system. Upon returning home, the participant has an instrument which can immediately be placed into service providing accurate radiation information. The cost of this lab-made instrument is approximately $22.

A diagram of the basic circuit is provided for those persons interested in making their own pyranometer. A few guidelines are in order. The silicon cell (Edmond Scientific Co., 101 E. Gloucester Pike, Barrington, N.J., 08007, Call #30748, Price — $6.95) is designed to produce 90 MA short circuit current. The circuit has the silicon cell operating through a resistor of less than 1 ohm resistance, because it is the short circuit current that is linear with respect to the incident radiation. The wire in the circuit is constantan. The resistance of constantan wire is constant over a broad temperature range; this gives the circuit stability and insensitivity to changes in ambient air temperature. The resistive elements in series and parallel with the meter are selected to allow the meter to be adjusted during calibration to give a direct scaled readout of the incident radiation.

Publisher's Note

TAET TRANSFER is published bi-annually by the Training in Alternative Energy Technologies program to provide information on the program and its activities to interested parties.

The TAET program is a cooperative effort of the U.S. Agency for International Development and the University of Florida.

Any past participant interested in submitting articles or items of interest to this newsletter should address them to: Editor, **TAET TRANSFER,** Training in Alternative Energy Technologies Program, University of Florida, 3900 S.W. 63rd Blvd., Gainesville, Florida 32608. Telephone: (904) 392-4674.

TAET and Transfer: A Worldwide Commitment

trans'fer (trans-fur, trans fer) to convey or shift from one person or place to another; to transport; to serve as a medium of transmission for; to communicate or make known; impart.

Since its inception in 1979, the Training in Alternative Energy Technologies program has been reaching out to the world in an attempt to transfer the alternative energy knowledge and experience of the United States to representatives of Third World countries.

With the publication of the first issue of *TRANSFER* comes a continued commitment to inform, educate and otherwise communicate with the peoples of the world and, through TAET, form a worldwide network of knowledge.

We invite you to share with us your experiences since attending the TAET program and any important energy news from your country. We also welcome any comments you, as a former TAET participant, have concerning the TAET program. With your interest and cooperation, through *TRANSFER* we can continue the commitment that was established with the Training in Alternative Energy Technologies program.

Briefly Speaking...

Deadline Dates Set for 1983 Sessions

Dates have been set for the two TAET training sessions scheduled in 1983. The dates and application deadlines are as follows:

	SPRING 1983	**FALL 1983**
Orientation	February 17-18	August 18-19
Start of Session	February 21	August 22
End of Short Course	March 4	September 2
End of Extended Session	June 3	December 9
Deadline for Applications	December 1, 1982	May 4, 1983

Persons interested in participating in the program should contact the local USAID mission to obtain further information on the program and to receive application packages.

Staff Changes

Former TAET instructor Dr. Anil Rajvanshi has returned to his home country, India, where he is Director of the Energy Division at the Nimbkar Agricultural Research Institute. He and his wife, Nandini, are the proud parents of Noori, a baby girl born May 17 of this year.

Rajvanshi was replaced by Dr. Martin Bush, who joined the TAET staff in June 1981. Dr. Bush has previously taught at the University of Calgary (Canada), the University of Waterloo at Ontario and the University of the West Indies at Trinidad.

Participant List Available

A list containing the names, addresses and affiliation of all TAET participants has recently been updated to include Session VI participants and changes in former participants' addresses.

TAET alumni can receive a copy of the list of fellow participants and countrymen by contacting: Dianne Wright, Training in Alternative Energy Technologies program, University of Florida, 3900 S.W. 63rd Blvd., Gainesville, Florida 32608.

TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES
University of Florida
3900 S.W. 63rd Boulevard
Gainesville, FL. 32608
(904) 392-4674

Address Correction Requested

TAET Transfer

Volume 1, Number 2 • October 1983

The Biannual Newsletter of the Training in Alternative Energy Technologies Program at the University of Florida

TAET Session 7 Comes to a Close

Session 7 of the Training in Alternative Energy Technologies program ended in early June this year. Twenty-four participants from 14 developing countries attended the course which ran for 15 weeks from February 22nd through June 4th. So far, a total of 225 persons from 50 developing countries have participated in the TAET program. The picture above shows the Session 7 group including the two participants who attended only the two-week short course. From left to right, standing: **Dr. Marwan Mahmoud**, Royal Scientific Society, Amman, Jordan; **Dr. Tara Chandra Kandpal**, Centre of Energy Studies, New Delhi, India; **Francis Mkwawa**, Capital Development Authority, Dodoma, Tanzania; **Bakri Osman Hamed**, National Energy Administration, Khartoum, Sudan; **Jirakorn Padumanon**, Electricity Generating Authority of Thailand, Nonthaburi, Thailand; **Ms. Shirley Toth**, USAID, Washington, D.C., USA; **Dr. Niyom Boonthanon**, Chiangmai University, Chiangmai, Thailand; **Dr. Martin Bush**, TAET Instructor; **Ms. Kawther Abdelgadir Elsheikh**, National Energy Administration, Khartoum, Sudan; **Ms. Sharon Loschke**, TAET staff; **Daddy Dampha**, Department of Community Development, Banjul, The Gambia; **Dongrin Mangok**, Regional Ministry of Industry and Mining, Juba, Sudan; **Martin Asare**, Ministry of Fuel and Power, Accra, Ghana; **Mukti Joshi**, Water and Energy Commission, Kathmandu, Nepal; **Vann Chesney**, TAET staff; **Samsul Oesman**, LEMIGAS Cipulir, Jakarta, Indonesia; **Joe Kurinec**, TAET staff; **Tanay Sidki Uyar**, Marmara Scientific and Industrial Research Institute, Gebze, Turkey; **Jose Martinez**, Instituto Centro Americano de Administracion de Empresas, Managua, Nicaragua; **Widjosenc Kaslan**, LEMIGAS Cipulir, Jakarta, Indonesia.

In front, from left to right: **Mohamed Sobni Abd El Salam**, Qattara Hydro and Renewable Energy Projects Authority, Cairo, Egypt; **Ibraham Hussein Saleh Rabie**, Qattara Hydro and Renewable Energy Projects Authority, Cairo, Egypt; **Ms. Chureerut Suwanvithaya**, Electricity Generating Authority of Thailand, Nonthaburi, Thailand; **Ms. Bulgis Suliman Algadir**, National Energy Administration, Sudan; **Ms. Louris Fawzy Rizkalla**, Egyptian Electricity Authority, Cairo, Egypt; **Mustafa Ahmad Zahran**, National Planning Council, Amman, Jordan; **Abdel Moneim Mohd Abdel Razig**, National Energy Administration, Khartoum, Sudan; **Dr. Erich Farber**, Distinguished

continued page 2

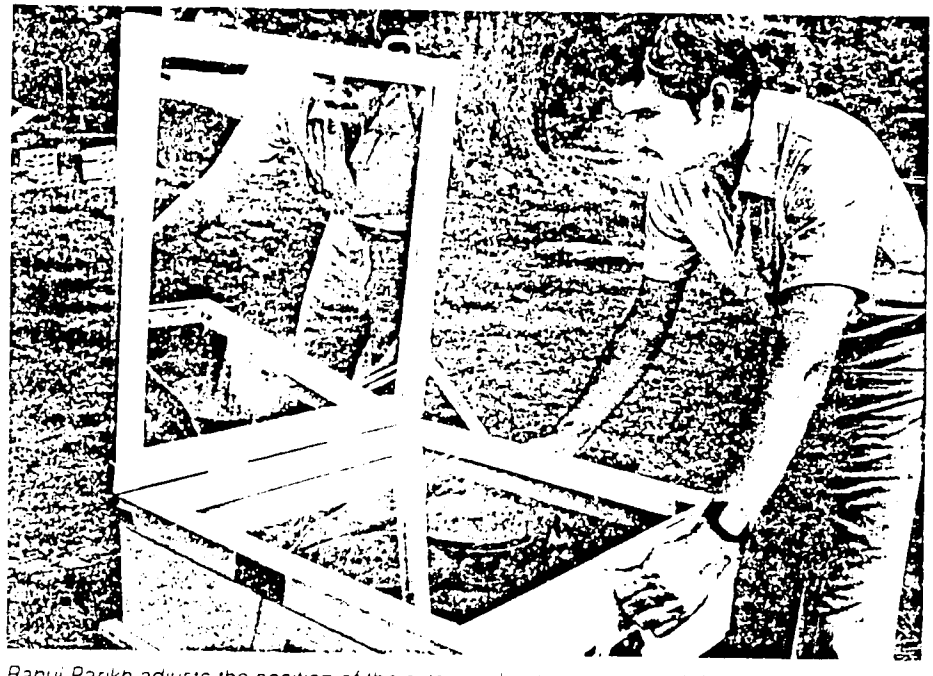
In This Issue . . .

Participant Update

Rahul Parikh (Session 5) writes from India that he is continuing his work on the development of his solar cooker at the Agricultural Tools Research Centre in Bardoli. The original design has been modified in an effort to improve its efficiency. Model number 2 has twice the reflector area of the first model, a modification that Parikh says results in significantly higher temperatures in the box. The third model of the cooker has the lid fitting inside the box, a change that Parikh hopes will lessen convective heat losses when the wind is strong. In addition to the work on the solar cookers, Parikh is also working on solar dryers, solar stills, and fixed-dome biogas digesters.

Marsal Alimin (Session 4), is working in Indonesia setting up the Puspiptek Energy Research Laboratory, PERL. He writes that "the purpose of PERL is to develop an Indonesian cadre of energy related technical manpower, and to strengthen the energy related technological institutions needed for continued economic growth of Indonesia, with both emphasizing the non-petroleum energy sector. Technical activity will focus on the identification of US commercially available energy technologies suitable for Indonesia, the evaluation and adaptation thereof to Indonesian requirements, and the fostering of commercial manufacture and marketing of such energy equipment in Indonesia."

According to Alimin the ultimate objective of PERL is to expedite the transfer of technology to Indonesia to help establish new Indonesian energy-related enterprises.



Rahul Parikh adjusts the position of the solar cooker he constructed during the fifth session of the program.

TAET Session 7

continued from page 1

Service Professor, University of Florida; **Mohamed Mahmoud Ramsy Hamed**, Qattara Hydro and Renewable Energy Projects Authority, Cairo, Egypt; **Ms. Maha Ali Elsayed Elfaki**, National Energy Administration, Khartoum, Sudan; **Dr. Roberto Pagano**, TAET Technical Director.

The group picture, taken during the first week of Session 7, does not include two participants who arrived a few days later: **Ibrahima Lo** and **Toure Matar**, both with the Centre for Renewable Energies Study and Research in Dakar, Senegal.

In Burma, **Htein Lin** (Session 5) is hard at work at the Central Research Organization in Rangoon on their national-scale biogas project. His work includes the design and fabrication of cheap biogas stoves and biogas lamps, as well as the design of the system instrumentation and the machinery for feedstock preparation.

Htein Lin is also building a gasifier to power a gasoline engine, and planning to construct tracking and concentrating photovoltaic systems.

Over in Sierra Leone at Fourah Bay College, **Malcolm Whitfield** (Session 4) is supervising projects in biogas technology, small hydro, and solar energy. Now a member of the Sierra Leone National Energy Committee, he is about to lead the second phase of a Canadian-sponsored project developing solar crop dryers. One comment that Whitfield makes that may be of interest to readers is his belief that the addition of lime juice to the digester feed slurry improves biogas production.

"The need of the hour is to eliminate wasteful use of wood because even with the most ambitious social forestry programmes, it will not be possible to bridge the gap between the supply and demand of wood in the coming decade." So says **Dr. S.K. Sharma**, a member of the faculty of Chemical Engineering and Technology, Panjab University, convenor of the science and technology cell of the Panjab Pradesh Congress Committee (I) and a TAET Session 1 participant.

Dr. Sharma, who has worked extensively in the field of new and alternative sources of energy, chose the subject of 'social and farm forestry' as the principal topic of the first edition of the newsletter of the Science and Technology Cell. The newsletter, the first of its kind, will be circulated among politicians, government officers, ministers, and party workers.

Dr. Sharma asserts that conservation efforts should be directed towards popularizing the smokeless chula in rural homes. "Even if twenty per cent of the population starts using these chulas, 1.8 crore tonnes of wood can be saved annually. This is equal to 25 lakh hectares of fuel wood plantation, which is 80 per cent of the Sixth Plan target of social forestry for the country," he points out. A number of scientists, including Dr. Sharma, have been appointed by the Commission for Alternate Sources of Energy to test the new smokeless stoves.

From the Republic of Liberia, **Emile Rhinelander** (Session 4), a physicist in the Ministry of Lands, Mines and Energy, reports that he has recently been working with a team of energy ex-

perts engaged in the task of assessing Liberia's energy situation. This major and definitive study, jointly undertaken by USAID and the Government of Liberia, has just b... ...mpleted. Also contributing to ... ...was **Jacob Sandikie**, Rhir... ...ion 4 colleague who w... ...sessment of residential e... ...Liberia.

Oscar Solera ...n 5) is now Coordinator for New and Renewable Sources of Energy at the Energy Secretariat of the Ministry of Industry, Energy, and Mines (MIEM) of Costa Rica.

Solera writes that Costa Rica is moving aggressively ahead in developing the country's bioenergy resources. One example: in the rural town of Horquetas a wood-gasifier generator system will provide approximately 100 KW of electrical power to meet residential and commercial requirements of the town, which is not currently served by the national grid system. The MIEM is also supporting projects in biogas technology, improved stoves, and improved charcoal production.

In the Philippines, **Rachel Polestico** (Session 4) is now working full-time in the Appropriate Technology Centre of the Xavier University College of Agriculture. Although operating only since January 1983, the Centre has already run eight training courses in various aspects of appropriate technology and alternative energy technology. "Basically we offer one seminar a month for the production-utilization-processing of a particular agricultural product, and one seminar about appropriate technology to special groups of audiences," Ms. Polestico says. When not busy teaching, Ms. Polestico translates technological literature into the vernacular, an exercise that she feels makes the new technologies more accessible to the villagers.

Now in charge of the Nuclear Power and Energy Division of the Bangladesh Atomic Energy Commission (BAEC), **Mohammed Abdul Quaiyum** (Session 2) is involved in many alternative energy projects. He has prepared a Renewable Energy Programme for BAEC and this nas recently been approved. As part of this programme, Quaiyum writes that BAEC is looking into solar powered pumping systems, solar refrigeration systems, and photovoltaic technology. They also plan to study the growth characteristics of fast growing trees and shrubs such as Ipil-Ipil (**Leucaena leucocephala**) and Dhaincha (**Sesbania bispinosa**).

From Jordan, **Rashad Aburas** (Session 3) has been working on a feasibility study of a potential 1 MW hydropower site. He has also just finished a paper on the global energy demand and supply situation. Aburas collaborated with the World Bank in writing and publishing a report on Jordan's Energy Sector. At the present time he is working on a village electrification scheme using photovoltaics, a project financed by the Government of Japan.

Since his return to Bolivia last December, **Jorge Medina** (Session 6) has worked with the local AID office and has developed plans for the appraisal of alternative energy sources in the Pando region. Medina notes that the new hospital in Cobija has a solar hot water system, the first time, he believes, that a large solar thermal system has been constructed in that part of the world.

Since she returned to Bangladesh over a year ago, Mrs. **Nazma Begum** (Session 5) has been busy. She is working on the design and fabrication of a solar cooker using circulating oil as a heat transfer medium. She has also designed high-efficiency mud stoves for biogas use, as well as helped to organize training programs in biogas technology for people in the rural areas.

And lastly from the National Physical Laboratory in New Delhi, **Dr. Santosh Kumari** (Session 6) has written to us saying that she is continuing her research in photovoltaic technology. Dr. Kumari will be back in Florida in April next year when she will present a paper at a conference in Orlando. She hopes to have enough time to return to Gainesville and to renew old friendships. We look forward to her visit.

Finally, a word to all of you out there who have not yet written to us here in Florida. Please remember that this newsletter cannot be an effective medium for information exchange unless we all participate in putting it together. What we need from you is a brief letter describing your work. Let us know what's happening!

Publisher's Note

TAET TRANSFER is published biannually by the Training in Alternative Energy Technologies program at the University of Florida. TRANSFER is sent to all TAET alumni, to AID missions, and to those working in the field of alternative energy technology who request the publication.

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From the Project Manager

Dear Alumni:

I would like to express my appreciation, and that of the Agency for International Development (AID), to the TAET staff for the excellent job they have done in putting together this newsletter. A newsletter of this quality takes a lot of time and effort in researching and writing articles, and I very much appreciate the hard work and dedication the TAET staff gives to this program. I would also like to express my gratitude to all the alumni who have kept us informed of their activities, for without their participation and letters this newsletter would not be possible. I would also like to urge alumni to submit articles for the newsletter on any work they feel their fellow alumni, TAET program staff, or AID would be interested in.

I enjoy hearing from you, and even though I might not respond as quickly as I would like, please believe me that you are not forgotten.

My best wishes.

Sincerely,

Shirley A. Toth
Office of Energy
Agency for International Development

Western Field Trip Covers Broad Range Of Alternative Energy Technologies

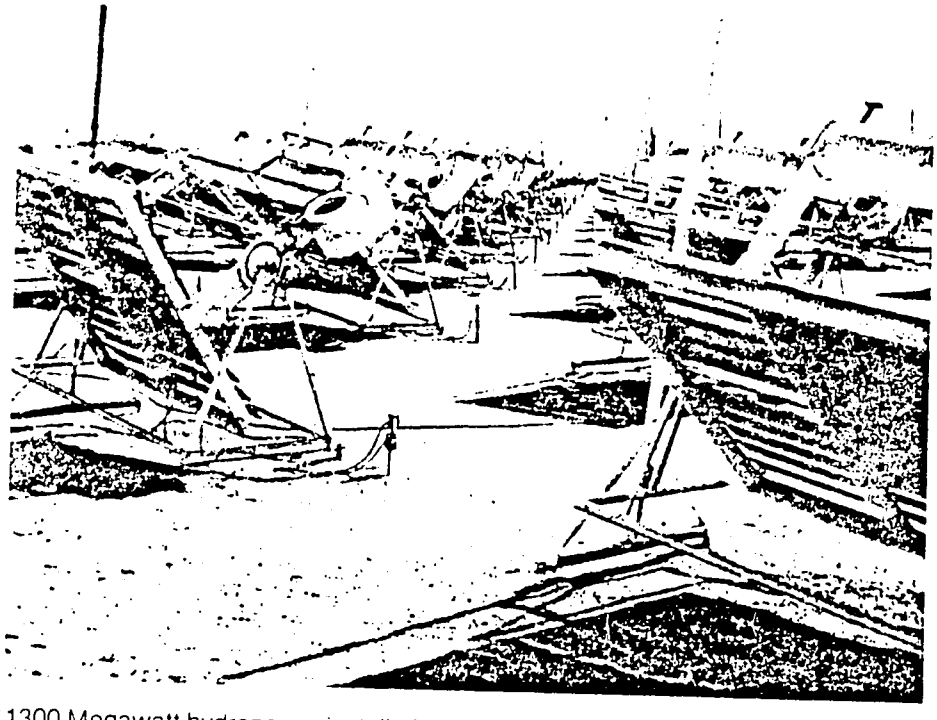
Session 7 participants viewed a broad range of alternative energy systems during the week-long western field trip run during the middle of May, week 13 of the 15-week training program.

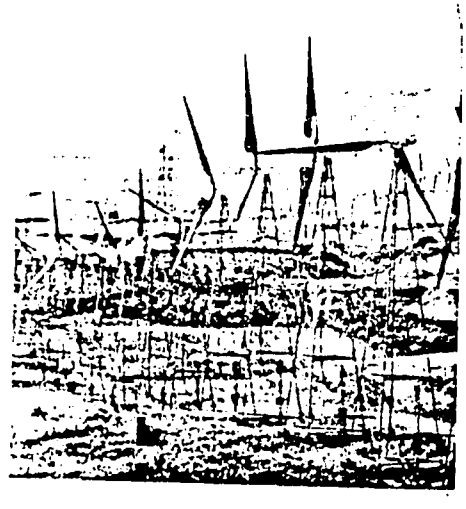
Leaving Gainesville early in the morning of Sunday, May 15, the group flew to Phoenix, Arizona, where they inspected the Sky Harbor photovoltaic system at the Phoenix airport. This installation was, until very recently, the world's largest grid-connected photovoltaic power plant. Rated at 225 kilowatts peak power, the installation is of particular interest since it uses Fresnel lenses to concentrate sunlight onto the tracking photovoltaic panels.

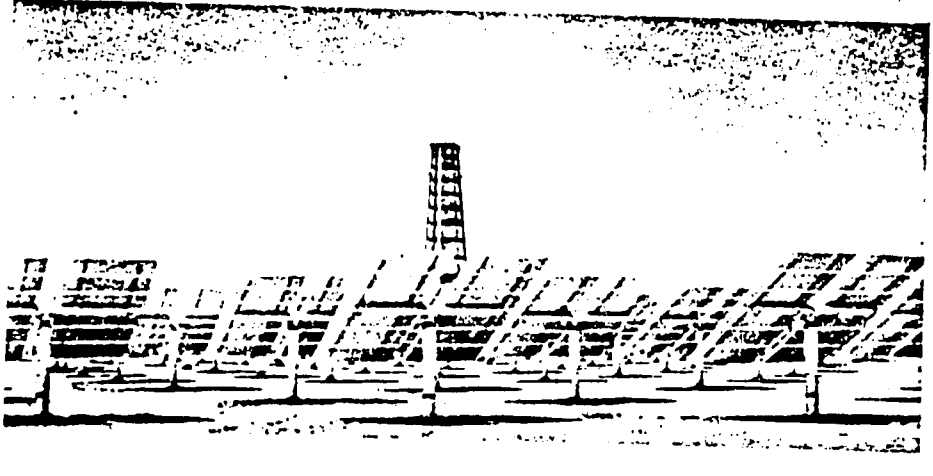
The TAET group then drove to Professor John Yellott's nearby home in Scottsdale to view Yellott's solar heating system and solar-powered Yazaki air-conditioning installation.

The next day the group journeyed north to DSET laboratories located in Black Canyon City, Arizona, about 40 miles north of Phoenix. DSET Labs is an internationally recognized materials weathering and solar device testing organization with operations in Arizona, California, Florida, and New Jersey. In Arizona, the laboratory runs both real-time and accelerated test procedures on a wide range of materials, pigments, coatings, and other devices. They also test a broad range of solar technologies including hot water systems, flat plate and concentrating collectors, and photovoltaic panels. After staying the night on the southern rim of the Grand Canyon, the group traveled west towards Nevada and on Tuesday spent most of the afternoon on a guided tour of the Hoover dam, a 1300 Megawatt hydropower installation that is one of the largest in the United States. When it was constructed in the late 1930's, the Hoover dam was without precedent. Over 200 metres thick at its base, the arch gravity structure rises 220 metres above bedrock and curves for nearly 400 metres across Black Canyon. The dam is the key to the control and regulation of the lower Colorado River and the tempering of that river remains its principal function. Lake Mead, America's largest man-made reservoir, backs up for almost 180 kilometres behind the dam and holds an estimated 35 billion cubic metres of water.

On Wednesday morning, the participants continued their journey into California. First stop was the unique







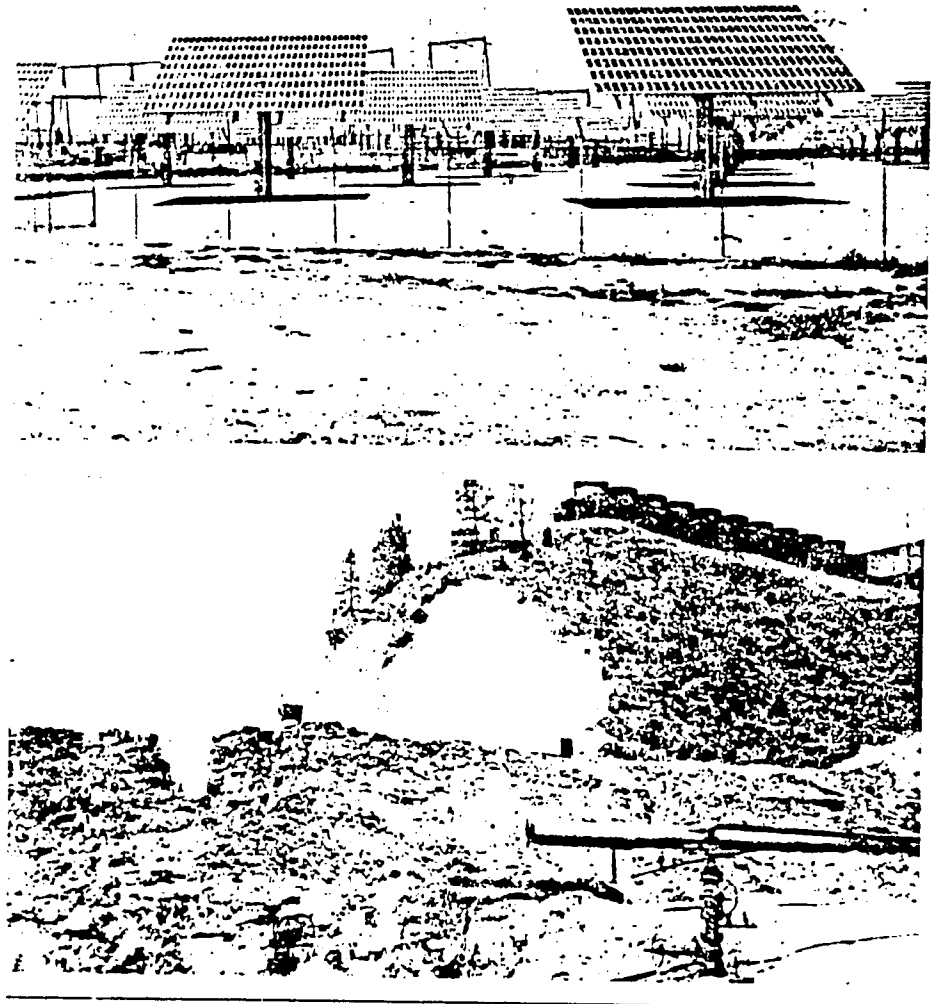
Top photo: Accelerated testing at the DSET labs near Pheonix, Arizona. Above: Altamont pass wind farm showing part of the field of 800 56kW wind machines. At left: Solar One central receiver system. 1818 heliostats, each with an area of 40 square metres, focus sunlight onto the receiver. Peak power output is about 10 MWe. Facing page, top photo: The 1 MWe photovoltaic power station near Hesperia, California. Each of the 108 tracking arrays holds 256 Arco M-51 PV panels. Facing page, bottom photo: Part of the Geysers geothermal field in California. In the background is one of the 12 generating stations that are powered by geothermal steam from the field.

Solar One installation near Barstow in Southern California: a 10 MWe, solar thermal, central receiver electric power plant. Popularly known as a 'power tower' unit, the plant employs 1818 heliostats, each with an area of 40 square metres, to focus sunlight onto a receiver positioned 90 metres above the ground. At peak levels of insolation approximately 65 MW of radiation strike the receiver panels, generating 14.2 kg/s steam at 516°C and 10.3 MPa. Steam from the central receiver drives a General Electric turbine generator with a maximum gross output of 12.8 MWe.

After a guided tour of the Solar One installation, the TAET group traveled southeast to view the 1 MWe photovoltaic system at Hesperia. Installed at a cost of approximately 12 million dollars, this tracking PV system is connected to the Southern California Edison grid.

Wednesday night was spent in Fresno. Thursday morning saw the group's coach climbing high into the Sierra Nevada where Pacific Gas and Electric is completing construction of the Helm's Pump Storage project. Located on the Wishon reservoir in the Sierra National Forest, the project uses baseload night-time power to run turbines in reverse and pump water from Lake Wishon to an upper reservoir 500 metres above the level of Lake Wishon. During the day, at times of peak power demand, the installation operates in much the same way as a conventional hydroelectric power plant: water flows through the three Francis turbines back to the lower reservoir. For every four units of electrical energy used to pump water to the upper reservoir, PG and E engineers claim that three should be recovered during peak load power generation.

Based now in San Francisco, the participants on Friday were taken on a tour of the Geysers geothermal power plant approximately 50 miles north of San Francisco. Saturday, the last day of the field trip, provided one of the highlights of the tour — a visit to the Altamont Pass wind farm, where 800 wind turbines provide electricity to the local grid, followed by a look at the impressive 2.5 MWe Mod 2 wind turbine near Solano.



Staff Notes

Inky Laketek, TAET laboratory manager, is planning a trip through a number of developing countries at the end of 1983. Leaving Florida in December, he will visit Turkey, Egypt, the Sudan, India, Thailand, and Indonesia, before returning to Gainesville via Hong Kong, Japan, Hawaii, and San Francisco. Inky expects to be home some time in January, 1984. While in India he will give a number of lectures and also consult with **Dr. Anil Rajvanshi**. Those alumni who attended the TAET program during 1980 and 1981 will remember Dr. Rajvanshi as one of the program instructors at that time. Dr. Rajvanshi is now Director of the Energy Division, Nimbkar Agricultural Research Institute, in Phaltan. Inky also plans to visit **Dr. Amarianto Kusumowardhoyo** in Timur, Indonesia. Better known to previous participants as 'Kusumo', Dr. Kusumowardhoyo was also an instructor with the TAET program in 1981.

Inky Laketek would be pleased to meet with TAET alumni during his trip. Anyone interested should write to Inky for details of his itinerary.

We are sorry to have to report that a number of TAET staff members are no longer with us. **Mary Green**, who was our information specialist, left the program at the end of 1982 to take up a position with Shands hospital in Gainesville. More recently, both **Loree Taylor** and **Patricia Romejko** have left the program. We are sure that all their friends around the world will join with us in wishing Mary, Loree, and Patricia the very best of luck and success in their new work.

Improved Metal Charcoal Stove

Like many other African countries, Tanzania is faced with the prospect of a shortfall in indigenous supplies of fuelwood and charcoal. In the Dodoma region, site of the new capital, a well-planned afforestation program is in progress but the first harvest is reckoned to be ten years away. One way to mitigate these problems is to improve the existing end-use technology — the cookstove. The traditional charcoal stove used in Tanzania, called sigiri, is cheap, portable, reliable, simple, but inefficient.

Session 7 participant **Francis Mkwawa** from Tanzania, set out to build an improved sigiri while attending the TAET training program. He set five design criteria: the improved stove should be similar in appearance to the existing metal stove, easy to construct from local materials by traditional stove makers, convenient to use, fuel-efficient, and cheap.

The improved sigiri, developed by Francis, has a double wall to reduce radiative and convective heat losses, and contains an inner cone to hold the hot charcoal away from the sides of the stove. The improvement in thermal efficiency produced by these simple modifications to the traditional sigiri is substantial. The new stove boils water in half the time, and uses about 75% less charcoal to do the same cooking job as the traditional stove.

Mr. Mkwawa's report: "A Comparison of Effectiveness of Traditional Metal Charcoal Stove 'SIGIRI' and An Improved Metal Charcoal Stove," is available on request.

Francis Mkwawa, from Tanzania, checks the performance of the improved charcoal stove. In the foreground is the traditional sigiri.

A Reminder

By now, all TAET alumni should have received in the mail a questionnaire, sent out by us at the TAET program. We would like you to respond to this questionnaire and return it to us as soon as possible please. Sharing information about what you are doing in the field of alternative energy technology is very important, not only for the program staff at the University of Florida, but also for our sponsors in Washington.

The 1984 Program

Dates have been set for the two TAET training sessions scheduled for 1984. The dates and application deadlines are as follows:

	SPRING 1984	FALL 1984
Orientation	February 9-10	August 2-3
Start of Session	February 13	August 6
End of Short Course	February 24	August 17
End of Extended Session	May 25	November 16
Deadline for Applications	December 1,1983	May 4,1984

Persons interested in participating in the program should write to the Staff Assistant, TAET Program, for further information.

Bulgis Suliman Algadir holds two synthetic charcoal briquettes and the groundnut shells from which they were made.

Groundnut Shells Show Fuel Potential

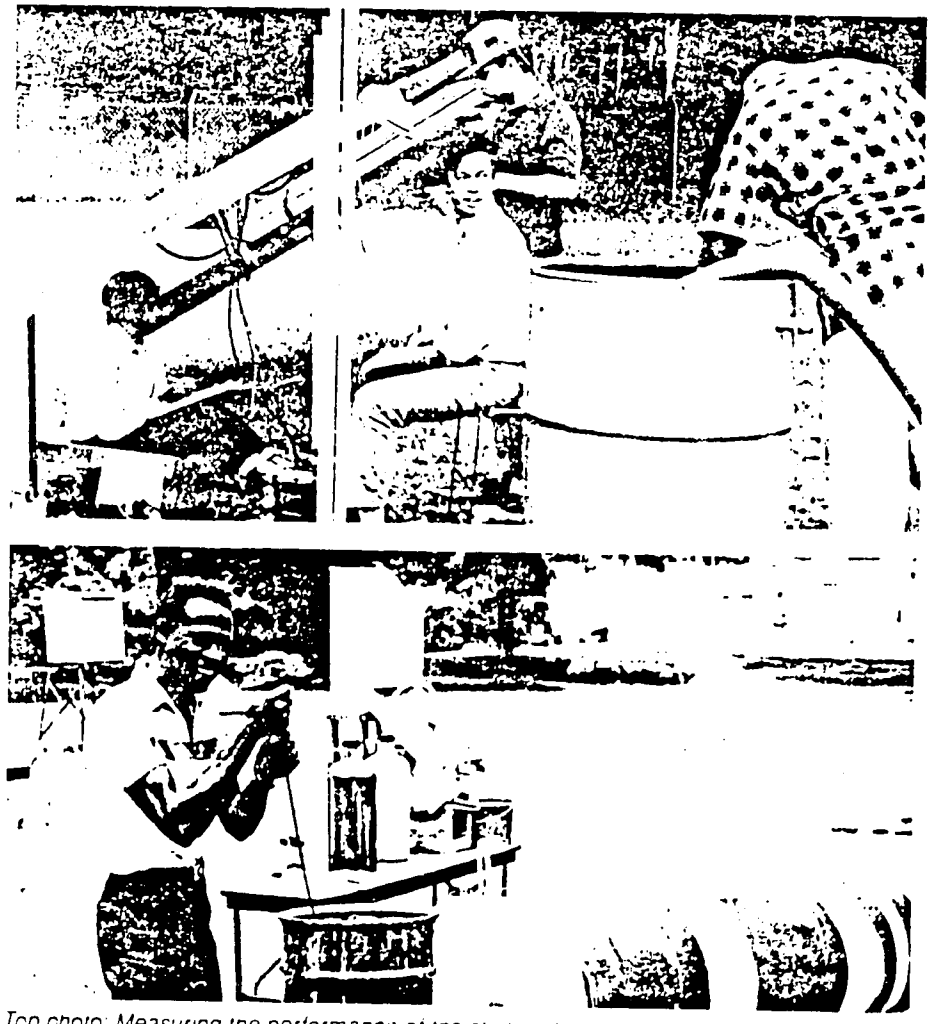
One particularly interesting group project in the seventh TAET session was the successful processing of groundnut shells to make a synthetic charcoal. **Ms. Bulgis Algadir**, from the Sudan, devised a simple but effective way of carbonizing the shells, which are generally discarded as a worthless crop residue in her homeland.

Using a simple kiln, fabricated from an oil drum, groundnut shells can be easily carbonized. The trick is then to produce 'charcoal' briquettes from the powdery carbon char. Ms. Algadir's novel approach involved the use of molasses as a binder. The carbon-molasses mixture was compacted into the shape of a small cake or briquette with the aid of a simple plunger and tube press that she made herself. The briquettes were then dried in the sun. Although the energy content of the new fuel has not yet been determined, Ms. Algadir found no problem cooking with the briquettes using a traditional African charcoal stove.

Group Project Reports Available

Session 7 participants produced some excellent work on their group projects. The group project reports are now available from the TAET program. The reports are: (1) ***Wind Turbine Design, Manufacturing and Testing***, by Ibranim Rabie, Marwan Mahmoud, Tanay Uyar, and Kawther Abdelgadir. (2) ***A Comparison of Effectiveness of Traditional Metal Charcoal Stove 'SIGIRI' and an Improved Metal Charcoal Stove***, by Francis Mkwawa. (3) ***Intermittent Ammonia-Water Refrigeration System***, by Monammed Sobhi Abd El-Salam, Matar Toure, and Niyom Boonthanom. (4) ***Testing Solar Ovens and Methods of Improving their Efficiencies***, by Kawther Elsheikh and Martin Asare. (5) ***Development of Solar Collector Testing Procedures***, by Mukti Joshi and Tara Kanabar. (6) ***Photovoltaic Pumping System***, by Louris Rizkalla, Mohamed Hamed, Tanay Uyar, Ibrahima Lo, Niyom Boonthanom, and Marwan Mahmoud. (7) ***Javan Biogas Plant***, by Daddy Dampha, Mana Eifaki, Bulgis Algadir, and Dongrin Mangok. (8) ***The Establishment of A Credible Insolation Data Base***, by Samsul Oesman, Widjoseno Kasian, and Chureerut Suwanvithaya. (9) ***Charcoal from Groundnut Shells***, by Bulgis Algadir. (10) ***The Design and Construction of a Multiple Disk Turbine***, by Adel Moneim Razig. (11) ***Small Scale Hydropower Performance and Efficiency Data***, by Bakri Hamed, Martin Asare, and Dongrin Mangok. (12) ***Solar Radiation Measurement***, by Jirakom Padumanon.

Anyone interested in obtaining a copy of one or more of these reports should write to: The Administrative Director, TAET Program, 3900 SW 63rd Blvd., Gainesville, FL 32608, USA.



Top photo: Measuring the performance of the photovoltaic powered water pump. From left to right: Louis Rizkalla (Egypt), Niyom Boonthanom (Thailand), Mohamed Hamed (Egypt), and Ibrahima Lo (Senegal). Above: Feeding the horizontal biogas unit, Daddy Dampha from the Gambia stirs things up.

Plan On It

1983 Third Annual Trade Fair, Technology for the People
November 21-27, 1983. Manila, Philippines. Contact: TFTP/PHILCITE, P.O. Box-P.A., Roxas Blvd., Manila, Philippines.

Arab International Solar Energy Conference
Kuwait, November 4-10, 1983. The Arab section of ISES will convene the First Arab International Solar Energy Conference in Kuwait. Distinguished international speakers will give comprenensive talks on the state-of-the-art in the full range of solar-related issues. For more information contact: 1983 Arab Solar Energy Conference, Energy Department, Kuwait Institute for Scientific Research, P.O. Box 24885, Safat, Kuwait.

Atmospheric Radiation
October 31-November 3, 1983 in Baltimore, Maryland. The Solar Radiation Division of the American Section (ASES) will hold a special meeting in conjunction with the American Meteorological Society's Conference on Atmospheric Radiation. Topics will include solar radiation models and measurements, radiation cooling of buildings, daylighting and agricultural applications. For more information contact: Professor K.N. Lion, Department of Meteorology, University of Utah, Salt Lake City, Utah 84112, USA.

1st International Exhibition on Alternative and Recyclable Energy Types in Africa
November 7-13, 1983 in Dakar, Senegal. For further information, contact: EXCAF — 7, rue de Thiong, BP 1656, Dakar, Senegal.

6th Miami International Conference on Alternative Energy Sources
December 12-14, 1983 in Miami Beach, Florida. For further information write to: Clean Energy Research Institute, University of Miami, P.O. Box 248294, Coral Gables, Florida 33124, USA.

Coming Soon

One objective of the TAET program is to familiarize participants with the alternative energy technologies. Ideally, we would like to have examples of all the technologies operating on-site at the TREEO Center in Gainesville. It will be some time before we get to that point but, in the mean time, we can report on our latest efforts to set up new operating systems.

Session 8 participants will see quite a few changes to the grounds out at TREEO when they come out to the training center for the first time. The small hut housing the solar hot water system has been replaced by a much larger shed housing, not only a rebuilt solar thermal system, but also a photovoltaic-powered refrigerator. Nine Solarex SX110 panels will provide power for the operation of an Arctic-Kold 12 volt refrigerator. Battery storage is provided in the shed. The system is to be fully instrumented and should provide excellent operating and performance data for a group project.

By the beginning of September we should be operating a 50 kW wood-gasifier, with which we will drive our long-dormant Opel gasoline engine. We feel that this system will prove to be an interesting technology for the next group of participants.

Also on order is a wind metering system which will be positioned on the top of the TREEO building. This instrumentation will provide a practical contribution to the lectures on wind assessment. We are also rebuilding the solar crop dryer, the biogas digester, and setting up a couple of hydraulic rams on the edge of the pond.

TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES
University of Florida
3900 S.W. 63rd Blvd.
Gainesville, Florida 32608
USA

Address Correction Requested

TAET Transfer

Number 3 • March 1984

The Biannual Newsletter of the Training in Alternative Energy Technologies Program at the University of Florida

Session 8 Review

Session 8 of the Training in Alternative Energy Technologies program ended in early December 1983. Participant evaluations indicate that the last session was one of the most successful in the program's history. Twenty eight participants from thirteen developing countries attended the full course, bringing the number of TAET alumni up to 251.

Shown above is the Session 8 group of participants, including four members who attended only the two-week short course. From left to right standing: **Peter Smith,** Bureau of Standards, Kingston, Jamaica; **Joe Kurinec,** TAET staff; **Dr. Daniel Livramento,** Ministerio Desenvolvimento Rural, Santiago, Cape Verde; **Mpiguzi Nilla,** Tanzania Petroleum Development Corporation, Dar Es Salaam, Tanzania; **Dr. Jayanta Nayak,** I.I.T. Bombay, India; **Vann Chesney,** TAET staff; **Amnuay Thongsathitya,** Bangkok, Thailand; **Ms. Melody Daley,** Ministry of Mining and Energy, Kingston, Jamaica; **Dr. Sutendra Sharma,** Regional Engineering College, Srinigar, India; **Lawrence Limbe,** Small Industries Development Organization, Dar Es Salaam, Tanzania; **Rudolf Wende,** Cofadena, La Paz, Bolivia; **Chand Jotshi,** Panjab University, Chandigarh, India; **Ali Elnasri,** Ministry of Energy, Khartoum, Sudan; **Ms. Dianne Wright,** TAET staff; **Ms. Jacquelyn Smith,** TAET staff; **Ms. Nancy Allen,** TAET staff; **Leonard Laketek,** TAET Instructor; **Mohamed Metwally El-Said,** Egyptian Electricity Authority, Cairo, Egypt; **Ms. Sharon Loschke,** TAET staff; **Camille Nzabonimana,** National University of Rwanda, Butare, Rwanda; **Lloyd McClymont,** College of Arts, Science and Technology, Kingston, Jamaica; **Lang Suwareh,** Department of Community Development, Banjul, The Gambia; **Robert Bolt,** Scientific Research Council, Kingston, Jamaica; **Ian Fowlin,** Vocational Training Development Institute, Kingston, Jamaica; **Charles Garretson,** TAET staff; **Dr. Kenneth Soderstrom,** Visiting Professor, University of Florida; **Aloysius Barthelmy,** Ministry of Finance and Planning, Castries, St. Lucia; **Antoine Charlot,** Centre National De Technologie, Petion-Ville, Haiti; **Gossett Oliver,** College of Arts, Science and Technology, Kingston, Jamaica.

From left to right, front row: **Anupong Hirun,** Chiang Mai University, Chiang Mai, Thailand; **Dr. Boonsong Siwamogsatham,** King Mongkut Institute of Technology, Bangkok, Thailand; **Ms. Mardia Ibrahim Osman,** National Administration for Water, Khartoum, Sudan; **Dr. Erich Farber,** Distinguished Service Professor, University of Florida; **Mrs. Syeda Kamrun Nahar,** Bangladesh Council of Scientific and Industrial Research, Dhaka, Bangladesh; **Dr. R. H. Bhawalkar,** National Physical Laboratory, New Delhi, India; **Saderr Ceesay,** Department of Forestry, Banjul, The Gambia; **Ayodele Coker,** Federal Ministry of Science and Technology, Lagos,

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In This Issue . . .

Participant Update

We continue to receive news about the work and activities of our past participants. **Emile Rhinelander** (Session 4) writes from Liberia that he is completing a paper entitled: "The Need to Improve the Efficiency and Design of Present Traditional Cooking Stoves in Liberia." Rhinelander mentions that his colleague **Jacob Sandikie** (Session 4) is commencing graduate studies at the University of Pittsburg. Both Rhinelander and Sandikie were contributers to a major study of the energy situation in Liberia. This project was jointly sponsored by the Government of Liberia and USAID. The final report of the initial phase of this project, entitled: "An Assessment of Energy Options for Liberia" was issued in June, 1983.

Rhinelander nas been active both in solar thermal and small hydropower technology. He is coordinating a 35 kW hydroelectric project intended to serve more than 50 houses. This project is scheduled for completion at the end of 1984. Rhinelander writes that his Session 4 compatriot **Anthony Zeh-youe** has also been productive: Zeh-youe became a father again in September 1983.

From Fourah Bay College in Sierra Leone, **Malcolm Whitfield** (Session 4) has written a long letter describing his work and research in the renewable energy technologies. He is supervising projects on biogas, minihydro, and solar energy. In biogas technology, Whitfield is pursuing his research on the effects of lime-juice on gas yields. He reports that the addition of lime-juice tc the digester significantly improves performance. Whitfield's theory is that the lime-juice contains acids that are similar to the acids produced by the bacteria in the first stage of the two-stage digestion process. The lime-juice acids would therefore be immediately accessible to the methanogenic bacteria.

Whitfield is also leading a project developing natural-circulation solar driers. This project is sponsored by a Canadian organization and is a joint venture of Fourah Bay College and the Rice Research Station in Rokpur. The hydro-mini project that Whitfield is involved with seeks to establish design criteria for low-cost locally-manufactured hydropower technology in the kilowatt range.

Working with Whitfield at Fourah Bay College in Sierra Leone is Session 5 participant **Joe Ben Davies.** Dr. Davies is active in many fields. He is designing small-scale agricultural machinery, including a hand-operated peanut roaster. He is also working on the design of solar cookers. He writes that the simple photovoltaic pyranometer he built during his stay in Gainesville has been put to good use in his country. In fact, he hopes to extend his work and to prepare both solar and wind energy maps for Sierra Leone.

From I.I.T. Kharagpur, **Dr. Bankim Ghosh** (Session 5) has written to say that he has returned to India after working for a year at the University of Warwick on the computer simulation of free piston Stirling engines.

Down in Tanzania, **Frederick Sumaye** (Session 5) is working on biogas digesters, solar water heaters, and soon, gasification technology within the newly-formed CAMARTEC organization. The Centre for Agricultural Mechanization and Rural Technology started operations in January, 1982, as a result of the merger of the Tanzania Agricultural Machinery Testing Unit (TAMTU) and the Arusha Appropriate Technology Project (AATP). The stated aim of the new center is to improve the quality of rural life through development, adaptation, and implementation of appropriate technologies in the fields of agricultural mechanization, water supply, building construction and sanitation, rural transport and energy.

From the Philippines comes word from Session 3 participant **Concepcion Inductivo.** Working in the Energy Research and Development Center of the Philippine National Oil Company, Ms. Inductivo is primarily involved with the implementation and monitoring of the company's program on the development and commercialization of gasifier systems using rice hulls as fuel. She is also completing an MBA thesis which examines the operation and management of family-owned integrated farm systems which include biogas technology.

Rafael Despradel (Session 4) writes from the Dominican Republic that funding for energy related research at the Universidad Catolica Madre y Maestra appears to be declining. However, he is involved in what may become a major project to provide potable water to rural communities in the northwestern part of the country. Although the region is semi-arid, reservoirs of saline water have been found at depths of 10-20 metres. Despradel and his colleagues are looking into the possibility of using solar distillation to provide water for the local communities.

Dirar Al-Daim (Session 6) has written to us from Yemen Arab Republic that he has been working on his own private photovoltaic project. On returning to Yemen after his stay in Gainesville, he says that he felt "inspired" to build his own experimental solar energy station. This system consists of four Arco Solar photovoltaic panels, which provide power to a number of small devices and appliances. Mr. Al-Daim presented a paper describing this and other photovoltaic projects at the 1st International Arab Solar Conference, which was held in Kuwait in early December 1983.

Since his return to Jamaica at the end of 1982, **Peter Earle** (Session 6) has been involved in a multitude of alternative energy projects. These include the national biogas program; an energy plan and system design for two Jamaican villages; the energy

Session 8 Review

continued from page 1

Nigeria; **Samirkumar Chandra,** Bharat Heavy Electricals Ltd., Hyderabad, India; **Adiele Nwchuku,** Anambra State University of Technology, Enugu, Nigeria; **Mohamed Salih El-Hassan,** National Administration of Water, Khartoum, Sudan; **Dr. Martin Bush,** TAET Administrative Director; **Dr. Roberto Pagano,** TAET Technical Director. The group photograph does not include three TAET participants who arrived in Gainesville a little behind schedule: **Dr. Paul Ezema,** Anambra State University of Technology, Enugu, Nigeria; **Dr. Elsheikh Magzoub,** University of Khartoum, Sudan; and **Jose Recinas Leiva,** ICAITI, Guatemala.

assessment of nine rural townships; a feasibility study of the production of photovoltaic cells in Jamaica; a market survey of photovoltaic applications; an assessment of renewable energy resources and applications in the Hellshire Bay area; the design and installation of photovoltaic demonstration plants for desalination and telecommunication systems; and lastly, a feasibility study of a wood gasification plant.

According to **Martin Asare** (Session 7), the Ministry of Fuel and Power in Ghana is planning to establish rural energy centers in certain areas of the countries. Part of Asare's duties and responsibilities have been to provide technical assistance to his country's Energy Program and to advise the Ministry on matters relating to the alternative energy technologies.

Gyani Shakya (Session 2) writes from Kathmandu that he is now the energy project coordinator for the Resource Conservation and Utilization Project — a project funded by the USAID. Shakya is responsible for all the energy technology activities related to the project. So far, Shakaya's small team has installed about 285 fuel efficient and smokeless stoves, a small hydropower unit, a biogas — supplemented diesel mill, and a variety of solar water heaters and solar driers, in three districts of Nepal.

The operation of his wood-powered truck is explained to TAET participants by Robert Hargrave.

New Gasifier in Operation

Increasing interest in gasifier technology, both in the developing countries and in the U.S., prompted TAET program administrators to give a little more time to the teaching and demonstration of this important energy technology during the eighth session. The program now has in operation a downdraft gasifier which is used to power an old 1100 cc Opel gasoline engine. The new gasifier was built by Robert Hargrave, a retired teacher, who has been building and operating gasifiers since 1979. In 1980, Hargrave fired up the first wood-powered tractor in the U.S. at his farm north of Gainesville. And Hargrave now teaches what is believed to be the country's first course on how to build your own gasifier, at a community college close to the city. The course teaches participants how to build, operate, and maintain their own gasifier units.

Hargrave works closely with University of Florida professors Kay Eoff, Don Post, and Lawrence Shaw, and this group has become one of the foremost research teams on producer gas technology in the U.S. Of the expert panel that wrote the recent National Academy of Sciences report: *Producer Gas: Another Fuel for Motor Transport*, no less than four members were from the University of Florida — further testimony to the progressive work underway at the University.

While on the subject of gasification technology, it may be of interest to note that one of our visiting lecturers from England is the principal author of a recent publication in the field. Gerald Foley, who works with Earthscan in London, lectures to TAET participants during the two-week short course. Foley's book on gasification: *Biomass Gasification in Developing Countries*, has recently been published in England.

A Message from the Advisory Committee

In the early stages of the Program an advisory committee was established to work with the TAET faculty in program development and course content. The members of the advisory committee (Dr. Martin Bush, Administrative Director, TAET Program; Dr. R. Hunt Davis, Director of African Studies; Dr. John P. O'Connell, Chairman, Department of Chemical Engineering; Dr. M.J. Ohanian, Associate Dean for Research, College of Engineering; Dr. Roberto Pagano, Technical Director, TAET Program; Dr. Hugh L. Popenoe, Director of International Programs, Institute of Food and Agricultural Sciences; Dr. Vernon P. Roan, Jr., Professor of Mechanical Engineering; Dr. Wayne H. Smith, Director, Center for Biomass Energy Systems, Institute of Food and Agricultural Sciences) are broadly representative of areas relevant to the Program and function as a review board.

During these past few years the Advisory Committee has seen the original well-conceived TAET program become even better in serving the needs of you, the participants, and the countries you represent. The strong professional and personal ties that have developed between the TAET staff and the participants and among the participants is yet another step towards better understanding among nations and we, the Advisory Committee, hope that — as the TAET program develops in new directions — these relationships will continue to be nurtured.

We wish you all the best in your important endeavors to help assure adequate energy supplies for your respective countries.

M.J. Ohanian, Chairman,
TAET Advisory Committee

Eastern Field Trip

For the first time since the training program started in 1980, Session 8 participants visited energy installations in the eastern part of the U.S., instead of traveling to the western states. This time the group spent two days in Atlanta with the Georgia Power Company, and then five days in Washington, D.C., where the participants met with USAID personnel, and also visited a number of alternative energy installations in the vicinity of the capital.

The group flew to Atlanta on Sunday, October 9, and set off almost immediately for Future 1. According to Georgia Power Company (GPC), Future 1 is the nation's first photovoltaic powered home to be extensively monitored. The roof of the house supports 64 photovoltaic panels with a total area of 544 square feet — an array which produces just over 4 kW peak. The house is connected to the grid and excess power is sold to GPC when the photovoltaic array produces more power than the domestic load.

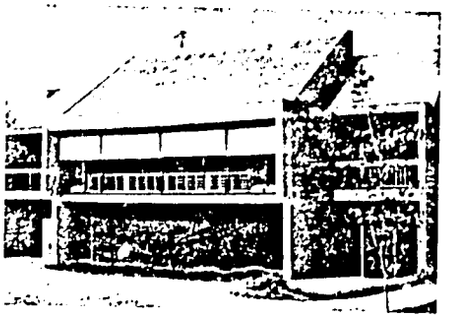
The house also boasts some impressive energy conservaton and passive solar features. The house has large double-paned windows on the south side, but no windows in the east or west walls. In the living room, heat from the winter sun is absorbed by eutectic-salt thermal storage rods which release the heat into the room at night. The lower part of the house also features a Trombe wall to bring in additional heat duing the winter. Backup heating and cooling is provided by an efficient heat pump system.

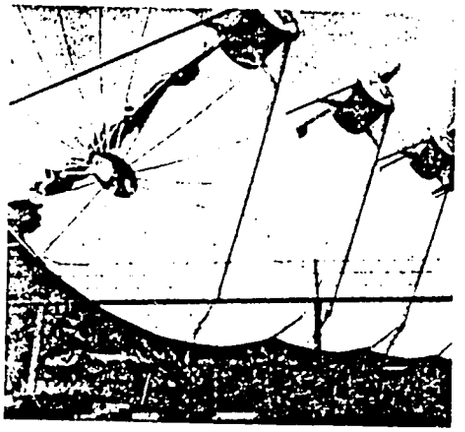
An extensive monitoring system keeps track of the performance of the heating, cooling, and photovoltaic systems. Every 15 minutes, a reading is taken from each of 76 sensors located both inside and outside the building. The data are sent to Albuquerque, New Mexico, for analysis and are included in a monthly report of system performance.

The next day the group traveled 60 km southeast of Atlanta to visit the spectacular parabolic dish complex at Shenandoah, Georgia. This unique system uses 114 parabolic dish collectors, each 7 metres in diameter, to provide process steam, electrical power, and air-conditioning to an adjacent factory.

The system circulates a silicone heat transfer fluid through the receiver tubes of the parabolic dish solar collectors. With a concentration ratio of about 235, the focusing collectors are capable of heating the fluid to about 400 degrees Centigrade (400°C). The fluid is pumped to a heat exchanger where superheated steam at 380°C and 5 MPa is generated. This steam drives a high-speed turbine alternator rated at 500 kVA. Steam at 180°C is extracted from the turbine for use in the factory. Finally the low-pressure exhaust steam is used to drive an absorption chiller, rated at 257 tons, which is used for air-conditioning the factory work space.

After a lunch hosted by Southern Electric International, Monday afternoon was spent touring GPC's corporate headquarters in downtown Atlanta. This office tower has the largest solar system for climate con-



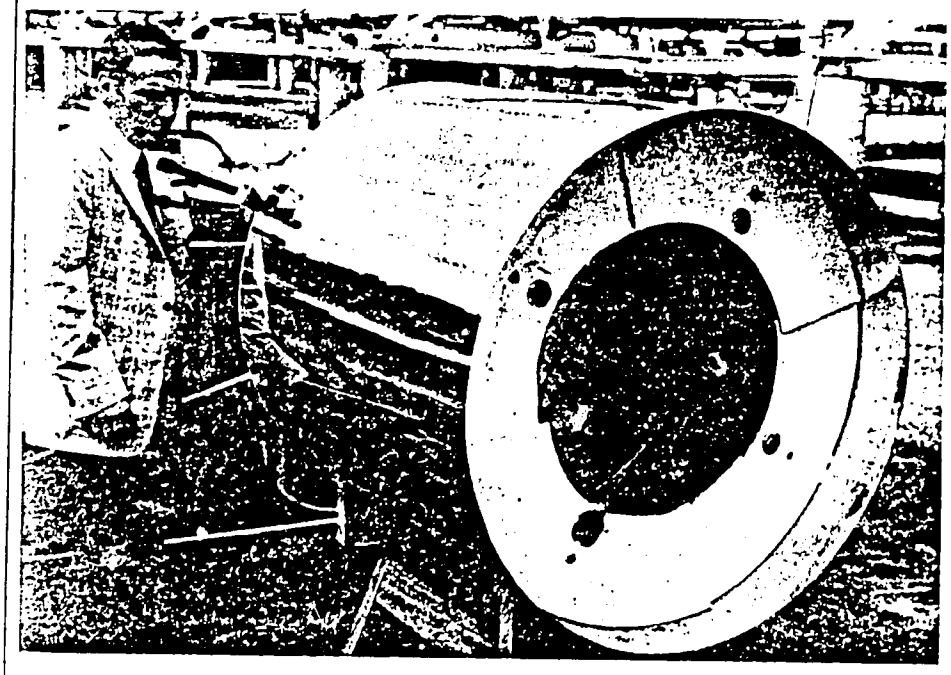


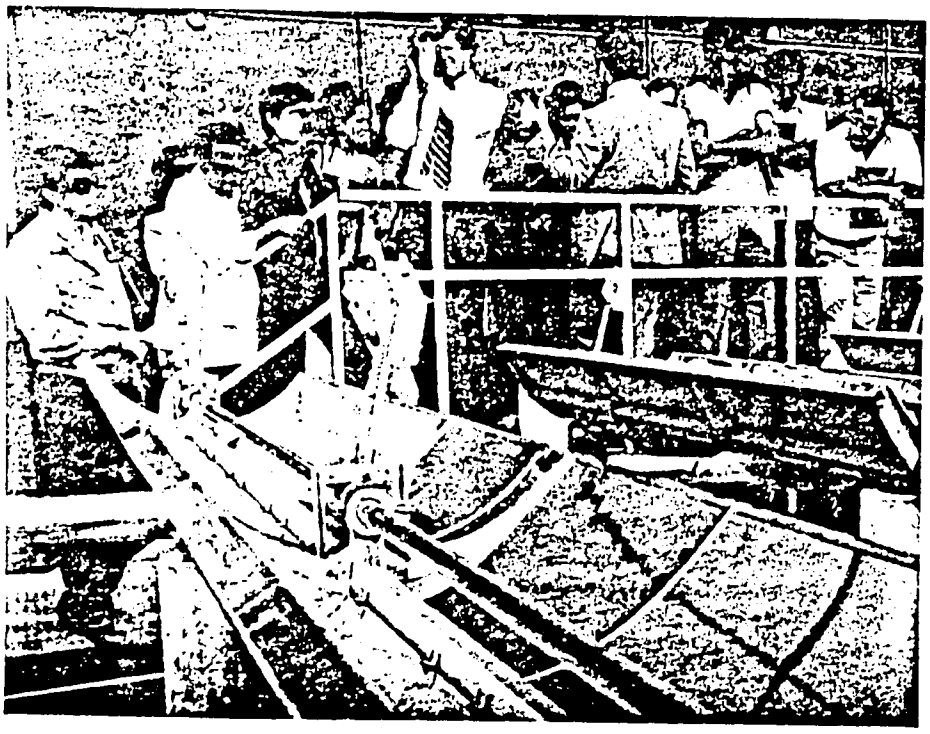
Above, called Future 1, this research home outside of Atlanta has 50 square metres of photovoltaic panels which generate over 4kw at peak levels of insolation.

Top right, part of the field of 114 parabolic dish collectors, each 7 metres in diameter, which provides electricity and process steam to a nearby factory at Shenandoah, Georgia. Above, TAET program participants watch as a Worthington Pump engineer measures the power produced by a centrifugal pump acting in reverse as a turbine. Facing page, top, TAET Technical Director, Dr. Roberto Pagano, examines a receiver from one of the parabolic dish collectors. Facing page, bottom, Session 8 participants examine the field of line focusing solar collectors that power an absorption air-conditioning system at Georgia Power Company headquarters in Atlanta.

trol and water heating of any commercial building in the U.S. Using both passive and active solar features as well as innovative energy conservation measures, this 24 floor building uses only about half the energy consumed by other office buildings of similar size. A field of nearly 1500 parabolic trough collectors covers a 0.6 hectare rooftop adjoining the office tower. This system provides about one-third of the air-conditioning load, and also provides some water and space heating.

The building's most distinctive passive solar feature is the "upside-down-staircase" south wall, with each floor overhanging the one beneath. This unusual configuration lets the winter sun in to heat the building, but prevents direct insolation from the high summer sun from entering. Horizontal sunscreen tubes shade the lower half on the south-facing windows during the summer.





On Tuesday the group flew up to Washington, D.C., where they met on Wednesday with AID project managers in the Office of Energy, and with personnel in the Regional Bureaus. The following day the participants traveled north to Mason-Dixon farms, just outside Gettysburg, Pennslyvania. This farm operates a large horizontal biogas unit using the dung from about two thousand cows. The gas is compresed and used to fuel two large spark-ignition generator sets that provide power to the farm. Waste heat from the engines heats water that is pumped though pipes in the digester. This ensures adequate gas production during the cold Pennslyvania winters.

Thursday afternoon was spent with engineers at Worthington Pumps, a division of McGraw-Edison Company, at their facility near Taneytown, Maryland. Worthington has undertaken an extensive testing program to analyze the performance of centrifugal pumps used as hydraulic turbines. Pumps as turbines have many advantages for the small power producer. Pumps are readily available and many sizes are stock items. Pumps are essentially fixed geometry turbines, without wicket gates, or variable pitch runners, and are therefore easier to operate and maintain. Because there is so much pumping equipment already in operation, spare parts are usually readily and cheaply available. Finally, the capital cost of a pump/turbine and generator can be as little as one-half the cost of a small conventional hydraulic turbine.

The next day the TAET group traveled to York, Pennsylvania, to view the engineering and turbine testing facilities of the Hydro-Turbine Division of Allis-Chalmers Corporation. Allis-Chalmers is, of course, the world's biggest single supplier of hydraulic turbine machinery. The division has built and installed more than 12,000 turbines in 37 countries since its very first turbine set to work powering a grist mill in 1877.

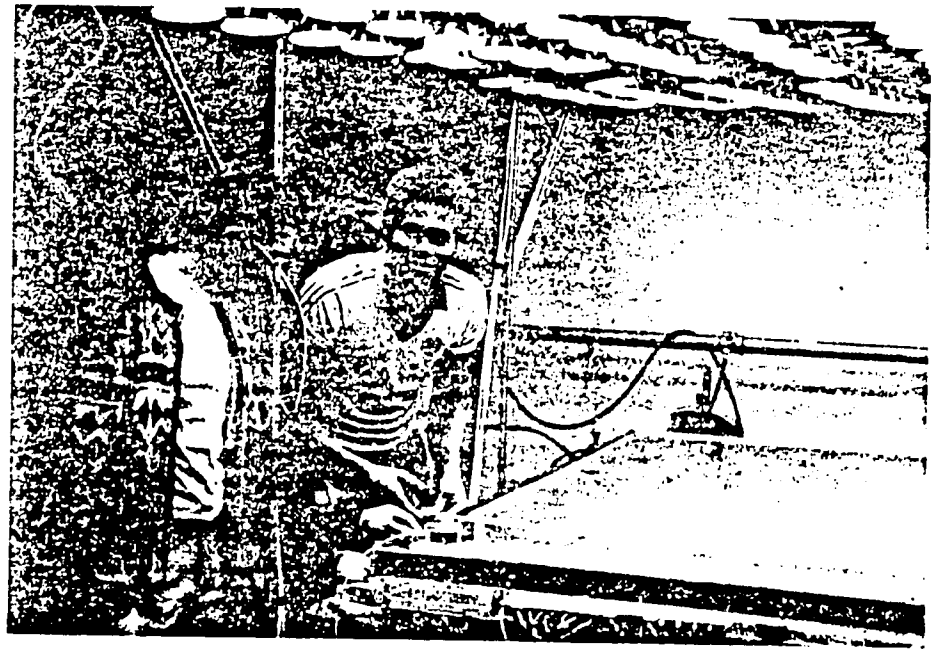
Saturday was a free day for the Session 8 participants, and a chance to do a little sightseeing in the nation's capital before returning to Gainesville on October 16.

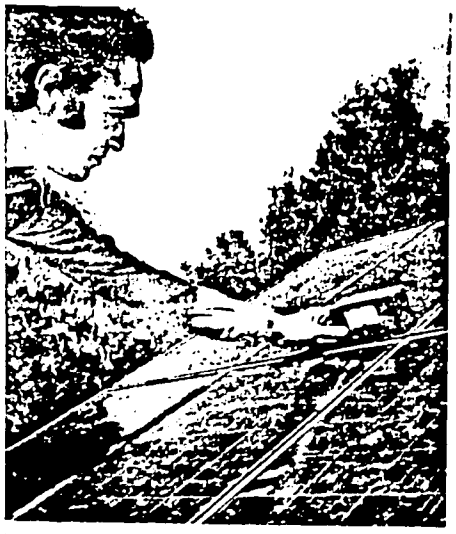
Group Project Reports Available

The group project report produced by the participants in the eighth session of the program are now available. There are twelve reports: *Ammonia/water Refrigeration Systems*, by Chand Jotshi, Dr. Jayanta Nayak, and Rudolf Wende; *Testing and Efficiency Improvement of a Solar Air-Collector*, by Camille Nzabonimana; *Stand-Alone Photovoltaic Energy System for a Medical Dispensary*, by Dr. Sutendra Sharma; *The Application of a Downdraft Gasifier for Shaft Power Production*, by Lawrence Limbe, Ali Ibrahim Elnasri, Amnuay Thongsathitya, Mpiguzi Nilla, and Robert Bolt; *Efficiency Tests of Cooking Stoves*, by Lang Suwareh, Saderr Ceesay, and Dr. Elsheikh Magzoub; *The Potential Use of Solar Energy for Tobacco Curing in Thailand*, by Anupong Hirun; *Improvement in Box-Type Solar Ovens*, by Dr. R.H. Bhawalkar; *Performance Evaluation of a Hydraulic Ram*, by Samirkumar Chandra; *Flat Plate Collector Testing*, by Peter Smith, Lloyd McClymont, Ian Fowlin, and Dr. Paul Ezema; *The Potential for Wind Energy Utilization in Haiti*, by Antoine Charlot; *Photovoltaic Characteristics*, by Mardia Osman and Mohamed Metwally El-Said; *Solar Radiation Measurements and Data Analysis for Gainesville*, by Syeda Nahar, Adiele Nwachuku, Aloysius Barthelmy, Mohamed Kheir Salih, and Dr. Boonsong Siwamogsatham.

Anyone interested in obtaining a copy of any of these reports should write to: The Administrative Director, TAET Program, 3900 S.W. 63rd Blvd, Gainesville, Fl. 32608, USA.

Above, back to basics: Dr. Elsheikh Magzoub (Sudan) and Suwareh Lang (the Gambia), prepare to measure the efficiency of the simplest stove. Below, Dr. Sutendra Sharma (India) measures the insolation on an array of Solarex photovoltaic panels. The array provides power to a 12 V refrigerator.





Top, measuring the cooling effect of the laboratory-scale ammonia/water intermittent system: Dr. Jayanta Nayak (left) and Chand Jotshi, both from India, watch over the system. Above, Ian Fowlin (left) and Peter Smith, both from Jamaica, measure the efficiency of a solar collector in the TAET laboratory. Left, Lawrence Limbe (Tanzania) and Amnuay Thongsathitya (Thailand), discuss the performance of the wood-fueled gasifier.

Questionnaire Results Analyzed

Earlier this year, brief questionnaires were sent out to all our alumni. So far, 74 completed questionnaires have been returned to us — almost exactly one-third of the number sent out. The answers to the questions have been analyzed, and they show some interesting characteristics. First of all, with one notable exception, every single respondent continues to work in th field of renewable energy technology. The exception is Mr. Charles Ntakirutinka, (Session 1), who has been appointed Secretary General of the National University of Rwanda.

In answer to the question: "In which area(s) of energy technology do you now work?", the responses were as follows. More than one-third of the respondents indicated that they work with solar thermal technology. One-third also work with biogas technology. The scores were 38 and 36 percent respectively. After these principal technologies, in decreasing order, come photovoltaics, energy conservation, crop drying, wind-pumping systems, and gasification; topics that score 31, 26, 24, 24, and 20 percent respectively. Then comes solar cookers, improved stoves, charcoal production, wind-electric systems, fuel alcohol, and hydropower in decreasing order. These areas of work score between 10 and 20 percent. Six participants work in refrigeration or air-conditioning technology; three work on direct combustion, and three with geothermal energy. Stirling engines, energy crops, and social forestry, hold the interest of only one participant in each category. Nobody works with OTEC.

Almost one-third of the respondents are in administration (32 percent). 23 percent are engaged in teaching, while 20 percent work in either energy planning or energy assessment.

The participants were also asked to evaluate the alternative energy technologies in terms of their potential to supply energy to their countries. Seven areas of renewable and alternative energy technology were evaluated: biomass energy, solar thermal technology, wind energy, hydropower, geothermal energy, OTEC, and photovoltaic technology. The technologies were given a score between 1 and 5, where a low score indicates a technology with limited potential, and a high score indicates a technology considered to have the greatest potential to supply energy. The mean scores were as follows: hydropower 4.2; biomass 3.9; solar thermal 3.5; wind energy 2.7; photovoltaics 2.7; geothermal 2.3; OTEC 1.5.

The participants were asked about their professional experience since returning from the TAET program, and if the program had helped them in their work. Almost without exception the comments that we received were very positive. Nearly all respondents felt that the training they had received had given them a much better understanding of the alternative energy technologies. Many participants have been promoted, and now enjoy greater responsibility and authority. A good number are now involved with energy planning and policy at the national level.

The results of the questionnaire are very encouraging. We've always said we were doing a good job — now we can point to some solid evidence to support that conclusion.

Solar Drying of Tobacco

Tobacco is an important export cash crop for Thailand. In 1982, production amounted to over 60,000 tons, of which about two-thirds were exported, earning over 100 million dollars for Thailand's tobacco industry. According to Anupong Hirun, TAET session 8 participant, Thai tobacco is renowned for its excellent characteristics such as low tar, low nicotine, and high sugar content. Its mildness makes it a popular tobacco for blending with other stronger varieties.

In Thailand tobacco leaves are cured immediately after harvest, usually in local curing stations. There are approximately 400 such stations in Thailand, most of them in the north of the country. Each station consists of several curing barns, which generally use firewood as fuel. It is estimated that fuel consumption may account for as much as 1 million cubic metres of fuelwood each year. This heavy use of fuelwood has resulted in deforestation problems in many areas where tobacco is the major industry. Clearly, if solar heated air could be used in the drying and curing process then fuelwood utilization could be reduced, and the deforestation problems could perhaps be made less severe.

Hirun chose to assess the potential of solar energy for tobacco curing in Thailand as the topic for his TAET project. He constructed two small solar air-heaters of different design and measured their efficiencies. One collector uses black polyethylene film as the absorber, the other collector tin cans. The cans are cut along their length into strips, and the strips are spread out at the end facing the sun. The base of each can is attached to the bottom of the collector and the whole assembly is painted black.

Hirun's testing and analysis showed that the use of discarded tin cans as absorbers in a solar air heater significantly improves performance. Based on his experimental results, Hirun made a preliminary design for a solar assisted curing barn of the type commonly found in Thailand. He estimated that a standard barn having a volume of 324 cubic metres would need about 90 square metres of collector area. The air heater could supply about 25 percent of the energy required for curing the tobacco. Hirun estimates total fuelwood savings across the country could potentially reach 250,000 cubic metres of fuelwood a year.

Below, Anupong Hirun (Thailand) covers his "tin can" solar collector with plastic film.

Bookshelf

The following books and technical reports are some of the documents that have been added to the reading room out at the TREEO Center in the last few months. *Wind Power Plants: Theory and Design*, by Desire Le Gouieres, Pergamon Press, 1982; *Energy Economics, Demand Management and Conservation Policy*, by Mohan Munasinghe and Gunter Schramm, Van Nostrand Reinhold Co., 1983; *Energy Planning for Developing Countries: A Study of Bangladesn*, by Russell DeLucia, Henry Jocoby, and others, The John Hopkins University Press, 1982. From the National Academy of Sciences comes two new reports that should be of considerable interest to those seeking ways to reduce petroleum imports: *Alcohol Fuels: Options for Developing Countries*, and *Producer Gas: Another Fuel for Motor Transport*. While stocks last, these two reports may be obtained from: Office of International Affairs (JH217), National Research Council, 2101 Constitution Avenue, Washington, D.C., 20418. The World Bank has a new report out that makes interesting reading. It is *The Energy Transition in Developing Countries*, available from The World Bank, 1818 H Street, N.W., Washington D.C., 20433. The National Technical Information Service (NTIS) continues to provide us with the bulk of our technical reports on the alternative energy technologies.

In the past few months we have acquired the following documents: *Manual of Solar Distillation of Saline Water*, by S.G. Talbert (1970), document No. PB201029; *Stirling Engine Design Manual*, by W. Martini (1983), document No. N83-30328; *Wind Power for Developing Nations*, by A. Mikhail (1981), document No. DE81025792. Some other texts we have acquired are: *Fundamentals of Solar Energy Conversion*, by E. Anderson, Addison-Wesley Publishing Co., 1983; *Photovoltaic Energy Systems: Design and Installation*, by Matthew Buresch, McGraw-Hill Book Company, 1983; *Liquid Piston Stirling Engines*, by Colin West, Van Nostrand Reinhold Company, 1983; *Biomass Gasification in Developing Countries*, by Gerald Foley and Geoffrey Barnard, Earthscan, London, 1983.

And Now: The Bad News

It is with great sadness that we have to inform our friends and colleagues in the developing countries that the TAET program may soon be coming to an end. Session 9 — the session now in progress — will probably be the last session of the training program.

During its short life the TAET program has trained over 270 technologists from 50 Third World nations. This issue of TRANSFER will be read by many hundreds of people working with the alternative energy technologies in developing countries around the world.

While training programs may come and go, the energy problems facing the developing countries cannot be so easily brought to an end. We regret that the TAET program may no longer be a part of the international effort to find new sources of energy for the Third World.

We would like all of our TAET participants to know that they have our support and affection. We wish them every success in their work.

Staff Notes

Leonard Laketek, TAET laboratory instructor, left early January on a three-week vacation that took him to Egypt and India. Leonard met with several TAET alumni during his travels, including Dr. Santosh Kumari in New Delhi, and Chitta Das in Bombay. In Phaltan, Leonard visited Dr. Anil Rajvanshi, who was a TAET program instructor until he returned to India in 1981. Dr. Rajvanshi is now Director of the Energy Division of the Nimbkar Agricultural Research Institute.

Meanwhile, back in Gainesville, the program has seen quite a few staff changes. Jackie Smith who was our fiscal assistant, moved out to California at the end of 1983. Jackie will be missed by all of us. Also leaving the TAET staff was Student Assistant Melissa Limcangco. Melissa graduated from the University of Florida at the end of the fall session and is now living in Virginia. We wish both Jackie and Melissa the very best of luck and success.

And last, but certainly not least, congratulations to Senior Technician Chuck Garretson and his wife Patti on the birth of a son — their first child. Zachary Nathan was born on Sunday morning, February 19, 1984.

Publisher's Note

TAET TRANSFER is published biannually by the Training in Alternative Energy Technologies program at the University of Florida. TRANSFER is sent to all TAET alumni, to AID missions, and to those working in the field of alternative energy technolgy who request the publication.

The TAET program is a cooperative program of the U.S. Agency for International Development and the University of Florida.

Anyone interested in submitting articles or items of interest to this newsletter should send them to: Dr. Martin Bush, Administrative Director, 3900 S.W. 63rd Blvd., Gainesville, Florida 32608, USA.

Plan On It . . .

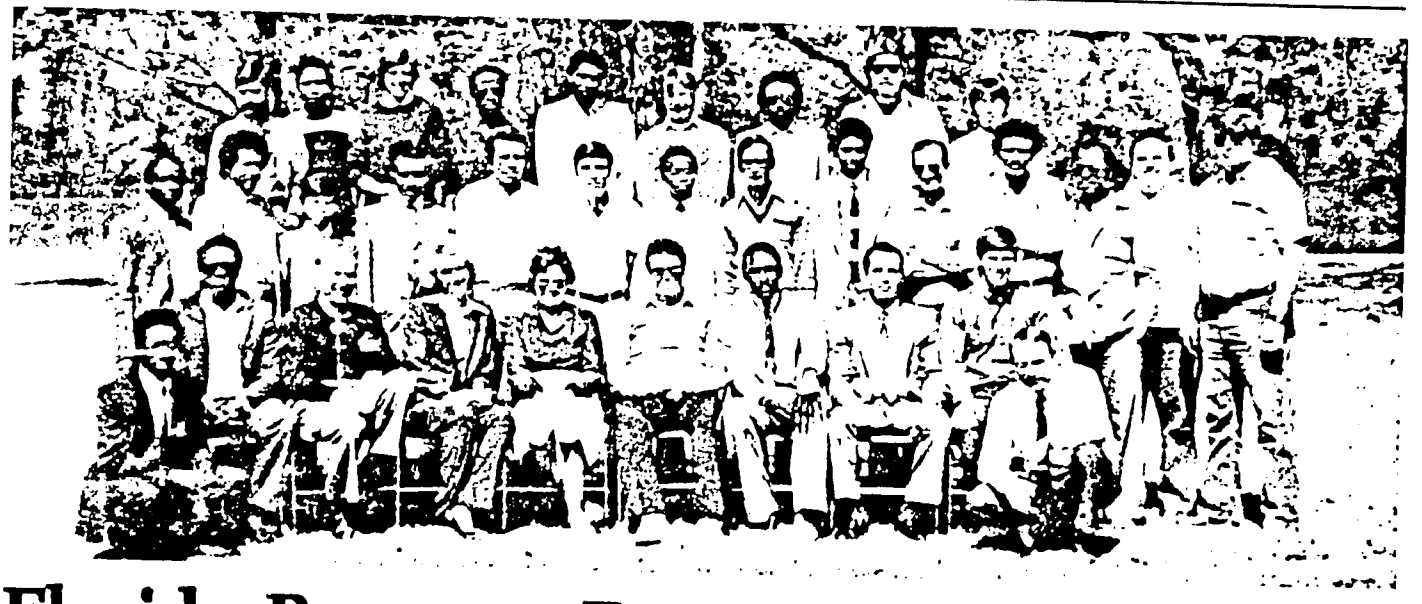
Sixth British Wind Energy Association Conference.
March 28-30, 1984; Reading University, Reading, England. Contact: Dr. Peter Musgrove, Reading University Engineering Department Energy Group, Reading RG6 2AY, England.

Symposium on Photovoltaic Materials and Devices.
May 10-11, 1984; National Physical Laboratory, New Delhi, India. For more information contact: Dr. B.K. Das, Secretary Organizing Committee, Symposium on Photovoltaic Materials and Devices, National Physical Laboratory, Hillside Road, New Delhi 110012, India.

TAET Transfer

Number 4 • September 1984

The Biannual Newsletter of the Training in Alternative Energy Technologies Program at the University of Florida



Florida Program Draws to a Close

The ninth and final session of the Training in Alternative Energy Technologies program at the University of Florida ended on May 25, this year. Twenty-three participants from twelve developing countries attended the course. With the graduation of this last group of trainees the number of TAET alumni now stands at 290.

Shown above is the Session 9 group. From left to right, front row: **John Manukaji**, Solar Energy Research Centre, Bida, Nigeria; **Lamine Jobe**, Ministry of Water Resources and the Environment, Banjul, The Gambia; **Dr. Erich Farber**, Distinguished Service Professor and Director of the Solar Energy and Energy Conversion Laboratory, University of Florida; **Dianne Wright**, TAET Staff Assistant; **Nancy Allen**, TAET Word Processor Operator; **Badr Hassan El-Kattan**, Qattara Hydro and Renewable Energy Projects Authority, Cairo, Egypt; **Saihou Omar Sallah**, Ministry of Education, Banjul, The Gambia; **Shalabi Shelbya**, Egyptian Electricity Authority, Cairo, Egypt; **Mark Williams**, TAET Student Assistant; **Dr. Roberto Pagano**, TAET Technical Director. Second row: **Edmond Zowulu**, Forestry Development Authority, Monrovia, Liberia; **Mohamed Hassan Nur**, USAID/VITA, Mogadishu, Somalia; **Pichai Namprakai**, King Mongkut's Institute of Technology, Bangkok, Thailand; **Omer Musa Osman**, National Administration for Water, Khartoum, Sudan; **Mohamed Fawz Mohamed Ali**, National Energy Administration, Khartoum, Sudan; **Dagoberto Vega Aragon**, Cooperativa Agricola Industrial de Tierra Blanca, Tierra Blanca de Cartago, Costa Rica; **Audace Ndayizeye**, Ministry of Public Works, Energy and Mines, Bujumbura, Burundi; **Sohan Lal Daga**, Chemicals Research Institute, Bhavnagar, India; **Abdoulkarim Moussa**, VITA/ISERT, Djibouti; **Moawad Ali**, Qattara Hydro and Renewable Energy Projects Authority, Cairo, Egypt; **Salaheldin Mohamed Nour**, National Energy Administration, Khartoum, Sudan; **Chukwubueze Odunukwe**, Projects Development Institute, Enugu, Nigeria, **Leonard "Inky" Laketek**, TAET Instructor; **Charles "Chuck" Garretson**, TAET Engineering Technician.

Back row: **Lalit Shingal**, Engineers Ind a Ltd., New Delhi, India; **Melvin Smith**, Ministry of Lands, Mines, and Energy, Monrovia, Liberia; **Dr. Martin Bush**, TAET Administrative Director; **Bocar Sy**, CERER, Dakar, Senegal; **Mamadou Dianka**, Ministry for Industrial Development and Handicraft, Dakar, Senegal; **Vann Chesney**, TAET Engineering Technician, **Abdelsalaam Ahmed Abdelsalaam**, National Energy Administration, Khartoum, Sudan; **Joseph Kurinec**, TAET Engineering Technician; **Songkeat Limsiri**, Electricity Generating Authority of Thailand, Bangkok, Thailand.

In This Issue . . .

California Hosts Session 9 Field Trip

For the renewable energy technologist, California is the place to be. The state boasts the most impressive array of alternative energy systems and technologies to be found anywhere in North America. There are hydropower plants, geothermal fields, solar energy systems, wind farms, photovoltaic systems, and a multitude of biomass energy technologies all available to the interested observer in a wide variety of sizes, models, and design concepts.

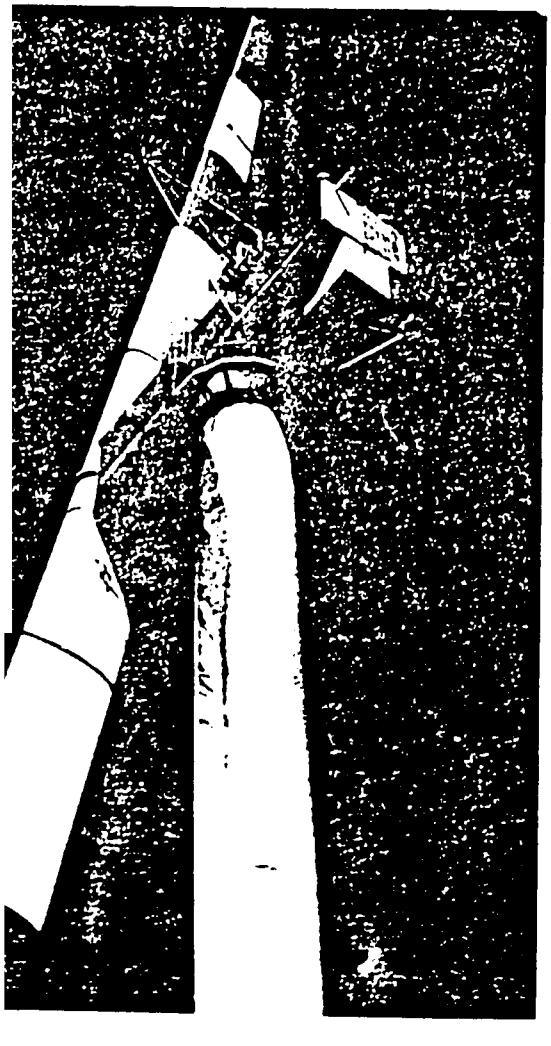
Session 9 participants spent seven days out in California in early May, and had an opportunity to visit a number of interesting alternative energy installations. The tour started in the far south of the state: at El Centro, just a few miles from the Mexican border. The group flew from Gainesville to Los Angeles and was then taken by bus down to El Centro, reaching the town on Sunday evening, May 6. The next morning the participants visited the East Mesa geothermal plant operated by the Magma Electric Company. The Magmamax process uses the hot geothermal brines to drive two, essentially independent, Rankine cycle power systems. The working fluids are isobutane and propane. Gross power generation is about 11 MWe, but parasitic loads (mainly reinjection) bring net power output down to about 6 MWe.

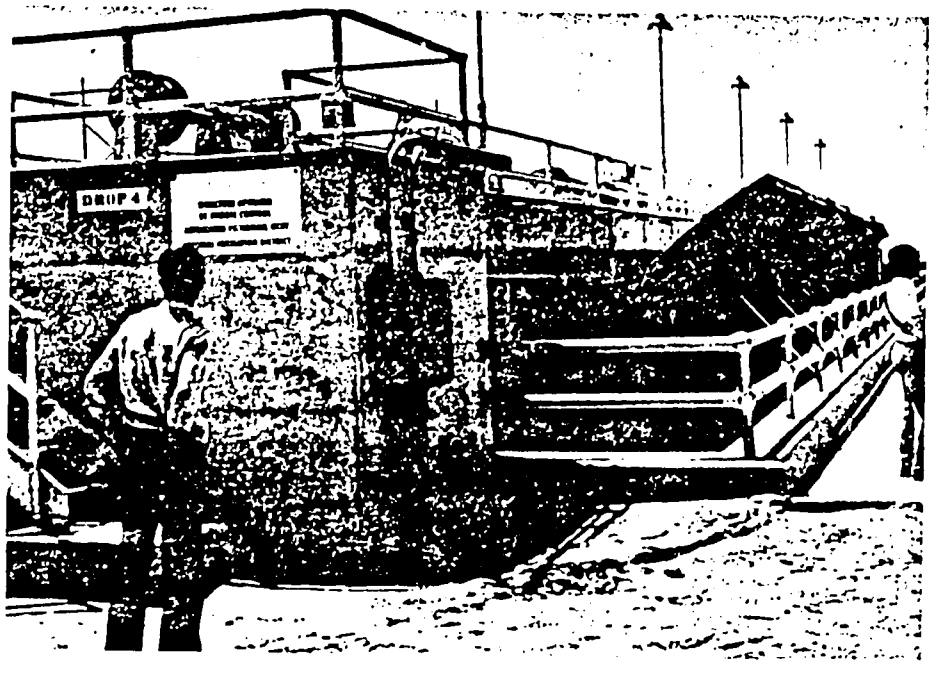
The group then moved on to view two of the low-head hydropower units operated by the Imperial Irrigation District. The district's hydro system consists of seven generating plants and a total of thirteen units. The rated output of the system is just over 77 MW. All but one of the generating plants are located on the All American canal, or on one of the other major water supply canals. The first plant, called Drop 4, has 2 units running off a 15 meter head. Unit 1 is a vertical shaft Kaplan unit rated at 10 MW; unit 2 is a vertical shaft fixed blade unit rated at 9.6 MW. Interestingly enough, unit 2 is the older unit — it was commissioned in February, 1941; unit 1 is nine years younger. About a mile down the canal, the group visited the Drop 5 installation — 2 horizontal axis units each generating 2 MW from a 7 meter head.

The drive up to San Bernadino from El Centro was notable for the discovery of some interesting wind machines in the vicinity of the San Gorgonio pass. While the existence of a number of large wind farms in that area is well-known, the group's route happened to take them close to a wind machine testing site run by Southern California Edison (SCE) a few miles east of Banning. In operation of this site is a 50 kW DAF INDAL Darrieus machine, and a large Bendix horizontal axis machine rated at 1.3 MW at a windspeed of 13.5 m/s. The Bendix was under repair, and had been since March, when winds of over 45 m/s swept through the San Gorgonio pass and ripped the fabric off one of the 24 meter blades.

On Tuesday, the group continued its journey north, stopping first at the 1 MWe photovoltaic power plant at Hesperia, about fifteen miles northeast of San Bernadino. The 8 hectare site holds 108 computer controlled two-axis trackers each supporting an array of 256 single-crystal silicon solar cell modules. On a good day each tracker produces about 9.6 kW which is converted to 480V, 3 phase 60Hz current, and then injected into the SCE grid after step-up to 12kV. Data from the site indicates that the tracking system generates roughly 40 percent more power annually than an identical array of fixed orientation (south-facing with 30 degree tilt).

Tuesday afternoon was spent touring





Left, the Solano MOD-2 wind machine is rated at 2.5 MW. The rotor — 91 meters tip to tip — is supported on a 59 meter steel tower. Above, the Drop 4 low-head hydropower plant on the All American canal in southern California. Two vertical axis turbines generate 20 MW from the 15 meter drop.

the 10 MWe central receiver system, Solar One, which is located just outside of Barstow. This power plant uses 1818 computer-controlled heliostats to reflect sunlight onto a receiver system supported on a 75 meter tower in the center of the heliostat field. At peak levels of insolation the receiver absorbs about 65 MW of radiation over an area of about 300 square meters. The working fluid is water at 10 MPa pressure; gross power output is nearly 13 MWe.

Wednesday was spent travelling from Bakersfield to San Francisco via Highway 1, the spectacular coast road that runs from San Luis Obispo north to Monterey. En route, however, the group had an opportunity to take a look at another photovoltaic power plant — this one still under construction. When completed in 1985 the Carrisa Plain plant will generate 16.5 MWe. The installation uses two-axis trackers, similar to those in operation at Hesperia, but with the addition of mirrors to boost power output.

Based now in San Francisco, the participants drove north from the city early Thursday morning heading for the Mayacamas Mountains and the world's largest geothermal operation. The Geysers geothermal plant is a complex of 16 units that generate a total of over 1250 MW of electric power. More than 200 wells, each drilled at a cost of about one and a half million dollars, bring high pressure dry steam to the power plants. By 1988 it is expected that 22 units will be in operation generating 1600 MW — about 10 percent of Pacific Gas and Electric's total generating capacity.

Friday, the last working day of the trip, was a day set aside for a review of wind power technology. The first visit was to the 2.5 MW Mod-2 wind machine located just south of Cordelia in Solano County. This large two-bladed machine consists of a 59 meter steel tower, an 11 meter long nacelle containing the gearbox, generator, and other pieces of equipment, and a 91 meter long rotor. The entire machine stands 107 meters tall with the blade at its highest point and weighs 286 tons.

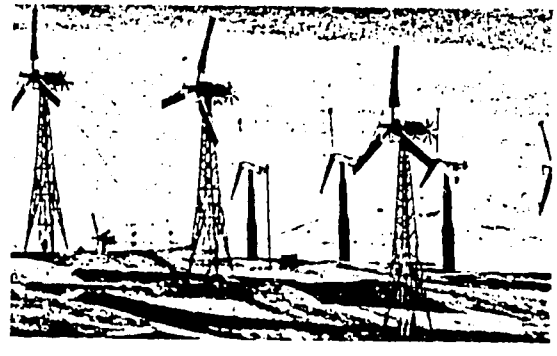
The famous wind farms of California offer an alternative approach to megawatt scale power generation from the wind. The Altamont pass area, just west of Livermore, is literally covered with wind machines. The majority are horizontal axis machines rated somewhere between 50 and 150 kW; but there is also a large and spectacular group of Flowind, 170 kW, Darrieus units in operation.

The economics of these very different power generation technologies were obviously of great interest to the members of the TAET group. Piecing together information from the technical literature and from other sources, it is possible to estimate the cost of electricity generated by each of these alternative energy technologies. For instance, the 6 MW East Mesa geothermal plant cost about $18 million dollars; a quick calculation of energy costs gives a figure of about 10¢/kWh. The Geysers plant, not surprisingly given the high quality of the steam, generates power much more cheaply. Assuming a 110 MW plant requires 15 wells, and that both the plant and the wells costs about $25 million each, the cost of energy is about 1-2¢/kWh. Only PG & E's old hydropower plants can beat that price.

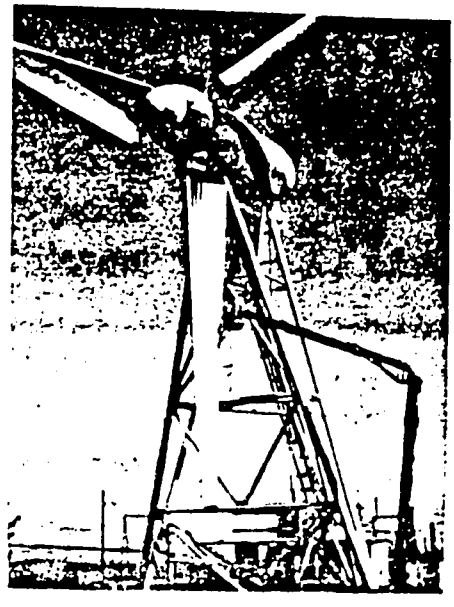
The 1 MW photovoltaic plant at Hesperia cost about $12 million; that would give energy costs of about $1/kWh. The 10 MWe central receiver system, Solar One, generates power at about the same price: with a capital cost of about $14.1 million, the cost of a unit of electricity would again be about a dollar.

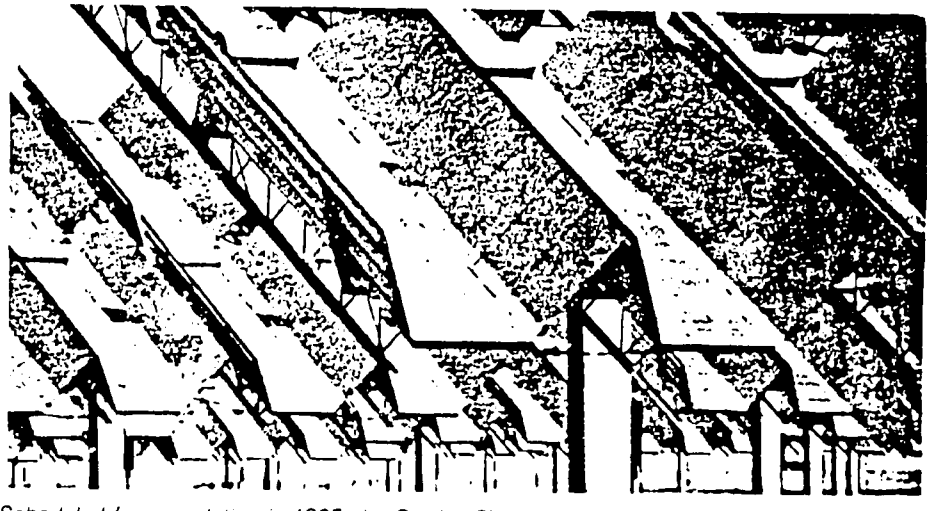
With wind systems the cost of energy is absolutely dependent on how good the wind is. The 2.5 MW unit in Solano county cost about $6 million (not including site work). With an annual average windspeed of 9 m/s, which just might be possible at that site, the cost of generated power would be about 60¢/kWh. The smaller machines (50-150 kW) generally used on the windfarms cost roughly $2000 per kilowatt to install. The cost of energy from these machines is reckoned to be about 10-15¢/kWh. This assumes a mean windspeed at the site of approximately 6 m/s.

These figures are, of course, only approximate, but they provide an interesting perspective on the economic viability of the new power generation technologies.



Above, the windfarms of the Altamont Pass, east of San Francisco. Total installed capacity for California as a whole is reckoned to be over 200 MW. Below, the 1.3 MW Bendix wind machine near Banning, California. The machine is shown under repair after a storm ripped open one of the 24-meter blades earlier this year.





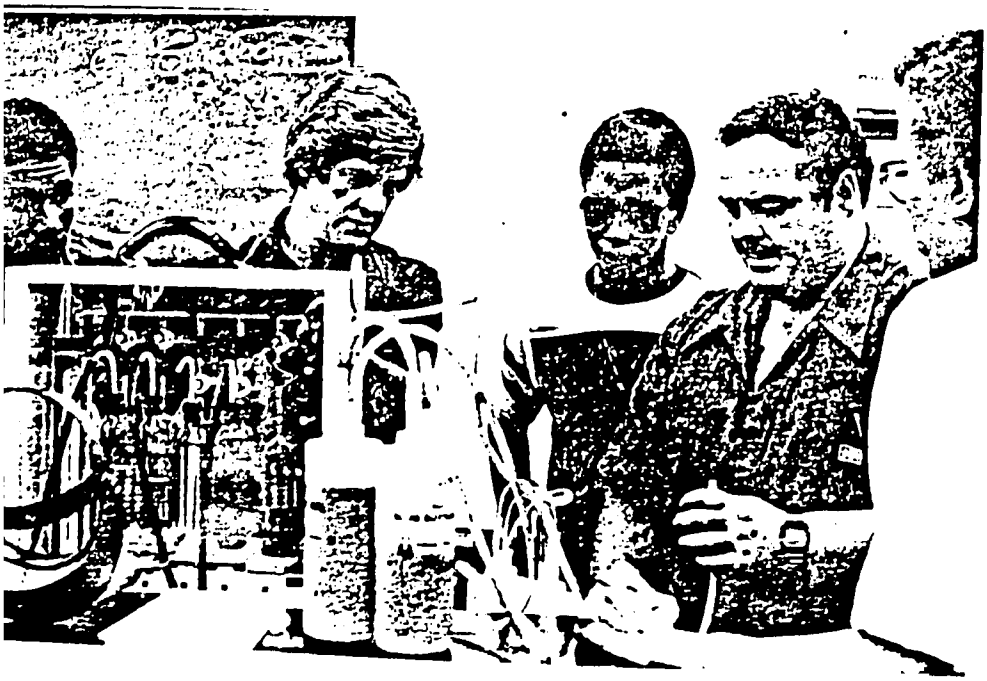
Scheduled for completion in 1985, the Carrisa Plain photovoltaic power plant will generate 16.5 MWe peak. Two-axis trackers hold ARCO Solar panels and booster mirrors.

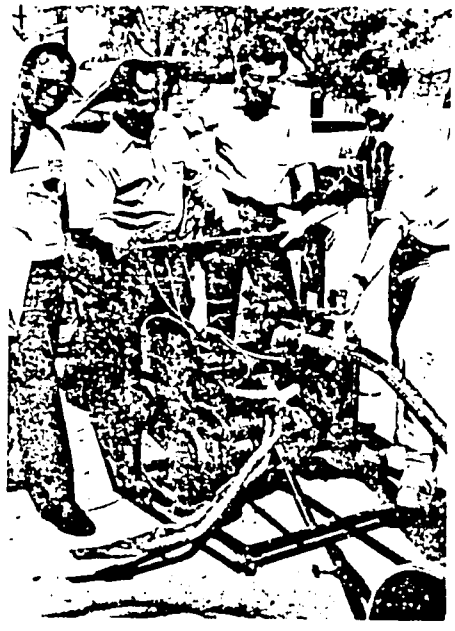
Above, starting up the mini-digester: Mamadou Dianka (Senegal) adds cowdung slurry to the unit while Melvin Smith (Liberia) lends a hand, and Salaheldin Mohamed Nour (Sudan) looks on. Right, Mohamed Hassan Nur (Somalia) and Audace Ndayizeye (Burundi) measure the thermal characteristics of 3 solar cells. Each cell has been encapsulated using different materials. Below, measuring the composition of the gas from the anaerobic digester: from left to right: Mamadou Dianka (Senegal), Dr. Martin Bush (TAET Administrative Director), Melvin Smith (Liberia), Inky Laketek (TAET Laboratory Supervisor), and Mohamed Fawz Ali (Sudan). Opposite page, left, TAET Technician Vann Chesney explains the operation of a gasifier-powered spark ignition engine. From left to right: Chukwubueze Odunukwe (Nigeria), Edmond Zowulu (Liberia), Mohamed Fawz Ali (Sudan), and Vann Chesney.

Group Project Reports Available

Project reports written during the ninth TAET session are now available from the University. There are nine reports: *Wind Data Analysis*, by Shalabi Shelbya; *Thailand's Energy Situation*, by Songkeat Limsiri; *Solar Radiation Measurement*, by Pichai Namprakai, and Omer Osman; *Performance of Down Draft Gasifiers*, by Edmond Zowulu, Mohamed Fawz Ali, and Abdelsalaam A. Abdelsalaam; *The Performance of a Locally Encapsulated Photovoltaic Module and Study of the Cost and Efficiency of the Solar Electric House*, by Audace Ndayezeye, Abdelkarim Moussa, Mohamed H. Nur, John Manukaji, Omer Osman, and Bocar Sy; *Low Level Temperature Energy Technologies*, by Lalit Shingal; *Box Type Solar Cookers*, by Badr El-Kattan, Saihou Sallah, and Moawad Taha Ali; *An Investigation of Refrigeration and Air-Conditioning Absorption Systems Requiring Low Heat Source*, by Lamine Jobe, Bocar Sy, Abdelkarim Moussa, John Manukaji, and Chukwubueze Odunukwe; *Biogas Technology and its Development in Three African Countries*, by Melvin Smith, Mamadou Dianka, and Salaheldin Mohamed Nour.

Anyone interested in obtaining a copy of any of these reports should write to Dr. Martin Bush, TAET Program, 3900 S. W. 63rd Blvd., Gainesville, Florida 32608, USA.





Above, gasifier expert Mr. Robert Hargrave discusses the technology with a group of participants. From left to right: Bob Hargrave, Mohamed Fawz Ali (Sudan), Sohan Lal Daga (India), Moawad Taha Ali (Egypt), and Abdelsalaam Ahmed Abdelsalaam (Sudan).

News From Abroad

Aubrey Marks (Session 5) writes from Guyana that he has been actively involved with a number of photovoltaic projects. A year ago he assisted in the installation of a photovoltaic system at Waramuri. Since then he has helped install systems for two rural hospitals at Kumaka and Sand Creek.

From Turkey comes news from **Tanay Uyar** (Session 7). Dr. Uyar has been travelling through western and southeast Anatolia assessing the potential for the utilization of solar energy in industry. He is also involved in projects designed to develop and utilize more effectively Turkish lignite resources, to investigate wind power applications in the country, and to develop energy sector models. Dr. Uyar also sent us a copy of a monograph publisned by his institute entitled "Introduction to Selective Surfaces and Radiative Property Measurement Techniques." This excellent manuscript has been placed in the TAET reading room.

Down in the Caribbean, **Petronald Green** (Session 4) has written from Dominica to tell us of his work with the government of that island. Dominica hopes to meet all of its electrical power needs using hydropower, which now accounts for 80 percent of power generation, the remainder being generated by diesel units. Green has been involved in a number of microhydro projects, as well as a solar crop drying project. Geothermal energy is also under consideration for power generation since Dominica appears to have a number of promising sites.

Also in the Caribbean, **Dwight Butterfield** (Session 6) has moved from his native Jamaica down to Trinidad where he is a Research Assistant at the University of the West Indies in St. Augustine. Butterfield is working on developing a system for the anaerobic digestion of distillery wastes. Anyone familiar with the rum distillery on the Beetham Highway in Trinidad will appreciate the fact that anaerobic digestion is one of the few energy technologies that has a very definite positive environmental impact.

Further afield, we have heard that **Dr. Paul Ezema**, renowned Session 8 participant, resigned his post at Anambra State University and is now Commissioner for Finance and Economic Planning. We trust that Dr. Ezema will use his new-found influence to support the introduction of the alternative energy technologies in both the Anambra area and in Nigeria as a whole.

Further afield still, **Sidhartha Tuladhar** (Session 4) has written to us from Nepal where he is working primarily with biogas technology. He is coordinating a UNICEF project aimed at evaluating the performance of Nepal's 1400 biogas units. The objectives of this study are to investigate and report on the operation of the plants; to compare the economics of community-scale versus family-sized units; to assess the health and sanitation benefits of the plants; and make recommendations about the future direction of biogas technology in Nepal, particularly with respect to the development of lower cost systems.

Also working with biogas technology is Tanzanian Session 6 participant **I. Tenga**, project supervision manager at the Small Industries Development Organization (SIDO) in Dar es Salaam. Tenga is supervising the installation of 10 biogas plants designed to provide fuel to an equal number of rural medical dispensaries in the Kilimanjaro Region of Tanzania. His Session 8 colleague **Lawrence Limbe** is introducing gasifiers into rural villages dependent on diesel generators; so far, five gasifiers have successfully been put into operation.

From Nepal, **Gyani Shakya** (Session 2), who is energy project coordinator for the USAID funded Resource Conservation and Utilization Project, has sent over a copy of a monograph that he helped to write. Entitled **Small Scale Renewable Energy Resources and Locally Feasible Technology in Nepal**, the book is an interesting review of alternative energy and appropriate technology activities going on in the country.

Francis Mkwawa (Session 7) has written to us from Tanzania and says that the work he did on his improved charcoal stove was well received, and that there is now a major program underway to disseminate the new stoves. According to Mkwawa, Tanzania is also about to receive 1000 solar hot water systems from Australia; photovoltaic systems will also be included in the package.

And finally from the Sudan comes word from Session 8 participant **Mardia Osman**. Ms. Osman, whose group project work was on photovoltaic technology, has had an opportunity to use her new skills. She is currently involved in a pilot project to install a photovoltaic powered pumping system in her country. The system is being provided by Japan.

Cookstoves:

Improved or Unproven?

Most of the readers of this newsletter will be familiar with the problem of deforestation in the developing countries, and the efforts being made by many international agencies, organizations, and development-assistance groups to improve the situation. It has long been argued that one of the main causes of deforestation is the widespread use, in the rural areas of the Third World, of open fires for cooking, a practice that is held by many observers to be inefficient, wasteful or fuelwood, and in need of improvement.

As a result, improved cooking stoves have been widely promoted in the Third World. An extraordinary amount of time, money, and human resources has been devoted to this effort. There are reckoned to be at least one hundred organizations involved in the campaign, and programs designed to encourage the acceptance and use of the new stoves are part of the national energy plans of many developing countries.

But the claims made for the new stoves in terms of their ability to reduce the demand for fuelwood, and their impact on the pace of deforestation, have recently been seriously challenged.

The controversy was touched off by the publication in August, 1983, of a technical report, issued by Earthscan in London, entitled "Improved Cooking Stoves in Developing Countries." The principal author of this monograph was Gerry Foley who was a visiting lecturer in TAET Sessions 8 and 9. The report's main conclusions were presented as follows:

1. Appropriately designed stove programmes have a valid role to play in development assistance.

2. There is a need for realism in the expectations placed on stove programmes, particularly regarding their potential fuel savings.

3. Stove programmes are unlikely to have a major impact in preventing deforestation or reducing national woodfuel consumption, though they can bring useful benefits at the individual level.

4. Claims of substantial fuel savings should be viewed with caution unless backed up by reliable field tests; energy savings in the laboratory are a very poor guide of what is achievable in practice.

5. Well designed stoves can help people save fuel provided they are used correctly; the fuel savings, however, are impossible to predict in advance and will vary from user to user.

6. Low-cost stoves made of non-durable materials such as mud are unlikely to deliver significant fuel savings in the long run, even if they do initially.

7. Convenience, safety and general appearance will often be as important as stove efficiency to potential users; this should be taken fully into account at the design stage.

8. The opportunities for introducing improved stoves are greatest in places where people pay for woodfuel and traditional stoves are already on sale and widely used. In such cases, it should be possible to introduce and disseminate a well designed fuel saving stove through normal market channels.

9. If people are not accustomed to paying for woodfuel or buying stoves, the problems of designing and disseminating a stove are greatly increased, and may not justify the expenditure of effort and resources required.

10. Subsidies can play a useful role in stimulating stove adoption, but their size should be kept to a minimum and they should be used for as short a time as possible.

Not surprisingly, this critical assessment of the efficacy of the new stove designs was not entirely welcomed by those who have championed the dissemination of the supposedly improved stoves.

In the December, 1984, issue of Cookstove News, a newsletter published by the Aprovecho Institute, Ianto Evans dismissed the Earthscan report as "an attempt to discredit stoves." He went on to say: "One has the suspicion, from the way it is presented, that conclusion 3 was decided early in the research and it offered just too juicy a controversy to be abandoned, even if it was hard to substantiate."

But a long article in VITA News a month later strongly supported the opinion voiced in the Earthscan report that the new stoves would not make a significant difference to the rate of deforestation in the developing countries.

Sam Baldwin, a physicist working with VITA, spent 18 months carefully assessing the performance of stoves in a number of West African countries. The results of this study were summarized as follows.

Francis Mkwawa from Tanzania (Session 7), watches the pot on a modified charcoal stove. But are the new stove designs really an improvement?

First, improved stoves alone will not significantly slow deforestation, but they do show enormous potential to reduce the expense of cooking fuel for the world's urban poor and the burden of collecting fuel for the world's rural poor. Better stoves may also aid in maintaining long term soil productivity by reducing the need to burn crops residues and dung.

Second, massive stoves, particularly the multipot ones promoted by various groups around the world, do not and cannot reduce wood use sufficiently to be of more than marginal interest. In addition, such stoves cannot be readily disseminated.

Finally, alternative stove designs emphasizing light-weight construction and artisanal mass production can achieve the necessary combination of high performance, rapid production, and low cost.

Both the Earthscan report and the VITA News article should be mandatory reading for people actively involved in cookstove programs. Supporters of cookstove development and dissemination programs can point to a number of successful projects. But far too many programs have suffered from poor technology, poor planning, and a conspicuous lack of objective assessment.

A Letter from Professor Farber

Dear Alumni:

Training in Alternative Energy Technology, with the main emphasis on solar energy since it is the largest source of energy income which is available to practically all peoples of the world, has been carried out at the University of Florida in the Solar Energy and Energy Conversion Laboratory for over 30 years.

This training was carried out for people from all parts of the world who came as individuals or in small groups to pursue special education or training in this field. Some just wanted, or needed, special information and training and left after they had achieved their goal; others pursued undergraduate or advanced technical degrees.

Because of the reputation of our laboratory, many requests were received from all over the world for help and training, and personnel from the laboratory traveled widely trying to satisfy as many of the needs as possible. Five years ago, however, because of the great demand, it was decided to set up a special concentrated five year program, with the financial help of the U.S. Agency for International Development, to bring from 40 to 50 people in each group for 15 weeks of training, offering this special program twice each year. This program was intended to provide the needed knowledge for people responsible for or actively involved in the energy programs of their respective countries, so that they could return after a relatively short time and be of great help to their own people. Most of you are familiar with this activity.

This five year commitment, which was carried out and proved very successful, ended in June of 1984, after training almost 300 participants from over 50 countries. This program increased considerably the many persons who have been trained over the years in our laboratory.

The closing ceremonies on the last day of the last session. Mr. Mohamed Hassan Nur bids the TAET staff farewell on behalf of the participants. On the left is Dr. Erich Farber, Principal Investigator for the training program.

With this concentrated effort having come to an end, we shall rely again upon the regular training which is, and always has been, the main core of our training. This flexible program can easily be adjusted to an individual's or group's needs.

This program can be adjusted to an individual who wants to get in-depth training in a particular area (many Fulbright Scholars come under this arrangement), or to small groups who are interested in a particular subject area. The time of these special programs can consist of a relatively short seminar type training, or of programs lasting weeks, months and even years. If the ultimate purpose is also to obtain graduate or advanced degrees, then the University of Florida rules, regulations and requirements must be satisfied. This includes official admission to the University (meeting entrance requirements), qualification (in competition with other students) for financial aid, etc.

As can be seen from the above, Training in Alternative Energy Technology under the Solar Energy & Energy Conversion Laboratory, with its great flexibility, can and has provided most effective programs for individuals or groups from all parts of the world. In this manner it attempts to contribute in its way to making this world of ours a better place to live.

If you desire additional or more specific information about the many courses offered in Alternative Energy Technology, particularly in solar energy, or about the various programs available, or if you need help or advice, please contact me at the address below.

Sincerely,

Dr. Erich A. Farber, P.E.
Distinguished Service Professor
Director, Solar Energy & Energy Conversion Laboratory
University of Florida
Gainesville, Florida 32611

And from Shirley Toth

Dear Participants:

In the last five years approximately 300 people have participated in the Training in Alternative Energy Technologies program and many friends have been made throughout the world. Even though I am not able to correspond with each and everyone of you, I will never forget those of you that I have met, and what you have taught me about your country and culture. Hopefully, someday soon, we will meet again in your own country.

With the closing of the TAET program this will be the last newsletter to be published under this program. However, the closing of TAET does not mean that the Agency for International Development (AID) is no longer willing to support renewable energy programs. In fact, the Office of Energy is developing a new program which will provide training opportunities more closely tied to energy demand and specific renewable resources and associated technologies. We anticipate that this program will provide opportunities for in-country and regional training activities to support renewable energy projects planned, or now underway, in AID countries. If you are involved in such activities we would appreciate your assistance in helping us identify the types of training which would be most useful. When all the details are worked out for this new program AID Missions will be notified. And, when sites are selected we will be looking to our many friends overseas to help us set up seminars and workshops, and to familiarize us with local institutions and customs.

Until then, I wish you all the best and look forward to hearing from you and meeting you again in your country.

Sincerely,

Shirley A. Toth, Project Manager
Office of Energy
US Agency for International Development

Bookshelf

Some new publications recently acquired by the TAET program that may be of interest to our readers include the following. *Brochures of Wind Turbine Manufacturers 1984*, this is a binder containing technical specifications and information on a large number of US and European wind turbine manufacturers. The package is available from the Alternative Energy Institute, West Texas 79016; write to Dr. Vaughn Nelson. There are two new textbooks out on hydropower technology. *Hydropower Engineering*, by Calvin Warnick, includes contributions by Howard Mayo, who was a visiting lecturer for the TAET program. This text is published by Prentice-Hall. The other book is *Small and Mini Hydropower Systems*, edited by Jack Fritz. This book is a compendium of chapters written by a variety of authors, including John Gladwell, John Cassidy and Roger Arndt, all of whom have lectured to TAET participants. The book is subtitled "Resource Assessment and Project Feasibility," and this text spends more time on hydrology, site assessment, economic and financial analysis, and institutional and policy considerations, than the text by Warnick, which focuses more on the engineering of hydropower systems.

Gerry Foley, also a TAET visiting lecturer, has written another technical report for Earthscan. It is *Improved Cooking Stoves in Developing Countries*, coauthored with Patricia Moss, and available from Earthscan in London.

We have also belatedly discovered the excellent series of monographs published by the Steering Committee on Wind Energy for Developing Countries (SWD) in the Netherlands. Sixteen technical publications are available covering all aspects of wind energy science and technology. Anyone interested in the use of wind energy either for irrigation or for electric power generation should find the monographs extremely useful. They are available from SWD, c/o DHV Consulting Engineers, P.O. Box 85, 3800 AB Amersfoort, The Netherlands.

Publisher's Note

TAET Transfer is published biannually by the Training in Alternative Energy Technologies program at the University of Florida. *Transfer* is sent to all TAET alumni, to AID missions, and to those working in the field of alternative energy technology who request the publication. This is the last issue of the newsletter.

The TAET program was a cooperative program of the U.S. Agency for International Development and the University of Florida. The program ended on June 30, 1984.

Postscript: A Note from Dr. Bush

Most of the readers of this newsletter will be aware that the Training in Alternative Energy Technologies program at the University of Florida has now ended. Earlier this year, at my request, many of you wrote to the AID Missions in your countries, and to the Regional Bureaus in Washington, D.C., expressing your strong support for the program, and urging USAID to keep the TAET program going.

Many of you sent copies of your letters to me, and I was very pleased with the number of letters that I received. I was also impressed by the strength of feeling expressed in many of the letters. Thank you all for helping us in our efforts to keep the program in operation.

My job now is to collect all the reports, handouts and lecture notes that we have accumulated over the last five years, and to organize this material into a set of technical training manuals. I am also compiling a bibliography on the alternative energy technologies, and writing a final project report on the program. This work should be completed by the end of the year.

The project report will include the results of the questionnaire which was sent out to all former participants in August this year. Please take a moment to complete this questionnaire and return it to me if you have not already done so.

Plan On It

First International Photovoltaic Science and Engineering Conference
November 13-16, 1984, at the International Conference Centre in Kobe, Japan. Contact Dr. Y. Nagata, Manager Research Department, Sanyo Electric, 1-1813 Hashiridani, Hirakatashi, Osaka, Japan.

European Wind Energy Conference and Exposition
October 22-26, 1984, Hamburg, West Germany, Sponsored by the Commission of the European Communities and the European Wind Energy Association. Contact: H.S. Stephens, European Commercial and Technical Conferences, Agriculture House, 55 Goldington Road, Bedford MK 40 3LS, England.

Intersol 85: Congress of the International Solar Energy Society
June 23-29, 1985, Montreal, Canada. Contact Dr. K.G.T. Hollands, Intersol 85, Suite 410, P.O. Box 1427, Desjardins Postal Station, Montreal, Quebec, Canada H5B 1H3.

International Conference on Solar and Wind Energy Applications
August 1-4, 1985, Beijing, China. For more details contact: Professor Lu Weide, Chinese Solar Energy Society, No. 3 Hua Yuan Road, Beijing, China.

7th Miami International Conference on Alternative Energy Sources
December 9-11, 1985, Miami, Florida. Contact Dr. T.M. Veziroglu, Box 248294, Coral Gables, FL 33124, USA.

Appendix 8

Budget Allocations to the TAET Program 1979 - 1984

Category	Budget Period				
	1980 (1)	1981	1982	1983	1984 (2)
Salaries	196,800	210,576	211,919	199,688	101,573
Support Faculty	-	-	23,255	19,736	12,922
Fringe Benefits	34,668	36,872	45,010	43,681	25,703
Travel	30,000	32,100	27,250	21,800	7,500
Materials & Supplies	)	)	70,451	81,000	52,348
Equipment	) 262,540)	) 211,261)	18,000	2,000	5,000
Indirect Costs	124,992	133,621	113,965	110,371	60,014
Participant Support	351,000	375,570	318,306	237,800	107,940
Total	$1,000,000	$1,000,000	$828,156	$716,076	$373,000

Notes: 1. September 1, 1979 to December 31, 1980
2. January 1, 1984 to June 30, 1984

APPENDIX 9

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Appendix 10 Program Advisory Committee

One of the recommendations of the 1980 Site Assessment report was that the training program curriculum should be subject to peer review "either by a College of Engineering faculty committee or a university-wide interdepartmental or interdisciplinary panel".

This committee was convened in October, 1980, and served until the end of the TAET program in June 1984. The committee consisted of the following faculty members.

Dr. M.J. Ohanian (Chairman)	Associate Dean for Research College of Engineering
Dr. H. Davis Jr.	Director of African Studies
Dr. J.P. O'Connell	Professor of Chemical Engineering
Dr. H.L. Popenoe	Director of International Programs Institute of Food & Agricultural Sciences
Dr. V.P. Roan	Professor of Mechanical Engineering
Dr. W.H. Smith	Director, Center for Biomass Energy Systems, Institute of Food and Agricultural Sciences

Appendix 11 Participant Questionnaire Results

Questionnaire #1

In late 1983 a brief questionnaire was sent out to all TAET program alumni--at that time about 220 former participants. 74 completed questionnaires were returned; the results were as follows.

First, with one exception, all of the respondents indicated that they were still working in the field of renewable energy technology. The lone exception was a participant from Rwanda who had been appointed Secretary General of the National University of Rwanda. The respondents were asked to indicate in which areas of energy technology they worked. The statistics were as follows.

Technology or activity	No. of respondents working in this area (1)	Percentage of group
Solar thermal systems	28	38
Biogas technology	27	36
Photovoltaics	23	31
Energy conservation	19	26
Crop drying	18	24
Wind pumping systems	18	24
Gasification	15	20
Solar cookers	14	19
Improved stoves	12	16
Charcoal production	9	12
Wind electric systems	9	12
Fuel alcohol	8	11
Hydropower	8	11
Energy planning	8	11
Energy assessment	7	9
Refrigeration, air-conditioning	6	8
Direct combustion	3	4
Geothermal	3	4
Stirling engines	1	1
Energy crops	1	1
Social forestry	1	1
Ocean thermal energy conversion	0	0

Notes 1. Nearly all participants work in more than one area, so totals are greater than the number of respondents.

Almost one-third of the respondents were in administrative positions and 23 percent held teaching positions.

The participants were also asked to evaluate the alternative energy technologies in terms of their potential to supply energy to their countries. Seven basic technological fields were assessed. Each technology was given a score between 1 and 5, where a low score indicated a technology with limited potential to supply energy in the participant's country, and a high score indicated a technology with significant potential. The mean scores are given below.

Energy Technology	Mean Score
Biomass energy	3.9
Solar energy	3.5
Wind energy	2.7
Hydropower	4.2
Geothermal	2.3
Ocean thermal energy	1.5
Photovoltaics	2.7

It is interesting to note that while the majority of respondents believed that hydropower was a very important technology, only 11 percent of the group were working in that field. Conversely, almost a third of the group worked with photovoltaics--a technology judged to be of less than average potential.

The participants were also asked about their professional experience since returning to their countries after attending the TAET program, and whether or not their training had helped them in their work. Almost without exception the comments received were very positive. Nearly all respondents felt that the training they had received had given them a much better understanding of the alternative energy technologies. Many participants said that they had been promoted, and now enjoyed greater responsibility and authority.

Questionnaire #2

A final questionnaire was sent out to all 286 program participants in August, 1984. A total of 83 completed forms were returned. The first question put to the group was: "Which elements of the training program did you find most useful?" The results are shown overlealf in order of descending usefulness.

Subject/element	No. of positive responses	Percentage of group
Solar thermal systems	63	76
Solar radiation measurement	56	67
Economic analysis	53	64
Photovoltaics	52	63
Biogas technology	51	61
Project planning	46	55
Gasification	43	52
Solar crop drying	43	52
Energy conservation	40	48
Refrigeration, air-conditioning	38	46
Hydropower	37	45
Wind pumping systems	36	43
Wind resource measurement	34	41
Wind electric systems	27	33
Solar cookers	23	28
Improved stoves	20	24
Stirling engines	20	24
Charcoal production	18	22
Geothermal energy	18	22
Fuel alcohol	16	19
Direct combustion	9	11

In answer to the question: "Have you been responsible for any renewable energy project activities since attending the program?" over 86 percent of the group replied in the affirmative.

The participants were then asked if they had been involved in any training activities providing information to their colleagues on a formal or informal basis. 78 percent of the respondents replied that they had been involved in some kind of training activity.

Finally, the questionnaire posed the question: "If a short training program was to be conducted in your country or region, would you be willing or able to assist in the coordination or presentation of the program?" Very nearly all of the respondents indicated that they would be willing and able to help with the organization of a training program; only 2 respondents indicated that they would not be able to offer assistance.