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Integrated Program Plan for UPR/CEER FY 1980 and FY 1981

Integrated Program Plan for UPR/CEER FY 1980 and FY 1981

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Introduction

The Council of Higher Education authorized the establishment of CEER effective July 1, 1976, after a successful one-year negotiation with ERDA (now DOE). The negotiations with ERDA (now DOE) were summarized in an action memorandum dated April 11, 1976. The establishment of CEER phased out the operation of the P.R. Nuclear Center (PRNC) which had been in operation since 1957. This change was a result of the new needs to focus on the changing world energy situation.

A document was prepared in April 1977 entitled "Integrated Program Plan for UPR/CEER FY 1977-82". It consisted of 50 pages plus five appendices entitled: (I) Biomass Research, (II) Solar Research, (III) Solar Materials Research, (IV) Conservation Research, and (V) Rice conversion Research. This document was to serve as a guide for energy and research programs for the recently established CEER organization.

The programs described in the above document and the funding and budget allocations have undergone changes and revisions. These changes and revisions are the result of the natural development process, research findings, budget restrictions, time schedule restrictions, personnel availability, newly set priorities, etc. This document revises the original Integrated Program Plan, establishing new plans for FY 1980 and FY 1981.

GEER Organization

The original organization chart of CEFR indicated four main divisions: (a) Base Programs, (b) Biomedical Research, (c) Environmental Research, and (d) Energy Research. In addition to the

above divisions, there were five administrative units attached to the Center's Director's Office: (a) Health and Safety, (b) Training and Education, (c) Administration and Services, (d) Technical Services, and (e) Facility Decontamination.

Various organizational changes have occurred during the period, mainly due to program reorientation, budget restrictions, and personnel availability, etc. Figure 1 is the present CEER organization chart. As can be seen in Figure 1, there are five main divisions as follows: (a) Solar, (b) OTEC, (c) Environmental Sciences comprising (d) Marine Ecology, (e) Terrestrial Ecology, and (f) Biomass.

There are five administrative units attached to the Director's Office: (a) Energy Assessment and Analysis, (b) Public Awareness, (c) Library, (d) Administration and Support Services, and (e) Health and Safety.

Budget Restriction

The greatest changes occurring in the original programs are mainly due to budget restrictions. Table 1 "Federal Funding" promised for "CEER/UPR Transition Period" shows the funding assignments contained in the referenced April 11, 1976 ERDA (DOE) Action Memorandum. The dollars indicated in Table 1 are FY 1977 dollars. Table 1 was modified to reflect inflation; the result of this modification is shown in Table 2.

Federal funding that has been actually allocated in Fiscal Years 1976-81 is based on current dollars. If Table 3 is deflated to 1977 dollars, the result will be Table 4, "Federal Funding Allocated Fiscal Years 1976-81 in FY 1977 Current Dollars". The ratio of the dollars "promised" (1977 dollars - Table 3) to actually allocated (1978 dollars - Table 4) is shown in Table 5, "Federal Funding Allocated as a Percent of 'Promise'". The indicated budget changes had considerable effect in the program as can be seen from Table 5, Base support which includes...

Overhead funds such as water and electricity, finance and maintenance overhead, materials science, Health and Safety, Human Ecology, tropical agro sciences, etc, were gradually cut to zero. Similarly, the funds for Training and Education were also cut to zero. Research and Development and Institutional Progress also suffered severe budget reductions as well as the Basic Health and Environmental Research (BER) Program. Not included in the funds illustrated in Tables 1-3 are what is normally called Competitive Funding Awards. These funds are obtained from various private, state, and federal agencies on a competitive basis.

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We are actively engaged in the development of new projects and ideas. Our team is constantly seeking ways to innovate and improve. We are particularly excited about project Aaysseatun 02, which is currently in the development phase. We are also working on a new initiative, SOFaTTT99s, which we believe has great potential.

Our mission is to create innovative solutions for our customers. We are dedicated to continuous improvement and are always looking for ways to better serve our customers. Our team is made up of highly skilled professionals who are passionate about what they do. We are committed to delivering exceptional results and exceeding customer expectations.

We are currently working on a number of exciting projects. Some of these include the development of new products and services, as well as the exploration of new markets. We are also investing heavily in research and development in order to stay ahead of the competition.

We are continuously looking to grow and expand our business. We are always seeking new opportunities and are committed to delivering the best possible results for our clients. We are also committed to the ongoing development and training of our staff, as we believe that our people are our greatest asset.

We are excited to develop specific projects of interest for a particular customer. Competitive awards are normally attracted through initial research work developed in related areas with the funds described in Tables 4:5 and labelled "Research and Development Programs" and "Institutional". GEER expertise in Health and Environment also has attracted funds under a

Competitive Basis Award. Competitive awards funding for specific customer needs are another source of program revision and changes. Major Revisions The major program revisions are as follows: HEALTH AND ENVIRONMENT RESEARCH PROGRAMS (BER) (2) Environment (RT03 in Original 1977 Plan) This program was intended to cover two major areas: Terrestrial and Marine Ecology. The objectives were to provide an ecological data base for assessment of alternative energy technologies as they developed. Each component of this program was to work in different geographical areas, but with the ultimate aim of integrating them into a more cooperative mode in order to assess the energy technologies being developed by BRDA (now DOE) and CHER.

(a) Terrestrial Ecology had as its primary objective, the description and characterization of the

ecology of a drainage basin and its inter-relationships to land use and man's activities. Another objective was to provide a baseline for future ecological studies and assessments related to planned energy production and utilization. In addition and subsequent to the issuance of the original Program Plan, the El Verde Research Park Project and the El Faro Environmental Research Project were added. The three major projects (Drainage Basin, El Verde Park, El Faro Project) were completed and reported by the end of FY 79. Subsequent work in the area would concentrate on the forested portion of the Basin with an emphasis on hydrological and climatological research. New directions, in accordance with the primary thrust of CER alternative energy program, will be explored. Projects are planned or already implemented in waste treatment (composting, water hyacinth tertiary sewage treatment, environmental assessment of coal-fired power plant, etc.) and a number of other related projects.

(b) Marine Ecology The original scope and objectives were to investigate and evaluate the effects of pollutants from an energy-related industrial complex on a marine ecosystem. The entire operation was to

Concentrate on the Tallaboa-Guayanilla Bay system located on the South Coast of Puerto Rico. The emphasis in the study was the determination of the impact imposed upon the ecosystem by various pollutants, using different assessments with varying degrees of water exchange with the adjacent open sea. The research program, as described in the original plan, is in its final stages and will result in a report during the current fiscal year. The new revised research program of the Marine Ecology Division will concentrate on providing "an ecological analysis of spatial and temporal patterns of pelagic ecosystem components which potentially may interact with the operation of an Ocean Thermal Energy Conversion (OTEC) plant near Punta Tuna, P.R." The major goals of the study are to identify water movement patterns in the discharge regions of an OTEC plant; to assess the impact of that discharge on the surrounding marine biota; and to measure biological responses to OTEC operational factors. The data obtained will relate to other CEER OTEC projects concerned with biofouling, corrosion, material studies, and economic variability in terms of OTEC operations. A moored buoy and a converted Landing Craft (UCU), anchored off Punta Tuna, will be used as the base station for these studies.

Wealth Studies (RP-01 in Original 1977 Plan) This program was concerned with the health impact of ecological alternatives due to human activities in the tropics. The intended emphasis was on the study and statistical analysis of diseases caused by energy-related sources of environmental contamination. Collateral studies to be completed and phased out by 1979 were: Health Impact of Hydroelectric Reservoirs; Epidemiological Models; and Fossil Fuel Pollutants. The primary concern of a revised program is to establish the health impact information needed in a regional planning model for locating future power plants. Correlation regression studies are to be performed on cancer and respiratory diseases.

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Reported to the 25 sub-regional hospitals in Puerto Rico. These studies will relate to the location of power plants and major air polluters.

EDUCATION AND TRAINING (706 and £E0305 in 1977)

This was one of the important programs contemplated in the design of the original (1977) plan for

CHER. As indicated in Tables 1-5, this program has been reduced to zero funding. CHER conducted several significant programs in this area, including an international three-week seminar in which scientists from Latin America participated. In addition, several summer energy-environment oriented training courses for local high school teachers and students have been conducted. CHER has also sponsored professional level seminars each year in the areas of energy and environment.

DEVELOPMENTAL RESEARCH PROGRAMS

1) Biomass Program

The objectives of the Biomass Program are: 1) to determine the agricultural and economic feasibility of tropical biomass production as a renewable energy source; 2) to identify superior clones of sugarcane and other tropical grasses, and 3) to expand the Saccharum genetic base for hybridization of superior biomass producing clones. The Biomass Program has not been altered from the original plans and is presently a continuation of that planned in the original program document. We will continue along the same lines for the remainder of the contract period.

2) Solar Program Plan and Solar Materials Program Plan

The original 1977 document contained two separate programs, one entitled Solar Program Plan and the other Solar Materials. The Solar Program Plan included two projects, OTEC and a Feasibility Design Study Project for a 100 kwe Level Pilot Plant Fueled by Hydrogen Produced by Direct Solar Radiation. The Solar Materials Program included four projects: a) Photo induced electron transfer processes for hydrogen production, b) Study of selective surfaces, c) Ferroelectric material development and d) Photovoltaic CS, cells research.

The OTEC program has grown into a major research.

Operation. The 100 KWe Pilot Plant Hydrogen Project was never funded by the DOE. The Solar Material Program terminated the photo-induced electron transfer hydrogen project and the selective surface studies. The program has been reoriented into two separate programs as follows:

(a) Solar Technology

1. Direct thermal applications such as hot water, process heat, space cooling
2. Photovoltaic systems: Expansion of commercial uses of photovoltaics
3. Solar data network: Obtaining accurate consistent island solar data
4. Solar materials: Test weatherability of solar materials and support the development of new materials for solar applications

5. International Programs on Solar Technology Transfer: To help increase the widespread use of solar energy in developing countries.

(b) Ocean Thermal Energy Conversion (OTEC): The program plan for 1980 calls for the implementation of three research projects: Biofouling, corrosion and heat transfer; physical oceanography at Punta Tuna; and advanced OTEC foam concept studies. During FY 81, the plans

are to continue these studies and possibly implement additional ones presently in the proposal stage. It is believed that successful development of these projects, which are funded on the basis of competitive awards, can contribute substantially to the development of an OTEC functional 100 megawatt plant in Puerto Rico and to the development of worldwide application of OTEC technology.

(c) Energy Conservation Program Plan: This program originally contained two projects: a) Energy Conservation in the Residential Sector by Shading and Insulating a Typical Puerto Rican House, and b) Low Temperature Power Cycles. The latter project included the utilization of waste heat from stack gases in electric power plants. The first project was completed and reported in FY 79. The second project was slightly modified and retitled "Assessment of the Potential of Energy Cogeneration on the P.R. System". It was funded and reported in FY 79.

16 This program was expanded to include the

Preparation of a comprehensive Energy Conservation Plan for the UPR system. This program has been terminated and approved by the UPR President. Other new energy conservation programs are included within Transportation and include Transportation Policy Studies and the Assessment of Hybrid Vehicles Utilization.

(4) Bioconversion: The original plan contained two bioconversion projects, one on carbohydrates from cellulose and another on rum wastes. The program has been expanded to include the following objectives:

- 1) Micrologically produce useful forms of energy from renewable biomass resources, primarily agro-industrial wastes, municipal wastes, and animal wastes;
- 2) Enhance the environment by converting biological wastes into valuable non-polluting products and energy;
- 3) Transfer the new technology from the research laboratory to potential users (local, national, and third world) as rapidly as possible;
- 4) Begin exploratory research in more advanced bioconversion methodologies.

Among these latter projects are methane production from landfills, marine biomass (Sargassum) production and utilization, hydrogen production via photolysis, and establishment of a CEER biomass research field station near San Juan for field testing and demonstration of bioconversion technologies.

Decontamination of Reactor Facility (R04): This project included the decontamination of the CHER nuclear reactor facility. Reactor operations were re-activated on October 1, 1976. The project plan has been carried out as originally described. The engineering assessment of the Decontamination Project was contracted with Yen Nuclear. The assessment work was completed. The next step will consist of selecting a Decontamination Contractor.

OBER Accomplishments: The major accomplishments of CEER during the last three years of operation have been the establishment of a base for research and development programs for alternative energy sources and the solution of environmental problems associated with these.

Baseline information has been.

Data has been collected, analyzed, and reported for important programs such as the siting of an Ocean Thermal Energy Conversion (OTEC) Plant in Southern Puerto Rico. CER's interest in an OTEC program in Puerto Rico is due to the fact that Puerto Rico has one of the best world sites, if not the best, for the location of an OTEC facility. OTEC plant baseline information developed includes biofouling corrosion, material studies, measurements of oceanographic environmental studies parameters, seawater surfactant systems, and variability relationships to an open cycle FOAM OTEC System and OTEC Parameter Ocean Spatial Variability.

Due to Puerto Rico's geographical location in a high insolation region with sufficient rainfall, good agricultural land, and the availability of facilities and agricultural research scientists, a base for energy research programs has been under development at CEER and the Agriculture Experiment Station of UPR.

Baseline information in relation to Biomass includes the development of agricultural technologies and optimization for harvesting large volumes of biomass and their economic and agricultural feasibility. Bioconversion projects producing methane from wastes have been developed. Wastes biologically digested together with biomass in an optimized mix can represent an attractive project from the point of view of integrated energy and environmental research in Puerto Rico as well as other areas, including the USA mainland.

A demonstration project (waste digestion only) for the US Army at Fort Buchanan has been developed by CEER and is in operation. Important information has been gathered for the design of larger systems. Various methane generators, including newly designed systems to digest rum distilling, have produced important baseline information.

A solar research program cannot be logically developed unless baseline solar radiation data is developed for the area under consideration. Solar radiation data has been under continuous monitoring by a series of CER measurements.

Stations are located in Aguadilla, Cabo Rojo, Lajas, Rio Piedras, Ponce, and Cataño. This global and diffuse data is collected hourly, stored in a computer, and has been mathematically modeled for practical use in research and design applications. Reports containing this important and vital information have been issued. Additional measuring stations are planned to generate more detailed information. A 4m evacuated tube CRC concentrator for producing steam for industrial requirements has been developed by CEER. This will form the basis of future industrial solar steam programs. Additionally, CEER has participated in the design phase of solar demonstration projects, including photovoltaics and solar thermal.

The design, testing, and evaluation of a solid desiccant air conditioning machine using silica gel has provided basic information for further study and consideration of this important system in the tropics. Air conditioning is a significant electrical load in Puerto Rico, especially in the commercial sector. In the ecology area, salient accomplishments include the establishment of baseline information for future ecological studies and assessments related to planned energy production and utilization. This has been accomplished through the El Verde Project and the Tallaboa-Guayanilla Bay ecosystem study, research of several years duration that carries over from PANC programs.

Additionally, the ecology section currently plays a large role in the ecosystem study for the OTSC site and in new siting considerations for a coal-fired plant.

Health programs form an important part of CEER's efforts. The main focus in the past has been on controlling water quality and tropical disease transmission through aquatic systems, such as schistosomiasis. As a result of CEER's efforts, schistosomiasis in Puerto Rico has been nearly eradicated. Ongoing programs are establishing baseline information required for the correlation of respiratory diseases, cancer and air quality, as well as the correlation between.

Gastrointestinal disorders and water quality are common in Puerto Rico. Materials have progressively been developed to provide basic information related to improvements and optimization of fuel cell electrodes. This includes the determination of properties of several solar selective surfaces and material degradation on solar collectors and water heaters in the tropics. A foundational base already exists in the area of materials research in terms of availability of scientists and laboratories.

In terms of integrated technological assessment, an energy analysis of various alternative energy sources has been conducted. This provides basic economic information and competitiveness periods for the timely selection and development of alternative energy sources. The studies indicate that nuclear energy, on a cost basis only, is the lowest cost energy for the rest of the century and beyond. Bioenergy and UTEC are strong contenders with costs lower than coal-fired power plants. The economics of photovoltaics look highly promising. The engineering economic analysis of alternatives is a very important aspect in an energy-environment program, and CEER is not overlooking this aspect.

Public awareness, training, and educational programs have received very little funding. However, CEER has conducted several significant programs in this area, including an international three-week energy seminar in which scientists from Latin America participated. In addition, several summer energy-environment oriented training courses for local high school teachers and students have been conducted. Basic information has been accumulated for future programs. CEER also sponsors and participates in many professional level seminars each year in the areas of energy and environment.

In the transportation and conservation sector, significant economic and policy studies have been and are presently being conducted. Base data has been established for important future policy and decision-making considerations. Over twenty-five (25)% of Puerto Rico's net petroleum imports are used in the transportation sector.

Present studies continue to evolve.

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Experimentation is focused on the feasibility of utilizing electric or hybrid electric vehicles. Both of these vehicles show promise for substantial reduction in gasoline usage due to the predominant high-density traffic in metropolitan areas. To keep abreast of the latest developments in energy and environmental research, CEER has sent their scientists to visit various research laboratories for

discussion of special projects and current research in the areas of prime interest to CEER. Some of these laboratories visited have been: ORL, JPL, SERL, WS, SRL, BNL, Sandia, and LBL. In addition, visits to major university research laboratories have also been carried out, among some of which are: MIT, U of Colo., Cole State U., U. of Fla., Cal Tech, UCLA, U. of Cal-Berkeley, U. of Mich. and U. of Miami.

Additional programs and accomplishments at CEER during the last four years include the success of the magnetic separation program (removal of pollutants from aqueous waste discharges); tertiary treatment of wastewater with water hyacinths; use of sludge and hyacinth compost to produce methane; joint efforts with the Venezuelan Government in the research required to establish the practicability of using microbial oil stimulation methods in marginal wells producing extra heavy crudes and biodegradation of heavy crudes by means of selected microorganisms. Extremely careful planning was necessary in making all the above CEER accomplishments through very limited funding, an average total on the order of \$3 million per year for all programs.

2 PROGRAMS AND BUDGET

(a) Developmental and Institutional Programs

A tabulation of all the Institutional and Development Programs since 1977 is illustrated in Appendix A. Table 6, "Appendix A Summary," describes by classification the Institutional and Development Funding and projected budgets for FY 80 and FY 81. The FY 81 budget requirements for Institutional & Developmental Programs are \$1,328,150. This figure supersedes the corresponding FY

61 projections were made in April 1979 in Budget Form \$120.2. However, planning estimates of \$850,000 for the fiscal year 1981 were made by the Department of Energy (DOE) for Institutional and Developmental matters through a letter dated August 1, 1979, signed by Mr. Richard Stephens. This imposes considerable restrictions on the goals and mission accomplishments of the CEER program.

(b) Competitive Research Programs

A tabulation of all the Competitive Research Programs since 1977 is illustrated in Appendix B. Table 7, "Summary of Appendix", describes by classification the competitive research awards and projected funding for FY 80 and FY 81. The FY 81 budget is \$1,144,000. This figure includes already contracted work plus reasonably expected contract extensions of various other projects. No new projects have been included.

(c) Environmental Research

Environmental research programs and budget for 1981 are projected in Budget Form 5120.2 for FY 1981, submitted to the DOE in April 1979.

23 The total is \$1,117,000. A recent revision of these programs (to be submitted in the CEER Proposed Five Year Plan 1982-86) illustrates funding requirements of approximately 2.5 times of

the indicated projections made in the April 1979 Budget Form 5120.2. Recent indications by ORD is that the budget submission to the Presidency (U.S.) by the DOE Honorable Secretary allocates only \$939,000 for CEER Environmental Research Programs. However, in light of program reorientation now underway, a more reasonable budget for purposes of this plan will project more than \$1.3 million for these programs in fiscal year 1981. The component breakdown of the Environmental Research Program is illustrated in Table 8 "Revised Total Budget".

(2) Others and Total Budget

The total budget, including Reactor Decontamination, BONUS Surveillance, and Competitive Programs, is illustrated in Table 8. The DOE Support budget for FY 1980 is \$1,735,000 and for FY 1981 is \$1,785,000. These are the budgets quoted in Table 3.

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