CEER – A 63

INTEGRATED PROGRAM PLAN FOR UPR/CEER
FY 1980 AND FY 1981

CENTER FOR ENERGY AND ENVIRONMENT RESEARCH
UNIVERSITY OF PUERTO RICO — U.S. DEPARTMENT OF ENERGY

INTEGRATED PROGRAM PLAN FOR UPR/CEER
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INTEGRATED PROGRAM PLAN FOR UPR/CEER FY 1980 AND FY 1981

Introduction

The Council of Higher Education authorized the establishment of CEER effective July 1, 1976 after a one year succesful 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 a 50 pages plus five appendixes entitled: (I) Biomass Research, (II) Solar Research, (III) Solar Materials Research, (IV) Conservation Research, and (V) Bioconversion 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 of 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 the FY 1980 and FY 1981.

CEER Organization

The original organization chart of CEER 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, 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; . Environmental Sciences Comprising c) Marine Ecology, d) Terrestrial Ecology; and e) 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 Restrictions

The greatest changes ocurring 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 I are FY

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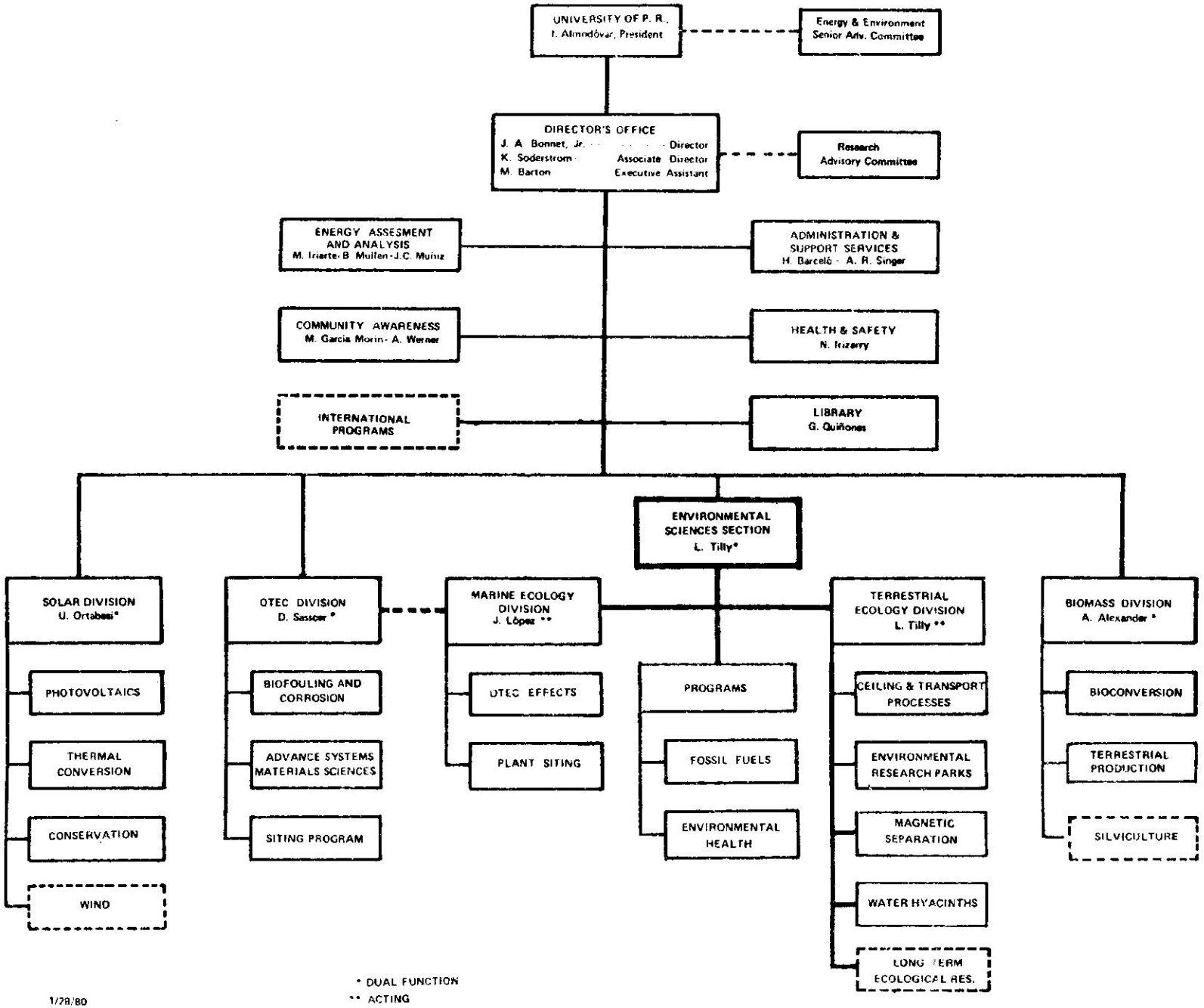

* DUAL FUNCTION
** ACTING

1/29/80

1977 dollars. Table 1 was modified to reflect inflation; the result of this modification is shown in Table 2. Table 3 reflects the Federal Funding that has been actually allocated in Fiscal Years 1976-81 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 program revisions 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 Programs also suffered severe budget reductions as well as the Basic Health and Environmental Research (BER) Program.

Not included in the funds illustrated in Tables 1-5 are what is normally called Competitive Funding Awards. These funds are obtained from various private, state and federal agencies on a competitive basis

TABLE 1

Federal Funding "promised" for CEER-UPR Transition Period

(thousands of dollars) [1/]

FUNDING SOURCE	FY-1976	FY-1977	FY-1978	FY-1979	FY-1980[2/]	FY-1981
Base Support	$ 862	$ 775	$ 500	$ 250	$ 0	$ 0
Training and Education	368	100	150	200	250	250
Research and Development Programs	0	50	250	600	650	500
Health & Environmental Research	1,082	845	900	950	950	1,000
Institutional	0	100	300	300	300	300
	$ 2,312	$ 1,870	$ 2,100	$ 2,300	$ 2,150	$ 2,050

[1/] Based on FY 1977 dollars

[2/] FY-1980 CEER Federal facilities to be transferred to University of Puerto Rico

TABLE 2

FEDERAL FUNDING "PROMISED" FOR CEER-UPR TRANSITION PERIOD
(Considering Inflation)

(thousands of dollars)[1]

Funding Source	FY-1976	FY-1977	FY-1978	FY-1979	FY-1980	FY-1981
Base Support	$862	$775	$532.3	$286,4	$ 0	$ 0
Training and Education	368	100	159.7	229.1	326.9	353.0
Research and Development Programs	0	50	266.1	687.4	849.9	706.0
Health and Environmental Research	1,082	845	958.1	1088.4	1242.1	1412.1
Institutional	0	100	319.4	343.7	392.2	423.6
TOTALS	2,300	$1,870	2,235.5	2,635.1	2811.1	2894.7

1) Based on then-current dollars (U. S. Consumer Price Index, Bureau of Labor Statistics used to calculate inflation rate, 8% inflation rate assumed for FY-1981).

TABLE 3

CEER-UPR TRANSITION PERIOD

Federal Funding Allocated Fiscal Years 1976-1981

(thousands of dollars) (1)

FUNDING SOURCE	FY-1976	FY-1977	FY-1978	FY-1979	FY-1980(2)	FY-1981(3)
Base Support	$1,230	$ 775	$ 540	$ 160	0	0
Training and Education	0	100	162	189	0	0
Research and Development Programs	0	50	243	375	450	500
Health & Environmental Research	1,082	705	788	839	935	935
Exploratory Research	0	100	330	350	350	350
TOTAL	$2,312	$1,730	$2,063	$1,913	$1,735	$1,785

(1) Based on current dollars

(2) FY-1980 CEER Federal facilities to be transferred to University of Puerto Rico

(3) Planning Estimates provided by DOE

TABLE 4

CEER-UPR TRANSITION PERIOD

FEDERAL FUNDING ALLOCATED FISCAL YEARS 1976-1981

(thousands of dollars)(1)

FUNDING SOURCE	FY-1976	FY-1977	FY-1978	FY-1979	FY-1980(2)	FY-1981(3)
Base Support	$1,230	$ 774	$ 507.0	$ 139.7	$ 0	$ 0
Training and Education	0	100	152.1	165.1	0	0
Research and Development Programs	0	50	228.1	327.5	344.2	354.1
Health & Environmental Research	1,082	705	739.9	732.8	715.4	662.2
Institutional	0	100	309.9	305.5	267.7	247.9
TOTAL	$2,312	$1,730	$1,937.1	$1,670.6	$1,327.3	$1,264.2

(1) Based on FY-1977 dollars, Consumer price index used as price deflator, 8% inflation estimated for FY-1981.

(2) FY-1980 CEER Federal facilities to be transferred to University of Puerto Rico.

(3) Planning estimates provided by DOE

TABLE 5

CEER-UPR TRANSITION PERIOD

Federal Funding allocated as per cent of "Promise"[1]

FUNDING SOURCE	FY-1976	FY-1977	FY-1978	FY-1979	FY-1980[2]	FY-1981[3]
Base Support	142.7%	100.0%	101.4%	55.9%	-------	-------
Training and Education	0.0%	100.0%	101.4%	82.6%	0.0%	0.0%
Research and Development Program	------	100.0%	91.2%	54.6%	53.0%	70.8%
Health & Environmental Research	100.0%	83.4%	82.2%	77.1%	75.3%	66.2%
Institutional	------	100.0%	103.3%	101.8%	89.2%	82.6%
TOTAL	100.0%	92.5%	92.2%	72.6%	61.7%	61.7%

1) Based on FY-1977 dollars

2) FY-1980 CEER Federal facilities to be transferred to University of Puerto Rico

3) Planning estimates provided by DOE

to develop specific projects of interest for a particular customer. Competetive awards are normally attracted through initial research work developed in related areas with the funds described in Tables 1-5 and labelled "Research and Development Programs" and "Institutional". CEER expertise in Health and Environment also has attracted funds under a competetive basis award. Competetive 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)

(1) Environment (RTO3 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 ERDA (now DOE) and CEER.

(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 emphasis on hydrological and climatological research. New directions, in accordance with the primary thrust of CEER's alternative energy program will be explored. Projects are planned or already implemented in waste treatment (composting; water hyacinth as tertiary sewage treatment; environmental assessment of coal fired power plants; 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 around the Tallaboa-Guayanilla Bay system located on the South Coast of Puerto Rico. The emphasis in the study was the determination of the "stress" imposed upon the ecosystem by the various pollutants, using different embayments with varying degrees of water exchange with the adjacent open sea.

The research program as described in the original plan is in its final states 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 spacial 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, and material studies, and oceanic variability in terms of OTEC operations. A moored buoy and a convert Landing Craft (LCU), anchored off Punta Tuna will be used as the base station for these studies.

(2) Health Studies (RT-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 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

(RT06 and EE0305 in 1977 Plan)

This was one of the important programs contemplated in the design of the original (1977) plan for CEER. As indicated in Tables 1-5 this program has been reduced to zero funding.

CEER 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. CEER 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. It 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 CdS_x cells research.

The OTEC program has grown into a major research operation. The 100 kwe Pilot Plant Hydrogen Project was never funded by DOE. The Solar Material Program terminated the photoinduced 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. 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 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.

(3). Energy Conservation Program Plan

This program originally contained two projects: a) Energy Conservation in the Residential Sectors By Shading and Insulating of 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.

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) Biologically produce useful forms of energy from renewable biomass resources, primarily agro-industrial wastes, municipal wastes, and animal wastes; 2) enhance the environment by conversion of biological wastes into valuable non-polluting products and energy; 3) transfer the new technology from the research laboratory to the 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.

(5) Decontamination of Reactor Facility (RUO4)

This project included the decontamination of the CEER nuclear reactor facility. Reactor operations were terminated on October 1, 1976. The project plan has been carried out as originally described. The engineering assessment of the Decontamination Project was contracted with Chem Nuclear. The assessment work was completed. The next step will consist in selecting a Decontamination Contractor.

CEER ACCOMPLISHMENTS

The major accomplishments of CEER during the last three years of operation has been the establishment of a base for research and development programs for alternative energy sources and the solution of environmental problems associated with them. Baseline information has been collected, analyzed and reported for such important programs as the siting of an Ocean Thermal Energy Conversion (OTEC) Plant in Southern Puerto Rico. CEER 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 and material studies, measurements of oceanographic environmental studies parameters, sewater 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, biomass 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 environment 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 has produced important baseline information.

A solar research program can not be logically developed unless a baseline solar radiation data is developed for the area under consideration. Solar radiation data has been under continuous monitoring by a series of CEER measuring stations located in Mayaguez, Cabo Rojo, Lajas, Rio Piedras, Ponce and Cataño. These data, both global and diffuse, are taken on an hour by hour basis, stored in a computer, and have been mathematically modeled for practical use for research and design applications. Reports have been issued containing this important and vital information. Additional measuring stations are planned to generate more detailed information. An evacuated tube CPC concentrator for producing steam for industrial requirements has been developed by CEER which will form the base of future industrial solar steam programs. In addition, CEER has participated in the design phase of solar demonstration projects (photovoltaics and solar-thermal.)

The design, testing, and evaluation of a solid dessicant air conditioning machine using silica gel has provided basic information for the 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 are the establishment of baseline information for future ecological studies and assessment related to planned energy production and utilization. This has been accomplished through El Verde Project and the Tallaboa-Guayanilla Bay ecosystem studies, research of several years duration that carries over from PRNC programs. In addition, the ecology section presently has a large role in the ecosystem study for the OTEC site and in new siting considerations for a coal fired plant.

Health programs form an important part of CEER programs. The main efforts in the past has been in controlling water quality and tropical disease transmission through aquatic systems (schistosomiasis). As a result of CEER's efforts, schistosomiasis in P. R. has been nearly erradicated. Ongoing programs are establishing baseline information required in connection with 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 programs have developed basic information related to improvements and optimization of fuel cell electrodes, determination of properties of several solar selective surfaces and material degradation on solar collectors and water heaters in the tropics. A base already exists in the

area of materials research in terms of availability of scientists and laboratories.

On integrated technological assessment, energy analysis of various alternative energy sources has been made, providing basic economic information and period of competitiveness 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. Biomass and OTEC are strong contenders with costs lower than coal fired power plants. Photovoltaic, economics 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 or Training and Education Programs have received very little funding. However, CEER has conducted several significant programs in this area including an International three weeks 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. Base 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 P.R. net petroleum imports are spent in the transportation sector.

Present studies and experimentation is focused toward the feasibility of utilizing electric or hybrid electric vehicles. Both of these vehicles show promises for substantial reduction in gasoline usage due to the predominant high density traffic in the metropolitan areas.

To keep abreast of the latest developments in energy and environment 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: ORNL, JPL, SERI, ANL, KMS, 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., Colo State U., U. of Fla., Cal Tech, UCLA, U. of Cal-Berkeley and 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 waste water 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 a microbial oil stimulation method in marginal wells producing extra heavy crudes and biodegration of heavy crudes by means of selected microorganisms.

Extremely careful planning was necessary in making periodic all the above CEER accomplishments through very limited funding, an average total on the order of $3 million per year for all programs.

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 figures supersedes the corresponding FY 81 projections made in April 1979 in Budget Form 5120.2. However, planning estimates of $850,000 for fiscal year 1981 were made by DOE for Institutional and Developmental through letter dated August 1, 1979 and signed by Mr. Richard Stephens. This imposes considerable restriction to CEER program goals and mission accomplisments.

(b) Competetive Research Programs

A tabulation of all the Competetive Research Programs since 1977 is illustrated in Appendix B. Table 7 "Summary of Appendix B" describes by classification the competetive 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 extension of various other projects. No new projects have been included.

(c) Environmental Research

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

The total is $1,117,000. 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 ORO is that the budget submission to the Presidency (U.S.) by the DOE Honorable Secretary allocates only $935,000 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".

(d) 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.

TABLE 6

CEER INSTITUTIONAL AND DEVELOPMENTAL PROGRAMS
FY'77 THROUGH FY'81

Subject Program	Funding					
	FY'77	FY'78	FY'79	FY'80	FY'81	Totals
BIOMASS	$ 12,329	$ 24,472	$ 90,545	$ 40,050	$ 80,000	$247,000
OTEC	----	99,608	89,999	34,500	75,000	299,107
SOLAR	72,379	239,308	187,680	182,850	275,000	957,217
ENERGY CONSERVATION	9,150	57,592	50,135	46,100	125,000	287,977
BIOCONVERSION	----	----	72,795	135,400	185,000	393,195
ENVIRONMENTAL HEALTH	----	21,705	82,240	108,560	161,000	373,505
FOSSIL FUELS RESEARCH	6,932	18,696	25,300	---	---	50,928
ENERGY ANALYSIS	----	22,400	17,250	34,500	50,000	124,150
OTHERS	49,136	89,704	109,056	197,800	377,150	822,846
Reserved-changes and Adjustments	----	----	----	20,240	---	20,240
SUB TOTAL	$149,926	$573,485	$725,000	$800,000	$1,328,150	$3,576,561
Less adjustment to reflect DOE planning estimates as per Mr. R. E. Stephens letter of Aug. 21, 1979	----	----	----	----	478,150	478,150
TOTALS	$149,926	$573,485	$725,000	$800,000	$ 800,000	$3,098,411

TABLE 7

SUMMALRY OF APPENDIX B
COMPETITIVE AWARDS
Thousands of Dollars

	Fiscal Year					
	1977	1978	1979	1980	1981	Totals
FOSSIL FUELS	56.4	108.5	116.3	50.0	---	331.2
ENVIRONEMNT AND HEALTH	266.3	452.8	243.1	736.3	463.0	2161.5
BIOMASS	213.0	249.0	307.0	348.0	350.0	1467.0
OTEC	---	2.9	449.9	683.9	---	1136.7
SOLAR	---	39.6	145.2	32.5	---	237.3
CONSERVATION	---	---	3.0	10.0	10.0	23.0
BIOCONVERSION	---	---	---	59.7	---	59.7
OTHERS	51.4	---	110.4	154.6	32.5	348.9
(DOE SPONSORED)	501.9	689.4	766.7	632.3	532.5	2844.8
(OTHER SPONSORS)	85.2	163.4	608.2	1462.7	503.5	2920.5
TOTALS	587.1	852.8	1374.9	2095.0	855.5	5765.3

TABLE 8

REVISED TOTAL BUDGET
(Thousands of Dollars)

	FY 77	FY 78	FY 79	FY 80	FY 81[6]
Base Support Programs[1]	775.0	540.0	160.7	--	--
Training and Education[92)]	100.00	162.3	189.3	--	--
Developmental and Institutional (See Appendix A)	150.0	573.5	725.0	800.0	850.0[3]
Environmental Research					
Marine Pollution Studies	391.3	435.2	489.2	565.0	565.0
Sultana Boat Support and Maintenance	38.6	43.0	42.9	45.0	45.0
Terrestrial Ecology	250.1	275.0	278.0	275.0	275.0
Environemntal Research Park	24.9	35.3	28.4	50.0	50.0
Subtotal Environment	704.9	788.5	838.5	935.0	935.0[4]
TOTAL DOE SUPPORT	1729.9	2064.3	1913.5	1735.0	1785.0
Reactor Decontamination (RU)	50.0	150.0	206.6	260.0[5]	
Bonus Nuclear Plant Surveillance (RU)	--	5.0	5.0	5.0	5.0
Competitive Programs					
DOE-Sponsored	501.9	689.4	766.7	632.3	352.5
Other Sponsors	85.2	163.4	608.2	1462.7	503.0
Total Competitive	587.1	852.8	1374.9	2095.0	855.0
TOTAL BUDGET	2367.0	3072.1	3500.0	4095.0	2645.5

(1) Base Support Programs, eliminated as of FY 79 included materials science, Health and Safey, Radiation Oncology, Nuclear Medicine, Tropical Agro Sciences, Human Ecology, Nuclear Engineering Curricula, and various general marine and ecology programs. A percentage of these programs funds was assigned to general overhead.

(2) Training and Educational funds included Energy Curriculum Development, Solar Energy Workshops, Energy Fundamentals and Perspectives, Technology Transfer, Solid Waste Management, Consumer Guides, etc.

(3) Institutional and Development Program Projections for FY 1981 is $1300 m as per Appendix A. This projection made in January 1980 supersedes the April 1979 Budget projections (Budget Form 5120.2) The total budget is adjusted to $850 m to reflect DOE intended allocation as per Mr. Richard E. Stephens letter dated August 21, 1979.

(4) The CEER (April 1979) projections is $1,117.000. The figure shown is promised ORO funding.

(5) The reactor decontamination budget assigned by ORO in letter of November 1979, signed by Dr. Hard is $260,000 for FY 1980. CEER Budget form 5120.2 submitted in April 1979 requested $517,000.

(6) Planning estimates provided by DOE.

APPENDIX A

APPENDIX A

TABLE 6 - CEER INSTITUTIONAL AND DEVELOPMENTAL PROGRAMS
FY '77 THROUGH FY '81

Proj. No.	Project Title	Location	Proj. Leader	Funding FY 77	FY 78	FY 79	FY 80	FY 81
BIOMASS								
07	A Study of the Nutritional Qualities of Various Cellulolytic Microorganisms	Cath. Univ.	Dr. L.A. Roig	----	----	13,800(I)	----	----
20	a) Economic and Technical Feasibility Study of a Bagasse Energy Pilot Plant, and b) Development of Methodology for Optimizing the Economics of Multi-Output Processes	Guaynabo, P. R.	Dr. L. Smith	----	----	5,750(D)	5,750	----
45	Marine Biomass Assesment Potentials	CEER	Dr. E. Werner	----	24,472(I)	----	----	----
48	Expansion of the Saccharum Base	UPR-AES	Dr. A. Alexander	12,329(I)	----	----	----	----
74A	Expansion of the Saccharum Genetic Base	UPR-AES	Dr. A. Alexander	----	----	12,650(D)	----	----
59A	Conversion of Tropical Biomass to Liquid & Gaseous Fuels by Short-Residence Pyrolisis	CEER UPR-MAZ	Dr. R. Cabán	----	----	58,345(I)	----	----

TABLE 6 - CONTINUED

Proj. No.	Project Title	Location	Proj. Leader	Funding FY 77	FY 78	FY 79	FY 80	FY 81
44	Evaluation of Woody Biomass Species as a Renewable Energy Source (Eucalyptus, Pines,etc.)	CEER R. P.	Dr.J. Whitmore Fed. Exp. Sta.	----	----	----	3,450	5,000
	Biomass Developmental Programs and Biomass Divisional Reorganizations	CEER	Dr. A.Alexander	----	----	----	10,000	30,000
	Biomass, compaifera species evaluation as a renewable energy source	CEER	Dr. A.Alexander	----	----	----	1,300	20,000
	TOTAL BIOMASS			$12,329	$24,472	$90,545	$40 ,050	$80,000
OTEC								
29	Heat Transfer Study as a Function of Biofouling (OTEC)	CEER	Dr. D.S. Sasscer		81,729	89,999(I)	34,500	75,000
36	OTEC Foam System Studies (see Proj. 93)	CEER	Dr. M. I. Kay	----	7,351(D)	----	----	----
37	OTEC Impact in P.R.	CEER	Dr. D.S. Sasscer	----	10,528(I)	----	----	----
	TOTAL OTEC			-----	99,608	$89 ,999	$34,500	$75,000
SOLAR								
14	Photo-Induced Electron Transfer States-A Hydrogen Source	UPR-RP	Dr. M. Gómez	14,418(D)	----	----	----	----

TABLE 6 - CONTINUED

Proj. No.	Project Title	Location	Proj. Leader	Funding FY 77	FY 78	FY 79	FY 80	FY 81
19	Study of the Weatherability and Wear of Solar Applications Materials	CEER	Dr. C. Cordero	----	----	9,775(I)	4,600	10,000
41	Studies of the Surface of Electrodes of Fuel Cells	UPR-RP	Dr. Blum & Dr. Vassos	12,099(I)	----	----	----	----
49	Study of the Optical and Aging Charact. of Various Selective Surfaces	UPR-RP	Dr. S.V. Weisz	20,116(I)	----	33,005(I)	----	----
55	Measurement of the Solar Insol. in P.R. (see Proj. 61)	UPR-RP	Dr. Vassos	7,295(I)	----	----	----	----
57	Direct & Diffuse Insolation; & Solar Research Project (see Proj. 61)	CEER UPR-MAZ	Dr.K.Soderstrom	18,451(I)	49,354(I)	22,540(D)	----	----
61	Solar Technology	CEER	Dr. U.Ortabasi	----	80,417(I)	69,460(D)	40,250	75,000
65	Thermal Conv. of Solar Energy	UPR-RP	Dr. S.V. Weisz	----	28,126(D)	----	----	----
67	Studies on the Surfaces of Electroces Used in Fuel Cells	UPR-RP	Dr. Blum & Dr. Vassos	----	27,983(I)	29,900(I)	----	----
72	Solar Air-Conditioning Machine	CEER UPR-MAZ	Dr. F. Pla	----	19,889(I)	23,000(D)	34,500	40,000
74	Thermal Energy Storage	CEER UPR-MAZ	Dr. R. Singh	----	17,322(I)	----	----	----

TABLE 6 - CONTINUED

Proj. No.	Project Title	Location	Proj. Leader	Funding FY 77	FY 78	FY 79	FY 80	FY 81
75,68	Ferroelectric Converters	CEER	Dr. M. Kay(75) Dr. F.A. Díaz(68)	----	16,217(I)	----	17,250	20,000
11	Solar Thermal Test Facility for Low-Medium Steam Temp. Range (140°F-550°F)	CEER MAZ	Dr. A. López	----	----	----	69,000	100,000
55A	Photocoustic Spectroscopy of Charge Carrier-Defects Interactions in cds/cus Heterojuntion Solar Cells	UPR RP	Dr. J.J.Santiago	----	----	----	17,250	30,000
	TOTAL SOLAR			$72,379	$239,308	$187,680	$182,850	$275,000
ENERGY CONSERVATION								
04	Ethanol & Ethanol Evaluation as a Motor Fuel	UPR-AES	Dr. H. Batiz	----	----	11,040(I)	----	----
43	Assessment of the Potential of Energy Cogeneration on the P.R. Energy System	Santurce P.R.	Mr. M.Robinson	----	----	28,750(I)	----	----
59 (17A)	Energy Conserv. in Transportation	UPR-RP	Dr. J. Mayda	9,150(I)	5,600(I)	----	16,100	25,000
77	Hybrid Vehicle Test and Evaluation Project	CEER MAZ	Mr. R. Brown	----	----	----	30,000	100,000

TABLE 6 - CONTINUED

Proj. No.	Project Title	Location	Proj. Leader	Funding FY 77	FY 78	FY 79	FY 80	FY 81
66	Energy Conservation in the Res. Sector by Shading & Insul of a Typical P.R. House	UPR-MAZ	Dr. H. Plaza	----	51,992(D)	10,345(D)	----	----
	TOTAL ENERGY CONSERVATION			$9,150	$57,592	$ 50,135	$46,100	$125,000
BIOCONVERSION								
18	Water Hyacinth for the Clarification of Wastewaters	CEER	Mr. J.Villamil	----	----	26,795(I)	23,000	30,000
51	Methane Expt. Station Palo Seco	CEER	Dr. E. Werner	----	----	23,000(D)	34,500	50,000
62	Instrumentation and Monitoring of a Field Scale Anaerobic Digestion Plant for the Production of Energy, Biomass and Fertilizer	CEER	Dr. E. Werner	----	----	23,000(I)	42,250	----
16	Extraction and Capture of Combustible gas from existing San Juan Municipal Landfill and Newly constructed Toa Baja Land Fill-Prelim. Study	CEER	Dr. E. Werner	----	----	----	12,650	25,000
53	Production of feed supplement high in crude protein by bacterial fermentation of Rum Wastes	CEER	Dr. M.D. Erdman	----	----	----	23,000	30,000
	TOTAL BIOCONVERSION			----	------	$72,795	$135,400	$185,000

TABLE 6 - CONTINUED

Proj. No.	Project Title	Location	Proj. Leader	Funding FY 77	FY 78	FY 79	FY 80	FY 81
ENVIRONMENT AND HEALTH								
10	Preliminary Bio-Assay Studies of Commercial Fish, Shellfish and Other Organisms	CEER	Dr. W. Jobin	----	----	22,425(I)	----	----
35, 144	Magnetite Seeded High Gradient Magnetic Filtration Treatment of Industrial and Domestic Waste	CEER	Dr. A. Block	----	----	45,210(I)	46,000	----
54A	Social Aspects Espíritu Santo Basine	CEER	Mr. P. Soto	----	11,954(I)	----	----	----
55A	Model of the Aquatic Ecology of Joyuda Lagoon	CEER	Dr. J. M. López	----	----	11,500(D)	----	----
58	Environmental Research on Bioluminiscence	UPR Cayey	Prof. M.Trujillo	----	----	3,105(I)	2,760	3,000
69	Resources MGN +/Espíritu Santo Basine	UPR-RP	Dr. López Pumarejo	----	9,751(I)	----	----	----
10A	Ecology of Marisa Cornuarietis and Biomphalaria Glabrata in Riceetelds	CEER	Dr. H. Negrón	----	----	----	23,000	30,000
33	Environmental Studies for Coal Power Plant Siting	CEER MAZ	Dr. J. López	----	----	----	17,250	25,000

TABLE 6 - CONTINUED

Proj. No.	Project Title	Location	Proj. Leader	Funding FY 77	FY 78	FY 79	FY 80	FY 81
43A	Seminar on Modern Techniques of Industrial Waste Treatment and Disposal	CEER	Mr. J. Villamil	----	----	----	2,300	3,000
54B	Environmental Health Analysis Respiratory and gastrointestinal, renal diseases correlations with env.	CEER	Dr. H. Negrón	----	----	----	17,250	100,000
	TOTAL ENVIRONMENT AND HEALTH			-----	$21,705	$82,240	$108,560	$161,000
FOSSIL FUELS RESEARCH								
40	Recovery and Solubilization of Petroleum Derivatives by Micelle Forming Surfactants	Cath.Univ.	Dr. G. Infante	6,932(D)	6,583(I)	16,100(I)	----	----
48A	Venezuelan Heavy Crude Oils (see Proj. 60)	CEER	Dr. J. Rigau	----	12,113(I)	9,200(I)	----	----
	TOTAL FOSSIL FUELS			$6,932	$18,696	$ 25,300	-----	-----
ENERGY ANALYSIS								
50	Engineering Economic Analysis, Energy Scenarios and Planning R&D Needs of Energy Alternatives	CEER	Dr. M. Iriarte	----	----	17,250(I)	34,500	50,000
78	Energy Policy Study	P.R. Energy Of.	Mr. F. Castellón	----	22,400(I)	----	----	----
	TOTAL ENERGY ANALYSIS			----	$22,400	$17,250	$34,500	$50,000

TABLE 6 - CONTINUED

Proj. No.	Project Title	Location	Proj. Leader	Funding FY 77	FY 78	FY 79	FY 80	FY 81
OTHERS								
15	Developmental, Visiting Scientists	CEER	Dr. J.A. Bonnet	14,305	63,652	78,006	115,000	125,000
63	Culebra Workshop	Wash. Univ.	Dr. J. P. R. Falconer	2,240(D)	----	----	----	50,000
69A	Efficiency Evaluation of Ocean Wave Energy Absorbers	Mass.	Alden Lab.	----	----	4,600(I)	----	10,000
37A	Energy Exhibition Trailer	Island	Prof.M. Vargas RUM	----	----	----	1,150	1,150
40A	Technical Seminar including Congress for the Investigation and Conservation of Energy Resources	CEER	Dr.M. Iriarte	----	----	----	6,900	7,000
41A	Environment, Planning and Small Developing Island Economies-a cost Benefit Approach	UPR	Dr. F.M.Andic	----	----	----	1,150	2,000
38	Advanced Training in Bionucleonics for UPR Graduate School Professors	UPR	Dr. F.D.Folch	----	----	----	3,450	5,000
47	Institutional (Seminars)	CEER	Dr. J.A. Bonnet	32,591(I)	26,052(I)	26,450(I)	11,500	12,000

TABLE 6 - CONTINUED

Proj. No.	Project Title	Location	Proj. Leader	Funding FY 77	FY 78	FY 79	FY 80	FY 81
57A	Establishment of an Electron Microscope Service Laboratory	CEER	I. Ortabasi	----	----	----	12,650	15,000
46	Publications							
48	Public Educational Programs							
49	Advisory Committee			----	----	----	46,000	150,000
80	Library							
	TOTAL OTHERS			$49,136	$89,704	$109,056	$197,800	$377,150
	Reserved - Adjustments and changes			----	---	---	20,240	---
	SUB TOTAL			149,926	573,485	725,000	800,000	1,328,150
	Less Adjustment to Reflect Total DOE Planning Estimates as per Mr. R. E. Stephens' letter of August 21, 1979			---	----	----	---	478,150
	TOTAL			$149,926	$573,485	$725,000	$800,000	850,000

APPENDIX B

APPENDIX B

COMPETITIVE AWARDS

Thousands of Dollars[1]

DIV. ACC.	PROJECT	SPONSOR	FISCAL YEAR 77	78	79	80	81[1]	TOTALS
FOSSIL FUELS								
60	Desulfurization of Organo Sulfur Compounds and Petroleum Fractions	DOE	56.4	108.5	116.3	50.0*	----	331.2
ENVIRONMENT AND HEALTH								
58	P.R. Energy Modelling (including Environmental considerations)	DOE	75.0	124.7	----	----	----	199.7
79	Fossil Fuels - Health Hazards	DOE	38.0	9.8	----	----	----	47.8
82	Hydroelectric Reservoirs schistosomiasis studies and control	DOE	58.8	104.3	----	----	----	163.1
26,80	Environmental Health Analysis[2] and Epidemiological Models	DOE	60.7	65.9	109.1	----	----	253.7
45	Biological Availability of Pollutants to Marine Organisms	EPA	2.1	----	----	----	----	2.1
75	Hydrocarbon Oil Extraction Studies	EPA	2.9	----	----	----	----	2.9
76	Offshore Environmental Studies of Power Plant Siting--Sediments Study	PRWRA	23.7	----	----	----	----	23.7

*An additional $106K are pending approval from DOE

DIV. ACC.	PROJECT	SPONSOR	77	78	79	80	81	TOTALS
ENVIRONMENT AND HEALTH (Continuation)								
61	Pilot Study of Raft Culture of the Mangrove Oyster in Puerto Rico	P.R. Dept. of Agriculture	2.7	----	----	----	----	2.7
73	Control of Schistosomiasis	EMCF	2.4	----	----	----	----	2.4
39	Environmental Effects of Rum Slops Discharges	EPA	----	122.8	29.2	----	----	152.0
90	"EL FARO" Environmental Park	P.R.Cons.Trust	----	19.6	20.3	----	----	39.9
33	Ecological Survey of Hydroelectric Power	Dom. Rep. Co.	----	----	5.0	----	----	5.0
32	Cancer Grant	Am. Coll. of Radiology	----	5.7	20.3	4.1	21.0	51.1
98	Field determination of limiting velocities for control of Biomphalaria glabrata in Irrigation Canals - Guajataca Canal System	WHO	----	----	12.3	5.7	18.0	36.0
97	Assessing the environmental impact of hydroelectric power generation at the Patillas reservoir	Energy Research and Applications, Inc.	--	----	7.9	----	----	7.9
21	Environmental Impact Study of Guayanilla-Mayaguez Transmission Line	PRWRA	----	----	2.5	----	----	2.5

DIV. ACC.	PROJECT	SPONSOR	77	78	79	80	81	TOTALS
ENVIRONMENT AND HEALTH (Continuation)								
65	Environmental and Ecological Studies off the South Coast of St. Croix	College of Virgin Islands	----	----	10.5	----	----	10.5
13	Replanting and Maintenance of Mangrove at South Coast Plant	PRWRA	----	----	1.9	----	----	1.9
82	PRASA (Support for Trailer Magnetic Filtration Plant and related Projects)	PRASA	----	----	24.1	.9	----	25.0
--	Trials of HGMF on waste streams under study by SKF Laboratory	SKF Company	----	----	12.0	----	----	12.0
--	To characterize a conceptual desig of a biological/chemical system for the treatment of our waste effluent	SKF Company	----	----	----	10.0	----	10.0
--	Par Pond Summary Report for Savannah River Laboratory	SRL	----	----	----	55.0	----	55.0
--	Palo Seco (Preliminary Survey of the Marine Ecology East and West of Isla de Cabras	PREPA	----	----	----	72.6	----	72.6

DIV. ACC.	PROJECT	SPONSOR	77	78	79	80	81	TOTALS
ENVIRONMENT AND HEALTH (Continuation)								
--	Environmental Studies for Coal plant installation	PREPA	----	----	----	576.0	424.0	1000.0
	Total Environment and Health		266.3	452.8	243.1	736.3	463.0	2161.5
BIOMASS								
81	Sugarcane and other Tropical Grasses as Potential Renewable Energy Sources	DOE	213.0	249.0	307.0	348.0	350.0	1467.0
OTEC								
91	OTEC-Biofouling Corrosion and Materials Study at Punta Tuna, Puerto Rico	Argonne National Laboratory	----	----	196.5	445.0	----	641.5
23	OTEC Measurement of Oceano-graphic Environmental Parameters Relatable to OTEC installation at Punta Tuna	Laurence Berkeley Laboratory	----	----	149.7	16.3	----	166.0
27	OTEC Parameter Spatial Variability Relatable to an OTEC Installation at Punta Vaca, Vieques	PREPA	----	1.9	23.1	5.0	----	30.0

DIV. ACC.	PROJECT	SPONSOR	77	78	79	80	81	TOTALS
OTEC (Continuation)								
56	OTEC PRWRA Power System Integration Issue	CTA	----	----	20.0	----	----	20.0
93	Seawater surfactant systems and variability relationship to foam OTEC Systems	ORNL	----	1.0	40.4	79.9	----	121.0
09	Electric System Planning Studies for OTEC Integration	PRWRA/DOE*	----	----	20.2	98.0	----	108.2
--	Corrosion Study of Electrical Cable	Simplex Wire and Cable Co.	----	----	----	40.0	----	40.0
	Total OTEC		----	2.9	449.9	683.9	----	1136.9
SOLAR								
89	Concentrating Photovoltaics for the tropics	DOE	----	27.2	130.9	----	----	158.1
34	Process steam generation by non-imaging solar concentration	Bacardi Corp.	----	12.4	14.3	----	----	26.7
--	Process Steam Generation	Roche	----	----	----	50.0	----	50.0

*The project was funded by PRWRA in FY 79 and by DOE in FY 80.

DIV. ACC.	PROJECT	SPONSOR	77	78	79	80	81	TOTALS
SOLAR (Continuation)								
--	Solar Photovoltaic Station at Mona Island	Howard Bayne Foundation	----	----	----	2.5	----	2.5
	Total Solar		----	39.6	145.2	52.5	----	237.3
CONSERVATION								
36	Policy R&D - Outline of a Methodology with Reference to decision making the field of energy, transportation 7 env.	Howard Bayne Foundation	----	----	3.0	----	----	3.0
--	General Energy Conservation Plan for the University of Puerto Rico	UPR-President's Office	----	----	----	10.0	10.0	20.0
	Total Conservation		----	----	3.0	10.0	10.0	23.0
BIOCONVERSION								
--	Production of a Usable Energy Sourcey by Anaerobic Digestion	DOE	----	----	----	9.7	----	9.7
--	Biomass/Bioconversion Field Station in Toa Baja	UPR/AES	----	----	----	50.0	----	50.0
	Total Bioconversion		----	----	----	59.7	----	59.7

DIV. ACC.	PROJECT	SPONSOR	77	78	79	80	81	TOTALS
OTHERS								
45	Intensive Summer Course in Energy	DOE	----	----	13.5	2.5	2.5	18.5
78,79	Summer Science Student Program (Site 1 and Site 2)	DOE (Dept. of Labor)	----	----	89.9	124.1	----	214.0
99	Southern Solar Energy Center (Atlanta, Ga.) P. R. Support	SSEC	----	----	7.0	28.0	30.0	65.0
62	Neutron Diffraction Studies	NSF	51.4	----	----	----	----	51.4
	Total Others		51.4	----	110.4	154.6	32.5	348.9
	GRANT TOTALS		587.1	852.8	1374.9	2095.0	855.5	5765.3

(1) Includes funds contracted for several projects and funds expected in contract extension in other projects

(2) Program was cancelled by DOE effective October 1, 1979. Late notification (November 1979) has accrued some charges.