

PD-AAU-784

4. 2

USAID/GOJ ENERGY SECTOR

ASSISTANCE PROJECT

ANNUAL REPORT AT 31.3.86

LOAN No. 532-W-016

PROJECT No. 532-0065

Prepared by:

MINISTRY OF MINING & ENERGY

2 St. Lucia Ave., Kingston 5.



PROJECT DIRECTOR

EXECUTIVE SUMMARY

The five-year USAID/GOJ Energy Sector Assistance project comes to an end in its present format on September 30, 1986, hence the project attempts to summarize as far as possible activities and achievements to date.

Project Objectives

- i) Institution Building:
 - a) including long term and short term training
 - b) on-the-job training through the use of Consultancies
 - c) reorganization of the Energy Division.
- ii) Expanding the GOJ energy conservation programme.
- iii) Expanding the GOJ programme in alternative energy resources assessment and solar energy programmes.

Institution Building

- a) This subcomponent has been reasonably successful with 9 of the 12 slated long-term Degree programmes completed or in progress; 26 long-term programmes completed in Jamaica and 151 short term specific courses and seminars completed in the USA and Jamaica.
- b) The energy sector and the Ministry in particular have benefited from 56 man-months of long term and 66 man-months of short term consultancies in various disciplines.
- c) The primary failure has been that the objective of restructuring the Energy Division to be more functionally oriented, providing career path and the ability to attract qualified and experienced personnel was not accomplished.

In spite of this failure the project has accomplished and in instances exceeded the physical activities, planned in Energy Conservation and Alternative Energy at considerably less cost than originally estimated.

Economic Planning

The major activity is the development of a National Energy Plan. A number of energy subsector surveys were completed and a National Steering Committee established comprising both public and private agencies which will advise the GOJ on strategies for Policy and Planning in the Energy Sector.

Energy Engineering (Energy Conservation & Solar Water Heating)

Sixty-two (62) energy audits and twenty-four (24) solar water heating installations were planned during the project life.

- Achievements
- (i) 63 audits were completed with an additional 3 audits in progress with retrofitting works being done in forty-one sites. The audits indicate that for an expenditure of approximately J\$11.0M there is a possible energy saving of 163,000 BOE/yr or US\$4.0M/yr at US\$24.0/barrel.
 - (ii) Thirty-one solar water heating systems in hospitals, educational institutions, health centres and markets were installed.

Other achievements include:

- o the application of a vibrant energy conservation programme and the establishment of an Energy Coordinators Association including agencies in the public and private sectors.
- o An automated Energy Information Centre in the Ministry.
- o Energy Conservation Manual for the Building Industry developed for incorporation in the National Building Code.
- o An Energy Centre at the College of Arts Science and Technology.
- o Eleven meteorological stations islandwide to measure solar radiation and potential for wind energy.

- o A solar testing laboratory at the Bureau of Standards.
- o An Alternative Energy Demonstration Centre at Knockalva.

Potential Savings identified from Energy Audits

	<u>Total at 31.3.86</u>
o Energy audits completed (excluding post audits)	63
o Total energy used by plants audited BOE/yr	871,000
o Total energy cost/yr @ US\$24/bbl	US\$20,904,400
o Potential Savings BOE/yr	165,000
o Total Potential Savings/yr @ US\$24/bbl	US\$3,960,000
o Potential Savings (percentage)	19%

Actual Savings from Retrofits

	<u>Cost J\$</u>	<u>BOE/yr</u>	<u>US\$ @ \$24/bbl</u>
Energy Conservation Retrofits	2,675,171	29,333	721,324.00
Verified Spin-offs	-	8,207	196,968.00
Solar Water Heating	2,349,334	2,220	53,280.00
Total Savings	5,024,505	39,760	971,572.00

Plans 1986/87

The GOJ and USAID have agreed for the continuation of the project to June 1987. However the overall objectives of the continuation overlapping with the existing project will aim to -

1. Achieve permanently improved energy efficiency, resulting in energy cost savings in specific facilities;
2. Improve the quality of service provided by the beneficiary institution;

3. To make significant near-term impact in the targeted sectors;
4. To generate local manufacturing capabilities and local employment in fabrication and installation of high efficiency energy saving components.

Project Beneficiaries

1. Tourism Industry: Hotels and villas with emphasis on the small hotels;
2. Public Buildings: emphasis on those with large public through-put i.e. courts, hospitals, airports;
3. National Water Commission: projects related to improve reliability of service and servicing and replacement of instrumentation and pump efficiency.

Primarily activities will be focused on winding-down sub-projects which will cease as at September 30, 1986 and servicing the objectives listed under plans 1-4.

Budget

The 1986-87 budget is established at GOJ J\$10.0M, and USAID J\$10.0M.

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1.0 INTRODUCTION

The objectives of the 5 year project (September 1981 - 1986) are:

- a) **Institution Strengthening:** to develop the capabilities of the Energy Division to plan and manage Jamaica's energy programme;
- b) **Energy Conservation:** to plan, expand and manage the Government of Jamaica's energy conservation programme in the public sector; and
- c) **Alternative Energy:** to plan and manage alternative energy programmes and encourage the utilization of alternative energy resources.

A. INSTITUTION BUILDING

The component comprises the following:

- i) Project Management;
- ii) Restructuring of the Energy Division;
- iii) Training; and
- iv) Strengthening of Linkages with energy related agencies and the Economic Planning Unit of the Energy Division.

1. PROJECT MANAGEMENT

a) STAFFING

The administrative and technical functions of the project are carried out by the following:

Project Director	-	W. Boyne
Administrator	-	P. Buchanan
Project Accountant	-	P. Cole
Contracts/Procurement Officer	-	V. Llewellyn
Economist	-	S. Eccles
Administrator (E.I.C.)	-	B. Mullings
Media Specialist	-	N. Gordon

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Abstractor/Indexer	-	C. Howell
Solar Engineer	-	P. Sangster
Fuelwood Specialist	-	K. Porter
Conservation Engineer	-	L. Edwards

Four secretaries , one Projectionist/Driver and two Drivers.

Invaluable support is received from the Economic Planning Branch (Grant/Jackson), Public Education (B. Chevannes) and the Consultants of Meta Systems.

During the fiscal year the following resignations and replacements occurred.

<u>Resignations</u>	<u>Replacements</u>
C. Roberts (Administrator)	P. Buchanan
B. Mullings (Administrator E.I.C)	vacant
P. Green (Abstractor)	C. Howell
E. Austin (Media Specialist)	N. Gordon
S. Taylor (Graphic Artist)	vacant

P.C.J. Engineering continued to assist the Project in Contract administration for Alternative Energy and Energy Conservation projects.

3.

b) REVISED ANNEX

The revised "Detailed Project Description" prepared in 1984 and agreed on by the Ministry and the USAID administration was not signed and subsequent to this was unofficially withdrawn.

c) PROJECT EVALUATION

A second evaluation of the project achievements was conducted in November 1985 by a joint team of one GOJ and two USAID representatives. In general the Evaluation concluded that:

- i) the Energy Division has considerably improved its linkages within the energy sector;
- ii) the energy conservation programme has exceeded the target of audits (62) and began retrofits in several institutions;
- iii) the alternative energy (solar hot water programme) has installed 32 systems exceeding the planned programme of 25 installations; established 11 meteorological stations islandwide, established an Energy Centre at CAST, an Alternative Energy Demonstration Centre at Knockalva, a Standards Laboratory at the Bureau of Standards, and conducted an alternative energy assessment of Jamaica;
- iv) expanded and maintained a vibrant Public Education Programme;
- v) established an automated Energy Information Centre;
- vi) The Energy Division however has failed in completing one primary objective namely the restructuring of the Division.

It further recommended that the Project Achievement Completion Date (PACD) of September 30, 1986 be maintained pending a review in June 1986 for a decision.

d) EXTENSION OF PACD

As a consequence of the Evaluation the Ministry was visited by the USAID Director Mr. Joslin on December 10, 1985. Following discussions with the Minister Hon. Hugh Hart and the Permanent Secretary, field visits to CAST, the National Chest

Hospital, Meteorological Office, Kingston Public Hospital and Kingston Ice Factory, the MME was requested to submit proposals for the extension of the project, indicating activities which would ensure continuation of the impact of the project on the Energy Sector.

The document was subsequently submitted to the USAID for consideration.

e) FINANCIAL AUDIT

The Financial Audit of the project by the GOJ Auditor General (which began in September 1984) was completed. The audit revealed general compliance by the Energy Division with the accepted financial principles and practices of the GOJ.

f) GOJ - FUNDING

During the financial year 1985/86, project activities were severely restrained through inadequate funding by the Ministry of Finance. Allocations to the project are made through monthly "warrants" by the Ministry of Finance. This method restricts the planning process and curtails the volume of work which can be negotiated. Of the J\$4.0M approved in the Budget only J\$3.02 million was made available to the project and during the months of September and December 1985 and January 1986 no warrants were available to the project to meet its commitments.

g) REIMBURSEMENT

The project document proposed that 40 percent of the expenditure by the GOJ on Audit and Retrofitting and Solar Water Heating projects (representing the foreign exchange component) would be reimbursable by USAID to the GOJ. In collaboration with the USAID the Ministry identified the actual foreign exchange cost of the projects to be

o	Solar Water Heating installations	39.6%
o	Audit and Retrofitting	51.3%

These ratios have been used as the basis of USAID reimbursement

to the GOJ.

To date six claims covering reimbursement due from the inception of the project to June 1985 have been reimbursed by USAID. Two additional claims July - December 1985 are now being processed.

<u>Claims No.</u>	<u>Component</u>	<u>S T A T U S</u>		
		<u>Engineering Cost J\$</u>	<u>Reimbursable Amount J\$</u>	<u>Amount Received J\$</u>
Claims 1 - 6	Solar Water Heating	1,671,488.10	661,909.10	661,909.10
	Audit & Retro-fitting	1,728,296.8	886,616.46	886,616.46
Sub Total		<u>3,399,784.9</u>	<u>1,548,525.6</u>	<u>1,548,525.6</u>
Claims 7 & 8 (being processed)	Solar Water Heating	544,346.93	215,661.38	
	Audits & Retrofits	100,068.38	51,335.08	
Sub Total		<u>644,415.31</u>	<u>266,996.46</u>	
Total		<u>4,044,200.21</u>	<u>1,815,521.52</u>	<u>1,548,525.6</u>

2. RESTRUCTURING OF THE ENERGY DIVISION

The original objective was to increase the Energy Division's professional staff from 23 to 32. This was subsequently revised by the Ministry and the USAID to reduce the number of staffing posts and reorganize the structure and upgrade the posts to provide a strong middle management group and more meaningful career path. This concept was approved by the Ministry of the Public Service in principle. However due to the GOJ economic constraints the final structure is yet to be submitted to the Ministry of the Public Service.

This has so far proved to be the only major failure in achieving the overall project objectives which has resulted in upwards of twenty (20) professional resignations from the Energy Division and the Project

since 1982.

3. TRAINING

The staffing of the Energy Division as well as associated agencies in the Energy sector have benefited considerably from the training facilities offered by the project. Training has been in several modules, namely

- o on-the-job training through the use of long and short-term consultancies;
- o long-term post-graduate training in the USA;
- o short-term training, seminars, conferences and workshops in the USA and Jamaica.

i) On-the-Job Training

a) Long-Term Consultants

The project paper proposes three long term consultants namely Energy Planner (60 man-months -reduced to 24 man-months), Conservation Advisor (30 man-months) and Alternative Energy Advisor (60 man-months - reduced to 24).

Energy Planner (Tom Tuschak)

The position was filled in 1983 for approximately nine (9) months. The incumbent was recalled and the job description revised to be more applicable to the requirements of the Energy Division. The position remained vacant until June 1985, when it was filled by Dr. T. Tuschak.

Dr. Tuschak is primarily involved in the development of a "National Energy Policy" including

- energy supply options,
- related investment alternatives,
- energy pricing issues,
- realistic alternative energy options, and

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- institutional issues and the role of the public and private sectors in energy development and utilization.

This assignment is for one year ending June 1986 but it is presently conceivable that an extension may be required to September 1986 to complete this assignment.

Alternative Energy Advisor (Frank Mathews)

This position remained vacant to February 1985 when Dr. Frank Mathews assumed the duties on a one-year assignment, completed on January 31, 1986. Dr. Mathews was requested to concentrate on the establishment of the Energy Centre at CAST, activities in improvement of the Meteorological data, the standards laboratory at the Bureau of Standards, the development of the Alternative Energy Demonstration Centre at Knockalva and in the general assessment of alternative energy resources. The latter will form the realistic alternative energy options in the National Energy Policy.

Conservation Advisor (David Keith)

The energy conservation advisor is the only long-term consultancy which has consistently been filled during the project since January 1983 (30 man-months). This advisor has been of invaluable service to the Ministry over the period and in addition to the foregoing tenure the Ministry has requested two short-term periods of 6 months each for specific tasks, in the continued process of the development of Jamaica's energy conservation programme.

Short Term Consultancies

In addition to the three long-term advisors eighty-seven (87) man-month of short term consultancies were allocated during the project, and utilized as follows -

<u>Functions</u>	<u>M-Month Allocation</u>	<u>Status</u>
Solar Technology Standards	3.0	On-going - DSET Laboratories
Wind Specialist (Meteorological data)	3.0	Not requested.
Solar Crop Drying Specialist	3.0	Completed - Brace Research Institute
Energy Centre (CAST)	6.0	Requested in January 1986.
Solar Design Specialist	3.0	Completed (1982)
Solar Water Heating Specialist	3.0	-do-
Alternative Energy Technologist	12.0	3 mm completed.
Forest Economist	6.0	1.5 mm completed.
Alternative Energy Demonstration Centre	11.0	2.0 mm completed.
Transportation Specialist	6.0	Completed - Southern Electric Company.
Conservation Planner	3.0	6 mm completed + 6 mm requested (D. Keith).
Conservation in Construction Industry	3.0	Completed 1983 (D. Bloome).
Public Education Specialist	5.0	3 mm used by Conservation Planner.
Economic Planners	14.0	Completed ANL.
Information Specialist	6.0	Ongoing (Ruhl).

Summary of Technical Assistance

	<u>Allocation (mm)</u>	<u>Committed/Requested (mm)</u>
Long Term	78	56
Short Term	87	65.5

In general, the consultants Meta Systems as the primary Consultancy Organization, Argonne National Laboratory, DSET Laboratory and Ruhl Information Management Inc. have assisted the Energy Division and the GOJ in the following:

- Training in energy planning, energy technology, project evaluation and information systems;
- assessment of renewable energy and energy conservation potential;
- computer hardware specification and software development;
- engineering assistance in energy auditing and specifications in hardware for retrofits;
- conservation planning, solar water heating and drying technologies, energy monitoring instrumentation and vehicle testing equipment;
- institution development at MME, CAST, Knockalva, and VIDDI; and
- the national energy policy.

LIST OF TRAINING PROGRAMMES

- conducted by the MME.

Energy Division Retreat - (Delucia, Leonard-Barton, Peterson, Keith, Norman Brown and C. Laws)

Energy Auditors Training Course - (1983) - Twenty-five (25) engineers of the public and private sectors (David Keith and Larry Banta).

Project Evaluation Workshop (1983) MME staff - (John Arnold).

Lighting Energy Efficiency Workshop - 1983 - Energy Coordinators Association (David Keith).

Air Conditioning Efficiency Workshop (1983) Energy Coordinators (David Keith).

Hotel Industry Energy Efficiency Workshop (1983) - Hotel managers and engineers - (David Keith).

Post harvest Losses and Refrigeration Systems Design - Agronomist of Caribbean region (Ron Alwood and David Keith).

Diploma Course - Energy Management and Policy - Practicing engineers and energy managers - UWI course (David Keith).

Fleet Management Workshop (1984) - workshops to public and private sector fleet managers. (John Dolce and Gary Johnson).

Energy Credit Fund Symposium (1985) Energy Conservation in Jamaica (David Keith).

Solar Crop Drying Workshop (1985) 40 participants in Agricultural sector (Energy Centre, Frank Mathews and Andrew Skelton).

Project Evaluation and Risk Analysis (1985) economist, engineers, planners of energy sector agencies and MME (John Arnold and Dr. Richman).

Energy Management in Industry (1985) Engineers, plant managers (David Keith and Larry Banta).

Energy Management in Transportation Fleets (1985) Fleet Managers - Fuel Conservation (John Dolce).

Steam Boiler Operating Efficiency (1985) Boiler operators - boiler operation and maintenance (David Keith).

Solar Hot water Systems Designs (1982 and 1985) private and public sector (Chandra and Frank Mathews).

Solar Installers Course (1983) Private and public sector (Chroma).

Information Systems - Automation and user seminars (Mary Jane Ruhl).

Publications: During the life of the project the following publications were produced and are available for reference in the Energy Information Centre.

Jamaican Energy Auditors Handbook - (June 1983)
by MME assisted by David Keith and Larry Banta.

Jamaican Energy Manager's Technical Reference Manual (June 1985)
by MME assisted by David Keith.

Energy Tips -
by MME assisted by David Keith.

Preliminary Design - Solar Water Heating Systems for Jamaica
(1983) - by C. Chroma and S. Chandra

Solar Water Heating Installation Manual (1983)
by C. Chroma

Review of Potential for Renewable Energy Sources in Jamaica
August 1983
by MME and John Arnold

Jamaica - Wind Energy Assessment (Sept. 1983)
Jamaica Meteorological Office and Vaughn Nelson

Fleet Fuel Conservation Reviews (Oct. 1984) (JPSCo. and
Ministry of Agriculture)

by Southern Electric International

Energy Conservation Manual for the Construction Industry (1983)
by David Bloome

Policy and Project Recommendation - Jamaica National Energy
Conservation Plan (Oct. 1983)
by David Keith

Proposed JPS Electric Rates to Encourage Energy Conservation
(February 1985)
by MME and David Keith

Solar Water Heating Designers Manual (1985)
by MME - CAST and Dr. F. Mathews

Project Evaluation for Electricity Generation (Sept. 1985)
by John Arnold assisted by MME.

TRAINING 1985/86

The Training Plan was completed in May 1985 and is the basis on which all training is carried out under the USAID/GOJ Energy Sector Assistance Project. Generally, the plan recommends that training should be related to functional areas and that long term training in particular be geared toward personnel who will fill posts identified on the staff structure of the Economic Planning Unit, Energy Engineering, Information and Energy Education sections.

Training methodology is grouped into two categories:

- Essential or job related training - which involves strengthening the management and planning capabilities and upgrading the functional abilities of the Energy Division.
- Desirable and/or Permitted Training which includes primarily short-term courses in Jamaica.

In accordance with the plan, 52 persons were trained in the F.Y. 1985/86 as follows:

<u>Area of Training</u>	<u>No. of Participants</u>	<u>Type of Training</u>	<u>Place of Training</u>
1. Economic Planning and Analysis	2	Masters - Long Term	U.S.A.) Continuing
2. Energy Resources	1	Masters - Long Term	") Continuing
3. Mechanical Engineering	2	BSc - Long Term	") Continuing
4. Energy Information Automation	5	Short Term	"
5. Energy Information Network	6	Short Term	Jamaica
6. Procurement and Supply Management	1	Medium Term	U.S.A.
7. Communications	1	Medium Term	"
8. Computer Usage	20	Medium Term	Jamaica
9. Audio Visual Techniques	3	Short Term	Jamaica
10. Bioenergy	2	Short Term	Thailand
11. Energy Technology	4	Short Term	U.S.A.
12. Spanish	5	Medium Term	Jamaica

SUMMARY

	<u>At 31.3.85</u>	<u>1985/86</u>	<u>Project total</u>
Long Term USA	4	5	9
Long Term Jamaica (UWI)	26	-	26
Short Term USA/other	42	14	56
Short Term Jamaica	61	34	95

In addition to participating in seminars/workshops put on by other energy related organizations such as CAST Energy Centre and the P.C.J. the Ministry organized and hosted the Energy Symposium in July 1985 and a User seminar for the Energy Information Centre in February 1986. The Energy Symposium consisted of Training courses, a conference session and an exhibition and covered a wide range of topics with input from other Caribbean countries.

During the Financial Year 1986/87 the five persons will complete their degree programmes and the senior administrator in the Energy Education Unit is scheduled to start reading for her masters in Energy Management and Policy.

Training in computer studies is to continue with courses in Computer Concepts and Word Processing for a small group of secretaries (3). There will also be specialised beginners training in the use of the computer for a group of accountants and administrators. The financial controller on the Project is scheduled to complete a diploma course in Systems Analysis and two other members of staff, one of the engineering section and the other from the Economic Planning Unit are also to do advanced courses in order to upgrade their proficiency with the computer.

There are plans to complete a short course in Bioenergy for the Fuelwood Specialist and a Supply and Procurement Course for the Office Manager who provides support services to the Energy Division.

2.0 ECONOMIC PLANNING

The project activities of the Economic Planning Unit involve

- i) strengthening of linkages between the MME and the private and public sector agencies of the Energy Sector. This is primarily being accomplished through the development of a National Energy Plan.

The methodology being adopted is the evaluation of the various energy options and parameters by five Task Forces namely:

- Resources
- Macro Economic
- Alternative Energy
- Energy Conservation, and
- Quantitative Analysis.

The Task Force findings are presented to a Steering Committee which makes the final recommendations to the Minister.

The Steering Committee comprises members from the Private Sector including the Petroleum Companies, Private Sector Organization of Jamaica, the public and private sector agencies such as JPSCo. and PCJ and Government Ministries and agencies namely, PIOJ, Ministry of Agriculture, Ministry of Public Utilities and Transport and Ministry of Mining and Energy. The objective is to propose recommendations to Government which have the concurrence of a cross-section of energy supply and demand interacting agencies.

ii) Energy Surveys

A number of Energy Surveys were conducted throughout the project of providing the base-data for the formulation of the National Energy Plan namely:

- a) Manufacturing Industry: to determine the quality and types of energy and the modes of consumption in the various industrial sub-sectors.

Results: A sample of 433 from a population of 784 firms (representing 99% of consumption of 12,070,819 BOE) was used. The final shares of energy consumption in the non-bauxite sector were:

Grid Electricity	12.6%
Fuel Oil	54.1%
Diesel Oil	20.2%
Gasolene	6.8%
LPG	<u>4.3%</u>
	100.0

More than 75% (or 747,000 BOE) of the energy consumed in miscellaneous industry could be for process heat and cogeneration and 13% was in the form of electricity. It is therefore recommended that energy policy in the industrial sector should focus on improved efficiencies of direct and indirect heating and electrical drives.

- b) Household Survey - collecting information at the household level on energy use, equipment and vehicle ownership and at the individual level on characteristics of trips/24 hour periods.

Results: 1983 investigations show total energy used in the sector as 1,569,000 BOE as cooking 46.6%, refrigeration 16.8%, and lighting 14.2% as the highest end uses. The dominant fuel was electricity 56%, kerosene 16%, LPG 13.4%, charcoal 12.3% and fuelwood 2.4%.

- c) Commercial/Industrial/Public (CIP) - to determine the use pattern of energy in the sector.

Results: Fuel demand was shown to be dominated by electricity (72.5%) with commercial diesel (20.2%) LPG (3.6%) and gasolene (3.4%) accounting for the remainder.

Air conditioners found to be the primary conserving device followed by boilers and incandescent lights.

The main recommendations in the short run were the substitution of Bunker C for diesel oil and the use of vapour lights.

- d) Transportation - involving primary and secondary data collection in vehicle fuel efficiencies, vehicle characteristics, and freight and passenger flows.

Results: The survey provided base year (1981) current and 5 year projections to year 2002, of transportation demand. Passenger transport currently consumes 80% of total transportation energy and is expected to double over the 1983-2002 forecast period. Limited opportunities exist for mode switching.

- e) Electric Sector - including the elements of
- description of the planning methodologies used in planning in the sector;
 - a power market survey to determine the demand for electric power for the period 1983-2002;
 - a description of the existing electricity supply system and its evaluation;
 - an assessment of the generation expansion options available or which will become available during the planning period.

Results: Formulation of a least cost expansion plan for the sector. The least cost plan required an overall expenditure of US\$2409M as against a fixed plan of US\$2573M. Thus implementation of indigenous sources i.e. peat, hydro will require

significantly higher capital expenditure but the cost of energy is appreciably less for this plan.

- f) Tourism - The survey completed work started in 1979 and provided a formulation of the analytical results into a format suitable for the Argonne National Laboratory model, showing hotels and villas consuming (1979) 85,192 BOE/yr and transportation 49,160 BOE/yr.

g) Renewable Energy Resources

The study was intended to collect the necessary data on renewable energy resources and technologies realistically expected to contribute to the energy mix to the year 2002, to be included in the National Energy Plan.

Results: The scope spanned the

- availability of renewable energy resources;
- conversion costs and efficiencies of the technologies;
- expected end-uses of these resources-technology combinations;
- extent to which the combinations will substitute the commercial fuels or meet new energy requirements; and
- the periods over which these combinations are likely to be introduced.

The resources included:-

Solar insulation
 Wind
 Hydropower
 fuelwood
 energy plantations
 biomass residues
 peat
 OTEC
 urban wastes

The potential end-uses include

- electricity generation
- irrigation pumping
- transport shaft power
- industrial process heat
- industrial shaft power
- on-farm shaft power
- on-farm process heat, and
- residential process heat.

- h) Economic Analysis - This analysis is the driver of the energy modelling and planning analysis and provided the GDP growth forecast up to year 2002 for each sector within the energy model network. The constant GDP and GDP growth rates for the 25 subsectors were provided in 3 scenarios - low, medium and high. Labour force and demographic growth rates were also provided.

iii) Project Evaluations

During the financial years (1985/86) the Economic Planning Unit carried various activities in the area of "project planning and appraisal", to be used as inputs in the preparation of the National Energy Plan, including:

- o project profiles for 9 hydro-electric sites;
- o economic analysis for 37 hydro-electric sites;
- o feasibility studies, financial and economic analyses for fuelwood plantation at Long Pond, energy conservation projects for Frome Sugar Factory and Rose Hall Intercontinental Hotel;
- o sensitivity and risk analyses for the Negril Peat Project and Coal Conversion by Bechtel;
- o feasibility review of using renewable energy resources for economic independence of Jamaica by consortium of Canadian Consultants;
- o economic feasibility of electricity generation with saw mill waste at F.I.D.Co.;

- o economic feasibility of electricity generation from biomass at Mavis Bank, St. Andrew;
- o survey of biomass potential in Jamaica as energy source;
- o economic survey paper on Ethanol from sugarcane for the Jamaica Association of Sugar Technologists.

iv) Post Evaluations

Eleven post-evaluations were conducted for energy conservation retrofits and solar hot water installations as verifications of the energy audit projections and actual energy savings. The general findings are that the actual savings are approximately 95% of the projections with expenditure of 52% of the expected cost.

The average energy savings in BOE as a percentage of use is 25.7%.

Some calculations i.e. St. Ann's Bay show small energy savings percentages since not all the ECOs identified in the audits were completed.

POST - EVALUATIONS - ENERGY CONSERVATION PROJECTS

S I T E	ECO'S (Retrofitted)	AUDIT ESTIMATES			ACTUAL			US\$ Saving for year	BOE Used/yr	Percentage Savings
		BOE/yr Savings	Cost J\$	Payback years	BOE/yr Savings	Cost J\$	Payback years			
Ministry of Foreign Affairs	Tinting windows	224	36,000	0.81	142	35,412	1.9	3,408	1,081	13.13
West Indies Pulp & Paper	Insulate steam pipes & provide accessories	1138	99,727	1.30	1276	33,286	0.2	30,624	4,060	31.4
Frome Sugar Factory	Lagging high & low pressure steam pipes	3120	140,000	0.28	3466	140,000	0.31	83,184	7,271	47.67
Wyndham Hotel - Rose Hall	Flourescent lighting	992	123,604	1.06	832	123,705	1.13	19,968	17,030	4.8
St. Ann's Bay Hospital	Solar Hot water systems	55	121,303	13.8	147	89,229	4.60	3,528	2,059	7.14
Shortwood Teachers' College	Flourescent lighting	79	12,959	0.88	432	12,950	0.23	10,368	930	46.45
Kingston Public Hospital	Boiler conversion	4774	1,005,030	0.15	4085	126,474	0.23	98,040	14,445	28.26
Spanish Town Hospital	Solar Hot water Systems	205	131,718	3.44	431	140,888	2.48	10,344	2,018	21.34
Long Pond Sugar Factory	Installation of preheaters	4000	780,000	2.0	3590	437,250	0.92	86,160	5,800	61.90
Casa Montego Hotel	Solar Hot water systems	242	142,000	5.70	265	113,658	3.25	6,360	2,426	10.92
Royal Caribbean Hotel	Solar Hot water systems	702	204,492	3 yrs.	138	131,619	7.23	3,312	516	26.74
TOTAL =			2,694,836		14,804	1,384,471		355,296	57,636	25.7

NOTE: US\$ Savings calculated at US\$24.00/bb. of oil at the time
the calculation was done

US\$1.00 = J\$5.50

B. ENERGY CONSERVATION

The Energy Conservation programme comprises two main components
- Energy Audits and Retrofitting of Public Sector buildings.

<u>Plans 1985/86</u>	<u>Status</u>
i) Full Scale Audits - 11	6 completed, 3 ongoing and two cancelled.
ii) Post Audits - 7	6 completed - 1 ongoing.

Summary

<u>Audits</u>	<u>At 31/3/85</u>	<u>At 31/3/86</u>	<u>Project Total</u>
Completed	57	6	63
In progress	-	3	66
Expenditure	J\$206,751	J\$30,550	J\$243,301

The 63 completed audits estimate that for an expenditure of J\$10.5M in retrofits there is a projected energy savings of 162,960 BOE/yr.

RETROFITS

<u>Planned 1985/86</u>	<u>Completed</u>	<u>Ongoing</u>
14 sites	6 sites	

Two retrofitting programmes at Bernard Lodge were cancelled due to the questionable future of the factory, and one at Coffee Industry Board due to refurbishing works being conducted on the site.

SUMMARY OF RETROFITS

<u>Retrofits</u>	<u>At 31/3/85</u>	<u>1985/86</u>	<u>Project Total</u>
Completed	35	6	41
Cost J\$ (including Audits)	2,106,466	812,007	2,918,473
In Progress			47
Savings in BOE/yr	17,168	12,165	29,333
US\$ Savings/yr @ \$24/Barrel	402,032	301,960	703,992

SUMMARY OF ENERGY AUDITS

No.	S I T E	COST ESTIMATED			ESTIMATED SAVINGS			Payback Years
		AUDIT	RETROFIT	BOE Used/yr	BOE/Yr	%age of Use	US\$/yr. @ US\$24/bb	
			<u>1982</u>					
1	Jamaica Daily News	800	10,000.00	1,108	32	2.8	763	2.4
2	National Chest Hospital	800	215,008.00	1,105	423	38	10,152	3.85
	SUBTOTAL	<u>1,600</u>	<u>225,008.00</u>	<u>2,213</u>	<u>455</u>	20.6	<u>10,920</u>	
			<u>1983</u>					
3	Coffee Industry Board	800	67,000.00	1,858	206	11.08	4,944	2.5
4	Port Authority Building	800	13,200.00	1,150	192	16.7	4,608	0.52
5	May Pen Hospital	800	12,364.00	548	137	25.0	3,288	1.68
6	JIDC & BOS Building	800	2,000.00	3,781	1,288	34.1	30,912	
7	SRC Building	800	O & M	389	85	21.85	2,040	
8	Min. of Agr. H.Q.	800	25,896.00	1,862	234	12.57	5,616	0.84
9	Post & Telegraphs	800	43,728.00	3,109	1,087	34.96	26,088	0.3
10	National Arena	800	11,000.00	183	33	18.0	792	2.5
11	Caribbean Products Ltd.	6,325	724,782.00	22,473	11,570	57.48	277,680	0.47
12	Jamaica Frozen Foods	4,000	66,450.00	1,210	383	32.10	9,192	1.30
13	Zero Processing	4,000	202,440.00	5,778	2,399	41.52	57,576	0.64
14	Rose Hall Hotel	5,000	533,503.00	18,804	9,948	52.9	238,752	0.41
15	Jamaica Soya Products	5,250	116,495.00	20,162	970	4.7	23,280	0.90
16	W.I. Pulp and Paper	4,000	41,039.00	4,058	837	20.63	20,088	0.37
17	New Kingston Hotel	4,150	532,669.00	12,327	1,771	14.37	42,504	2.28
18	Trelawny Beach Hotel	5,500	453,990.00	9,563	1,404	14.68	33,696	2.45
19	Ariguanabo Textiles	6,200	307,133.00	15,164	6,511	42.29	156,264	0.36
20	Min. of Foreing Affairs	4,856	36,000.00	1,081	224	20.7	5,376	0.12
21	UWI Hospital	5,000	135,000.00	23,162	572	2.5	13,728	1.79
22	Americana Hotel	5,500	415,628.00	12,570	2,822	22.45	67,728	1.12

No.	S I T E	ESTIMATED COSTS			ESTIMATED SAVINGS			Payback Years
		Audit J\$	Retrofit J\$	BOE Used/yr	BOE/yr	%age of Use	US\$/yr @ US\$24/tbl	
23	Holiday Inn Hotel	9400	263,447	9960	4113	41.3	98,712	0.49
24	W.I. Pulp & Paper	4640	135,913	4060	1138	28.02	27,312	0.90
25	Montego Beach Hotel	5000	149,520	4270	655	15.53	15,720	1.73
26	Casa Montego Hotel	4880	222,805	2426	996	41.05	23,904	1.69
27	Ministry of Education	800	1,972	1516	113	7.4	2,772	0.13
28	St. Ann's Bay Hospital	800	10,400	2059	101	4.9	2,424	0.78
29	Min. of Health	800	16,755	1442	115	7.8	2,760	1.1
30	Ministry of Finance	800	58,000	1202	467	38.85	11,208	0.94
31	Kingston Public Hospital		400,817	14445	4556	30.8	109,344	0.67
32	MME/MPUT Offices	800	42,859	1891	708	37.4	16,992	0.46
33	U.W.I.		66,922	14936	1693	11.3	40,632	0.3
34	Jamaica Hilton Hotel	5250	63,550	14879	796	5.3	19,104	0.6
35	Ministry of Social Security	800	140,292	496	816		19,584	1.3
36	Gordon House		17,412		28		672	4.7
37	National Gallery	800	5,980	2110	98	4.6	2,352	0.46
38	Caribbean Steel Mill	5000	300,916	38200	8664	4.9	207,936	0.26
39	Midland Cold Storage	5000	68,450	2719	118	41.1	2,832	4.4
40	FIDCO Saw Mill	4200	23,954	5058	143	2.8	3,432	1.27
41	Cornwall Regional Hospital	6300	68,300	12993	3118	24.00	74,832	0.16
42	Seprod Group of Co.	14000	111,500	30700	13551	44.1	325,224	0.06
43	Caribbean Cement Co.	14800	1,470,000	169760	56748	33.4	1,361,952	0.2
44	Runaway Bay Hotel	3500	166,800	7245	4808	66.4	115,392	0.26
45	Ocho Rios Sheraton	5000	620,600	12981	5704	43.94	136,896	0.82
	Sub Total	152,751	8,167,482	514,580	151,920	29.52	3,646,080	

No.	S I T E	ESTIMATED COSTS			ESTIMATED SAVINGS			Payback Years
		Audit J\$	Retrofit J\$	BOE Used/yr	BOE/yr	%age of Use	US\$/yr @ US\$24/bbl	
	<u>1984</u>							
46	Hedonism II Hotel	5500	267,530	9811	1183	12.06	28,392	1.71
47	Bellevue Hospital		91,311	3199	469	21.3	11,256	1.48
48	Savanna-La-Mar Hospital	6000	60,105	768	207	26.95	4,968	2.2
49	Mandeville Hospital	5400	69,819	1112	317	28.50	7,608	1.67
50	Spanish Town Hospital	5000	52,600	2018	344	17.05	8,256	1.16
51	Jamaica House & Gordon House	6500	53,335	1985	161	8.10	3,864	2.50
52	U.D. Corporation	4000	241,289	8936	1382	15.5	33,168	1.32
53	Tivoli Gardens High School		10,975	2155	71	3.3	1,704	1.17
54	Norman Manley Int'l Airport	8000	395,400	18277	3101	17.0	74,424	0.97
55	Bustamante Ch. Hospital	5000	61,700	1975	436	22.08	10,464	1.07
56	Port Antonio Gen. Hospital	7450	216,800	1448	200		4,800	8.2
57	U.W.I. Laundry	5550	60,500	3226	695	21.5	16,680	0.66
	Sub Total	<u>58,400</u>	<u>1,581,364</u>	<u>54,910</u>	<u>8566</u>	<u>15.6</u>	<u>205,584</u>	
	<u>1985</u>							
58	National Com. Bank	5250	322,086	1,279	656	51.3	15,744	3.7
59	Jamintel Centre	5000	32,864	8,021	256	3.2	6,144	0.97
60	Shortwood Teachers College	3800	22,399	930	183	19.7	4,392	0.93
61	Registrar of Co.		40,867	251	35	13.9	840	8.45
62	Jamaica Information Services	13000	50,152	730	198	21.2	5,544	1.6
63	Jamaica Bauxite Institute	3500	11,200	632	35	5.52	980	2.1
64	Radio Jamaica		ON - GOING					
65	Planning Institute of Jamaica		ON - GOING					
66	Jamaica B. Corporation		ON - GOING					
	Sub Total	<u>30,550</u>	<u>479,568</u>	<u>11,843</u>	<u>2019</u>	<u>17.04</u>	<u>48,456</u>	

RETROFITS

YEAR	S I T E	ENERGY EFFICIENCY TECHNOLOGY DEMONSTRATED	CAPITAL COST J\$	ENERGY	SAVINGS	PAYBACK YEARS
				BOE/YR	US\$/Yr	
1983/ 84	Kgn, Public Hospital	Boiler Fuel switching to HFO	100,905	645	18,060	
	Caribbean Products	Insulation - Condensate Return	72,417	2,044	57,232	
	Kgn. Public Hospital	Insulation - Blowdown Heat Recovery	13,727	742	20,776	
	W.I. Paper Products	Insulation	9,200	374	10,472	
	Post & Telegraphs	Bldg. EMS - Air Cond. Timers	2,441	241	6,748	
	Min. of Foreign Affairs	A/C Load reduction - window film	35,412	220	6,160	
	Ja. Soya Products	Insulation	34,156	169	4,732	
	Ja. Frozen Foods	Insulation	17,850	156	4,368	
	Inn-On-The Beach	Solar/AC Heat Recovery	56,273	98	2,744	
	Port Authority Bldg.	Bldg. EMS Air Cond. Timers	2,421	89	2,492	
	Jack Tar Hotel	Boiler Water Treatment	20,756	56	1,568	
	Shortwood Teach. Coll.	Flourescent Lighting	12,957	43	1,204	
	Bustamante Child'n Hospital	Air Cond. - Heat recovery	7,050	33	924	
	<u>Sub Total</u>		<u>386,565</u>	<u>4,910</u>	<u>137,480</u>	
1984/ 85	Long Pond Sugar Factory	Boiler Heat Recovery - Air Heaters	450,000	7,945	222,460	
	Rose Hall Hotel	Flourescent Lighting	123,600	992	27,776	
	W.I. Pulp & Paper	Insulation	28,645	677	18,946	
	Americana Hotel	Insulation - Condensate Return	36,000	484	13,552	
	Trelawny Beach Hotel	Room - EMS - Door Switches	41,102	350	9,800	
	Americana Hotel	Room - EMS	106,829	289	8,092	
	Trelawny Beach Hotel	Insulation - Boiler Water Treatment	42,005	247	6,916	
	Jack Tar Hotel	A/C Heat Recovery	59,800	237	6,636	
	Oceana Hotel	A/C Load Reduction - window film	41,824	227	6,356	
	Casa Montego	A/C Rehabilitation	10,200	193	5,404	
	Jack Tar Hotel	Insulation	16,933	169	4,732	
	Ministry of Min. & Energy	Selective Lighting Switches	8,561	63	1,764	
	Casa Montego	Boiler Water Treatment	20,751	56	1,508	
	Jamaica Conference Centre	A/C Load Reduction - window film	25,949	48	1,344	
	Ministry of Agriculture	" " " " "	21,131	47	1,376	
Tivoli Gardens C.H.S.	High Pressure Sodium Lighting	19,764	34	952		
	<u>Sub Total</u>		<u>1,053,794</u>	<u>12,258</u>	<u>343,224</u>	
1985/ 86	Frome Sugar Factory	Boiler Modifications	366,000	5,484	153,552	
	Frome Factory	Insulation	140,000	3,120	87,360	
	Seprod Group of Co.	Insulation	73,505	1,774	49,672	
	Cornwall Regional Hospital	Boiler Conversion to HFO	108,986	133	3,724	
	Long Pond Sugar Factory	Insulation	217,835	606	16,968	
National Gallery	A/C Reduction - window film	50,661	98	2,744		

26.

YEAR	S I T E	ENERGY EFFICIENCY TECHNOLOGY DEMONSTRATED	CAPITAL COST J\$	ENERGY BOE/YR	SAVINGS US\$/YR	PAYBACK YEARS
	Cornwall Regional Hosp.	A/C Heat Recovery	72,161	254	7,112	
	Cornwall Regional Hosp.	Flourescent Lighting & Switches	113,239	129	3,612	
	Trade Board UDC Bldg.	A/C Reduction - window film	50,661	98	2,744	
	Registrar of Co.	Flourescent Lighting	9,125	28	784	
	UWI Laundry	Steamline Insulation	10,336	225	6,300	
	Ministry of Foreign Affairs	A/C Load Reduction	46,026	21	588	
			1,234,812	12,165	240,620	

ENERGY CONSERVATION MANUAL

An Energy Conservation Manual for the Building Industry was prepared by David Bloome in 1983/84. Recommendations for the manual have been discussed with the Jamaica Institute of Engineers and the Jamaica Institute of Architects.

A committee from these associations has prepared a draft - "Addendum on Energy Conservation" for incorporation in the Jamaican Building Code.

A Public and Private sectors committee is now analysing the final documentation for initiation in the Jamaican Standards by the Bureau of Standards.

The Petroleum Corporation of Jamaica office building - Trafalgar Road was designed using the principles of this manual.

The project has financed an Automated system to measure energy savings as a result of the design which will form an important input into the Building Industry.

C. ALTERNATIVE ENRRGY1. SOLAR WATER HEATING

The overall project document proposed 25 solar hot water systems. To date the project installed 31 systems at a cost of J\$2.35 Million compared with the estimated cost of J\$4.09M. The Lionel Town Hospital system planned for completion during 1985/86 F/Y is incomplete due to labour unrest and closure of the site. Two systems are therefore planned in 1986 namely Lionel Town and Victoria Jubilee Hospital which will complete the programme.

PLANS FOR 1986/87

Installations: 2 - Lionel Town and Victoria Jubilee Hospitals.

Rehabilitation Programme: To rehabilitate any not-functioning units and complete handing over to the Ministry of Health.

SUMMARY

<u>Units</u>	<u>Completed at 31.3.85</u>	<u>Completed at 31.3.85</u>	<u>Project Total</u>
Hospitals	7	6	13
Edn. Institutions	5	1	6
Hotels	3	1	4
Health Centres	4	-	4
Markets	3	-	3
Office	-	1	1
	<u>24</u>	<u>8</u>	<u>31</u>
For Construction			2
Total			<u>33</u>

SOLAR HOT WATER SYSTEMS

S I T E	S I Z E O F S Y S T E M		Contract Sum J\$	A N N U A L S A V I N G S	
	Sq. Ft.	Gallonage		BOE	Cost US\$
a) <u>Hospitals</u>					
Annotto Bay	816	880	153,572	30.0	720
Falmouth	504	640	118,117	90	2160
Isaac Barrant	608	1120	71,625	108	3240
Linstead	660	648	81,616	65	1560
Mandeville	1334	1640	114,906	160.0	3840
May Pen	840	840	72,132	82	1968
National Chest	1240	1440	113,336	141	3384
Percy Junior	1536	1560	160,463	152	3648
Port Antonio	840	880	147,474	88	2112
Princess Margaret	960	1240	156,067	121	2904
Savanna-La-Mar	624	800	91,368	21	504
St. Anns Bay	1584	1620	121,303	35.0	1320
Spanish Town	1652	1920	134,717	188	4512
Lionel Town	640	720	Contract awarded		
Victoria Jubilee			Contract awarded		
	13,838	15,948	1,536,696	1301	31,872
b) <u>Edn. Institutions</u>					
Brooklyn T. Centre	216	240	23,640	23	552
Curphy Home	216	270	25,260	26	624
Jamaica Maritime	360	480	44,988	47	1128
Portmore (HEART) Centre	1824	1500	160,246	146	3504
Shortwood T. College	1024	1920	80,805	188	4512
Tivoli Gardens	192	240	23,803	23	552
	3,832	4,650	358,742	453	10,872
c) <u>Hotels</u>					
Royal Caribbean (2)	1920	2500	210,395	115	2760
Casa Montego	1512	2000	89,685	70	1680
Inn-on-the-Beach	512	1000	56,273	98	2352
	3944	4500	356,353	283	6792
d) <u>Health Centres</u>					
Stony Hill	96	120	6290	12	288
Mavis Bank	72	80	7285	8	192
Race Course	72	80	6940	8	192
May Pen	48	60	3287	6	144
	288	340	23,802	34	816

S I T E	SIZE OF SYSTEM		Contract Sum J\$	ANNUAL SAVINGS	
	Sq. Ft.	Gallonage		BOE	Cost US\$
e) <u>Markets</u>					
Old Harbour	96	120	8,350	12	288
Lucea	96	120	10,290	12	288
Chapleton	120	120	12,240	12	288
	312	360	30,880	36	864
f) <u>Offices</u>					
Jamaica House					
Kitchen		82	11,715	33	792
Laundry		200	31,146	80	1920
		282	42,861	113	2712
TOTAL		26,080	2,349.334	2,220	53,928

US\$ Savings calculated at US\$24/Barrel

US\$1.0 = J\$5.50

2. ENERGY CENTRE (C.A.S.T.)

The proposed programme for the 1985/86 financial year were;

- to expand the original concept of a Solar Energy Institute to an Energy Centre at CAST as well as continued developmental work in energy research.

DEVELOPMENT OF THE ENERGY CENTRE

A concept paper was prepared for the Centre by Dr. F. Mathews in collaboration with the Ministry of Mining and Energy, CAST and other agencies in the energy sector. The paper was also approved by USAID.

The formal opening of the Centre took place on November 1, 1985.

The main objectives were set as:

- i) education and training in the technology, economics, energy management and energy conservation systems;
- ii) applied research and cost-effective development in specific technologies and alternative energy;
- iii) the gathering, processing and dissemination of information to encourage the introduction and proliferation of alternative energy technologies.

Financial support for the Centre is projected as coming from CAST, support grants from Jamaican Agencies, international groups, MME (in the short term) and income generated by the Centre's activities such as tuition fees and consultancies.

ACTIVITIES

To date the activities of the Centre have been research oriented and launching out of marketing its products and services.

RESEARCH AND DEVELOPMENT

Solar Water Heating

- o Two model designs of low cost alternative systems were constructed with one undergoing testing and modifications.
- o One 800 gallon solar pond is in construction to develop shallow type solar ponds.

Solar Skills

A new design capable of producing 7.0 litres of distilled water per day is complete and ongoing testing. Two stills were installed in Montego Bay and Camperdown High Schools.

Concentrating Collectors

The acquisition of parabolic trough collectors and evacuated tube collectors has provided the Centre with the potential of constructing units of absorption type refrigeration and air conditioning. More short term applications are being examined as well as the feasibility of constructing and designing an absorption unit locally.

Solar Crop Drying

Drying experiments were conducted on specific crops with a high degree of public interests and requests including the following, ripe bananas, ginger, peppers, coconut flowers, copra, pimento and coffee. Data compilation includes, initial moisture content, percentage loss of crop during preparation, moisture content for safe storage, drying curves, packing density for drying, air flow resistance and maximum drying temperature.

A 540 ft² roof dryer prototype for large scale industrial dryers was completed, as well as investigation for the design and installation of a roof top dryer for Jamaica Frozen Foods.

Consultancy: There is one ongoing consultancy for the design of a lumber dryer.

Wind Energy

The centre began blade design for a 12' - 0" vertical axis wind turbine using available data from UWI and ^{the} Meteorological Office.

Training Courses

Training courses conducted or involving the Energy Centre during the year were:-

- | | | | |
|----|------------|---|---|
| 1) | June 17-21 | - | FAO workshop for Regional Extension Officers and Ministry personnel; |
| 2) | July 1-12 | - | Energy Symposium - Nine courses in Alternative Energy and Energy Conservation Technologies; |

- 3) September 2-3 - Caricom Energy Awareness Workshop;
- 4) September 30 - Oct. 11 FAO Workshop and Initial Processing of Agricultural Products;
- 5) November 1 - Seminar on Boiler Combustion Efficiency;
- 6) January 7-9 - Crop Drying Workshop on both Large and Small Industrial Dryers and Small Domestic Dryers with the University of Idaho.

PUBLIC RELATIONS

The activities of the Centre were publicised through the media i.e. Daily Gleaner, J.I.S., Jampress releases and radio and television network.

A meeting to emphasise the Role of USAID was held at CAST on January 28, 1986. The audience was addressed by the USA Ambassador to Jamaica Mr. Sotirhos, the Minister of Mining and Energy Hon. Hugh Hart, the Minister of Education Dr. Mavis Gilmour.

STUDENT PROJECTS

Final year engineering students are exposed to energy technologies through the following student projects.

- i) Charcoal Kiln Design; design and construction of efficient charcoal kilns.
- ii) Energy Audit; determination of Energy Conservation opportunities by energy audit of CAST buildings and facilities.
- iii) Heat Recovery System; the design, construction and installation of refrigerant vapour to water heat exchanger for the Canteen using waste heat from refrigeration system.
- iv) Gasohol; design and construction of still to produce alcohol for motor fuel, demonstration will be for use in the Centre's vehicle.
- v) Wind Energy Measurement Tower; design of a portable tower for wind measurement.
- vi) Shallow Solar Pond; design and installation of Shallow Solar Pond (800 gallons) for the male dormitory.
- vii) Energy Controller; construction of mechanically operated switch ("Key Card") adaptable to the typical wall switch.

- viii) Material Testing; using coir waste as insulator for solar hot water systems.
- ix) Power Inverter; to construct a 1000 watt sinusoidal output 12VDC to 110VAC inverter of high conversion (85%) efficiency.
- x) Parabolic Concentrator; to construct a parabolic mirror concentration of 1000:1, and assess applications of its use.
- xi) Appliance Energy Use; to determine the actual energy use of different home appliances i.e. stoves, irons, etc.
- xii) Control System for Solar Test Rig; to design and construct a control system for the automatic control of the flow rate and temperature of water cycled through a solar collector under test.

3. STANDARDS LABORATORY

The Ministry of Mining, Energy and Tourism (MMET)/USAID approved the contract for laboratory equipment acquisition. However, major delays occurred in contract changes when USAID revealed that their policy was to use AAPC Inc. as the purchasing agents. The original contract proposal had specified that DSET Inc. be given that responsibility.

Delays are still being experienced because of revisions being done to the project. Presently, consideration is being given to drastically reducing the equipment previously allocated to the Solar Laboratory.

The Solar Laboratory has not yet been fully established and consequently **testing of solar collectors and solar water heater systems have not yet commenced**, based on Solar Collector Thermal performance.

The Technical Secretary to the Solar Energy Committee had submitted to the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) a request for permission to adopt/adapt ASHRAE's systems. We have since obtained approval from ASHRAE and therefore the Solar Energy Committee will now be able to review the standard with a view to adoption.

Work in the area of Solar Collector and solar water heater systems product certification is contingent on test equipment arrival, set up and commissioning.

Our ambitions for the completion and submission to Standards Council of the draft safety requirements were not fully realized. However, the draft standard on Safety Requirements for the Manufacturing and Installation of Solar Water Heater Systems is approximately 60% complete.

The proposal for instituting the manufacturing of window type air conditioning units of certain minimum efficiency for submission to the Legislative Arm of Government has not yet been drafted by the Solar Energy Committee. This proposal is in keeping with the Laboratory's intention of being at the forefront in encouraging more efficient electrical appliances. Work in the broad areas of refrigeration and cooling systems testing is being planned.

Continued Activities Planned

1. Have national standard on Thermal Performance Test Methods edited, gazetted and available for public comments.
2. Progress to completion/^{of}the draft standard on Safety and Installation requirements for Solar Water Heater Systems.
3. Acquire research documents for window air conditioning units test methods for presentation to Solar Energy Committee.
4. Obtain approval and funding from MMET for fabricating 1200 imperial gallon water tank and proceed to have the tank in place before the end of this quarter.
5. (i) Obtain detailed requirements of electrical power supply needs for the Solar Laboratory and proceed to invite Class C electrical contractors to effect necessary modifications.
(ii) Submit Bureau of Standards' recommendations based on quotations received for electrical modifications to the Solar Laboratory to MMET for their approval and release of funds.
6. Make investigation on proposals received by the Solar Laboratory from private manufacturers concerning the manufacture of solar stoves. Have Solar Energy Committee discuss this.

Review of the Quarter January - March 1986

- a) The Standard on Thermal Performance Test Methods has already been approved by the Minister of Industry and Commerce and is now being edited by the Bureau of Standards.
- b) The Standard on Safety and Installation requirements for Solar Water Heater Systems is now approximately 60% complete.
- c) MMET has already approved our submission for the fabrication of the 1200 imperial gallon tank needed for the Solar Laboratory. However, we have not yet received funds to proceed to have the tank in place.

- d) Research documents for window type air conditioning units test method was not acquired and presented to the Solar Energy Committee. Efforts to acquire research documents are still being made.
- e) Details of electrical power supply needs for the Solar Laboratory was obtained from DSET Laboratories Inc. Final arrangements will be made in the first quarter April - June 1986 to effect the necessary electrical modifications.
- f) Investigations were done and a report written on the recent submission by a local manufacturer on certain designs of solar stoves.

4. IMPROVEMENT OF METEOROLOGICAL DATA

Objective: To assess meteorological data i.e. solar radiation and wind regimes which may be applicable in energy development. The analyses are conducted by the Meteorological office in association with the Physics Department of U.W.I., and CAST for the Ministry of Mining and Energy.

Achievements: Eleven meteorological stations have been established through the project with monitoring including eleven (11) other stations established by the PCJ, Alcan and Knockalva and the Meteorological Office.

NetworkSolar Radiation

<u>Site</u>	<u>Global</u>	<u>Diffuse</u>	<u>Direct</u>
1. Duckenfield	X		
2. Manley International Airport	X	X	X
3. Orange River	X		
4. Bodles	X		
5. Worthy Park	X		
6. Discovery Bay	X		
7. Allsides	X		
8. Crawford	X		
9. Sangster International Airport	X	X	X
10. Smithfield	X		
11. Cinchona	X		
12. Knockalva	X	XXX	
13. Alcan (Mandeville)	X	XXX	
14. Black River (PCJ)	X		
15. Negril (PCJ)	X		

X In operation

XXX To be activated

<u>Site</u>	<u>Direction</u>	<u>Speed</u>
Duckenfield	XXX	XXX
Folly Point Lighthouse		X
Manley International	X	X
Hellshire		X
Orange River		X
Portland Pl. Lighthouse	XXX	XXX
Coleyville		X
Spur Tree		X
Munro		X
Discovery Bay (instead of Galina)		XXX
Rose Hall		XXX
Sangster International	X	X

X - in operation

XX - to be reactivated

XXX - to be activated

Stations for re-activation resulted from disturbance in power outages resulting in interruption of measurements. Standby power source through the use of batteries is being used to minimize this effect.

In association with the Meteorological Office analyses by the Physics Department, U.W.I. have indicated the following potentials.

<u>STATION</u>	<u>% lime speed Cut-in Cut-out</u>	<u>Annual Energy by KEDCO 1605 Kwh</u>	<u>% wind Energy Available</u>	<u>Years of evaluation</u>
Bodles	25	140	26	4.2
Crawford	20	100	23	3.3
Manley	50	670	20	19.9
Mason River	30	130	25	1.2
X Morant Point	80	1750	26	1.7
Sangster	45	590	23	19.8
X Discovery Bay	65	1160	12	0.1
Fairy Hill	60	620	22	0.1
X Flagman/Munroe	80	2090	24	0.4
Fullerswood	10	40	19	0.2
X Hillside	80	1870	22	0.07
Passley Garden	55	468	23	0.2
X Pimento Hill	80	1960	24	0.6
X Vinery	70	930	26	0.3
X Yallahs	80	1640	27	0.3

The table shows that there are some sites (X) with potential but longer periods of evaluation are required. Other parameters of interest are diurnal variation and direction of the wind which peaks in the early afternoon and is lowest at nights.

The complete publication of the improvement in meteorological data through the project is being prepared by the Meteorological Office.

5. ALTERNATIVE ENERGY DEMONSTRATION CENTRE - KNOCKALVAObjectives

To integrate Alternative Energy technologies in the school's curriculum and to demonstrate and disseminate these technologies to students and the rural community.

Achievement at 31.3.86

Activities at the Centre started in September 1984 and achievements include the following:

- o Construction of workshop
- o Purchase of tools and equipment for the workshop.
- o Provision of literature materials for library.
- o Installation of pyranometer for solar radiation.
- o Demonstrations in
 - water pumping (wind pumps)
 - water heating - solar stills and solar water heaters.
 - photovoltaic - solar pumping of water.
- o Preparation of curriculum.
- o Construction of two solar water heaters.
- o Construction of two portable biogas digesters.
- o Generation of biogas from plastic digesters.
- o Partial establishment of Meteorological Station.
- o Establishment of 6.0 acres of fuelwood plantation (of acacia, calliandra, casuarina and leucaena).

Courses in Energy Technologies are now firmly established in the school's curriculum. Practical classes for the Spring Term for second and third year students are set at 45 hours each month for April to June, while work is in progress for the Theoretical Time Table for the 1986-87 academic year.

6. FUELWOOD PROGRAMMEObjectives

- o To encourage and promote the establishment and utilization of fuelwood as a energy source;
- o To determine most suitable species of fuelwood in relation to soil types, climatic conditions and productivity;
- o Establish investigatory fuelwood plots.

Achievements

Establishment of Plots: Approximately 25 acres of fuelwood planted as follows:

<u>Site</u>	<u>Acreage</u>	<u>Species</u>
Long Pond	15.0 acres	Leucaena, calliandra, cassia, casurina
Richmond	6.0 acres	Calliandra, Acacia
Knockalva	1.5 acres	Calliandra, Leucaena
Others	<u>2.5 acres</u>	Calliandra, Leucaena
	25.0	

Growth Assessment

Observed growth statistics are as follows:

<u>Site</u>	<u>Specie</u>	<u>Age (mths)</u>	<u>Ht.(m)</u>	<u>Dia(cm)</u>
<u>Long Pond</u>	Leucaena	18	3.46	3.0
	Calliandra	18	5.00	3.3
	Cassia	18	2.80	3.0
<u>Hampden</u>	Leucaena	18	5.34	4.2
	Calliandra	18	4.15	3.1
<u>Richmond</u>	Calliandra	15	3.90	6.0
	Cassia	18	4.30	7.0
<u>Knockalva</u>	Leucaena K8	21	6.5	5.2
	" K67	21	6.13	4.8
	Acacia	19	6.31	5.5
	Casaurina	20	4.73	3.8
	Calliandra	21	5.65	4.1

Diameters are measured 50cm above ground level. *Leucaena* is doing better at Hampden and Knockalva a reflection of better site conditions compared to Long Pond. *Calliandra* is fairly consistently productive being less site specific and more aggressive. *Acacia* is doing remarkably well at Knockalva. The results though preliminary substantiates previous growth data obtained by the Forest Department.

Long Pond Project

The Long Pond Project proposing the establishment of 500 acres of fuelwood for use as energy source to be funded directly by USAID and Long Pond has been cancelled by the USAID.

Collaborative Works

Research Efforts

Close working relationships have been maintained with the Forest Department in the following areas.

- a) Nursery activities - to standardize nursery practices for growing fuelwood seedlings in terms of proper seed treatment correct potting mixtures and proper care and maintenance of nursery stock. Efforts are also geared at keeping costs down so as to produce seedlings cheaper.
- b) Plot assessments - although no additional plots are established by the department - work was done in monitoring established plots - in terms of assessment of height, growth and biomass yield. Experiments that have run their stipulated term (5 years) are now being evaluated and will be statistically analysed.

There are clear indications that on the sites where plots were established, consistent growth can be expected up to year 3, after which increments begin to decrease. This suggests that harvesting could be done from 3 years for firewood. For charcoal production however, it might be necessary to allow another two years for densification and lignification of the wood.

- c) An interesting subsidiary to the use of fuelwood trees is the possibility to introduce them to farmers primarily for use as yam poles. After 1-2 years these poles can be used as firewood. As an extension outreach this seems to be the way to get farmers involved in planting fuelwood trees. Also, the foliage from *Leucaena* and *Calliandra* so grown can be fed to livestock. A pilot project is being looked at in the south Trelawny area where yams are the predominant crops.
- d) Species trials - In spite of the few strides made in terms of fuelwood development there still remains the need to investigate new exotic and local species for adaptability and tolerance especially in the drier southern and central areas for charcoal production. A list of species and sites are being compiled jointly with the Forest Department as a long term research idea.

Methane Production

The process of methane generation from *Leucaena* foliage got some focus during the year. Colloberative work with a local firm and MMET sought to boost investigation of this technology at a larger scale than previously done. Excited and interested participants were identified but again funding curtailed activities in this area.

Intense investigations in this area of biomass conversion is being done in many places and warrants all the local support possible.

7. ASSESSMENT OF ALTERNATIVE ENERGY RESOURCES

BODLES AGRICULTURAL RESEARCH STATION

Objectives To assess the potential of utilizing renewable energy resources, design and construct the plant to provide a self-sufficient energy system to the Research Station.

Achievements

- o Assessment of energy requirements for lighting and pumping or irrigation water.
- o Detail design of a System I, utilizing three Digesters and the available biomass generated by the Piggery and livestock facilities to provide lighting requirements.
- o Design of System II for remaining energy requirements, including identification of land resources to provide fuelwood to meet this demand.

The original concept was developed with the understanding that financing for the project would be through USAID local funding. System I was sent to Tender from prequalified contractors. The meeting of Instruction to Tenderers was attended by USAID representative (Dr. F. Ahimaz).

The contract for construction of System I was approved by the GOJ Contracts Committee for J\$711,655.71.

However with the present stance of USAID not to support developments of this nature, the project is now in abeyance.

The Ministry will therefore seek alternative funding to proceed with this project.

D. INFORMATION AND PUBLICATION1. ENERGY INFORMATION CENTRE (EIC)OBJECTIVES

1. Continue automated storage and retrieval of information.
2. Train Network members and Ministry staffers.
3. Continue developing the Energy Information Network.
4. Participate in the Energy Symposium '85.
5. Provide an efficient information service.

ACTIVITIESAutomation Project

Ruhl Information Inc. continued to assist with the development of the programme and visited the Ministry on four occasions during the year, from May 20-22, July 29 to August 14, October 22-24 and January 27 to February 11.

Staff and network members were trained during these periods and the database was brought into use.

During May the decision was made to use INMAGIC Software developed by Librarians for use in a database. During the July trip, a beginning was made for the input of data into the database toward a national energy bibliography. In October the search techniques and housekeeping formulae were developed and in January the Ruhl team developed the method for producing catalogue cards for the library stock on the computer. Two seminars, attended by 40 persons to introduce the users to the database were also organized during this visit on Friday, February 7 and Monday February 10. Four Hundred and Seventy One entries have so far been recorded into the computer for the national energy biography.

Collection Development

The library's stock grew by 76 to a total 4,378 during the year. There continued to be problems with the ordering and receipt of materials under the USAID scheme and towards the end of the year there was a suggestion that the facility of ordering through the American Overseas Book Company should cease. Several booklists were compiled and two were done for the Energy Symposium - 'Energy Conservation' and Solar Energy'.

Service

Users continued to find material in the library and a User Survey was designed to find the needs of users. The results are still not finalized. 1,542 books and other material were loaned to 812 readers during the year.

Students of the CXC exam found the Energy related materials useful as did consultants working on Energy Projects. A group of computer students from CAST visited to learn about the library management software, INMAGIC with a view to using it in their Energy Centre.

Personnel

The Centre suffered from serious setbacks due to the frequent staff turnover:-

Miss C. Dougherty - Librarian	Resigned September 2
Mr. P. Green - Abstractor/Indexer	Resigned October 1
Miss E. Peck - Library Assistant	Resigned February 5
Mrs. A. Lemard - Typist	Resigned January 31
Miss B. Mullings - EIC/Project Co-ordinator	Resigned May 23

New Arrivals

Miss D. Howell - Abstractor	November 11 who resigned March 31, 1986
Miss S. Hamilton - Typist	February 6
Mrs. M. Scott-Thomas - Administrator	April 1

Symposium '85

The library contributed staffing and other assistance at the Ministry's 1985 symposium.

Training

There were three training sessions under the Ruhl agreement and personnel from six libraries in the network received training on database development and management of the software. The courses were held:-

May 20 - 22	venue MMET
July 22 - 24	venue CAST
October 7 - 9	venue CAST

Four members of the Ministry's staff went on a ten day tour of New York and Washington to attend the National Online Conference and visited software manufacturers as well as other Energy related organizations. Members were: -

Blossom Mullings (Library)
 Chloe Dougherty (Library)
 Barbara Chevannes
 Courtney Jackson

It was during this trip that with Dr. Batty's assistance a decision was made to use the INMAGIC Software. The opportunity was also taken to clarify some of the American Overseas Book Company ordering problems. Other training received by the Ministry's personnel were as follows:-

B. Mullings	- Information Technology for Today by Department of Library Studies
P. Green	- Abstracting - Planning Institute (half day)
A. Gordon	- Conversational Spanish - Language Training Centre (MPS)
C. Dougherty & P. Green	- Computer Course at DATAMAC May 2 - July 26
B. Mullings	- Printery Course - January - February 1986.

Administration

The staffing resignations left a virtual crisis in the administration of the library as the Librarian, Library Assistant, Typist, Abstractor/Indexer and finally the Project Co-ordinator resigned. Of two replacements employed to date one, Miss Doreen Howell Abstractor/Indexer has since resigned. Part-time assistance has had to be found to assist in continuing the service. Miss M. Diaz - part-time Indexer, Miss J. Vernon part-time Classifier/Cataloguer and Miss E. Peck part-time Database Assistant.

Assistance to Library

The Information Centre continues to offer services to EXED and the UWI. Fieldwork was done by Miss Joy James of EXED from April 22-May 31 and Mr. Ramnouth Sookraj of the UWI Library Studies Department for a six week assignment during the summer holidays.

Network

The libraries in the network continue their co-operative exercises and there were meetings to discuss problems on September 27, January 10 and February 5.

Network members were circulated with new guidelines and items for their input into the database has begun. In furthering the network activities, visits were made between ALCAN, JNIP, Building Research Institute, PCJ and JLS for further information on the software being used by the Energy Information Centre. Miss Mullings addressed the ALCAN staff workshop on activities in the Automation Process.

Science and Technology Institute (STIN)

The Centre Co-ordinator participated in STIN meetings especially the planning of a Repackaging of Science and Technology Information Seminar planned for March 1986 which one member of staff attended - Miss Howell. Miss Chevannes was Chairperson for a panel discussion at this seminar

ENERGY INFORMATION CENTRE
APRIL 1985 - MARCH 1986

STATISTICAL RECORD

	<u>1 st</u> <u>QUARTER</u>	<u>2 nd</u> <u>QUARTER</u>	<u>3 rd</u> <u>QUARTER</u>	<u>4 th</u> <u>QUARTER</u>	<u>TOTAL</u>
Books loaned	95	104	74	127	400
Journals loaned	90	97	96	103	386
Pamphlet loaned	2	-	-	-	2
Other	1	1	1	-	3
Reference books used	172	167	211	68	618
Photocopies supplied	49	12	39	33	133
Total circulated	409	381	421	331	1,542
Enquiries satisfied	50	28	40	22	140
Books added	44	32	-	-	76
Pamphlets added	6	-	-	-	6
Current awareness	12	-	-	-	12
Gifts recieved	26	-	30	12	68
Indexed	28	-	-	-	28
Catalogued and Indexed	-	59	-	-	59
Clientele	193	207	239	173	812

Visits

The following visits are recorded:

The regular visits of the Ruhl Management team is recorded also the visit of Mr. W. Joslin, the new USAID director in December, also the team evaluating the USAID Project in November and Dr. A. Cruz of OLADE.

Future Plans

Continue the development of the database. Improve the critical staff situation and the service to readers. Expansion of the Energy Focus into a Ministry Focus.

2. ENERGY EDUCATION

During the financial year the energy education continued the programme of creating awareness in energy conservation and alternative energy technologies and highlighted these activities at the Energy Symposium and three (3) major exhibitions.

Advertising

Very little advertisement through the electronic media were done during 1985/86. Advertisement for the Energy Symposium and programmes of the Energy Centre were channelled through the Unit.

Mobile Unit

Thirty-four (34) lecture demonstrations and Audio Visual programmes were conducted during the year.

Video Productions

Completed two (2) video films i.e. "Alternative Energy in Jamaica" (20 minute video) and "Energy Credit Fund" (12 minute video).

Other films currently in production are -

"The Energy Centre"

"The Energy Audit"

"Tivoli Gardens Desalination Plant, and Lucky Valley" ($\frac{1}{2}$ hour video) to be aired on JBC Television.

Exhibitions

The programme prepared three (3) exhibitions in 1985/86 namely -

- o Solar Crop Drying - Denbigh Agricultural Show - August 3-5;
- o Public Utilities Expo - Energy Efficiency - Transportation and Electricity Nov. 8 - 16, 1985;
- o JMA/JEA Expo - The Energy Audit - A prescription for energy efficiency March 14-23, 1986.

Publications - include the following:

- Energy Symposium material, brochures, programme and Gleaner Supplement
- 1986 Calendar
- Energy in Jamaica (an update of the Jamaica energy situation)
- Energy Coordinators Manual - (L. Nelson)

- Energy News (12 issues)
- Conserve - Conservation in Lighting
- "Scope" (quarterly publication by JIS).

During the year 20,797 booklets were distributed and \$1,736 collected for materials sold to the public.

Billboards

Billboards now in place are:

Kingston Metropolitan Area	-	6
Rural areas	-	3
Bus Shelters	-	6

Message - "Conserve - keep some in reserve".

Requests

Requests for materials and technical assistance received from organizations and groups as follows -

- o FAO - assistance in organizing activities
- o UNDP and Building Research programme formulation
- o UN University - the use of mobile unit in Biogas programme for farmers
- o Capelton Jones and Co. energy conservation information for energy savings in hotels
- o OAS - Energy Fair - schools programme for the Caribbean
- o Display boards on loan to ICWI, SRC, Shell Co. and NRCD
- o CAST - Energy awareness workshop

Staffing

Two resignations from staffing occurred during the year.

Mr. S. Taylor, Graphic Artist and Mrs. S. Austin, Media Specialist.

Miss Nova Gordon has assumed the duties of Media Specialist.

Mr. C. Gerke, Peace Corp was attached to the section in July 1985.

Training

Short Courses and Seminars attendance for staff members of the section were:

N. Gordon		Coal Seminar
N. Gordon		CODE - Writers Course
B. Chevannes		" " "
M. Hall)	
S. Taylor)	Video Production Course
G. Brown)	

G. Brown	Photographic
B. Chevannes	Accounting and Budgeting
C. Gerke	Energy Symposium Training Courses and Solar Crop Drying
A. Williams	Solar Crop Drying
E. Maddan	Computer - Basic

56.
LECTURE/DEMONSTRATION BY EEU
1985/86

<u>DATE</u>	<u>PLACE</u>	<u>TOPIC</u>	<u>AUDIENCE</u>
25/4/85	Mo-Bay Community College	Energy Conservation	200 Students
25/4/85	Knockalva Agricultural School	Alternative Energy	160 Students
8/5/85	Naggo Head Primary	Energy Conservation	750 Students
14/5/85	Min. of Agriculture, May Pen.	Conservation and Agriculture	70 Field Exten- Officers
19/6/85	FAO Workshop	Conservation and Use of Cook Stoves	15 Extension Officers
9/7/85	Kingston Technical High School (HEART Students)	Conservation and Alternatives	45 Students
9/7/85	North Street Excelsior	Energy Conserva- tion	110 Students
15/7/85- 19/7/85	Energy Symposium '85 (at UWI)	Varied Topics	400 Students
26/7/85	CMP Warehouse Sale	Energy Conserva- in the Home	200 Students
1/8/85	Charlemont (HEART)	Energy Conserva- tion and Alter- native Energy	20 Students
6/8/85	St. Catherine High School	"	35 Students
6/8/85	Jonathan Grant Secondary	"	25 Students
2/8/85- 5/8/85	Denbigh Agricultural Show	"	3000 Persons
9/8/85	New Testament Church, Bull Bay.	Energy Conserva-	150 Persons
28/8/85	Jamaica Telephone Co. Training Division	Driver Educa- tion	30 Persons
3/9/85	Mamby Park Baptist Church	Energy Conserva- tion	10 Persons
12/9/85	Energy Coordinators' Association	Slide Package	20 Persons
29/9/85	St. Andrew High School	Alternative Energy	50 Persons
8/10/85	Food Specialities	ECO's	13 Persons
9/10/85	CAST Energy Centre	Alternative Energy Slide Package	30 Persons

		57.		
4/10/85	St. Andrew High School	Energy Conservation	75	Persons
15/10/85	Food Specialities Ltd.	Energy Conservation	17	"
21/10/85	Anglican Church Fair, Lyssons	Films - Video Alternative Energy Conservation	2000	"
22/10/85	Food Specialities	Energy Conservation	12	"
31/10/85	Millbank Community Centre	Energy Conservation and Cookstoves	80	"
31/10/85	Portland Parish Library	Energy Conservation	20	"
1/11/85	Passley Gardens Teachers' College	Energy Conservation	200	"
9/11/85- 16/11/85	Public Utilities Expo	Varied Programme	10,000	"
14/11/85	St. Andrew High School 'Open Day'	Film	200	"
4/12/85	CVSS Women's Section	Energy and Jamaica	10	"
13/12/85	School of Nursing UWI - Mona	Energy in the Home	75	"
14/12/85	Teachers' Coop. C.U.	Energy and You	25	"
9/1/86	Energy Coordinators' Association	Energy Story	12	"
28/1/86	Above Rocks Science Group	Energy Conservation	34	"
29/1/86	Ministry of Works (Seminar)	Energy and Trans- portation	40	"
22/2/86	Land Surveyors' Wives Ass.	Energy Conserva- tion	24	"
13/3/86	Energy Coordinators'	Energy Audit	14	"
14/3/86- 23/3/86	National Arena	Energy Audit	3000	"

PUBLICATIONS DISTRIBUTED FROM 1.4.85-31.3.86

Energy Saving 1	-	582
Energy Saving 2	-	1803
Energy Saving 3	-	1948
Energy Saving 4	-	2474
EE Compressed Air Systems	-	1497
EE Steam Boilers	-	1423
EE Electric Motors	-	532
Purchase and Maintenance of Electrical Appliances	-	900
Guide to Solar Energy	-	2322
Guidelines for Energy Coordinators	-	1007
Energy Saving Guide for Coordinators	-	1209
How About Biogas	-	300
Switch Off Stickers	-	2182
Fireless Cooker	-	220
Conserve	-	426
Ease Up On The Gas	-	1752
Ja. National Energy Policy and Programme	-	138
Career in Energy	-	14
Energy Tips	-	<u>68</u>
		20,797

\$

282 Do It Yourself Biogas @ \$2 ea.	=	564
229 Solar Hot Water @ \$2	=	458
82 Solar Crop Dryer @ \$2 ea.	=	164
15 Construction Manual @ \$20 ea.	=	250
25 Energy Management Handbook @ \$12 ea.	=	<u>300</u>
		\$1,736

EXPENDITUREProject Budget 1981

US\$ Estimate of Expenditure (by USAID) US\$7.5M = J\$13.35M

GOJ Estimate of Expenditure = US\$10.168M = J\$18.099M

- a) The original budget for USAID expenditure was US\$7.5M.
This was subsequently reduced to US\$6.5M by deobligating US\$1.0M.
At March 31, 1986 expenditure was US\$3,186,144.10 (= J\$12,670,494)
or 52.5%.
Amount presently unexpended = US\$3,413,856.00 (at 31/3/86).
- b) As a consequence of the deobligation of US\$1.0M the GOJ expenditure
is reduced to approximately US\$8.5M.
At March 31, 1986 GOJ expenditure is J\$11,990,700.00 or
US\$3,366,350.01 or 40% using the weighted average rate of exchange/
quarter/year.

USAID/GOJ ENERGY SECTOR ASSISTANCE PROJECT
STATEMENT OF EXPENDITURE FOR QUARTER ENDING MARCH 31, 1986

Description of Service	Allocation of Voted Provisions	1st Quarter April - June	2nd Quarter July - Sept	3rd Quarter Oct - Dec	4th Quarter Jan - March	Outstanding Advances	Expenditure Plus Advances	Balance
PUBLIC SECTOR								
1. Programme Planning & Development	812,595.00							
a. Staff Emoluments		96,197.29	71,087.06	147,570.15	149,051.49	641.48	464,547.47	
b. Training		21,158.15	31,469.47	3,994.40	23,722.90	-	80,344.92	
c. Energy Information Centre		1,624.42	1,616.82	2,914.93	3,233.80	-	9,389.97	
d. Energy Surveys		6,500.00	-	-	15,000.00	-	21,500.00	
e. Economic Planning		-	150.00	-	-	-	150.00	
f. Administrative Expenses		9,003.91	12,615.75	(72,709.32)	132,245.32	-	81,155.66	
g. Equipment and Supplies		-	825.00	13,784.22	749.62	9,316.38	24,675.22	
h. Vehicle Maintenance		23,111.30	7,381.56	18,672.47	11,323.77	-	60,489.10	
Total = \$	821,595.00	157,595.07	125,145.66	114,226.85	335,326.90	9,957.86	742,252.34	70,342.66
2. Energy Conservation - Public Ed.	787,900.00							
a. Services		12,175.66	56,283.29	63,337.28	9,711.85	56,729.00	198,237.08	
b. Mobile		-	-	1,780.92	642.93	-	2,423.85	
Audit and Retrofitting								
c. Retrofitting - Capital Fund		102,013.37	19,706.18	92,042.20	276,430.17	500.00	490,691.92	
Total \$	1,787,900.00	114,189.03	75,989.47	157,160.40	286,784.95	57,229.00	691,352.85	96,547.15
3. Alternative Energy	1,499,505.00							
a. Solar Water Heating		190,873.21	102,692.99	453,983.94	377,628.50	-	1,125,178.64	
b. Standards for Solar Industry		35,767.02	-	18,494.25	7,600.00	-	61,861.27	
c. Energy Centre - CAST		9,375.00	-	51,758.98	98,065.99	-	159,199.97	
d. Bio-Energy		8,094.24	6,913.50	6,665.10	29,973.44	-	51,646.28	
e. Assessment of Alt. Eng. Res.		35,521.00	250.00	16,800.00	25,074.00	-	77,645.00	
f. Alt. Energy. Demo. Centre		-	15,973.00	13,935.14	2,278.11	20,034.37	52,220.62	
g. Improvement of Met. Data		8,797.71	12,670.25	10,625.65	15,426.24	13,160.43	60,680.28	
Total	1,499,505.00	288,428.18	138,499.74	572,263.06	556,046.28	33,194.80	1,588,432.06	(88,927.06)
Grand Total	3,100,000.00	560,212.28	339,634.87	843,650.31	1,178,158.13	100,381.66	3,022,037.25	77,962.75

PROJECT ACCOUNTANT

DATE

PROJECT DIRECTOR

DATE

GOJ EXPENDITURE J\$

ACTIVITY	YEAR					TOTAL AT 31. 3. 86
	1981/82	1982/83	1983/84	1984/85	1985/86	
A. PROGRAMME PLANNING						
Administration and Expenses	170,651.15	529,466.07	683,070.96	715,820.93	720,865.39	2,819,874.5
Training	-	8,589.19	344,463.28	31,509.51	80,294.92	464,856.9
Economic Planning	-	1,500.00	7,288.00	7,918.00	150.00	16,856.0
Energy Surveys	-	89,261.45	287,027.00	45,820.00	21,500.00	443,608.45
<u>Sub Total</u>	<u>170,651.15</u>	<u>629,111.71</u>	<u>1,320,749.20</u>	<u>801,069.14</u>	<u>822,810.31</u>	<u>3,744,391.5</u>
B. ENERGY CONSERVATION						
Audits & Retrofits	-	27,762.25	876,473.76	728,287.71	490,191.92	2,122,715.6
Conservation Manual	-	-	12,413.22	-	-	12,414.22
<u>Sub Total</u>	<u>Nil</u>	<u>27,762.25</u>	<u>888,890.98</u>	<u>728,287.71</u>	<u>490,191.92</u>	<u>2,135,132.9</u>
C. ALTERNATIVE ENERGY						
Solar Water Heating	-	12,256.75	870,779.80	790,007.39	1,125,178.6	2,802,222.5
Solar Standards	-	52,043.47	188,779.66	391,041.24	61,861.27	693,725.64
Met. Data Imp't	-	-	48,664.45	53,640.00	47,519.85	149,824.7
Training Solar Installers	-	6,250.00	-	14,527.83	-	20,777.83
Energy Centre CAST	-	1,094.43	19,640.51	28,125.00	159,199.47	208,089.41
Solar Crop Drying Assessment Al.	-	-	-	5,438.25	-	5,438.25
Energy - Biogas	-	250,000.00	-	-	-	250,000.00
- Bodles Project	-	-	-	51,000.00	77,645.00	128,645.00
- Fuelwood	-	34,724.38	-	20,872.21	51,646.58	107,243.17
- Alt. Energy Dem. Centre	-	5,656.00	3,815.00	131,779.57	32,186.99	173,437.56
<u>Sub Total</u>	<u>Nil</u>	<u>326,025.03</u>	<u>1,135,679.48</u>	<u>1,486,452.30</u>	<u>1,555,237.8</u>	<u>4,539,394.5</u>
D. INFORMATION & PUBLIC EDUCATION						
Energy Inf. Centre	-	27,562.66	3,066.50	18,678.53	9,389.97	58,697.66
Public Education	-	501,592.07	679,075.85	188,482.49	143,932.53	1,513,082.9
<u>Sub Total</u>	<u>-</u>	<u>529,154.73</u>	<u>682,142.35</u>	<u>207,161.02</u>	<u>153,322.5</u>	<u>1,571,780.6</u>
TOTAL	<u>170,651.15</u>	<u>1,548,053.92</u>	<u>4,027,458.99</u>	<u>3,222,970.36</u>	<u>3,021,563.8</u>	<u>11,990,700</u>
* Exchange Rate	1.78	1.78	1.78, 1.78 2.39, 3.31	3.97, 3.95 4.70, 5.05	5.53, 5.80 5.50, 5.50	
US\$ Equivalent	<u>95,871.43</u>	<u>869,693.20</u>	<u>1,682,832.20</u>	<u>737,953.18</u>	<u>549,375.24</u>	<u>3,915,725.2</u>
* Exchange Rate =	Weighted Average/Quarter/Year					

EXPENDITURES - USAID/GOJ ENERGY SECTOR ASSISTANCE PROJECT

LOAN 532-W-016 PROJECT NO. 532-0065

F/YEAR		QUARTERS				TOTAL	CUMULATIVE TOTAL
		APRIL-JUNE	JULY-SEPT.	OCT.-DEC.	JAN.-MARCH		
1981/82	GOJ - Expenditure				170,651.15	170,651.15	170,651.15
	Exchange Rate				1.78		
	US\$ Equivalent				<u>95,871.43</u>	<u>95,871.43</u>	<u>95,871.43</u>
	US\$ Expenditure				2,504.00	2,504.00	2,504.00
	J\$ Equivalent				4,457.12	4,457.12	4,457.12
1982/83	GOJ - Expenditure	186,785.78	229,244.87	272,381.35	859,641.92	1,548,053.92	1,718,705.07
	Exchange Rate	1.78	1.78	1.78	1.78		
	US\$ Equivalent	104,935.88	128,789.20	153,023.23	482,944.90	869,693.21	965,564.64
	US\$ Expenditure	76,071.00	123,960.00	171,874.00	72,179.00	444,084.00	446,588.00
	J\$ Equivalent	135,406.38	220,648.80	305,935.72	128,478.62	790,469.52	794,926.64
1983/84	GOJ - Expenditure	740,505.67	743,295.16	851,117.41	1,692,540.75	4,027,458.99	<u>5,746,164.06</u>
	Exchange Rate	1.78	1.78	2.39	3.31		
	US\$ Equivalent	416,014.42	417,581.55	356,116.07	511,341.62	1,701,053.66	<u>2,666,618.30</u>
	US\$ Expenditure	183,945.00	313,025.00	167,817.00	153,093.00	817,880.00	<u>1,264,468.00</u>
	J\$ Equivalent	327,422.10	557,184.50	401,082.63	506,737.83	1,792,427.06	<u>2,587,353.70</u>
1984/85	GOJ - Expenditure	913,781.33	674,083.72	706,027.11	949,497.42	3,222,970.36	8,969,134.42
	Exchange Rate	3.97	3.95	4.70	5.08		
	US\$ Equivalent	230,171.61	170,654.10	150,218.53	186,908.84	737,953.18	3,366,350.01
	US\$ Expenditure	94,014	116,614.25	109,092.26	534,393.55	854,114.06	2,090,781.10
	J\$ Equivalent	373,235.58	460,626.29	512,733.62	2,714,719.20	4,061,314.7	6,645,997.2
1985/86	GOJ Expenditure	560,212.20	339,636.29	843,650.31	1,178,158.1	3,021,563.8	11,990,700.00
	Exchange Rate	5.53	5.80	5.50	5.50		
	US\$ Equivalent	101,304.19	58,557.81	153,390.97	214,210.56	549,375.24	3,915,725.2
	US\$ Expenditure	193,296.76	282,446.25	211,131.00	408,489	1,095.363	3,186,144.1
	J\$ Equivalent	1,068,931.10	1,638,188.3	1,161,220.5	2,246,689.5	6,024,496.5	12,670,494