PD-AAR-056 39315

PROJECT PAPER
ASIA REGIONAL

ASEAN
ENERGY III - Energy Conservation and Management

FEBRUARY 1985

ASEAN ENERGY III -- ENERGY CONSERVATION AND MANAGEMENT (498-0285)

TABLE OF CONTENTS

Page No.

Project Paper Facesheet i
Project Authorization ii

I. Project Summary and Recommendations

A. Recommendations 1
B. Summary Project Description 1
C. Summary Findings 3
D. PID Review Concerns 5

II. Project Background

A. Problem 6
B. ASEAN-US Cooperation in Energy 6
C. Relationship to AID Policy and Strategy . . . 7
D. Other Donor Assistance 7
E. Lessons Learned 8

III. Project Description

A. Project Goal and Purpose 10
B. Outputs and End-of-Project Status 10
C. Project Components 10
D. Project Financial Plan 16

IV. Project Administration

A. Implementation Schedule 17
B. Administrative and Monitoring Arrangements . . . 17
C. Procurement Plan 18
D. Evaluation Plan 19

V. Project Analyses

A. Technical Analysis 20
B. Economic Analysis 20
C. Social/Institutional Analysis 20
D. Environmental Analysis 20

VI. Project Conditions, Covenants, and Negotiating Status 21

VII. Annexes 22

A. PID Cable
B. Papers from Singapore Meeting
C. Logical Framework Matrix
D. Financial Plan Detail
E. Basis of PASA with DOE/LBL
F. Technical Analysis Detail
G. Economic Analysis Detail
H. Social/Institutional Analysis Detail
I. Statutory Checklist

V

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

1. TRANSACTION CODE: A (A = ADD, C = CHANGE, D = DELETE)

PP

2. DOCUMENT CODE: 3

3. COUNTRY/ENTITY: ASIA/REGIONAL (ASEAN)

4. DOCUMENT REVISION NUMBER:

5. PROJECT NUMBER (7 digits): 498-0285

6. BUREAU/OFFICE: A. SYMBOL: ASIA; B. CODE: 04

7. PROJECT TITLE (Maximum 40 characters): ASEAN ENERGY CONSERVATION AND MANAGEMENT

8. ESTIMATED FY OF PROJECT COMPLETION: FY 90

9. ESTIMATED DATE OF OBLIGATION: A. INITIAL FY 85; B. QUARTER 3 (Enter 1, 2, 3, or 4); C. FINAL FY 90

10. ESTIMATED COSTS ($000 OR EQUIVALENT $1 =)

A. FUNDING SOURCE	FIRST FY B. FX	FIRST FY C. L/C	FIRST FY D. TOTAL	LIFE OF PROJECT E. FX	LIFE OF PROJECT F. L/C	LIFE OF PROJECT G. TOTAL
AID APPROPRIATED TOTAL						
(GRANT)	( )	( )	(3,000 *)	( )	( )	(5,000)
(LOAN)	( )	( )	( )	( )	( )	( )
OTHER U.S. 1.						
OTHER U.S. 2.						
HOST COUNTRY & beneficiaries						2,100
OTHER DONOR(S)						
TOTALS			3,000			7,100

11. PROPOSED BUDGET APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. 1ST FY 85 F. GRANT	E. 1ST FY 85 G. LOAN	H. 2ND FY 86 I. GRANT	H. 2ND FY 86 J. LOAN	K. 3RD FY 87 L. GRANT	K. 3RD FY 87 M. LOAN
(1) SDA	740	878		3,000		1,000		1,000	
(2)									
(3)									
(4)									
			TOTALS	3,000		1,000		1,000	

A. APPROPRIATION	N. 4TH FY ___ O. GRANT	N. 4TH FY ___ P. LOAN	Q. 5TH FY ___ R. GRANT	Q. 5TH FY ___ S. LOAN	LIFE OF PROJECT T. GRANT	LIFE OF PROJECT U. LOAN
(1)						
(2)						
(3)						
(4)						
TOTALS						

12. IN-DEPTH EVALUATION SCHEDULED: MM 05 YY 88

13. DATA CHANGE INDICATOR. WERE CHANGES MADE IN THE PID FACESHEET DATA, BLOCKS 12, 13, 14, OR 15 OR IN PRP FACESHEET DATA, BLOCK 12? IF YES, ATTACH CHANGED PID FACESHEET.

1 = NO
2 = YES

14. ORIGINATING OFFICE CLEARANCE

SIGNATURE: Bruce Blackman *Bruce Blackman*

TITLE: AID/ASEAN Liaison Officer

DATE SIGNED: MM 02 DD 11 YY 85

15. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM DD YY

AID 1330-4 (3-78)

PROJECT AUTHORIZATION

Name of Country: Asia Regional on behalf of the Association of Southeast Asian Nations (ASEAN), including Indonesia, Philippines, Thailand, Malaysia, Singapore and Brunei.

Name of Project: ASEAN Energy Conservation and Management
Project No.: 498-0285

1. Pursuant to Section 106 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the ASEAN Energy Conservation and Management Project on behalf of the ASEAN countries of Indonesia, Philippines, Thailand, Malaysia, Singapore and Brunei, involving planned obligations of not to exceed $5,000,000 in grant funds over a four-year period from the date of authorization, subject to the availability of funds in accordance with the AID OYB/Allotment process, to help finance foreign exchange and local currency costs for the Project. The planned life of Project is through March 31, 1990.

2. The Project will promote cooperation among ASEAN countries and help improve the conservation and management of energy that is available to them. Emphases will be on (a) fostering policies that encourage both public and private sector adoption of energy efficient building design and maintenance and (b) enhancing human resource development in energy and technology management. The Project will be implemented through two grants. One will be to a participating country on behalf of the ASEAN countries. The other will be a grant to the Asian Institute of Technology for specified training and information system support.

3. The Grant agreements to implement the Project, which may be negotiated and executed by the Officer(s) to whom such authority is delegated in accordance with AID regulations and Delegations of Authority, shall be subject to the following essential terms and conditions, together with such other terms and conditions as A.I.D. may deem appropriate:

(a) Source and Origin of Goods and Services. Goods and Services, except for ocean shipping, financed by A.I.D. under the Project, shall have their source and origin in the United States or the ASEAN countries (Indonesia, Philippines, Thailand, Malaysia, Singapore and Brunei), except as A.I.D. may otherwise agree in writing. Ocean shipping financed by AID under the Project shall, except as AID may otherwise agree in writing, be financed only on flag vessels of the United States.

Signature _____
Assistant Administrator
Bureau for Asia

Date _____

ASEAN ENERGY III -- ENERGY CONSERVATION AND MANAGEMENT (498-0285)

I. PROJECT SUMMARY AND RECOMMENDATIONS

A. Recommendations. Current economic stringencies in the ASEAN countries show the need to improve both the efficiency of energy use and the effectiveness of energy management in the region. The authorization of $5.0 million in grant funds to ASEAN is recommended to further these ends of energy conservation and management. The grant will provide $3.0 million for activities to increase energy conservation in buildings that will include Indonesia, the Philippines, Thailand, Malaysia and Singapore; $1.4 million for training in energy management, including training in energy planning and renewable energy at the Asian Institute of Technology as well as training in energy management and coal use in the region and in the United States; and $600,000 in contingency (12% of grant amount) to be allocated to the above activities on the basis of a mid-term evaluation and approved annual work plans.

B. Summary Project Description. The goal of the project is to increase the efficiency of energy use in the ASEAN region. A subgoal is to improve the management of energy resources and technologies.

The project's purpose is to foster policies that encourage both public and private sector adoption of energy efficient building design and maintenance; and to enhance institutional and human resource development in the field of energy technology management.

The project is expected to produce the following results after five years:

(1) Greater coordination among policymakers at both the regional and national levels, along with a stronger public policy commitment to energy conservation in buildings in all five participating countries.

(2) Improved building codes in at least two ASEAN countries.

(3) Increased private sector awareness of technology and design alternatives for energy conservation in buildings..

(4) Adoption of microcomputer programs for architects and engineers to use in designing and evaluating energy efficiency in buildings.

(5) Expanded capacity in both national and local authorities for energy planning and management.

(6) Expanded public and private sector capacity in coal use technologies.

The project comprises two basic components: (1) energy conservation in buildings and (2) training in energy management.

The energy conservation in buildings component extends the work under ASEAN Energy II to the Philippines, Indonesia, Malaysia, and Thailand. Work plans will be developed in each of these countries to assess energy use in buildings; analyze the opportunities for energy conservation; evaluate the economic, social, and technical costs/benefits of different options; and develop strategies for implementation of policies, standards and activities to promote building conservation investments. Based on the Singapore work, one of the most promising conservation opportunities is in the use of efficient integrated window and lighting systems. Research on this "daylighting" approach will be pursued with Singapore. Another important area for research is the design of buildings with natural ventilation. This component also includes regional training in building energy conservation techniques and economics and activities to disseminate information to both private and public sector organizations.

The energy management component consists of several activities that support human resource development in energy management. Approximately twenty-four ASEAN participants will be trained at the Asian Institute of Technology (AIT) in energy planning/economics and renewable energy systems. A long-term advisor will be provided to AIT to teach energy management and AID support for AIT's Renewable Energy Resource Information Center (RERIC) will be extended. Closer cooperation will be fostered between public and private sector institutions concerned with energy use.

The second component will finance an intensive program of training in energy planning and management, with a major course in Malaysia and follow-on specialized training in the U. S. for selected ASEAN participants. The impact of this training will be assessed in a regional workshop during the latter stages of the project.

The project also extends the support provided under ASEAN Energy II for training in coal technology. Under this ASEAN Energy III project, the focus of the training is on coal use in electric power and industrial plants and coke production. Special training programs will be developed in the U. S. that include both formal and on-the-job training. This format was highly successful under ASEAN Energy II and U.S. private companies actively participated in both the formal course and in sponsoring trainees. A follow-up workshop in the region will, as in the case of the energy planning and management training, allow an assessment of the impact of the training on the transfer of technology and the capability to manage the development of coal resources.

In each ASEAN country, cooperating institutions for the buildings component have been identified. The structure of these organizations varies from country to country. In the case of Singapore and Indonesia, the national buildings division is the lead, while in the Philippines and Thailand it is the energy

conservation group within the Ministry of Energy. In Malaysia, the scientific and industrial research organization will be the technical coordinator. This project component has been discussed at length with technical representatives and the activities are what the ASEAN countries have developed themselves. The level of interest and enthusiasm for the project is high; all five countries want to participate actively in both components.

Technical services for the project will be arranged through three mechanisms. For the buildings component, the PASA arrangement with Lawrence Berkeley Laboratory (LBL) will be extended. LBL has a unique capability in buildings energy analysis and will be able to provide sound overall management based on its excellent, operational understanding of the ASEAN situation that has been developed over the past three years. LBL is expected to subcontract a substantial share of the PASA resources to 8a companies for such activities as training or architectural design in support of the Gray Amendment objectives.

A grant agreement will be signed with the AIT for the training effort in energy planning/economics and renewables and the related long-term advisor and information system support. For the energy management and coal technology training, it is planned that the project will avail itself of the AID Office of Energy contract with the Institute for International Education (IIE) for Conventional Energy Training. This contract was recently signed following a competitive selection process and provides for Bureau and USAID buy-ins. IIE staff have worked closely with USAIDs in the ASEAN region on training activities and attended the ASEAN Energy II Coal Training effort.

C. Summary Findings. This project flows from the pillars of AID policy and is supportive of the economic cooperation and development needs of the ASEAN countries.

Policy Reform. The project will contribute to the development of the proper energy policy framework by assessing energy use in the buildings sector and formulating and evaluating options for stimulating private investment in more energy efficient buildings. The building sector already consumes as much as 32% of all electricity in the ASEAN region. With rapid urbanization occurring in the region, the potential impact of policy reforms that stimulate appropriate and cost effective public standards, private practices and investments is significant.

Institutional Development. The buildings sector has generally been neglected in national conservation programs. AID therefore has the opportunity for long-term impact on the institutional as well as policy development of the region in this sector. Institutional development will touch

both government energy policy and buildings program offices and universities involved in buildings design and energy research. It also seeks to bring private organizations and firms involved in commercial building construction/maintenance into the assessment and policy phases of the project.

Technology Transfer. This project has a strong technical dimension embodied in the training, research and assessment/policy analysis activities. State-of-the-art technologies for building energy analysis will be transferred and adapted to conditions in the ASEAN region. ASEAN professionals will develop an appreciation for the new technologies and materials available for efficient lighting, air conditioning and overall building energy load management, and building insulation and construction. The technical quality of curriculum in architectural universities will be upgraded and the basis for more efficient buildings designs will be established with architectural companies. The research work on daylighting and natural ventilation will go beyond the transfer of existing technologies to the actual creation of new knowledge that is vital to improving buildings design in tropical climates. Training activities in component two will expose ASEAN technical managers to the latest in technologies and approaches to using low quality coals and to the latest in energy planning and management techniques.

Private Sector. Based on the experience in Singapore and the private sector attendance at the ASEAN Conference in Singapore, the private sector has both a strong interest and a crucial role to play in achieving improved building energy efficiency and more effective overall energy management. Building codes must be developed in close consultation with the private sector. The private sector is the supplier of instruments and materials essential for achieving the potential of new designs. Government price and tax policies will have an important impact on the investment decisions of private building owners and architects and the implications of different policy options on the private sector must be fully understood. Training and the transfer of knowledge from the U.S. must be oriented toward the needs of private architectural firms as well as government buildings authorities and energy policy officials. The ultimate success of the project will depend on acceptance by the private sector of the new technologies and on decisions by building owners to accept these new designs.

D. PID Review Concerns The APAC Review on July 12, 1984, raised the following issues.

1. Priority for use of scarce development assistance (DA) grant funds. Project analyses show potential foreign exchange impacts that have important economic implications for the ASEAN national economies altogether. The project emphasizes the development of sound national energy policies and devotes significant resources to both private sector participation in the development of such policies as well as the adoption of more energy efficient technologies by the private sector.

2. Energy Pricing. The project will support analysis of the structure as well as level of electricity tariffs. Of particular importance is the impact of peak load pricing on the economic incentives for investment in more energy efficient buildings. Issues of tariff policy will be dealt with in the training component, while special courses on tariffs and economic policy will be conducted and examinations made of pricing, tax, buildings standards and alternative government policy measures.

3. Project Coordination. Implementation and coordination arrangements are summarized in Section IB above. Project design indicates that all five countries are willing to undertake a concerted effort to develop sound national buildings energy policies. While the exact level of resource commitment will be defined in annual work plans, the indication from senior officials is that from 3-5 professionals in each country will be assigned to work full time on the project. Illustrative work plans have already been discussed with Indonesia and Malaysia while Singapore (on an advanced basis) Thailand and the Philippines have begun working on their plans.

4. Procurement. Project design has given special emphasis to involvement of minority companies in the program. Several potentially qualified 8a companies with U.S. experience in building energy audits and training have been identified. It is planned that LBL will sub-contract with one of the firms for specific activities within its competence, the dollar amount of which may be as much as $1.0 million. Such an approach is consistent with both sound technical management and involvement of minority firms. In this context, direct contract with these companies is not recommended since they have neither previous experience working in developing countries nor the breadth of technical expertise to manage the overall project activity.

II. PROJECT BACKGROUND

A. Problem. The ASEAN region is experiencing one of the most rapid rates of economic growth in the developing world. Industrialization and urbanization processes are creating a growing demand for energy, particularly oil and electricity. Consumption of commercial energy has increased at a rate of over 5% in most countries and electricity growth has been above 10% per annum. Despite their economic growth, ASEAN countries face severe economic stringencies and difficult resource and budgetary constraints. Energy expenditures and investments constitute a major share of total national budgetary and investment expenditures -- generally close to 25% -- and imported oil costs are a significant drain on the balance of payments of Thailand and the Philippines, accounting for about 30% of total export earnings. Energy conservation is increasingly recognized as a critical element of national energy policy, whereby considerable savings can be achieved in the short and medium term. To reduce dependence on imported oil, countries are pursuing programs to develop and diversify their domestic energy supply. The new areas of natural gas, coal, geothermal are being looked to for a significant contribution to future energy supplies. Yet the management capabilities needed to successfully develop these new resources are in short supply.

B. ASEAN-US Cooperation in Energy. Energy has been a major focus of the ASEAN-US Development Cooperation discussions since the First Dialogue in 1977. ASEAN has consistently given the energy sector strong emphasis in requests for new funding. In 1980, an ASEAN energy expert mission visited important U.S. facilities, laboratories and private companies. Based on discussions during this mission, AID provided a $400,000 grant to AIT in Thailand. This grant, which became known as ASEAN Energy I, supported a long-term specialist who taught energy economics/planning courses at AIT, supervised thesis research, consulted for ASEAN governments, and played a central role in the organization and implementation of a major ASEAN-US seminar in Indonesia on Energy Technology. The grant financed major costs of this seminar and its proceedings and supported the Renewable Energy Resource Information Center (RERIC) at AIT, which distributed the proceedings as well as other renewable energy publications within ASEAN and other Asian countries.

A second project (498-0272) was developed in 1982, after field discussions by several AID/W staff with all five ASEAN countries. This project, called ASEAN Energy II, is a $1.0 million project signed with the Government of Indonesia. It has three components: energy conservation in buildings, which is coordinated by Singapore; coal technology training, coordinated by Indonesia; and alternative energy systems for water pumping, coordinated by Malaysia. The current PACD is 3/31/85. The ASEAN Energy I project and the conservation and coal training components of ASEAN Energy II have been successfully completed. The water pumping component has been delayed by contracting difficulties, but the contract for US technical services has now been signed and site work has begun.

During the Fifth ASEAN-US Dialogue in Manila (December 7-8, 1983), ASEAN requested an extension of cooperative activities in energy conservation in buildings and coal technologies. These proposals were reviewed at the U.S.-ASEAN energy experts meeting in October of 1984, along with proposals on energy management and technology training. This project is based on the comprehensive work of that expert's meeting, which developed a detailed proposal for assistance in energy conservation and management, that has been approved by the ASEAN Committee of Science and Technology.

C. Relationship to AID Policy and Strategy. The new AID Energy Policy Paper identifies improving the efficiency of energy use as one of the Agency's three main goals in the sector. The project also conforms well with the different means that the Policy Paper advocates for achieving AID objectives -- namely, policy analysis, training, research and technology adaptation, and private sector promotion. Similarly, the project is supportive of the Asia Strategic Plan's objectives to: (1) develop improved national energy policies; (2) facilitate technology transfer and strengthen centers for energy training and research in the region; (3) stimulate private investment in cost-effective energy technologies; and (4) deliver assistance on a regional basis when feasible and cost effective.

It is complementary to the emerging USAID energy strategy in the Philippines and the proposed Technology Transfer for Energy Management project anticipates this ASEAN-level activity supporting assessment and training in the buildings subsector. This project is also complementary to other bilateral projects: (1) the Puspiptek Energy Laboratory project in Indonesia that involves technology training and research in coal and renewable energy technologies; (2) the Energy Planning for Development project in Indonesia, and (3) the new Science and Technology project proposal in Thailand with its emphasis on industrial standards, the application of computer technologies and the strengthening of scientific expertise in Thailand's technical universities.

D. Other Donor Assistance. Australia is the major foreign donor for regional energy assistance. The ASEAN-Australia cooperative program in energy currently includes several planned and ongoing projects in biomass development, coal processing, and energy conservation. This latter component contains proposed activities which address energy conservation in buildings. Aspects of these proposed projects of relevance to ASEAN III project are in the areas of energy auditing (e.g. Linhoff technique) and building energy modelling. The Australians are also participating in an Energy Conservation in Buildings Program sponsored by CHOGROM (Commonwealth Heads of Government Meeting) administered out of London, England. This program involves training and research in energy management such as auditing techniques, computer simulation and other applications.

The Australian and US proposals for assistance are seen as complementary and non-duplicative. The US assistance effort is already in place and country workplans are being developed. More importantly, both programs fall under the purview of the ASEAN Working Group on Non-Conventional Energy Research, which has strong capability for coordinating various donor programs.

France is the only other bilateral donor known to be active in the region's energy sector through its assistance to Indonesia in the development of an Energy Conservation Master Plan that includes buildings. Indonesian officials see no conflict between the proposed project and the more broad-based French planning assistance. In addition, ESCAP and UNIDO, both United Nations Organizations, are administering regional energy planning programs based in Thailand.

D. Lessons Learned. Other than the ASEAN Energy II pilot activity in Singapore, AID has no previous experience with energy conservation in buildings. There is, however, a growing body of knowledge from general energy conservation projects that appears applicable to this project activity. In summary, these projects have illustrated the importance of: (1) establishing (assisting) a small core technical group in national governments that understands the patterns and determinants of energy use in various sectors; (2) working directly with industries and major energy consumers in developing appropriate policies and technical solutions for improving energy efficiency; (3) price and tax policies as incentives or disincentives to investment in energy conservation measures, plus a common lack of technical knowledge about investment possibilities and payback periods.

Concern with energy conservation in developing countries has lagged behind that in industrial countries. This situation is particularly true in the buildings sector. U.S. experience in dealing with the buildings sector has also shown it to be slow in responding to energy conservation opportunities. When the U.S. Department of Energy began to examine the buildings sector following the Arab Oil Embargo, they found the following: (1) no data existed on energy use profiles in buildings; (2) the sector is highly diffuse in character with no large companies that design and produce buildings on a national scale; (3) that architects and engineers did not have experience with or know how to design energy-efficient facilities; (4) that energy analysis calculation techniques were either non-existent or primitive and cumbersome.

Major advances have occurred in all of these areas over the past 10 years, and the U.S. is now in a phase of having achieved clear technical gains in understanding energy phenomena in buildings. The potential for sharing these advances with developing countries is now significant. Experience shows the need to develop detailed energy use profiles for all primary types of buildings. These profiles provide a base to measure progress against and are the preliminary data needed to devise energy conservation strategies

and targets for the redesign of existing buildings and/or the design of new facilities. Although there are certain similarities between buildings, each utilizes energy differently than another. The first step in energy-efficient design or redesign practice is to establish precisely what the energy problem is and the opportunities are. As obvious as this step might seem, evidence suggests that it is often not taken.

As noted, the buildings sector is diffuse. It is characterized by a plethora of decision-makers involved in the building design and construction process, each focusing on particular interests. The common thread that runs through the entire process is building codes and standards. Since they offer a degree of control over design and construction practices in a country, they also constitute a vehicle for bringing about potential improvements in energy efficiency. While requiring time and effort, an effective way to achieve energy-efficient buildings is through revisions to the building code standards that govern design and construction.

Albeit surprising, the architectural and engineering practitioners of today don't know much about energy phenomena in buildings. Except for the most recent graduates, the typical design professional was educated in an era when energy was not only cheap, but U.S. society was technically geared to increasing its use to control or modify nature (e.g., higher and higher lighting levels caused larger and larger cooling loads that were met by using more sophisticated and energy-intensive equipment and controls). Until energy-efficient practices are integrated into the mainstream of buildings design and construction, a nation will not produce energy efficient facilities on a routine basis. It is critical to recognize that the diffusion of new technology in the building sector - including enhanced design, professional capabilities, etc.- takes anywhere from 10 to 20 years. Unlike the auto industry that may have a complete fleet turnover every 10 years, the building sector takes longer to assimilate new capabilities.

Large advances have been made in developing energy analysis techniques that are easy for designers to use. While evolving rapidly, microcomputer programs are already able to simplify and quickly solve component design problems that previously would have taken much greater effort. Building energy audit techniques have progressed as well, and it is now realistic to prepare workshops, seminars, and college curricula that can be used in this ASEAN III project.

For the ASEAN countries that are experiencing rapid urbanization and growth, it is important to install energy-efficient design practices and capabilities into the mainstream forthwith. Likewise, macroeconomic and sectoral disincentives to efficient energy use must be understood and rationalized if improved design capabilities are to elicit tangible efficiency gains.

III. PROJECT DESCRIPTION

A. Project Goal and Purpose. The project goal is to increase the efficiency of energy use in the ASEAN region. Its subgoal is to improve the management of energy resources and technologies.

The project purpose is to foster policies that encourage both public and private sector adoption of energy efficient building design and maintenance; and to enhance institutional and human resource development in the field of energy and technology management.

B. Outputs and End-of-Project-Status. The project is expected to produce the following results after five years:

(1) Greater coordination among policymakers at both the regional and national levels, along with a stronger public policy commitment to energy conservation in buildings in all five participating countries.

(2) Improved building codes in at least two ASEAN countries.

(3) Increased private sector awareness of technology and design alternatives for energy conservation in buildings.

(4) Adoption of microcomputer programs for architects and engineers to use in designing and evaluating energy efficiency in buildings;

(5) Expanded capacity in both national and local authorities for energy planning and management.

(6) Expanded public and private sector capacity in coal use technologies.

C. Project Components. The project is structured in two major components -- (1) Energy Conservation in Buildings and (2) Energy Management Training - that will advance the above results as described below.

Component I -- Energy Conservation in Buildings

This component includes a set of regional and country-specific activities in training, research, assessment and policy analysis and information dissemination.

Activity 1.1: Training. The project will support regional training activities to build professional capabilities in buildings energy analysis and management. Three kinds of training courses are planned.

-- Training in Department of Energy Model 2 (DOE-2) Program. Comprehensive training of ASEAN technical and managerial personnel in the use of the DOE-2 computer code for building energy analysis. This extend the application of DOE-2 beyond its successful demonstration in Singapore under the ASEAN Energy II Project into the other participating ASEAN countries.

-- Training in Building Energy Conservations. A course will be developed that provides technical and managerial personnel a comprehensive introduction to building energy conservation. The course will include such topics as building energy audit theory and methodology, energy performance estimation techniques, heat transfer and thermodynamics, numerical techniques, computer simulation, computer software, and energy conservation measures and management systems.

-- Training in Policy Analysis and Economics. Key energy managers and policy officials will be trained in short courses on techniques for analyzing the economics of building energy conservation and on tariff policy, standards development, building code preparation and implementation, and other policy instruments for influencing decisions on building energy consumption.

Activity 1.2: Research. This activity will extend the cooperative research investigations begun under the ASEAN Energy II project. Four priority topics for applied research were identified at the Energy Experts Meeting as follows.

-- Daylighting. Technical research will be conducted to evaluate the energy savings of different daylighting strategies against a range of building characteristics. The research will include assessments of the problems entailed in implementing daylighting approaches, e.g. daylighting availability, glare and its reduction, external obstruction, occupant behaviour in daylight conditions and availability and reliability of control systems. Specific products of the research will include algorithms to enable architects and engineers to easily estimate the effectiveness of different daylighting measures/strategies for specific buildings and to permit the assessment of compliance of daylighting measures with energy standards.

-- Natural Ventilation. Natural ventilation is a promising area for research, with substantial energy savings possible if a large number of buildings in the ASEAN region can be designed without airconditioning. Indonesian architects are working in this area.

— Comfort Index. Technical research will be undertaken to identify the ranges of psychometric parameters which define the comfort zone. The research shall consider the nature of work, climatic conditions, the traditional use of clothing in the region, etc. Thai energy experts have strong interest in this topic.

— Building Materials Thermal Characteristics. Technical research on the thermal characteristics of building materials will be supported. This research is aimed at developing design standards for public, commercial and residential buildings. Such standards can only be formulated through the knowledge of the thermal performance of commonly used building materials. It takes into account ASEAN's current interests in the design of building envelopes for the reduction of external heat gains.

Other appropriate topics for applied research are expected to be identified during project implementation. They would be eligible for project support subject to (i) regional applicability, (ii) ASEAN interest and commitment and (iii) funds availability.

Activity 1.3 — Building Energy Assessment and Policy Analysis. The project will support the technical work necessary to develop sound policies for energy conservation in buildings in each ASEAN country. A three phase process is envisaged, with participating countries proceeding at varying speeds and in different ways.

— Assessment Phase. This work will be divided into three elements:

(i) assess the significance of energy conservation in buildings relative to other aspects of energy policy in each country;

(ii) develop a profile of building energy use in each country by energy end use (lighting, cooling, ventilation) and by building characteristics (area, projected construction data, estimates of non-process energy use in industrial buildings, cost data, description of typical building designs, construction practices, use patterns, etc.); and

(iii) develop and/or refine energy audit techniques, train audit teams, apply micro-computer tools to evaluate energy audits, implement auditing activities, and gather and analyze audit data.

— Analysis Phase. This phase includes the following tasks:

(i) evaluate the accuracy and applicability of available computer codes for analyzing building energy use;

(ii) analyze conservation opportunities by simulating energy use in typical buildings, considering different combinations of conservation measures (i.e. lighting measures, windows design, ventilation, insulation, cooling equipment, control system, thermal storage) and using measured hourly weather data (including direct and diffuse components of solar radiation); and

(iii) analyze the costs and benefits of each conservation measure, incorporating installation costs, reduction in peak power demand, energy content of building materials, and prepare an overall life cycle cost calculation.

-- Policy Phase: This phase involves two parts:

(i) integration of the information gathered in the above tasks into an analysis of specific policy options (i.e. standards, price policy, tax incentives) for review by appropriate policymakers; and

(ii) development of techniques (e.g. handbooks, microcomputer tools, building codes) to help implement the policies.

Activity 1.4 -- Information Dissemination and Private Sector. An essential element of this component is an active effort to disseminate the technologies and the information developed within and among countries and especially with the private sector. The main tasks under this activity include:

-- conduct of seminars and workshops involving government and the private sector;

-- preparation of technical handbooks and manuals for engineers, architects and practitioners;

-- publication of reports and a network newsletter;

-- development of a flexible computer information base on building energy conservation involving microcomputers in every country's lead technical office;

-- convening of regular ASEAN Meetings on Energy Conservation in Buildings to share the major technical and policy conclusions of the project with a broad public audience;

-- holding of project coordination and planning meetings that will develop annual workplans and review progress in implementation.

Component II -- Training in Energy Management

The second component of the project is a set of regional training activities that will strengthen ASEAN institutional and human resource capabilities in energy planning, renewable energy technologies and coal technologies.

Activity 2.1: Training Program at Asian Institute of Technology. AIT will be the venue for training of ASEAN personnel in energy planning and in renewable energy systems. Twenty ASEAN personnel will attend AIT's three-month graduate certificate program in the Energy Technology Division. They will take 3-4 courses totalling 9-12 credits with an emphasis on energy planning. Four students will take a similar certificate program with an emphasis on renewable energy applications.

To strengthen AIT's capacity in energy planning and economics, AID will provide a long-term technical advisor for two years. This individual will serve on the faculty in the Energy Technology Division and teach courses, on an approximately half-time basis, in energy planning and economics. The advisor will also provide short-term consulting for USAIDs, ASEAN government agencies and corporations, and will assist as needed in the planning of the other energy training activities under this project. As a means of further developing an improved ASEAN capability in renewable energy systems management, the project will support AIT's Renewable Energy Resources Information Center (RERIC). RERIC will continue to produce monthly bulletins on specific renewable energy subjects and circulate other information to ASEAN energy decision makers and researchers. To better reach key individuals and organizations, RERIC will undertake a systematic survey of ASEAN subscribers.

Activity 2.2: Training in Energy Management. This activity has three parts.

-- The first is a training program for senior mid-level personnel involved in public and private sector energy management. The course is planned for Malaysia for an estimated period of 4 weeks. About 30 ASEAN participants and 3-4 US experts will participate.

-- The second is a follow-up to the above course for selected participants and involves specialized training in the U.S. Training may include energy planning methodologies, organizational aspects of energy management, energy information system design and operation, topics in energy economics, industrial energy auditing, field audit training, case studies work, implementation of energy conservation measures, retrofitting, bioenergy conversion, etc.

-- The third is a regional workshop to review and assess progress in energy planning in the region. It is envisaged that the participants trained under the two above courses will form the nucleus of energy planning organizations in the region. This workshop will follow the training courses to provide an update of energy planning activity and a post-hoc evaluation of the effectiveness of the training. The session is planned for Malaysia with lecturers drawn from senior ASEAN personnel and US experts.

Activity 2.3: Training in Coal Technology Management. As a follow-up to the previous AID-supported coal training effort on the general topics of coal production, transportation, processing and use, this activity supports training in the specialized areas of: (i) coal use in electric power and selected industries and (ii) coke production for both public and private sector officers.

-- A two-month program in the US is planned covering the areas of coal preparation (including sampling, analysis, blending and quality control); coal handling and storage management; combustion in power plant boilers, cement kilns and other industrial boilers; boiler system design philosophies and modification; and environmental control technologies. A formal course will be given covering 3-4 weeks and 4-5 weeks will be devoted to on-the-job training and technical visits. About 24 ASEAN technical managers will participate in this activity.

-- About 9 ASEAN personnel will receive specialized training in the issues concerning coke production from low-quality ASEAN coals. Areas to be covered through individualized placements in U.S. laboratories and companies include coal preparation, coal upgrading, coke processing, coke testing, and environmental control technology.

-- As in the energy planning area in Activity 2.2, a seminar on the above topics will be held in the ASEAN region where experts from the U.S. and ASEAN will present papers. This meeting will allow an assessment of the progress made in these areas following the training activities and provide opportunities to personnel involved in areas of coal technology who have not participated in any of the ASEAN-U.S. coal training activities. It is envisaged that 5 experts from the U.S. and 2 experts from each of the ASEAN countries would present papers at the meeting. There would be 5 other participants from each of the ASEAN countries.

D. Project Financial Plan. Based on the above-described components and activities, it is expected that funds will be allocated to the project approximately as follows:

PROJECT FINANCIAL PLAN

Uses of Funds	Sources of Funds (US$000s) AID	ASEAN	TOTAL
Component 1 - Energy Conservation in Bldgs.			
-- Training	920		920
-- Research	755		755
-- Assessment, Analysis, Policy	800		800
-- Information Dissemination	525		525
Sub-Total	3,000		3,000
Component 2 - Training in Energy Management			
-- AIT Training	500		500
-- Energy Management Training	400		400
-- Coal Technology Training	500		500
Sub-Total	1,400		1,400
Operational/Support Costs			
-- Person Years		1,800	1,800
-- Facilities/Local Expenses		300	300
Contingency/Evaluation (12%)	600		600
GRAND TOTAL	5,000	2,100	7,100

Supporting material for these line item estimates is contained in Annex D.

IV. PROJECT ADMINISTRATION

A. Implementation Schedule. The precise timetable for project implementation will be determined in the annual project work plans. This procedure of work plans was used effectively under ASEAN Energy II. Plans for each component and each country will be developed within about three months of the signing of the technical contracts and AIT grant. ASEAN has proposed a project meeting in April 1985 in Singapore, to coincide with their Energy Committee meeting. Recruitment of the long-term AIT advisor will begin immediately upon the signing of the grant with AIT as will the process of nominating and selecting participants for the AIT training effort. Illustrative first year work plans have been prepared for Indonesia and Singapore and are included in the Bulk Annexes.

B. Administrative and Monitoring Arrangements. Through its structure of technical committees, ASEAN has formally identified the following national agencies as responsible for the energy conservation in buildings component:

Singapore:	Deputy Director, Development and Building Control Division, Department of Public Works, Ministry of National Development.
Malaysia:	Director, Standards and Industrial Institute of Malaysia (SIRIM).
Indonesia:	Director of Public Buildings Ministry of Public Works.
Thailand:	Director of National Energy Administration Ministry of Science, Technology and Energy.
Philippines:	Director, Bureau of Energy Utilization Ministry of Energy.

To date, Brunei has not indicated an interest in the project. Consistent with ASEAN practice, it will be invited to participate in major meetings and seminars. Coordination and monitoring of the project activities will be accomplished through several mechanisms.

-- Annual work plans focusing on specific sub-activities and budgets, will be prepared for AID review.

-- The technical coordinators for each country will meet at least twice a year for planning, coordination and review of progress.

-- The annual ASEAN Conference on Energy Conservation in Buildings will prepare a proceedings to summarize technical accomplishments over the year.

AID administrative arrangements are determined by the procurement and contracting actions envisaged under the project. These are described below.

C. Procurement Plan. It is planned that the procurement of services for this project will be divided into three separate actions.

1. PASA with the US Department of Energy/Lawrence Berkeley Laboratory. Technical direction and services for component one of the project will be acquired under a PASA with the Lawrence Berkeley Laboratory (LBL) of the Department of Energy (DOE). This extends the productive and successful performance of LBL under the ASEAN Energy II. Annex E shows justification for extension of the PASA. As under ASEAN Energy II, the AID PASA manager will be the Asia Bureau's Energy Advisor with field support from the AID/ASEAN Liaison Officer.

2. A Grant Agreement with AIT. Activity 2.1 will be conducted through a grant agreement with AIT, the mechanism that was used under the ASEAN Energy I project. It is planned AID will conclude a direct PSC contract for the services of the long-term advisor under this grant. The AID/ASEAN Liaison Officer will perform field management of this project element with technical support by the Asia Bureau's Energy Advisor.

3. Amendment to contract with the Institute for International Education (IIE). The AID Science and Technology Bureau's Office of Energy recently concluded a new contract with the Institute for International Education (IIE) for the conduct of the Conventional Energy Training Program. This program provides masters degree training in universities, short-term internships in U.S. companies and laboratories, and short-term structured courses in the fields of oil and gas, coal, electricity, energy conservation and management. The contract provides for "buy-ins" by USAIDs and regional bureaus. IIE staff has worked with the Asia Bureau's Technical Office in the development of training programs for Thailand, Philippines and Indonesia. Moreover, IIE staff attended the ASEAN Coal Training Program at Argonne National Laboratory under the ASEAN Energy II project and have a good understanding of the coal training needs of the region. It is assumed that the level of buy-ins available under the IIE contract will suffice to accommodate the US training. Here again, the Asia Bureau Energy Advisor will manage this US-sited element of the project with field support from the AID/ASEAN Liaison Officer.

It is noted that the project will rely extensively on contractors and intermediaries. This is foreseen in the Asia Region Strategy Plan. Also required will be collaborative AID management involving both Asia Bureau/Washington and ASEAN Office/Philippines. The workability of such approaches has been at least partially demonstrated under the ASEA/AID Energy Cooperation Program to date.

D. Evaluation Plan. The system of annual work plans, an annual Conference on Energy Conservation in Buildings and seminars to follow up the major training activities provide built-in mechanisms for continuous evaluation of project progress. These mechanisms will be supplemented by a mid-term evaluation at the end of two and a half years using outside experts. AID/W and/or outside contractors will also be sent to the annual Conference on Energy Conservation in Buildings to assess the quality and significance of the work reported at the meeting. The mid-term evaluation will focus principally on the degree to which each country has demonstrated a commitment to developing policies and interventions to increase the efficiency of energy use in buildings.
The project is initiated with a 12% contingency. The Allocation of the contingency will be determined by the mid-term evaluation.

V. PROJECT ANALYSES

Following are summary statements of analytical findings about the project. Detailed write-ups are in the Annexes indicated.

A. Technical Analysis. The project has been analyzed in terms of its fit with ASEAN policies and programs; nature and determinants of energy use in the building sector; potential for energy savings in buildings; technical capabilities of ASEAN; technical research needs and issues; and energy management and coal technology. Conclusions of these technical reviews show the project to be sound and feasible. See Annex F.

B. Economic Analysis. Economic analysis of the project has considered, in micro terms, the paybacks on investment in various conservation measures, including lighting, equipment maintenance and daylighting. The macro analysis focuses on cost savings available to ASEAN economies through reduction of energy use in buildings. The returns to investment in research and training are also considered. The conclusion of these approaches to the project show it to be economically appropriate and vital. See Annex G.

C. Social/Institutional Analysis. Social and institutional analyses have reviewed: the structure of AEAN country decision-making on energy conservation; social barriers to energy conservation in buildings; the regulatory environment and building codes; perspectives of the private sector and research community; and manpower development and institutional strengthening. Considerable variance is noted among the ASEAN countries. The project design allows for variance (e.g. through the annual workplan procedure) as well as seeks solutions to "common theme" issues and constraints in the energy conservation sector. See Annex H.

D. Environmental Analysis. No environmental assessment is required, according to AID's revised Environmental Procedures, 22 CFR Part 216.2 (c) (2). This is because the project consists of analyses, studies, research, training and information transfers.

VI. PROJECT CONDITIONS, COVENANTS, AND NEGOTIATING STATUS

The preceding, proposed Project Authorization contains recommended conditions to this grant assistance. No special covenants are envisaged.

The project has been collaboratively developed with the responsible ASEAN agencies, working groups and committees. Negotiation of the grant agreements will follow project authorization. The Government of Indonesia is expected to sign on behalf of ASEAN. A grant agreement will also be negotiated with the AIT for specified training and information system support.

VII. ANNEXES

A. PID Cable
B. Papers from Singapore Meeting
C. Logical Framework Matrix
D. Financial Plan Detail
E. Basis of PASA with DOE/LBL
F. Technical Analysis Detail
G. Economic Analysis Detail
H. Social/Institutional Analysis Detail
I. Statutory Checklist

Bulk Annexes (in AID/ALO File)

Proposal from ASEAN-US Energy Experts Meeting
Illustrative First Year Work Plan: Indonesia

ANNEX A

ACT: AID-6 INFO: DCM CPU/8/GC

VZCZCML0286
RR RUEHML
DE RUEHC #0384 2000505
ZNR UUUUU ZZH
R 18043Z JUL 84
FM SECSTATE WASHDC
TO RUEHML/AMEMBASSY MANILA 6431
INFO RUMTBK/AMEMBASSY BANGKOK 9236
RUEHKL/AMEMBASSY KUALA LUMPUR 3091
RUEHJA/AMEMBASSY JAKARTA 5102
RUEHGP/AMEMBASSY SINGAPORE 0363
BT
UNCLAS STATE 210384

LOC: 59 350
18 JUL 84 0504
CN: 04036
CHRG: AID
DIST: AID

ACTION COPY

Action Taken: _____
No action necessary: _____
Date: _____ Inits: _____

AIDAC MANILA ACTION FOR ALO, INFO FOR USAID

E.O. 12356: N/A
TAGS:
SUBJECT: ASEAN: ASEAN ENERGY III PROJECT (498-U285) - APAC APPROVAL OF PID

SUMMARY: ASIA PROJECT ADVISORY COMMITTE (APAC) APPROVED THE PROJECT IDENTIFICATION DOCUMENT (PID) FOR THE ASEAN ENERGY III PROJECT JULY 12. FURTHER PROJECT DEVELOP;ENT IS AUTHORIZED. APAC REVIEWED ISSUES UELOW. END SUM;ARY

DIV	ACT	INF
OD		✓
E		
PE		
RIG/II		✓
AR		
DUE DATE 7-26-84		

1. PRIORITY FOR USE OF SCARCE DEVELOPMENT ASSISTANCE (DA) GRANT FUNDS.

THE APAC CONSIDERED THAT AMONG BENEFICIARIES MIGHT BE RELATIVELY WELL OFF OWNERS OF MODERN BUILDINGS WHO WOULD BE HELPED TO SAVE ON ENERGY COSTS. HOWEVER, THE IMPORTANCE OF DEVELOPING SOUND NATIONAL ENERGY CONSERVATION POLICIES AS ASLAN COUNTRIES DEVELOP MORE ADVANCED URBAN SECTORS AND CONSERVING SCARCE FOREIGN EXCHANGE WAS RECOGNIZED. THE KEY CONSIDERATION FOR FURTHER-DESIGN WILL BE SERVING THE POLICY FORMULATION NEEDS OF THE INDIVIDUAL ASEAN COUNTRIES AND ASSISTING IN IMPROVING PRIVATE SECTOR ACCESS TO EFFICIENT ENERGY TECHNOLOGY.

2. ENERGY PRICING.

THE APAC NOTED TPAT MUCH OF THE INCENTIVE FOR CONSERVATION ARISES FROM PRICES TO CONSUMERS REFLECTING THE FULL COST TO THE ECONOMY OF ELECTRICAL ENERGY. FURT,ER PROJECT DEVELOP,ENT WILL SEEK TO STRENGTHEN ECONOØIC RESEARCH ELEMENTS OF THE PROJECT.

3. PROJECT COORDINATION.

WHILE FINAL DESIGN (IN CONSULTATION WITH ASEAN REPRESENTATIVES) WILL HAVE TO DITERMINE SITES OF PROJECT ACTIVITIES, THE APAC UNDERSTANDS INDONESIA AND THI PHILIPPINES ARE UNDER CONSIDERATION AS-COORDINATORS OF FURTHER ENERGY CONSERVATION ACTIVITIES. FURTHER DESIGN

WILL FOCUS ON THE RESOURCES VARIOUS MEMBER COUNTRIES CONTEMPLATE HAVING AVAILABLE FOR PROJECT ACTIVITIES.

4. PROCUREMENT.

AS AN ALL-GRANT ACTIVITY, THIS PROJECT WILL BE EXPECTED TO GIVE PARTICULAR EMPHASIS TO PROCUREMENT FROM MINORITY SOURCES AS REQUIRED TO MEET GRAY AMENDMENT OBJECTIVES.

AID/W ACTION: ASIA BUREAU UILL DISTRIBUTE COPIES OF THE PID TO ALO AND INFO ADDRESSEES (YOUR COMMENTS INVITED). WE WILL SEND ALO DETAILS OF PLANS FOR FURTHER DESIGN ACTIVITIES SEPTEL. DAM
BT
#0384

NNNN

24

SINGAPORE PAPER

POLICIES TO ACHIEVE COST-EFFECTIVE ENERGY REDUCTIONS IN ASEAN BUILDINGS

Analysis of Buildings in Singapore and Application to ASEAN Member Countries

Mark D. Levine, Richard Curtis, and Isaac Turiel
Lawrence Berkeley Laboratory
April, 1984

Introduction

This report presents recommendations on policy approaches to reduce energy use in commercial buildings within the six countries of the Association of Southeast Nations (ASEAN).* The recommendations are based on the technical work performed by the Lawrence Berkeley Laboratory research team. The research is one of three sub-projects within the ASEAN energy project funded by the U.S. Agency for International Development.**

This report is directed at the decisionmakers within the ASEAN member countries concerned with guidelines, information disemination, standards, or other policy approaches to reduce energy use in commercial buildings. It is intended to be relevant to the entire building community, with both the private and public sectors, interested in ways to achieve energy conservation in buildings.

The quantitative studies on which this report is based were performed for a hypothetical building in Singapore. Singapore was chosen as the first of the ASEAN members for detailed study because of the Singapore experience in developing, promulgating, and implementing energy standards in commercial buildings. The main body of the analysis, reported in an accompanying technical report entitled "Parameteric Energy Analysis in Support of Singapore Energy Conservation Standards for Buildings," uses the Singapore Overall Thermal Transfer Value (OTTV) approach as the starting point for a comprehensive analysis of measu

*After the bulk of the study was completed, Brunei was accepted as the sixth member of ASEAN. It was thus not possible to include Brunei in the first phase of the sub-project.

**The responsible U.S. AID personnel are Mr. Robert Ichord, project manager, U.S. AID, Washington, D.C. and Mr. Donald Melville, ASEAN coordinator, U.S. AID, Manila, Philippines.

to conserve energy in buildings. The technical work was a collaborative effort between researchers from LBL and the Singapore Development and Building Control Division and the National University of Singapore.

It is expected that the sub-project will continue and that the second phase will focus on some or all of the remaining ASEAN members. The primary objective of this report is overall policy guidance to ASEAN on measures and policy approaches to achieve energy conservation objectives in commercial buildings within ASEAN. Assuming a continuation of the project, the second phase will provide technical information in support of those aspects of this report (and other ideas generated by ASEAN members) judged valuable to individual ASEAN members.

A conference on the sub-project will be held in Singapore on May 29, 30, and 31, 1984. The final day of the conference will be a closed session with ASEAN representatives to decide on priorities for the second phase of the sub-project. Responses to this report from each of the ASEAN members will provide useful guidance for a second phase of this sub-project.

The report contains information about the energy savings and the likely economic attractiveness of specific measures. Two limitations to these statements need to be recognized: (1) They are appropriate for a hypothetical office building in Singapore and do not apply to every office building. As such, the results are applicable to common commercial office buildings in Singapore. They are appropriate for qualitative guidance about effects of conservation measures in buildings in other ASEAN countries. (2) They are based on approximate estimations of the economics of the conservation measures. Even with a large uncertainty in the economics, a sorting of measures into three categories--cost-effective; uncertain (depends on criteria, detailed costs, particular designs); not cost-effective--is possible. We have used these three categories as the basis for recommendations.

Organization of Paper

The paper is organized into the following sections: relevance of building energy conservation in ASEAN; high priority conservation measures for ASEAN buildings; alternative policy options for reducing energy use in commercial buildings; analysis of specific conservation measures

(lighting, windows and daylighting, equipment maintenance, other); conclusions and recommendations.

Relevance of Energy Conservation in Commercial Buildings to ASEAN

Energy use in commercial buildings is a significant portion of energy demand within the five present ASEAN member countries. To the extent that expenditures on energy for space conditioning, lighting, and other uses can be reduced without loss of amenity and without compromising the functions which the energy fulfills, the ASEAN nations will benefit economically from measures to conserve energy. These benefits will accrue both to the nations as a whole in the form of reduced oil imports, improved balance of payments, and lower costs in the modern sector as well as to the individual building owners and occupants.

To assess the impacts of energy conservation in buildings on the economies of the ASEAN member countries, we need to estimate (1) total energy use of commercial buildings for each country, (2) the cost of the energy used in the commercial sector, and (3) the potential for cost-effective measures to reduce energy use.

Table 1 shows the estimated energy use of the five ASEAN countries for the latest year available, an approximate projection to 1982 to place all on a common basis, the amount of electricity used within commercial buildings, and the total cost of the electrical energy use in buildings. Many of the numbers in Table 1 are estimates, but they are likely to be within 10 or 15 percent of the actual consumption.

The first observation from Table 1 is that buildings consume a significant portion of total electricity in the ASEAN countries. Counting only the electricity for the commercial sector, 26 percent of electricity in ASEAN is used in commercial buildings. If one assumes that about 15 percent of industrial electricity use is space conditioning and lighting industrial buildings, then the estimate of energy use in ASEAN commercial buildings increases to 32 percent of total electricity production. This varies from a high of 50 percent of electricity use for buildings in Singapore to a low of 21 percent of electricity use for buildings in Thailand. These estimates are shown for each of the ASEAN countries in Table 2.

All countries in ASEAN generate almost all of their electricity from oil. If one assumes (for the sake of simplicity) that the cost of a kilowatt

27

Table 1. Energy Use in ASEAN Countries[a,b]

Country	*Energy Use per Capita (1980) (mmBtu/yr)*	*Total Electricity (1980) (Gwh/yr)*	*Electricity in Commercial Buildings (Gwh/yr)*
Indonesia	6.8	7,000	2600
Malaysia	21.4	8,470	2510
Philippines	11.3	19,400	4770
Singapore	72.6	6,670	3330
Thailand	11.7	15,900	1800

[a]Sources: Total energy use is derived from "Asian Energy Problems: An Asian Development Bank Survey," Praeger, 1982. The total use includes only commercially sold fuels. Many ASEAN countries use considerable quantities of non-commercial fuels, so comparisons among the countries should be made with care. Population data are from "The World Almanac," Newspaper Enterprice Association, 1984. Total electricity production data and electricity use in commercial buildings are derived from (1) "Energy Planning for Development in Indonesia," Energy/Development International, 1981 and "Renewable Energy Technology and Services—Prospects for a Strong USA/Indonesian Trade Relationship," Jerome Weingart and Associates, 1981; (2) "31st. Annual Report of the National Electricity Board of the States of Malaya,"; (3) "Ministry of Energy Report for 1982," Phillipines Ministry of Energy; (4) "Energy Conservation in Singapore," Lee Ek Tieng, in Energy—the International Journal, 1983; and (5) "Electric Power in Thailand 1981," Thai National Energy Administration.

[b]Brunei is not included in this and the next two tables because they joined ASEAN late in the ASEAN energy sub-project.

Table 2 Electricity Use in ASEAN Commercial Buildings

Country	*Electricity Use in Commercial Buildings (Gwh/yr)**	*Percentage of Total Electricity Use in Nation*	*Annual Cost in $ Millions (at $0.10 per kwh)*
Indonesia	2600/2700	38.6	270
Malaysia	2510/3070	36.2	307
Philippines	4770/6170	31.8	617
Singapore	3330/3330	50.0	333
Thailand	1800/3350	21.1	335
TOTAL	5,000/18,600	Avg: 32.4	1860

*Two figures are presented for electricity use in commercial buildings. The first represents the total use in commercial buildings others than those associated with industrial activities. This number includes the portion of transmission losses in each of the countries appropriately allocated to the commercial sector. The second estimate includes commercial buildings serving the industrial sector. This is derived by assuming that 15 percent of industrial electricity use goes for space conditioning, lighting, and related uses in buildings. The percentage of total electricity use estimates are derived from the latter electricity use (including industrial buildings).

hour of electricity is about $0.10 (U.S. currency), then the total annual expenditure for electricity for buildings in ASEAN is between $1.5 and $1.9 billion. (The higher estimate accounts for electricity use in industrial buildings.)

The implications of these estimated expenditures for policies to conserve energy in buildings are substantial. If, as we suggest later in this report, ASEAN countries could reduce energy use in buildings by 15 percent in the near term and as much as 40 percent in the longer term, then the total annual reduction in energy costs for ASEAN would be $280 million (near term) and $750 million (longer term). The estimated savings do not take into consideration the growth of the commercial sector. Electricity demand has grown rapidly during the past years among all ASEAN countries and is expected to continue to grow. Electricity use in buildings has also increased, as the ASEAN economies have spurred construction.

It is worth stressing that these reductions in energy costs ($280 to $750 million) are annual savings. Because such a large percentage of electricity is generated from oil, a large portion of the savings will go to reducing imports (with the exception of Indonesia), thus having an impact on balance of payments. Table 3 compares the near term savings in oil costs to the ASEAN countries that import oil (Philippines, Singapore, and Thailand) with total deficits in trade balance. (A price of imported oil of $31 per barrel is used for the calculation.) It is evident from this table that the 15 percent near-term reduction of energy use by commercial buildings can contribute to a reduction in balance of payments deficits among the three oil importing ASEAN countries.

Thus, a basic conclusion is that energy conservation in ASEAN buildings can make significant contributions to the ASEAN economies.

High Priority Conservation Measures

To gain an overview of the potential for reducing energy use in commercial buildings in ASEAN, it is useful to understand how energy is currently used. This permits the assignment of priorities for revisions to the energy standards.

A hypothetical commercial office building was simulated using the DOE-2 computer code. Typical building operating profiles and hourly weather data for Singapore were used in the simulation. Thus, the results

Table 3. Commercial Building Energy Use, Trade Balance, and Oil Imports in the Three ASEAN Countries Oil Importing Countries*

Country	*Cost of Oil Imports for Electricity for Commercial Buildings** *($millions)*	*Balance of Trade Deficit ($ millions)*	*Cost/ Trade Deficit*
Philippines	340	2800	0.121
Singapore	180	7400	0.024
Thailand	185	2900	0.064

*Imported oil is assumed to cost $31/barrel. The source of the balance of trade deficits is "The World Handbook," 1984. The balance of trade deficit data are for 1981.

are directly applicable to Singapore. However, because the weather in most ASEAN cities is hot and humid most of the year, the results give a qualitative feeling for the sources of commercial building energy use throughout ASEAN.

The total energy use of the hypothetical office building was estimated to be 540 kBtu (158 kWh) per square meter per year. 53 percent of the energy is used for air conditioning (cooling and air movement). 38 percent of the energy is for lighting. The remainder is for miscellaneous equipment.

The largest sources of the cooling loads are solar radiation through windows (28 percent), lights (22 percent), and ventilation (16 percent). Occupants contribute 13 percent of the cooling loads. Walls contribute only 10 percent and glass conductance, 5 percent.

It is useful to look at individual components to understand their contribution to total building energy use. The most important is lighting. As noted, the electricity to operate lights is 38 percent of total energy use. However, lights contribute to the cooling load as well. When this contribution is accounted for, lights consume 51 percent of the total energy use of the office building.*

Windows are also an important component. Through their impact on cooling loads, they contribute about 13 percent to the total energy use of the building (for a hypothetical building conforming to OTTV requirements). Of equal or greater importance, they have the potential to reduce the amount of artificial lighting required by the building. Thus, windows have a considerably greater potential for reducing energy use than their 13 percent contribution to total energy use suggests.

Of the remaining 36 percent of the energy use of a hypothetical building, the contributions come from miscellaneous equipment (9 percent), ventilation (8 percent), occupants (7 percent), and walls (5 percent).

Because of the variability of miscellaneous equipment, energy savings for equipment have not been analyzed. Ventilation levels are presently set in most codes. The issue of maintaining proper ventilation

*The assumption is made that the lighting power is 20 watts/square meter. If the actual lighting power is 16 watts/square meter, the total contribution of lighting to energy use (including its effect on cooling) is reduced to 45 percent of the total.

32

levels (not too low for health reasons; not too high for energy reasons) is treated as a maintenance problem, discussed below. Loads due to people are not subject to control. Walls contribute little to total building energy use. Because the temperature is above interior comfort conditions day and night for almost the entire year, cooling of the building at night yields little reduction in energy use in Singapore. The potential for designing buildings to take advantage of night cooling in other parts of ASEAN needs to be explored.

Equipment energy efficiency is a final important energy saving measure. Present practice for new buildings in Singapore appears to be good (based on discussions with Singapore professionals). We have no data as yet on building practice in the other ASEAN countries. Equipment in most existing buildings, however, is not adequately maintained: the major concern of building managers is in the comfort of the occupants. Ventilation rates are often higher than necessary. Cooling equipment, fans, and pumps are permitted to degrade in efficiency so long as comfort conditions can be met. Considerable energy savings are likely if policies relating to the maintenance of equipment are adopted and carried out. Policies to establish good maintenance practices in buildings have been given little attention; they deserve much more.

This brief discussion suggests that the following three areas deserve priority attention in considering commercial building energy conservation policies in ASEAN: lighting, windows (especially to encourage the use of daylight), and equipment maintenance. The analysis completed for Singapore suggests a 15 to 20 percent reduction in energy use is cost-effective and possible in the near term and a reduction of up to 40 percent may be possible in the longer term, considering measures affecting lighting, windows, and equipment maintenance. We anticipate that similar magnitudes of savings can occur throughout ASEAN, although the specific measures and the cost-effectiveness is likely to vary with location.

In short, the economic potential of energy conservation in commercial buildings throughout ASEAN is substantial.

Alternative Policy Approaches

There are numérous approaches to realizing the potential for cost-effective conservation in ASEAN commercial buildings. It is premature at

this point in the study to provide recommendations regarding the most desirable approaches. However, a description of the alternatives does give a sense of the options available.

The choices range from purely informational to mandatory standards with enforcement. For many countries, it is useful to approach conservation policies in an evolutionary manner, beginning with information and developing over time a set of requirements that can be followed and are accepted without a great deal of difficulty. Thus, we describe the policies in different steps, recognizing that different nations have designers and builders who are at different stages of awareness and implementation of energy conservation in buildings. We also recognize that political and economic considerations will play an important role in determining which steps might be omitted, what emphasis to give to different policies, and how far it is reasonable to pursue energy conservation poilicies for commercial buildings.

Step 1: Modest Information Campaign

This involves making widely available to the building community information about the most effective (and presumably most cost-effective) ways of achieving energy conservation in new and existing commercial buildings.

For most of ASEAN, this step would involve high quality information packages that would focus on the three most important areas for reducing energy use: lighting, windows and daylighting, and building equipment maintenance. Different packages are needed for new and for existing buildings.

This phase of the program is likely to be accompanied by a government program exhorting the building community to adopt energy conservation practices.

Step 2: Government Buildings Program

The government can set an example by retrofitting existing buildings and requiring new buildings to be energy conserving. This can take the form of taking measures that will ensure that most government-owned buildings are energy efficient or by choosing a select number of buildings that are made to be very energy efficient.

It may seem obvious to note that government actions should emphasize the measures that are most cost-effective in saving energy. Unfortunately, there have been many cases of "showcase" energy conservation buildings that performed poorly. Often this occurs because the attempt is made to design and build the most advanced (and often untested) energy conserving features into the building. Also, lack of knowledge of the conservation measures most likely to succeed in different climates and among different building types is widespread. The importance of energy conservation is a recent recognition among the building community. The technical knowledge to design and build effective energy conservation measures in commercial buildings is not widespread, even among professionals who are expected to be familiar with the subject.

Thus, in initiating a program to achieve conservation in government buildings, the ASEAN countries are advised to be highly critical of the approaches that are recommended to reduce energy use.

Step 3: Development of Tools to Evaluate Conservation Measures

The uncertainty about the effectiveness of energy conservation measures in different climates and building types gives rise to the need for evaluation tools. Such tools may be developed as part of step 3, so that the governments can themselves assess different proposals to achieve energy savings in commercial buildings.

There have often been misunderstandings about the use of different types of computer codes for estimating the energy use of commercial buildings (in order to assess energy savings of different measures). There are highly sophisticated computer programs such as DOE-2, BLAST, and NBSLD. These programs are valuable for researchers. They are also powerful tools for government use in performing calculations that guide government policy. However, they are much too complex for use by practitioners who are seeking guidance about impacts of conservation measures (except for very experienced users who need a complex, accurate tool for assessing conservation measures in large buildings).

A tool is needed for practitioners that is reasonably accurate but relatively simple to use. It is not reasonable--nor is it cost-effective in most instances--to expect or encourage practitioners to use DOE-2 or similar programs to assess building designs for most buildings.

35

There are several relatively simple computer codes (running on microcomputers) available in the United States for evaluating commercial building energy use. These codes have not yet been thoroughly tested, but testing is taking place. These tools need to be tested in ASEAN climates against more complex computer tools before they should be made available within ASEAN. The choice of using an existing microcomputer code or constructing a new or modified code depends in part on the policies adopted by the ASEAN countries. If a country is interested in developing relatively simple procedures for implementing conservation measures and if analysis shows that relatively simple calculations can accurately assess impacts of these measures, then it may be most effective to develop a new microcomputer code for use by practitioners. We believe, for example, that a relatively simple computer code can be written for a revised Overall Thermal Transfer Value (OTTV) standard for Singapore. Such a microcomputer program could be fit precisely with the OTTV standard and still give accurate results about energy use.

Step 4: Energy Labels

A system that is gaining favorable attention in several countries (notably France and the United States) involves labeling buildings to indicate their expected energy performance. The building labels would provide sufficient information that the owner, occupants, and prospective purchasers could readily determine if the building in energy conserving, average, or the building equivalent of a "gas guzzler." Such labels are presently used for automobiles and most major household appliances in the United States.

The advantage of a labeling system is that it can be adopted without placing mandatory requirements on building designs. Labels can serve as an educational instrument in several ways. First, the building designer is required to evaluate the building design to determine its energy conservation rating. The process of evaluating the building, if done correctly, will educate designers about the measures that can most effectively reduce energy use. Second, the existence of a label can serve the purpose of making the tenants and prespective building purchaser aware of the anticipated energy performance of the building. Some designers may use the label as a marketing tool: a low energy use building may command a higher price in the market than one with a less favorable energy rating

and an architect who produces buildings with favorable ratings may use this in seeking clients.

Labels can also be combined with voluntary or mandatory standards (see steps 5 and 6) to provide incentives for builders and designers to go beyond standards. An "average" rating may correspond to the standard; thus, buildings with anticipated energy use significantly below the standards would be identified through its label. The label could be combined with a government incentive program if the government deemed it desirable to encourage more energy efficient buildings.

It is also reasonable to use labels as a means of gradually introducing standards. The technical development of labels requires the same research and analysis as standards. (A simple microcomputer code for analyzing the energy use of buildings is needed to support labels or standards.) The labeling approach can be a pretest of standards, indicating which measures are understandable and easily adopted by the building community.

It is worth repeating that the same effort to develop standards is needed to promulgate building labels. Thus, none of the ASEAN countries are presently in a position to implement a commercial building labeling program.

Step 5: Component Standards

Many countries throughout the world have adopted the component standards put forward by the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) for various building components (eg., lighting, wall insulation, heating and cooling equipment). These standards may be optional, mandatory (but without enforcement), or mandatory (with enforcement).

ASHRAE is unquestionably a trustworthy source of information and guidance about measures to use to achieve energy conservation in buildings. However, ASHRAE standards have been established for the most common climates in the United States. The research and analysis the underlies the ASHRAE standards in almost all cases have been performed for moderate climates. As a result, considerable care must be taken in the application of the ASHRAE standards to countries in ASEAN. As an example, elements of ASHRAE were used in part as a basis for the Singapore

OTTV standard. Research conducted during this project has shown that (1) simplifications can be made to the ASHRAE formulation because of the Singapore climate and (2) these simplifications are likely to be considerably more accurate than the more complex formulation based on ASHRAE.

Thus, if component standards are selected for ASEAN countries, research is needed to develop information that applies to the individual countries. The fruits of this research are likely to be a code that is much easier to implement--as well as more accurate--than using ASHRAE codes directly would achieve.

Step 8: Implementation of Mandatory Standards

The approaches to energy conservation standards include: (1) prescriptive component standards, (2) component performance standards (which allow tradeoffs among some of the components of a building), and (3) whole building performance standards. We do not discuss the prescriptive standards, as such standards based on ASHRAE procedures are discussed in the previous section (step 5).

The Singapore OTTV is an example of component performance standards. The OTTV consists of an overall requirement affecting envelope conductivity, window conductivity, and radiative gain through windows. As implemented, the Singapore standard allows tradeoffs among these three contributors to energy use of a building, so long as the overall OTTV is no greater than 45 watts/square meter. Singapore separately limits the lighting power (to 20 watts/square meter for commercial office buildings) and also prescribes ventilation standards for all commercial buildings.

A limitation of the Singapore approach is that tradeoffs are permitted only among the building envelope and windows. If a building has a very efficient lighting system or uses methods to take advantage of natural lighting to replace artifical lighting or has a very efficient cooling system, no added credit is given toward meeting OTTV. The effect is to reduce the incentive to reducing energy use for certain building components. The limited number of tradeoffs may also cause the choice of sets of energy conservation measures that are less cost-effective than choices that might be made under performance standards.

These comments are a theoretical argument against either a prescriptive approach to energy standards or a component performance

approach that does not allow tradeoffs among the most important conservation measures. The theoretical nature of the argument needs to be recognized. In practice, no country in the world has yet adopted a performance approach to the setting of energy standards for buildings. The United States government attempted to develop and implement a performance standard (the Building Energy Performance Standards or BEPS). However, BEPS was not approved by the U.S. Congress, in large measure because of its perceived complexity. Some state governments in the United States (notably California) have adapted standards that allow a performance approach to be used instead of the standard prescriptive approach. It is notable that the performance approach is virtually never used in these states, presumably because meeting prescriptive standards is much easier for building designers.

Thus, the choice of methods for the implementation of energy conservation standards in ASEAN (if some member countries choose to adopt standards) is not a simple one. The work accomplished to date--involving considerable quantitative assessment of energy conservation measures in an office building in Singapore--provides new insight into policy approaches, beyond the discussion above. The findings of the analysis suggest that it may be possible to develop relatively simple but accurate equations that will allow (1) a performance approach not suffering from the complexity of previous efforts to permit tradeoffs among all major conservation measures and (2) a microcomputer code that will facilitate the implementation of such an approach. It should be noted that this approach is likely to work in Singapore, where one does not need to be concerned about heating and where the climate is not variable. Whether a simplified but accurate performance approach is possible in other ASEAN climates requires considerable additional research.

Specific Measures to Reduce Commercial Building Energy Use in ASEAN: Lessons from the Singapore Analysis

We summarize here the most important findings of the analysis of measures to reduce energy use in commercial buildings in Singapore. The quantitative results will not hold for other ASEAN countries, but because of the hot, humid climates throughout all of ASEAN most of the qualitative results will apply throughout the region.

1. The Desirability of Reducing Lighting Levels

The present lighting standards in Singapore are 20 watts per square meter of floor space for commercial buildings. For a typical office configuration using standard lamps and ballasts, this lighting power may be expected to yield about 500 lux. A lighting level of 20 watts per square meter is likely to be typical of much of the commercial building stock in ASEAN.

It is desirable to reduce the lighting power to 15 or 16 watts per square meter for most commercial buildings (excluding retail stores and some other building types). This lighting power can be achieved in all new buildings and also in the replacement of lighting systems in existing buildings.

This measure will reduce energy use in buildings in Singapore by 10% to 12.5%, depending on which of the levels is set. About 75% of the energy savings will be in electricity for lighting; the remainder will be a reduction of chiller and fan energy use. Comparable reductions in energy use can be expected in the other ASEAN countries through the reduction of lighting power.

At present, 16 watts per square meter can be achieved with no reduction in lighting levels, with no complex lighting strategies, and with easily obtained lighting equipment. It is not necessary to use solid state ballasts to achieve 16 watts per square meter and 500 lux illumination.

Achieving 15 watts per square meter will require energy efficient lighting systems plus one of the following measures: (1) introduction of some task lighting, (2) limited lighting control systems, (3) reduction in lighting levels (by about 6% or to about 470 lux), or (4) the use of solid state ballasts.

Achieving this level of lighting power is likely to be cost-effective in most of ASEAN.

*2. Daylighting**

The single most effective strategy for reducing energy use in

*Daylighting involves the use of natural light through windows and skylights to reduce the demand for artificial light. The results discussed in the text are based on the use of photosensors to measure the lighting levels, a control system that adjusts the artificial lighting levels within the perimeter zone, and internal shades to reduce glare problems. More sophisticated or complex systems (eg., light shelves, variable shading devices) have the potential for either increasing energy savings somewhat

commercial buildings in Singapore is the use of daylighting to replace artificial lights. While we have not done an analysis of daylighting in other ASEAN countries, this strategy holds promise in these countries as well. However, effective daylighting depends on many factors that are certain to vary throughout ASEAN. Of particular importance is the fraction of diffuse to direct radiation. Thus, the results obtained in a Singapore climate cannot be extrapolated to other ASEAN climates.

For a hypothetical office building in Singapore, the use of daylighting (without more efficient lighting systems) typically resulted in a reduction of energy use by 20 percent or more. Combining daylighting strategies with energy efficient lighting reduces energy use by 30 percent or more. (It clearly makes sense to use efficient lighting systems and daylighting in combination.)

The reduction in energy use is critically dependent on the amount of perimeter zone (unobstructed space generally within 15 feet of windows) within the building. The reference building chosen for analysis has a large area of unobstructed perimeter zone. For a new building that is designed to take advantage of daylighting savings, these estimates are realistic. For existing buildings or for new buildings not designed with daylighting in mind, the expected energy savings are reduced (in direct proportion to the reduction in percentage of perimeter area in the building).

We have studied the effects of a number of variables on energy use in a daylighted building: (1) window to wall ratio, (2) shading coefficient (or visible light transmittance), (3) external shading of the building, (4) lighting power density, (5) step control versus continuous dimming, and (6) alternative strategies to reduce glare (automatic control of internal shades or blinds versus imperfect operation of blinds by occupants). The following general conclusions relate to energy conservation in Singapore buildings:

- The effects of window to wall ratio and shading coefficient (or visible light transmittance) on the performance of daylighting systems are relatively easy to calculate. The product of the two variables is the

or (more likely) improving the quality of light within the interior space.

fraction of incident light that passes through windows.

- Everything else held constant, daylighted buildings with external shading use less energy than those without shading. (The external shading causes an increase in artificial lighting requirements; this is more than offset by reduction in cooling loads.)

- External shades have the additional benefit in daylighted buildings of reducing the sensitivity of energy use to window to wall ratio and shading coefficient, so that the building designer has considerable flexibility in the design of the exterior envelope and window system.

- So long as the window to wall ratio and shading coefficients are not too high, daylighted buildings without external shades perform well and reductions in energy use are substantial.

- The effects of lighting power, lighting levels, and the efficacy of the lighting system on the energy savings of daylighting can be estimated relatively easily. Thus, the key lighting variables can be taken into consideration in developing a simple calculational procedure for estimating effects of daylighting on building energy use.

- A major concern about daylighting systems has been the issue of control of glare. The analysis of the glare problem indicated that glare is not likely to be a major issue in Singapore. Because of the high

fraction of diffuse radiation, the Singapore environment is conducive to daylighting. We do not know how serious glare problems are likely to be in other ASEAN countries, when daylighting is employed as an energy conservation measure.

In those ASEAN countries where daylighting is an effective energy conservation measure, it is likely also to be highly cost-effective. For a building with a high perimeter area in Singapore, we calculate a payback of less than three years, without including the benefits of reductions in equipment sizing.

3. Maintenance of Building Equipment

While there are no empirical data on the losses in energy efficiency resulting from poor maintenance of equipment, it is widely recognized that poor maintenance of building equipment is common and gives rise to significant increases in energy use.

We have analyzed in a Singapore climate impacts of the degradation of chiller performance resulting from salt deposits and scale on heat exchange surfaces in the condenser and the evaporator. The situation simulated is not unusual after a long period of chiller use. Building managers are not likely to give the problem particular attention so long as the chiller is able to meet the comfort conditions of the building occupants. The degradation of performance affects energy use substantially--increasing the building energy use 19 percent in the case in which both condenser and evaporator are dirty--but does not significantly impact comfort conditions. The results obtained above--for Singapore--are likely to be similar to results of this type of analysis applied to the other ASEAN countries.

This is just one example of a serious maintenance problem that generally goes untreated in the absence of measures to require appropriate action. There are numerous other problems that degrade the efficiency of building systems but do not necessarily affect comfort conditions.

Our judgment is that an effective maintenance policy could reduce energy use in buildings by 10 percent or more in most ASEAN countries. (This is undoubtably a very conservative estimate, based on the

experiences of researchers and energy auditors who have observed the condition of equipment in U.S. buildings.)

4. Alternative Approaches to Implementing Policies to Reduce Energy Use in Commercial Buildings

We discussed earlier in the paper the different policy approaches to reduce energy use in commercial buildings. What have we learned in studying revisions to Singapore's OTTV standard that can provide insight into policy formulation?

The approach taken to the study of OTTV in Sinapore involved simulations of all factors included in the formulation of OTTV: envelope conductivity, window conductivity, and radiative gain through windows. It also involved simulating all other major factors in a building design, to determine if important conservation measures were omitted from the OTTV formulation. The purpose of the analysis was twofold: (1) to estimate the ability of OTTV to measure energy use in Singapore, considering only measures included in OTTV and (2) to determine if OTTV captured the most important conservation measure. The full analysis is complex and detailed. Here we are interested only the the major finding and their implications to ASEAN, rather than the details of the investigation.

The study of the first issue--ability of OTTV to measure energy use--indicated that the OTTV formulation used in Singapore significantly overestimated the effects of increased glass conductivity (e.g., when going from tinted single glazing to clear double glazing). It also overestimated the effects of wall conductivity, which has virtually no impact on building energy use.

These findings are important for Singapore, as they raise the possibility of both increasing the accuracy of OTTV as a measure of building energy performance and of simplifying the approach to standards. The latter can be accomplished by omitting calculations of envelope and window conductivities, to the extent that their effects are very small compared to radiative gains (as demonstrated by the analysis to date).

This is an important finding for ASEAN for at least two reasons. First, it illustrates potential difficulties in adopting ASHRAE results to ASEAN unless climate data from the individual countries are used. The data for evaluating effects of window and wall conductivities on energy use in

Singapore were derived from ASHRAE estimates. The extrapolation of the ASHRAE estimates to a hot, humid climate with no night cooling is not accurate. Second, the analysis sugests the possibility, in ASEAN as well as Singapore, that an extensive anaylsis of energy use in ASEAN buildings may greatly simplify the approaches to the evaluation of energy use.

We studied OTTV for two reasons. The second was to determine if important terms were omitted from OTTV. The omission of lighting from OTTV is important; however, Singapore dealt with this issue by setting a separate standard for lighting. The contributions of natural light to reductions in lighting power (through daylighting strategies) are not included in OTTV. In order for the standard to encourage daylighting, a modification of the OTTV expression to include effects of natural lighting could be very valuable.

The principal lesson from this analysis for ASEAN is that the detailed study of all important conservation measures has the potential of providing a quantitative tool for implementing conservation policy. If the experience of Singapore holds true for other ASEAN countries, then this tool may be considerably simpler (although not less accurate) than similar tools developed for other climates. This could be a significant benefit in reducing the complexity of energy conservation policies for commercial buildings in ASEAN.

Conclusions and Recommendations

We have already noted the substantial energy conservation opportunities for commercial buildings in ASEAN. It is worth repeating some earlier figures: ASEAN has the potential of reducing its energy costs by as much as $280 million per year in the near term and $750 million per year in the longer term. These estimates underscore the potential economic benefits of effective energy conservation policies applied to commercial buildings.

Achieving these large energy savings depends on policies adopted by the ASEAN countries. We have no recommendation on one particular policy approach. Each country should evaluate the different approaches to decide which are most appropriate to their economic and political environment.

Regardless of the policy approach followed in the different countries, the need for detailed research and analysis to support the conservation policy is great. We comment on the most important issues to be addressed, as guidance to the second phase of this study.

The type of analysis performed in the technical study for Singapore is directly applicable to the other ASEAN countries. With minor modifications, the steps followed for Singapore are needed to establish a basis of buildings energy conservation policy in ASEAN. These steps include: (1) design of a hypothetical building or buildings, (2) choice of DOE-2B to assess conservation measures, (3) gathering of weather data, (4) performing single parametric simulations using DOE-2B, (5) analyzing combinations of conservation measures, (6) assessing alternative policy approaches, (7) developing preliminary recommendations, (8) performing detailed studies of most promising measures, and (9) proposing final policy recommendations with a design of an implementation package.

An important issue for the continuing work is the quality of the weather data in the different ASEAN countries. Because of the importance of solar radiation to cooling loads and its potential for reducing lighting loads, high quality data on direct and diffuse radiation are needed. This is an important task that the participating ASEAN countries need to perform to support the overall research activities.

Active participation of the ASEAN countries in the project is important not only to gather weather data but also to (1) gain a technical understanding of the methods of the analysis so that they can carry the work forward in the future, (2) obtain needed information on the energy performance of the existing building stock to provide a basis for estimations of energy savings resulting from conservation policies, and (3) communicate to the LBL researchers the types of policy approaches that are likely to be acceptable and effective in the individual countries.

The transfer of DOE-2B during the course of the project continuation can serve at least two objectives: (1) provide a powerful tool to support many types of research on the energy performance of buildings, thus enhancing the research capabilities of ASEAN countries in this area and (2) giving the government the capability of expanding and revising their conservation policies on the basis of new technical analysis performed in the country (after the AID study is completed).

46

The development of a microcomputer tool for implementing the conservation policies is a desirable objective for the project, once the technical analysis has been completed and the policies approaches agreed upon. Because the analysis in Singapore is much more advanced than that of the other ASEAN countries, the developing and testing such a tool in Singapore would be an appropriate undertaking while the more basic work is completed in other ASEAN countries.

Finally, because of the potential for daylighting strategies to accomplish a great deal in Singapore (and undoubtably in other ASEAN countries), research on daylighting--especially daylighting demonstration programs in ASEAN buildings--will yield substantial benefits to ASEAN.

In short, the LBL recommendations to ASEAN for the continuation of the analysis of energy conservation in buildings include:

apply the approach used in Singapore to other ASEAN countries

This involves a comprehensive analysis of impacts of conservation measures in commercial buildings using the DOE-2B computer code. It requires the ASEAN participants to gather detailed solar radiation data and participate in the project in other key ways.

transfer the DOE-2B computer code to those ASEAN countries desirous of using it for the analysis of energy performance of buildings

work with the ASEAN government policy community to understand appropriate energy conservation policy approaches which the technical analysis can support; work with the government, research, and buildings communities to support demonstrations of advanced

conservation measures with high potential payoffs within ASEAN

develop a microcomputer program for the implementation of conservation policies, with initial work on this program beginning in Singapore.

We anticipate that these recommendations will form the starting point for discussions to be held on May 31, 1984 among the ASEAN participants to the energy conservation conference in Singapore, U.S. AID representatives, and the LBL researchers.

AID 1020-20 (1-78)

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number: ASEAN ENERGY III - ENERGY CONSERVATION AND MANAGEMENT (498-0286)

Life of Project: 5 years
From FY 1985 to FY 1990
Total U. S. Funding 15,000,000
Date Prepared: February, 1985

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes: (A-1) Increase the efficiency of energy use in the ASEAN region Sub-goal: Improve the management of energy resources and technologies.	**Measures of Goal Achievement: (A-2)** A decrease in current and projected growth in ASEAN petroleum consumption. More efficient use of coal and energy technologies.	**(A-3)** National Government statistics	**Assumptions for achieving goal targets: (A-4)** Relative prices of energy sources will not vary widely from current case.
Project Purpose: (B-1) Foster policies which encourage both public and private sector adoption of energy efficient design and maintenance; and enhance institutional and human resource development in energy and technology management.	**Conditions that will indicate purpose has been achieved: End-of-Project status. (B-2)** 1) Stronger public policy commitment to energy conservation in participating countries; 2) Improved building codes in at least two ASEAN countries; 3) Private sector adoption of efficient hybrid lighting and other conservation designs; 4) State-of-the art microcomputer programs for architects and engineers already in use in designing and evaluating energy efficient buildings; 5) Technical handbooks and manuals for use by architects and and engineers on daylighting, building energy maintenance and other key topics; 6) Improved national energy plans; 7) Increased managerial capacity in coal technologies in national electricity authorities.	**(B-3)** Annual Work Plans Seminars and regional workshops ASEAN Conferences on Energy Conservation in Buildings Progress reports from AIT Semi-annual meetings of ASEAN Technical Coordinators and its progress reports AID PIR reports	**Assumptions for achieving purpose: (B-4)** That ASEAN officials are receptive to energy conservation in buildings and that conservation measures do not present significant financial/social/cultural burden on legislators/beneficiaries.
Project Outputs: (C-1) 1) Greater coordination among policy makers at both the regional and national levels. 2) Increased private sector awareness of technology and management alternatives for energy conservation in buildings. 3) Expanded capacity in building divisions and task national and local authorities in energy planning and management. 4) Expanded public and private sector capacity in coal use technologies.	**Magnitude of outputs: (C-2)** To be quantified in the annual workplans 8 ASEAN countries using DOE-2 Some 200 ASEAN public and private sector personnel trained in energy planning and management.	**(C-3)** Joint mid-term evaluation Annual work plans Conferences on Energy Conservations in Buildings. Follow-up seminars and regional workshops	**Assumptions for achieving outputs: (C-4)** That appropriate individuals can be identified and released for training, counterparts and support facilities identified or established, and needed items and/or services obtained.
Project Inputs: (D-1) AID : U.S. and ASEAN professional and training services, travel and per diem, grant to Asian Institute of Technology, U.S. technical contracts, evaluation and contingencies. ASEAN: Operational/support costs (person years, facilities/local expenses)	**Implementation Target (Type and Quantity) (D-2)** Contributions to Project component as follows (000s): Component / AID / ASEAN / TOTAL 1 - Energy Cons. in Bldgs. Training 900 - 900 Research 750 - 750 Assessment, Analysis, Policy 800 - 800 Info Dissemination 525 - 525 2,975 - 2,975 2 - Training in Energy Mgmt. AIT Training 900 - 900 Energy Management Training 400 - 400 Coal Technology Training 1,000 - 1,000 2,300 - 2,300 Operational/Support Costs Person Years - 1000 1000 Facilities/Local Expenses - 700 700 - 1700 1700 Evaluation/Contingency 500 - 500 GRAND TOTAL 5,775 1700 7,475 Annex B of Project Paper provides further details.	**(D-3)** Semi-annual reports from ASEAN technical coordinators Progress reports from AIT AID PIRs and PPAR reports	**Assumptions for providing inputs: (D-4)** Grant agreements can be negotiated. Qualified organizations/individuals can be identified and contracts negotiated.

Best Available Document

Detail Support of Financial Plan

Detailed Budget for Activity 1.1: Training - Energy Conservation in Buildings

A. DOE-2 Training Course (20 participants at LBL)

-- Travel (20 round trips X $2,000/trip)	$ 40,000	
-- Per Diem ($5,000/4 months X 20)	100,000	
-- LBL Staff (12 person months)	120,000	
Sub-Total		$260,000

B. Building Energy Analysis (2 courses for 20 participants).

-- Travel (20 round trips X $2,000 X2)	80,000	
-- Tuition ($4,000 X 20 X 2)	160,000	
-- Maintenance (2 month X $2,500/2 mos X 20)	100,000	
-- Overhead	65,000	
-- Misc.	40,000	
Sub-Total		445,000

C. Short Courses on Economic Policy and Tariffs in ASEAN - 3 courses of 2 weeks each for 10 participants

-- Preparation (3 person months X $ 10,000)	30,000	
-- Teaching (2 person months X $10,000)	20,000	
-- Airfare (10 roundtrip X 2,000 x 3)	60,000	
-- Per Diem (Instructors)	15,000	
-- ASEAN Travel & Per Diem (10x3 courses x $2,000)	60,000	
-- Materials	1,000	
-- Overhead	29,000	
Sub-Total		215,000
TOTAL		$920,000

Detailed Budget for Activity 1.2: Research in Energy Conservation in Buildings

A. Daylighting		
-- Technical Assistance (24 person months x $10,000)	$240,000	
-- Equipment	50,000	
-- Travel and Per Diem (4 round trips x $5,000)	20,000	
Sub-Total		$310,000
B. Natural Ventilation		
-- Technical Assistance (10 person months x $10,000)	100,000	
-- Equipment	50,000	
-- Travel & Per Diem (2 round trips x $5,000)	10,000	
Sub-total		160,000
C. Comfort Analysis		
-- Technical Assistance (8 person months x $10,000)	80,000	
-- Travel & Per Diem (5 round trips x $5,000)	25,000	
Sub-Total		105,000
D. Building Materials Thermal Characteristics		
-- Technical Assistance (8 person months x $10,000)	80,000	
-- Travel & Per Diem (6 round trips x $5,000)	30,000	
-- Equipment	50,000	
-- Local Expenditures	20,000	
Sub-Total		180,000
TOTAL		$755,000

Detailed Budget for Activity 1.3: Assessment, Analysis and Policy

A. Assessment		
-- TA (6 person months x $10,000)	$ 60,000	
-- Travel & Per Diem (3 round trips x $5,000)	15,000	
-- Local Audits Costs	20,000	
-- Equipment	5,000	
		$100,000
B. Analysis		
-- TA (40 person months x $10,000)	400,000	
-- Travel & Per Diem (10 x $5,000)	50,000	
-- Local Costs	20,000	
-- Misc.	30,000	
		500,000
C. Policy		
-- TA (15 person months x $10,000)	150,000	
-- Travel & Per Diem (6 round trips x $5,000)	30,000	
-- Misc.	20,000	
		200,000
TOTAL		$800,000

Detailed Budget for Activity 1.4: Information Dissemination/Private Sector

A. Seminars & Workshops		
-- Technical Assistance (7 person months x $10,000)	$ 70,000	
-- Travel & Per Diem (2 x 15 x $2,500)	75,000	
-- ASEAN Travel (3 meetings x 5 yrs. x 3 persons x 4 countries x $500)	90,000	
-- Misc.	5,000	
Sub-total		$240,000
B. Technical Manuals		
-- Technical Assistance (2 person months x 10,000)	20,000	
-- Travel & Per Diem (2 round trips x $5,000)	10,000	
Sub-total		30,000
C. Publication of Reports & Newsletters		
-- Technical Assistance (3 person months x $10,000)	30,000	
-- Production (2 x 5 x $200)	2,000	
-- Mailing	2,000	
Sub-total		34,000
D. Computer Data Base Development		
-- PC Computers (5 x $10,000)	50,000	
-- Technical Assistant (5 person months x $10,000)	50,000	
Sub-total		100,000
E. Annual ASEAN Meeting		
-- ASEAN Travel (3 persons x 5 countries x $500 x 5 yrs.)	37,500	
-- Misc.	8,500	
Sub-total		46,000
F. Project Coordination and Planning Meetings		
-- ASEAN Travel (2 meeting x 3 persons x 5 countries x $500 x 5 yrs.)	75,000	75,000
TOTAL		$525,000

Detailed Budget for Activity 2.1: Training at Asian Institute of Technology

A. Course in Energy Planning		
-- (20 participants x $7,000)	$140,000	
B. Course in Energy Technology		
-- (4 participants x $5,500)	22,000	
C. Long-term Advisor (2 years)		
-- Salary & Allowances	160,000	
-- Travel & PD	30,000	
-- Secretarial & Office Support	10,000	
-- Other	38,000	
Sub-Total		$400,000
D. RERIC		
-- Salaries	27,000	
-- Publications	25,000	
-- Acquisitions.	10,000	
-- Mail	5,000	
-- Staff Travel	7,000	
-- Access to U.S. Data Bases	9,000	
-- Misc.	7,000	
-- Subscriptions	10,000	
Sub-Total		100,000
TOTAL		$500,000

Detailed Budget for Activity 2.2: Energy Management Training

A. Energy Management Course (30 participants) in Malaysia		
-- Preparation (2 person months x $10,000)	$ 20,000	
-- Teaching (2 person months x $10,000)	20,000	
-- Air fare(4 round trips x $2,500)	10,000	
-- Per Diem (60 days x $100/day)	6,000	
-- Materials, etc.	3,000	
-- ASEAN Travel & Per Diem (25 x $3,000)	75,000	
Sub-Total		$134,000
-- IIE (20%) Administrator		26,800
Sub-Total		160,800
B. Specialized Energy Management Training in U.S. 10 participants (2 months)		
-- Tuition (10 x $100/day x 60 days)	60,000	
-- Maintenance (10 x $2,500/two months)	25,000	
-- Air Fare (10 x $2,500)	25,000	
sub-total		110,000
-- Administration (IIE-20%)		22,000
Sub-Total		132,000
C. Regional Follow-up Workshop		
-- Prep & Teaching (2 person months x $10,000	20,000	
-- Airfare (2 round trips x $2,500)	5,000	
-- Per Diem (20 days x $100/day x 2)	4,000	
-- Materials	1,000	
-- ASEAN Travel (15 x 500)	7,500	
-- ASEAN Per Diem (18 x $100 x 20 days)	36,000	
Sub-total		73,500
-- IIE (20%)		14,700
D. Misc.	19,000	
Sub-Total		107,200
Total		$400,000

Detailed Budget for Activity 2.3: Coal Technology Training

A. Coal Utilization in Power and Industry Course		
-- Travel and Per Diems		
-- Int'l Air Fare (3,000 x 24)	$ 72,000	
-- Per Diem (60 days x $100 x 24)	144,000	
-- Internal Travel ($500 x 24)	12,000	
Sub-Total		$228,000
-- On-the-job-training costs	50,000	
-- Instructors and Course Management	50,000	
Sub-Total		100,000
B. Coal Production Training		
-- Travel and Per Diem		
-- Int'l Airfare ($3,000 x 9)	27,000	
-- Per Diem (60 x $100 x 9)	54,000	
-- On-the-job Costs and Placement	12,150	
Sub-Total		93,150
C. ASEAN-US Coal Seminar		
-- Conference Facilities (ASEAN @ provide)		
-- ASEAN Travel ($500 x 35)	17,500	
-- Per Diem ($75 x 42 x 7)	22,050	
-- US experts:		
- Salary (5 x $2400)	12,000	
- Travel (5 x $3,000)	15,000	
- Per Diem (5 x $75 x 7)	2,625	
-- Miscellaneous	9,675	
Sub-Total		78,850
Total		$500,000

1. AID Funding

AID will provide $5.0 million in Section 106 funds for following activities

Table V : Summary of AID Funding

Component I: Energy Conservation in Buildings

Activity 1.1:	Training	920,000	
Activity 1.2:	Research	755,000	
Activity 1.3:	Assessment, Analysis, Policy	800,000	
Activity 1.4:	Information Dissemination	525,000	
	Sub-Total		$3,000,000

Component 2: Training in Energy Management

Activity 2.1	Training Program at AIT	500,000	
Activity 2.2	Energy Management Training	400,000	
Activity 2.3	Coal Technology Training	500,000	
	Sub-Total		1,400,000
Evaluation and Contingency			600,000
TOTAL AID FUNDING			$5,000,000

2. ASEAN Contribution

The expected ASEAN contribution is substantial in terms of both person years and facilities/local cost coverage.

Estimated ASEAN Contribution (over 5 years)

	Person Years	Facilities & Local Expenses
Singapore	25	60,000
Malaysia	15	60,000
Indonesia	20	60,000
Philippines	15	60,000
Thailand	15	60,000
	90 x $20,000	300,000
Total Equivalent	1,800,000	300,000

Total ASEAN Contribution $2,100,000

ANNEX E

Basis for PASA Award to DOE/LBL

The Lawrence Berkeley Laboratory is both uniquely and particularly suitable for technical assistance and to undertake the work. LBL facilities and resources are not competitive with private enteprise. It is in AID's interest to conclude a second stage PASA with DOE/LBL for the following reasons:

-- LBL has a unique capability in commercial buildings analysis, including an expertise in computer modelling and specifically DOE-2 that is not found in the private sector. A major portion of the project involves the application of LBL-developed techniques to analyzing building energy use and conservation opportunities. Through its implementation of the ASEAN Energy II program, LBL staff have developed an understanding of the needs and capabilities of the ASEAN countries and have formed personal relationships that would take another contractor several years to develop from scratch.

-- LBL has identified several competent 8a firms that, under LBL's guidance, can carry out some of the work of the project. The PASA will thus support in a major way the objectives of the Gray Amendment. We estimate that as much as $1.0 million will be subcontracted to 8a companies. Without strong technical and project management guidance from LBL senior staff, however, these companies would not be able to deliver the quality of technical assistance demanded in our high visibility assistance programs with ASEAN.

-- AID has no in-house technical specialists in the area of energy conservation in buildings. A PASA with DOE/LBL is therefore important to ensure the proper technical management of U.S.Government resources.

-- AID and DOE have had a close working relationship since the initiation of the ASEAN-US Economic Dialogue. DOE has been very supportive of the energy conservation in buildings program with ASEAN and LBL scientists have made substantial personal and resource commitments in excess of the specific resource level in the PASA since they see technical benefits arising to the US program from the work with ASEAN.

-- The buildings sector in the United States has proven to be one of the most sluggish to respond to price and other incentives for conservation. This fact has been critical to DOE management's decision to maintain a substantial DOE program in this area. The same situation appears true in the ASEAN countries. In addition, the major emphasis in the project on developing appropriate government policies to encourage conservation involves working with government officials on options and with data that is generally viewed as sensitive information. ASEAN officials have sound working relationships with LBL, whereas no private companies are currently working with ASEAN governments in this area.

Technical Analysis Detail

1. ASEAN Energy Policies and Programs. The ASEAN countries vary considerably as to their energy needs and resources. Indonesia has the lowest per capita energy consumption and the largest and most diverse energy base, with substantial oil, gas, coal, geothermal, hydro, and biomass resources. Singapore has the highest per capita use and has no indigenous energy resources except the solar insulation that falls on the country. Philippines and Thailand are among the top ten oil-importing LDCs and are actively seeking to reduce their oil import dependence. Thailand is emphasizing natural gas and lignite development, while the Philippines is planning to increase its domestic production of coal, geothermal, hydro, and wood energy supplies. Although a net oil exporter, Malaysia is concerned about reducing its future demand for oil through a combination of domestic natural gas and hydro development and imported coal and possibly domestic lignite production.

Singapore and the Philippines have pursued market pricing strategies and developed national conservation policies and programs. Over the past two years, Indonesia, Thailand and Malaysia have adopted energy price reforms and have launched energy conservation programs. These efforts are in nascent stages and suffer from a shortage of skilled manpower in energy planning and management. Indonesia is currently completing an energy conservation master plan with assistance from France. Thailand has reduced the subsidy on diesel fuel and is seeking to keep the average annual growth of energy consumption to below 4.8%. Malaysia has established an Energy Conservation Committee under the Ministry of Energy, Telecommunications and Posts and is beginning an energy audit program in the industrial and buildings subsectors.

Electricity consumption is growing in importance in the ASEAN region as industrialization and urbanization processes continue. Much of this electricity is generated from oil: Singapore (100%); Malaysia (84%); Thailand (36%); Indonesia (64%) and Philippines (58%). Significant consumption of electricity is occurring in commercial buildings in the region. A preliminary estimate suggests that commercial buildings consume an estimated 30% of total electricity in the region and that annual costs for electricity (assuming $0.10/kwh) amount to about $1.6 billion (see macro-economic analysis below for details).

Rapid growth in the buildings sector reinforces the need to consider energy conservation opportunities. Except for Singapore, most ASEAN countries are still in the early stages of assessing energy use in buildings. This project will assist them in developing suitable policies and programs. Singapore's experience in developing an explicit energy standard (OTTV of 45 watts/sq. meter) and in placing a 50% surcharge on buildings that do not

comply with this standard represents an important case for evaluating the effectiveness of a buildings energy standard approach. Tremendous interest in the potential of building energy conservation was generated in the other ASEAN countries as a result of the May, 1984 Singapore Conference, which reported on the results of the ASEAN-U.S. project. The ASEAN proposal is an indication of their strong interest in mounting a substantial effort in this area.

2. Nature and Determinants of Energy Use in the Building Sector. In tropical climates, such as exist in most areas of ASEAN, commercial buildings will consume most of their energy for lighting and cooling (assuming air conditioners are utilized). Other uses include miscellaneous electrical equipment (e.g. video display terminals and electric typewriters), and fans. There are many factors that influence energy use in buildings. The most important are shown in the tabulation below. A discussion of the major determinants follows.

Perhaps the three major factors that determine the quantity of energy used in a building are the building type (i.e., is it an office building, residence, retail store, etc.); the building floor area; and the outdoor climate. As floor area increases, energy use increases in an almost linear manner. Building usage patterns must be known if reliable estimates of energy usage are to be made. For example, retail buildings are usually operated for longer time periods than office buildings; they may therefore have higher lighting levels and more occupants per square foot of floor space. All of these contribute to greater energy usage. Weather is another very important factor -- outdoor temperature, humidity and solar radiation all influence space conditioning use (energy used for creating comfortable conditions for building occupants).

The variables that affect energy usage in buildings can all be placed in one of three categories: factors affecting lighting energy use, factors affecting heating and cooling loads, and factors affecting space conditioning equipment efficiency. In ASEAN, we need not concern ourselves with heating. If all of the factors in Table I are well known, it is possible to determine energy usage to a high degree of accuracy. This can be done by using various computer programs that simulate the operation of a building in a particular climate.

TABULATION - MAJOR DETERMINANTS OF ENERGY USAGE IN BUILDINGS

Building Type
Floor Area
Climate
Occupancy Patterns
Miscellaneous Electrical Equipment
Electrical Lighting Power
Composition of External Walls
Composition of Roof
Roof and Wall Color
Window Area
External or Internal Shading
Window Type
Infiltration Rate
Cooling and Heating Equipment Types
Thermostat Setpoints for Heating and Cooling
Outside on Flow Rate
Use of Economizer System
Efficiency of Cooling and Heating Equipment

The computer program calculates hourly energy use for lighting, fans and other electrical equipment, cooling loads caused by heat generated by lights, people, miscellaneous electrical equipment, solar radiation, etc. and the energy used by cooling equipment to remove that heat. The use of a fast running computer program allows an architect, engineer or researcher to study the effect on energy use of changing the architectural or equipment features of a building. While these hourly calculation type of computer programs require much experience to use properly there are other simpler programs that may possibly be utilized for building energy analyses. The applicability of these programs to tropical climates however, must be tested.

3. Potential for Energy Savings in Buildings. The potential for energy savings in both existing and new buildings in ASEAN is great. Preliminary estimates indicate that on the average 30% of all energy use in ASEAN buildings is for cooling and lighting.

Figure 1 ranks a number of conservation measures according to their effectiveness in reducing energy use in a Singapore office building. It can be seen that measures to reduce lighting energy use or reduce cooling loads are the most effective in reducing total energy use. The use of daylight as a partial substitute for electrical lighting reduces both electrical energy use for lighting

and electrical energy for air conditioning and is the most effective single measure of those studied. The second best measure is the use of more efficient lighting systems. This can be accomplished through the use of energy efficient fluorescent lamps, more efficient luminaires, solid state ballasts. etc.

The next three measures all reduce cooling loads produced by solar radiation by respectively using external shading, reducing window area and reducing the transmission of light through the windows. After the next highest ranking measure (cooling setpoint increase), the effectiveness of the other measures studied falls off rapidly. The exact change in the parameter studied is shown to the right of each box except for daylighting. It should be noted that the order of ranking and the absolute effectiveness of conservation measures is dependent upon the climate and building type. Although in general, similar measures will be important in the other parts of ASEAN, we do not know if the same order of ranking or absolute magnitudes will be found in other climates or in other building types. In addition, some measures, such as the use of nighttime ventilation, which were not effective in Singapore, may be effective in climates with greater diurnal variation in temperature.

A systematic study will have to be performed for the most important building types and in several climate regions in order to fully determine the most effective energy conserving measures for the various combinations of building type and climate. Additionally,combinations of measures will be studied to determine the maximum total energy savings achievable for a realistically designed building.

Aside from superior accuracy, an hourly calculation building simulation program has the advantage of allowing the user to determine the building energy use as a function of time. Therefore, the effect of energy conservation programs on the time and magnitude of peak electrical demand can be studied. This is very important to building owners in locations where the rates are dependent on time of use. Peak electrical demand is also a driving force in the construction of new electrical power plants. In addition to the use of complex computer analyses, there is an additional method (energy audits) by which energy-conserving measures may be evaluated. The use of energy audits whereby trained personnel perform an on-site survey of a building is one method of appraising energy conserving opportunities for existing buildings. This information, gathered by observing different functions of a building, is used to make estimates of possible energy savings that may result from changing various architectural or system features. These estimates are usually performed by hand, but could also be carried out with simplified computer codes.

4. Technical Capabilities of ASEAN. Singapore has significant technical capabilities in all aspects of the analysis and implementation of energy conservation policies for buildings. The other ASEAN countries have pockets of expertise in specific areas that can be built upon to form a nucleus for the project and the development of institutions to pursue building energy conservation policy.

Thailand has a strong research community, centered at KMIT and AIT but including other universities. The architecture faculty in several universities in the Bangkok region have members who are eager to pursue energy conscious design (as evidenced by attendance at the U.S. AID/ASEAN conference in Singapore and later contacts with the project team). The expertise in energy analysis of building design is not as yet well advanced. The National Energy Administration is staffed to work on energy conservation in buildings, but the expertise in energy auditing, computer techniques of building energy analysis, and policy analysis is not yet sufficient to carry out the project. The building code officials in Thailand are not conversant with issues of building energy use. The private sector building community is by and large uninformed about energy conservation opportunities for buildings. The electricity generating authority has shown little interest in energy conservation in buildings.

Indonesia has an interagency energy conservation task force, which has sponsored efforts to measure energy use in several buildings. The electricity department has a group assigned to energy conservation (including buildings). The Public Works Department has two key staff members and ten staff in total who are assigned to work on energy conservation in buildings, but the work awaits the initiation of the ASEAN Energy III Project. Several research institutions are conducting research on selected aspects of energy use in buildings. (The most relevant of this work is research on daylighting being conducted at LIPI, Bandung). The Indonesian government has received assistance from the French to include building energy conservation activities in the energy master plan. There has been little evidence of strong private sector interest in building energy conservation; recently, however, private sector funds have been allocated to increase the energy efficiency of three large buildings.

The Philippines has expertise in the Bureau of Energy Utilization, Ministry of Energy, on enginering aspects of energy conservation. Although most of this expertise is in the industrial sector, an increasing effort is now being devoted to buildings. The University of the Philippines and other universities have engineering and architecture faculties knowledgeable about selected aspects of the problem, and interested in being more involved in research on energy use in buildings. (UM would like to have DOE-2 running at its facilities). The private sector has considerable interest in energy efficiency in buildings, as evidenced by their attendance at meetings on the subject sponsored by BEU and the willingness of the trade associations to participate in the development of energy standards. An officer of the Philippine Association of Architects participated in the U.S.-ASEAN Experts planning meeting for this project. Building equipment contractors have knowledge of HVAC performance and efficiency. The Public Works Department and building code officials have shown little interest in building energy efficiency to date.

Malaysia has begun a small program to perform energy audits of buildings. The standards institute (SIRIM) is willing to devote staff to building energy problems. Faculty in various universities are working on aspects of the problem (particularly in the engineering faculties), but are not focussed on applying the knowledge and expertise to buildings. The private sector and building code officials have not as yet shown significant interest or expertise in energy efficiency of buildings.

Thus, with the exception of Singapore (which has established expertise in all areas), the remaining ASEAN countries have an emerging knowledge base that is centered in one or two institutions. The expertise at the universities throughout ASEAN is latent in that it can be, but has not as yet been, directed at buildings issues. The architectural community and the construction industries throughout ASEAN have not shown particular interest in energy efficient buildings (although some elements of traditional architecture effectively reduce energy use through designs that take advantage of climate). The energy planning agencies are among the most advanced institutions in addressing energy efficiency in buildings for three ASEAN countries that have strong energy planning activities (Philippines, Indonesia, Thailand). The building code officials are not generally conversant with energy issues.

5. Technical Research Needs and Issues. There are several energy conserving measures that cannot be implemented immediately upon completion of the studies described in Section VI A.3. These include daylighting, natural ventilation, and radiative barriers. Further research is needed before these measures can be implemented. In some cases, experimental studies are required, while in others, theoretical analyses must be extended to new situations.

The substitution of natural daylight for artificial, electrically produced light is known as daylighting. Daylighting is only possible in the perimeter areas of a building where sunlight may penetrate. The core of a building cannot utilize daylight. In the perimeter zones of a building that utilizes daylight, photoelectric sensors detect the magnitude of daylight available at all times. The use of artificial light in those zones is then reduced accordingly, while maintaining a fixed total (electrical plus daylight) lighting intensity at all times. The study of daylighting is very complex since many factors impact the effectiveness of daylighting system. Some of these factors are: window area, visible and total solar transmittance of the windows, installed lighting, power, desired lighting intensity and the degree of external shading. An important issue is the degree of occupant satisfaction with a daylighting system. For example, will productivity suffer because of excessive glare or will interior shades be drawn and left drawn (defeating the purpose of a daylighting system) when the glare becomes too great?

It will probably be necessary for ASEAN to gain experience in the use of daylighting systems through demonstration projects in actual buildings located in ASEAN before substantial use of such systems is realized. Since so many factors influence the potential energy savings that can be achieved with a daylighting system, building designers will need a simplified approach for optimization of their particular system. Analyses will be performed to create a data base from which a simple, fast running daylighting optimization computer program can be written.

The use of natural ventilation is a second major area requiring further research. In this case, both experimental and theoretical studies are needed. Natural ventilation is the movement of outside air into a building without the use of fans, as is usually the method for large commercial buildings. The magnitude of natural ventilation achieved in a building will depend upon such factors as the size and placement of openings (e.g. windows and louvers) in the building envelope and the location and size of obstructions within the building. Some of the nations in Southeast Asia have utilized natural ventilation for many years prior to the common use of air conditioning. The comfort of building occupants is a very important issue in the use of such a strategy. Comfort depends on several

factors other than temperature and humidity, such as air movement, temperature of surrounding surfaces, clothing worn and level of activity indoors. Experimental study of these factors is required for individuals in buildings located in ASEAN. The results of these experimental studies can then be incorporated into computer codes to determine the percentage of time occupants are comfortable under various building design conditions. A final product might be a chapter in a design manual and or a microcomputer program that allows designers to determine the effect of design modifications on occupant comfort.

6. Energy Management and Coal Technology. The ASEAN countries have made significant strides since 1973 in diversifying their energy mix and reducing dependence on imported oil. Yet the development of the human and institutional base for the development and use of coal, gas, geothermal and renewable energy sources has lagged behind. Overall manpower development and training programs are not yet in place to produce both the technical and managerial talent needed in these new energy areas. National energy planning organizations have been established and are staffed with a few highly competent individuals. But the depth and technical skills of these offices need to be increased. AID has a program in Indonesia to assist in this process and to develop a unit within the Ministry of Mines and Energy that can prepare national energy plans and serve as the secretariat to the Cabinet-level committee on energy, ADB, UNDP and other donors are providing similar support in Thailand and Malaysia. A particular need exists for expanded expertise in energy economic and financial/investment skills given the difficult tradeoffs between projects given current budget stringencies. The training in this project will help meet these needs.

The ASEAN countries also need to expand the capabilities of their technical program and project managers. The strategies being adopted in the region for coal, gas, geothermal, conservation, and renewable energy development are placing enormous demands on the available technical manpower. The individuals who are responsible for these programs, although experienced in such fields as hydro, oil-fired power plants, or even nuclear, have not received the kind of training needed for handling the technical and operational problems in the new fields of coal/lignite, geothermal and renewables and conservation.

The ASEAN-US program has placed special emphasis on human resource development in coal project and technology management. This project builds on the successful coal training course at Argonne National Laboratory during the ASEAN Energy II project. It focuses the training on coal use in power and cement, the two largest projected markets in the future. The ASEAN countries are planning major (six or seven-fold) expansions in coal use between 1984 and 1993 to as much as 27 million tons per year. Over two-thirds of this increase will be in power generation. A total of

over 400MW in new coal-fired capacity is expected to be installed by 1990, primarily in Indonesia and Thailand. But the Philippines, which has a new coal plant, and possibly Malaysia will also add new capacity. Singapore is considering a coal unit between 1990 and 1995. Training of personnel to manage these projects has been a consistent priority expressed by senior officials of both national energy planning bodies as well as national electric companies.

Economic Analysis Detail

1. Micro-economic Analysis: Paybacks on Investment in Various Measures. Because little attention has traditionally been given to investments in improving the energy efficiency of buildings, the payback period for these investments tends to be short. Many energy efficiency measures have paybacks on the order of one year. After the initial (relatively easy) measures are installed, then a wide array of measures are likely to return the initial investment in one to two years. Thus, expected returns on investment are on the order of 50 to several hundred percent, so long as the most cost-effective measures are employed. These are general statments that will vary from country to country within ASEAN and from building to building within a country.

The Singapore work stimulated three general conclusions. In the near term, improvements in energy efficiency of lighting systems was recommended. In the intermediate term, improved maintenance of building equipment can reduce energy use significantly. In the longer term, daylighting systems have considerable potential for reducing commercial building energy use.

We use each of these three recommendations as a basis for illustrating the paybacks from investments in energy efficiency. Because we do not have local costs, we have used costs in the United States. (Because of the availability of efficient lighting systems and equipment for daylighting within the ASEAN region, these costs are reasonable to apply to ASEAN. The labor rates are considerably higher in the United States; as such, the cost estimates are more likely to be high rather than low.) The estimates of an effective maintenance program are much more approximate than the costs of the other measures, because considerable uncertainty exists about how such a program could be carried out.

a. Lighting. We compare three different lighting systems: (1) a standard 40 watt cool white lamp with a standard two lamp F40 CBM ballast yielding 58 lumens per watt and a power density of 2 watts/ft^2, (2) a 40 watt lite white lamp, efficient core ballast yielding 70 lumens per watt and a power density of 1.6 watts per ft^2 and (3) a 40 watt lite white lamp with a solid state ballast yielding 85 lumens per watt and a power density of 1.36 watts/ft^2. All three systems are available from major manufacturers (e.g. Sylvania and General Electric) and costs are taken from catalogues of these manufacturers. The installation costs of all three systems are comparable. We assume that the lighting level is 50 footcandles; lower lighting levels change the relative cost-effectiveness of the three lighting systems very little.

An approximate estimate of payback periods is obtained very easily. Case (1) has a capital cost of $1.41 per square foot; case (2) costs $1.42 per square foot; and case (3) costs $1.35 per square foot. If we assume that the lights are used on average 3000 hours per year, then the direct use of electricity for lighting is: for case (1), 2 watts/ft^2* 3000 hours per year = 6 kwh per ft^2 per year; for case (2), 4.8 kwh per ft^2 per year; and case (3), 4.1 kwh per ft^2 per year. In addition to reducing direct use of electricity for lighting, the efficient lighting systems also reduce electricity for chillers and fans. Taking a typical cooling system (including fans) coefficient of performance of 3 and a typical situation in ASEAN in which the heat of lights must be removed from conditioned space, the electricity use must be increased by 33 percent for the three spaces.

Thus, at $0.10 per kwh, use of equipment described in case (23) saves 1.2 kwh/yr* 1.33* $.10 = $0.16 per ft^2 per year at an incremental initial cost of $0.01 per ft^2. The payback period is less than one month.

These figures seem very small when calculated on a per square foot basis. However, for a medium-sized building of 10,000 square feet, the savings per year totals $1600 on an initial increase in investment of $100. Going from case (1) to case (2) represents a reduction in total building electricity use of 6 to 10 percent in ASEAN, depending on the total lighting levels in the building.

Case (3), the solid state ballast system with appropriate lamps, presently has a lower first cost than either case (1) or case (2): $1.35 per ft^2 compared with $1.41 or $1.42 per ft^2. (Even though a single solid state ballast is more expensive than a standard or energy efficient ballast, the cost per square foot of a solid state ballast is lower. This results from the fact that fewer solid state ballasts are required to achieve a given lighting level, because of its higher efficiency.) The electricity use of the solid state ballast system is 4.08 kwh per ft^2 per year (5.4 kwh per ft^2 year including electricity for cooling) compared with 6.0 kwh per ft per year (8.0 kwh per ft^2 per year) for a standard lamp/ballast system (case (1)). Thus, total savings are $0.26 per ft^2 per year for the solid state ballast system. This is a savings of $2,600 for the 10,000 square foot building per year along with a reduction in first cost of $600. Electricity savings for the building are 10-17 percent of total electricity use.

b. Equipment Maintenance. The payback for equipment maintenance measures is very difficult to estimate. It is useful to make a few assumptions to determine the types of return that might be expected from an effective equipment maintenance program. For a 10,000 square foot building, annual costs of electricity for cooling are likely to be on the order of $6000 to $10,000 per square foot

per year. An effective maintenance program is likely to reduce electricity use by at least 10 percent. Thus, the annual savingsfor a relatively small building is $600 to $1000. If the cost of such a maintenance program is about $300, then the payback period is from 3 to 6 months. $300 is probably a reasonable cost, assuming that less than one week of labor and minor costs of parts are required for this level of maintenance. For a large commercial building, with 200,000 square feet, the annual cost of electricity for cooling and fans is likely to be $120,000 to $200,000. A good maintenance program could reduce energy costs by $12,000 to $20,000 per year. Such a program, for this size of building, is not likely to cost more than $2000 to $3000, unless major repairs are required for the air conditioning system. Under these assumptions, the payback period for the maintenance program is likely to be one to two months.

These are admittedly very approximate estimates of the costs of equipment maintenance programs. They are useful to show an order of magnitude estimate of the relative costs and benefits of a low-cost program within ASEAN. They suggest that such a program could have very short payback periods; however, they are no more than guesses at this time.

c. Daylighting. In this calculation, we assume that efficient artificial lighting is installed along with daylighting to bring the installed lighting power density down to 1.5 W/ft^2. This measure typically reduces total energy use by about 10 percent. The use of a daylighting system with this same installed lighting load reduces total energy use by another 220%, based on calculations for a Singapore climate carried out during ASEAN Energy II. The cost of installing a daylighting system (photosensors and controls) is estimated to be $1/ft^2.

It is convenient to carry out the calculation for the reference building that was used in the Singapore work. This building has a floor area of 55,000 ft^2 and a perimeter floor area of about 42,000 ft^2. The total capital cost for installing this typical system in the reference building is approximately $40,000. Additionally, capital cost savings result from at least a 15 percent reduction in chiller size and fan capacity. (This is a conservative estimate. It is probably possible to achieve capacity reductions of 20 percent with daylighting, but experience in the operation of daylighted buildings is needed before the sizing and capacity reductions are known accurately.) This yields a capital cost reduction (from recent Singapore data) of approximately $23,000, based on an estimated capital cost for the chiller and peripheral equipment of $150/kw of installed capacity. Using this reduction in capital costs, the net capital outlay for the daylighting system is

$17,000. The reduction in energy use in this building, resulting from the daylighting and lighting efficiency improvements, is estimated to be 144 thousand kilowatt hours per year. Thus, the simple payback period is $17,000/ (144* 10^6 kwh/yr* $0.10/kwh.)= 1.2 yrs.

A critical element of the analysis is the downsizing of fans and reduced capacity of chillers. While the analysis completed in phase II shows that the downsizing is possible, actual experience with daylighted buildings in ASEAN is essential for engineering firms to be willing to install equipment of smaller capacity.) If no downsizing and capacity reduction of equipment in daylighted buildings takes place, then the simple payback of daylighting increases to 2.7 years.

The foregoing analysis did not consider the costs and benefits of external shading of windows. External shading will (1) add to the costs of the building, (2) reduce energy use (operating costs), and (3) further reduce size and capacity of equipment. Data have not yet been analyzed to show whether external shades will increase or decrease the payback time of daylighting systems.

d. Conclusions

For both the most promising near, intermediate, and long term measures investigated to date, payback periods of less than one year seem possible. This is certainly the case for efficient lighting systems, where much shorter payback periods can be achieved. It is likely to be the case for equipment maintenance programs, although data are not yet known for such activities in ASEAN. Daylighting appears to have potential payback periods of one to two years, depending on numerous details of the daylighting design and on the degree to which experience with daylighting permits assurance that smaller cooling equipment can be used in daylighted buildings.

These observations are significant when it is realized that the measures discussed in this section can result in a total of 40 percent reduction in commercial building energy use in ASEAN. These measures presently appear to have the potential of yielding very short payback periods (recognizing the present uncertainties that need to be resolved for both maintenance programs and daylighting.)

2. Macro-economic Analysis: Potential Savings

a. Introduction. Demand for energy in commercial buildings is primarily satisfied by electricity, which forms a significant portion of electricity demand within the five ASEAN member countries (Indonesia, Malaysia, the Philippines, Singapore and Thailand).* As noted later, approximately 30 percent of total electricity generation within ASEAN is used to provide space conditioning, lighting, ventilation and other commercial building needs. Thus, commercial buildings consume a substantial portion of electricity requirements in ASEAN. Achieving a key objective of this project-- the reduction of energy use in buildings in a cost-effective manner-- will yield important benefits to ASEAN. The direct effect of implementing cost-effective conservation measures is a significant reduction in expenditures on electricity.

Based on work in ASEAN Energy II, near term reductions in energy use can amount to 160 million dollars (U.S.) per year in the near term (10 percent reduction in energy use in commercial buildings), 320 million dollars per year in the intermediate term, and one half billion dollars per year in the longer term. These benefits will accrue both to the nations as a whole in the form of reduced oil imports, improved balance of payments, and reduced need for capital investment in power plants as well as to the individual building owners in the form of reduced electricity bills.

While the benefits of an effective policy to reduce electricity use in ASEAN buildings are significant, they involve important costs and committments on the part of ASEAN. First, the technical knowledge to standards development is needed. Second, effective implementation of building energy conservation policies requires trained staff within the implementing agencies. Research capabilities to evaluate the policies and to assess new approaches to reducing energy use are needed. Third, the governments must be prepared to take the steps to approve and implement the policies. Finally, investments are needed to achieve reductions in energy use. Adequate experience that demonstrates a short payback on investments is needed in many ASEAN countries to demonstrate the overall benefits of the conservation policies.

*Brunei which recently became an ASEAN member country is excluded from this analysis since Brunei is not presently participating in the project.

Thus, while we discuss below the overall potential benefits of an effective policy to reduce energy use in ASEAN buildings, we need torecognize that the policies will be adopted slowly and carefully, as their effectiveness is demonstrated. There is clearly a benefit to carrying out the project throughout ASEAN, as experiences in one country can influence the others.

The project is designed to overcome some of the early costs of developing effective conservation policies in buildings. It provides technical support for the development of standards (or other policy approaches) that are sensitive to the ASEAN weather and architectural environments. It provides training to develop the staff of the agencies in the ASEAN countries. It provides support for research on energy use in buildings as well as demonstration projects that will take place within ASEAN. Thus, the project attempts to meet many of the preconditions for establishing effective policies to reduce energy use. In addition to providing a strong technical basis for building energy standards, the project emphasizes the development of institutions throughout ASEAN which can carry the work forward to implementation.

Even if the requirements to train staff in ASEAN and to carry out demonstration projects to show the benefits of energy efficient design of buildings and energy retrofits result in a gradual adoption of policies, the magnitude of the benefits are so large that the benefits of both the project and the policy adoption well outweigh the costs. Each percent reduction in electricity use in the buildings sector in ASEAN results in approximately $16 million per year reduction in expenditures on electricity. Because this is an annual reduction that carries through to future years, the present value of the reduced electricity costs is about $100 million per one percent decline in electricity expenditures. Thus, even if partial project goals are achieved at a slower pace than might be desired, large benefits resulting from the project and associated ASEAN government actions can be expected.

b. Quantitative Estimate of Benefits. To assess the impacts of energy conservation in buildings on the economies of the ASEAN member countries, we need to estimate (1) electricity use in commercial buildings and total electricity use in each country, (2) the cost of the electricity used in the commercial sector, (3) the potential for cost-effective measures to reduce energy use, (4) the quantity of oil used for power generation and the quantity displaced by reduced demand for commercial electricity, and (5) power plant investment needs.

Table 1 shows the energy use (excluding traditional energy sources such as fuel wood and agricultural wastes) per capita in the five countries, and electricity sales in these countries for 1982. Energy use per capita in these countries varies roughly in proportion to their GNP per capita (Table 2). The figure for Indonesia is disproportionately low because of the heavy use of traditional fuels for cooking, while that for Singapore is high because of the advanced economy and the complete urbanization of that country.

Table 3 presents the estimates of electricity sales to commercial buildings, the percentage of total electricity used in commercial buildings, and the annual cost to ASEAN members of commercial building energy use. Two different estimates of commercial building electricity use are presented. The first (eg., 1828 Gwh/yr for Indonesia) excludes any electricity use in industrial buildings for space conditioning, lighting, ventilation and related uses in buildings. The second estimate (eg. 2221 Gwh/yr for Indonesia)

Table 1. Energy and Electricity Use in ASEAN Countries, 1982*

Country	Energy Use per Capita (1981) (TOE)	Electricity Sales (Gwh)
Indonesia	191	7,848
Malaysia	689	8,368
Philippines	281	15,596
Singapore	4492	7,000
Thailand	284	15,018

*Sources: Commercial energy use per capita is from the "World Development Report 1984," The World Bank. Total electricity production data are derived from (1) "Asian Electric Power Utilities Data Book," Asian Development Bank, Manila, Philippines, May 1983. (2) "Indonesia Country Report," Chris Pignone, Oct. 1984, LBL Draft, (3) "31st Annual Report of the National Electricity Board of the States of Malaya,"; (4) "Ministry of Energy Report for 1982," Philippines Ministry of Energy; (5) "Electric Power in Thailand 1982," Thai National Energy Administration.

Table 2. GNP Per Capita and Urbanization in ASEAN Countries

	GNP Per Capita (1982 US $)	Urbanization 1982 Percent)
Indonesia	580	22
Malaysia	1860	30
Philippines	820	38
Singapore	5910	100
Thailand	790	17

Source: The World Bank, "World Development Report 1984".

Table 3. Electricity Use in ASEAN Commercial Buildings, 1982*

Country	Electricity Sales to Commercial Buildings (Gwh/yr)**	Percentage of Total Electricity Use in Nation	Annual Cost in $ Millions (at $0.10 per kwh)
Indonesia	1828/2221	28.3	220
Malaysia	2518/3177	38.0	320
Philippines	3205/4370	28.0	440
Singapore	2595/3077	44.0	310
Thailand	1694/3116	20.7	320
TOTAL	11,840/15,961	Avg: 29.6	1610

*The sources for this table are the same as for table 1.

**Two figures are presented for electricity use in commercial buildings. The first represents the total use in commercial buildings others than those associated with industrial activities. The second estimate includes commercial buildings serving the industrial sector. This is derived by assuming that 15 percent of industrial electricity use goes for space conditioning, lighting, and related uses in buildings. The estimates of percentage of total electricity use and annual cost of electricity are derived from the latter electricity use (that includes industrial buildings).

The second estimate is based on the assumption that about 15 percent of industrial electricity use is non-process energy in industrial buildings. We use the estimate that includes industrial building energy use in the calculation of percentage electricity used by buildings and in the estimates of annual cost for electricity demand in buildings.

The first observation from Table 3 is that the commercial buildings sector consumes a significant portion, about 30 percent, of total electricity in the ASEAN countries. The percentage varies from a low of 21 percent in Thailand to a high of 44 percent in Singapore.

These five ASEAN countries, except Thailand, generate most of their electricity from oil. Taking the average price of a kilowatt hour to be U.S. $0.10 (the average price for electricity in the commercial sector in Thailand, Indonesia and Malaysia), then the total annual expenditure for electricity for buildings in ASEAN is about $1.6 billion.

The implications of these estimated expenditures for policies to conserve energy in buildings are substantial. If, as suggested in the work during ASEAN II, ASEAN countries could reduce electricity use in buildings by 10 percent in the near term, 20 percent in the intermediate term, and 30 to 40 percent in the longer term, then the total annual reduction in electricity costs for ASEAN would be $160 million (long term). It is worth stressing that these reductions in energy costs ($160 to $640 million) are annual savings.*

The estimated savings do not take into consideration the growth of the commercial sector or the rapid increase in electricity price in some of the countries. Electricity demand has grown rapidly during the past years among all ASEAN countries and is expected to continue to grow. Electricity use in buildings has also increased, as the ASEAN economies (except the Philippines) have spurred construction. In Indonesia and Malaysia, electricity demand growth in buildings has grown fast and significantly faster than total electricity demand. For Indonesia, annual building energy demand increased 24.2 percent from 1978/1979 to 1982/1983, compared with overall annual growth in electricity demand of 18.7 percent, according to a recent LBL report on energy demand and supply in Indonesia. Similarly, commercial building electricity demand in Malaysia has grown about 50 percent faster than total electricity demand--12.5 percent per year from 1978 to 1982 for buildings compared with 8.6 percent per year for total electricity demand. Commercial building electricity use has grown somewhat faster in Singapore than total demand. Because of a lagging construction industry in the Philippines, commercial building electricity use will increase more slowly than total electricity demand. The historical data for Thailand are less

*These figures do not take into account rising electricity prices. Nor do they reflect the benefit to the nation (as distinct from the building owner or occupant, who pays average prices for electricity) of avoiding marginal costs of electricity. Marginal costs could be 50% higher than average costs.

certain--showing lower growth rates for commercial electricity use than for total electricity demand--but forecasts for that country also suggest a demand for electricity in buildings growing faster than overall demand. Thus, so long as the economies of the ASEAN countries show continued growth (excepting the Philippines), construction activity is expected to be strong and--in the absence of policies to promote building energy conservation--building energy demand is likely to continue its high growth patterns.

Because a large percentage of electricity in ASEAN is generated from oil, reduction of electricity use results in reduced use of oil. The percentage of electricity generated from oil, shown in Table 4, varies from a high of 100 percent (Singapore), a low of 36 percent in Thailand, and a median value of 64 percent in Indonesia. Table 4 also shows the annual cost of oil to produce electricity for buildings as well as the annual reduction in oil costs resulting from 10, 20, and 30 percent reductions in commercial building electricity use, respectively. Comparison of the data in tables 3 and 4 reveals that about 45 percent of the cost savings from reduced electricity use in buildings results from decreased use of oil.

Table 4. Oil and Commercial Building Electricity Use*

Country	% Electricity Generated from Oil	Annual Oil Cost for Electricity Use in Buildings (US $ Millions)	Reductions in Oil Costs for Different Conservation Levels (US $ Millions)**
Indonesia	64	154	15/30/45
Malaysia	84	165	16/33/49
Philippines	58	176	18/35/53
Singapore	100	179	18/36/54
Thailand	36	70	7/14/21
Total	--	744	74/148/222

*Oil is assumed to cost $31/barrel. The percentages of electricity generated from oil are derived from the sources contained in the footnote to Table 1. The annual oil costs are calculated by multiplying barrels of oil used to generate electricity in each country (from the references to table 1) by the fraction of total electricity use in buildings (from table 3) by $31/barrel.

**The three different conservation cases are: 10, 20, and 30 percent reductions in energy use in commercial buildings.

Equally important are the savings in investment requirements for new power plants. If we assume that the savings in capacity are about the same as those for energy (10 to 30 percent), and that the commercial load profile is the same as the overall load profile in each country, then the savings can be translated to power plant capacity displacement. The total capacity in 1982 in the five countries was 15,700 MW. (The sources for this information are contained in the footnote to table 1.) Of this 4600 MW (29.6 percent) may be attributed to the commercial sector. A 10 percent reduction in commercial building electricity use ultimately results in avoiding building 460 MW of new electricity generating capacity in ASEAN. A 30 percent reduction in commercial building electricity use avoids construction of about 1400 MW capacity. Using capital cost of US $1500 per kilowatt of new capacity, results in a one time savings in costs of new power plants of $700 million to $2 billion for the 10 and 30 percent commercial energy savings cases, respectively. From an investment standpoint these are substantial savings to the ASEAN countries.

Although, these calculations show the rough value of savings, a detailed analysis is needed since the commercial load profile does not match the overall load profile in each country. For instance, in Indonesia demand peaks during the evening, while commercial demand likely will peak during the day. Our estimated peak savings are therefore higher than those that would result from a detailed analysis. The costs of new generating capacity are very approximate estimates and the effects of building energy conservation on load factors of utilities in ASEAN (taking in consideration growth of new electricity demand in other sectors of the economy) are not treated in this discussion. Nonetheless, it is clear that reduction in growth of new generating capacity is a significant impact of an effective building energy conservation program throughout ASEAN. Considering the widespread demand for investment capital to support economic growth within ASEAN, defering power plants will redirect capital in these countries to other productive uses.

Thus, a basic conclusion is that energy conseervation in ASEAN buildings can make very significant contributions to the ASEAN economies. An estimate of the magnitude of the savings is in the reduced fuel bills. A ten percent reduction in energy use in commercial buildings in ASEAN results in a $160 million per year reduction in electricity costs. At this level of savings, the investment to achieve these reductions in electricity use is likely to be paid back within one to three years, thus yielding a 33 to 100 percent return on investment and a long term annual savings to the nation of $160 million. As noted in the text, these savings impact the nation through reduced oil use (and lower imports for three countries in ASEAN), reduced construction of generating capacity, and lower electricity bills for commercial building owners and/or renters.

3. Returns to Investment in Research and Training

The basic benefits of the project are the development of specific policies to reduce energy use in buildings, the energy and economic savings resulting from the implementation of these policies, and the development of educated personnel and institutions to design and carry out the policies. We discuss the contributions of each of the four project tasks to these objectives.

The first task involves the training of a core staff in each ASEAN country in the fundamentals of building energy analysis, computer tools to analyze energy use in buildings, and policy studies relating to energy conservation in buildings. These three activities will result, respectively, in core teams that have strong technical backgrounds in the field, the ability to apply this knowledge to problems in their own country, and an ability to design and analyze policies that will result in reductions in energy use in buildings.

There are two key strategies in the training that are intended to significantly increase the benefits of the project: (1) the core staff is expected to form the leadership of activities and institutions leading to the adoption of building energy conservation policies and (2) the core staff is expected to organize courses for their own staff and participants from the private sector to expand greatly the knowledge base of the countries so that the policies can be implemented. Thus, the end product of the training is the significant strengthening of institutions to support a process of policy formulation, adoption, and implementation. To this end, educational materials, specific to ASEAN, will be developed for use in courses to be set up and carried out by the ASEAN core staff. To this end, participants in the U.S. training will be selected on the basis of their ability and their continuing involvement in the project and its associated policy processes in the ASEAN countries.

The return to investment in research (task 2) is strengthening the ability of ASEAN researchers to experiment with and demonstrate the viability of new concepts that can significantly increase energy efficiency of buildings over a five to ten year period.

The use of daylighting has been demonstrated to be able, in principle, to yield very large benefits in Singapore (and in likely to be applicable throughout ASEAN). For daylighting to achieve widespread use in the region, at least three conditions need to be met: (1) the effectiveness needs to be demonstrated in actual practice, (2) various problems with its operation must be ironed out, and (3) simple design tools need to be developed and information made available so that architects can incorporate good daylighting designs into the building design.

The research on natural ventilation and thermal characteristics of building materials will also foster the development of new knowledge that has the potential to significantly improve the efficiency (and/or comfort) of ASEAN buildings in the intermediate term.

The energy conservation policies can be designed to encourage the use of these new techniques for energy conservation, if the research effectively demonstrates practical application. All three areas of research have the potential for widespread use and inclusion in the policy process in a five to ten year time period. If this happens, then the overall benefits of the policies are significantly increased. Even in the absence of near-term commercial acceptance of the specific research components, their inclusion is essential to provide the underpinnings of evolving policies to improve energy performance of buildings within ASEAN. The involvement of all ASEAN countries in the project, combined with the promotion of one or more advanced approach to energy efficiency by just one ASEAN country, is likely to provide stimulus to other ASEAN countries to continue to pursue new approaches and encourage their commercialization. The strengthening of the research community--as well as the involvement of the researchers with the policy developers as encouraged throughout the project-- will also encourage the continued evolution and strengthening of the energy conservation policies.

The assessment, analysis, and policy development phase (task 3) yield the benefit of the policy formulation. The analysis will provide a sound technical basis for the policy design. This is essential for at least two reasons: (1) it assures that the policies will encourage or require measures with the largest economic payoff and (2) it will provide ASEAN with technical information that can be used to reduce or avoid efforts to modify the polices unless such modifications are supported by sound arguments and information. The policy development includes the development of implementation tools (computer codes/handbooks), essential for the policies to be carried out in practice. Thus, the benefit of this activity is in providing a sound basis for extending the project results into real application throughout ASEAN through the development of the policies. It is through this means that actual energy and economic benefit are realized.

The task of information dissemination (task 4) is an essential part of the overall process. It is intended to accomplish at least three objectives; (1) information sharing among ASEAN, to both established project designs and also to permit the ASEAN countries to play an increasing role in learning from one another throughout the project, (2) education of the key personnel within the institutions that will develop and carry out policies, and (3) education of larger communities within the public sector (e.g., building code officials) and the private sector (the building design and construction communities, ventilation and cooling equipment contractors, building owners) affected by building energy conservation policies. Effective information dissemination, ultimately carried out by the ASEAN countries themselves, is essential to realize the benefits of the project.

In summary, the benefits of the project can be substantial. They can in time amount to reduced expenditures for fuel in ASEAN in the hundreds of million of dollars per year (U.S. equivalent), if the nations are able to fully implement effective energy conservation policies for buildings. The return on investment depends both on the successful achievement of all tasks in the project and on the committment of ASEAN to implement policies and provide education based on the technical knowledge gained throughout the project. Even selected successes of the project-- enhanced education in most or all countries, adoption of policies in some countries, and implementation at varying levels of effectiveness in some countries-- yield very substantial returns (in the tens to hundreds of million of dollars per year in reduced fuel costs) to ASEAN.

Social/Institutional Analysis Detail

1. Structure of ASEAN Country Decision-making on Energy Conservation in Buildings.

In the absence of strong government policy directives, decisions regarding energy conservation in buildings are left by default to building architects, builders, occupants, and owners, who are assisted occasionally by researchers and equipment manufacturers and contractors. In ASEAN nations, with the exception of Singapore, this ad-hoc decision-making process appears to be the norm.

One of the purposes of this project is to improve this decision-making process by providing decision makers with better information and analytical tools. In the public sector, the project will attempt to strengthen the ability of policy-making bodies to design and implement progressive codes and standards. In the private sector, the project will attempt to make practitioners aware of available energy-saving technologies and improve linkages between practitioners, government agencies, and research institutions.

In Singapore, strong leadership in reducing energy use in buildings is provided the Development and Buildings Control Division (DBCD) of the Public Works Department. The DBCD promulgated a building energy standard in 1979 that now applies to all existing buildings. Compliance has been strictly enforced, and a substantial electricity price surcharge is planned for buildings not in compliance. The DBCD is currently upgrading the 1979 standard with hopes of doubling energy savings.

The DBCD has reached out to the private sector by writing a handbook explaining compliance with the standard and conducting courses based on the handbook for architects and builders. In addition, the DBCD-led task force on standards briefs a committee of architect and engineer practitioners on prposed changes in energy standards. Researchers from the National University, who are engaged in research directly supportive of the standards activity, also participate on the government task force.

Clearly, institutions to support strong policies for energy conservation in buildings are well developed in Singapore. By continuing to develop and implement more effective standards, Singapore can serve as a model in the larger ASEAN effort to reduce building energy use.

In the other four participating ASEAN countries, (Indonesia, Thailand, Malaysia, and the Philippines) there is considerable scope for strengthening the policy-making abilities of institutions responsible for energy conservation in buildings. All have established building energy conservation as a national priority, but none has implemented a comprehensive nationwide program.

In Indonesia, the development and implementation of building energy standards, rests with the Public Works Department. The Policy formulation process has been initiated under the auspices of French assistance to develop an energy conservation master plan. A governmental task force has gathered and analyzed relevant data on government buildings, and has established energy svings policies for existing buildings. However, outside of the Jakarta area, building codes are enforced by local governments that are constrained by lack of manpower and expertise.

In Thailand and the Philippines, policy formulation responsiblity rests with national energy planning agencies, the National Energy Administration and the Bureau of Energy Utiliztion, respectively. Both have been constrained by lack of expertise, analytical techniques, and data. In both countries, there is a need to strengthen the Public Works Departments, because they will be responsible for implementing building energy conservation policies, and adipting exsiting building codes.

In Malaysia, building energy conservation policies will be developed and implemented by the Standards and Industrial Reseach Institute.

2. Social Barriers to Energy Conservation in Buildings

The most important barrier to energy conservation in buildings in ASEAN countries is the lack of informationamong all members of the building community. Few builders are informed about energy efficient design, and few courses or other sources of information on the subject are available. Outside of Singapore, there has been insufficient expertise and equipment, including computer capabilities, to conduct energy audits or measure the effects of conservation measures. This lack of information precludes policy-making in the public sector and rational decision-making in the private sector.

A second and related barrier is lack of government personnel with an adequate base of expertise to develop government programs. Until basic expertise is developed, lower level personnel cannot be mobilized to perform energy audits or enforce energy building codes. Further, this expertise is a prerequisite to government cooperation with the private sector in increasing building energy efficiency.

A third barrier is the potential for increasing the initial cost of buildings. While economic conservation measures assure that higher initial costs will be offset by reduced fuel costs, the imposition of additional expenditures on buildings may be difficult to implement in many ASEAN countries. Demonstration projects are mecessary to prove that conservation measures pay off. Further, careful economic accounting can demonstrate that reduced initial costs from downsized cooling equipment can result from energy conserving designs.

A fourth barrier is pervasive energy wasting habits. Buildings throughout the ASEAN region are kept colder than is necessary for comfort. (Ironically, cooling systems designed to keep buildings at low temperatures actually can consume more energy when the buildings temperature is raised without reoptimization.

The relatively recent introduction of western architecture has led to the loss of traditional cooling designs. Two examples of traditional architectural forms in the ASEAN region that contribute to energy efficiency are natural ventilation and the use of external sunshades over windows.

Government policy and information programs can assist in modifying wasteful habits and reinforcing traditional energy saving practices.

3. Regulatory Environment and Building Codes

The regulatory environment within which buildings are designed and built provides an attractive opportunity to improve the energy efficiency of new and sometimes existing construction. In ASEAN countries, as elsewhere, building codes have the capacity to control building design in great technical detail, as architects, engineers and contractors are legally required to comply with their provisions. However, only Singapore has used its code to improve energy efficiency. Thus, one of te elements of this project is to provide technical support to national level agencies and committees in developing energy conservation standards for building codes. Though usually developed at the national level, building codes are almost always administered at the provincial or local level. Another element of this project, therefore, will focus on training and technical support to public works department staffs responsible for monitoring and enforcement and to private sector architects and engineers that must comply.

4. Perspectives of Private Sector & Research Community

The building sectors of the ASEAN countries are highly diffuse in character. There are no single companies that design and produce buildings on a national scale. As a result, there are no major privately funded research efforts on building sciences, and historically, the sector has relied on government sponsored research.

5. Manpower Development & Institutional Strengthening

A comprehensive manpower development program is necessary if the ASEAN project is to influence the building design process. An appropriate approach would include government policy makers, personnel responsible for building codes and standards, design professionals, enforcing and educators.

Government policy makers must be able to perform the economic and policy analyses to justify promoting energy conservation measures. The existing program at A.I.T. is sufficient at an introductory level, but more advanced coursework, especially if macroeconomics is needed.

Officials from government public works departments must be included in the professional development training. They are the ones who will actually implement the improved energy efficiency design criteria for buildings embodied in revised buildingg codes. Improved policy is only as good as its implementation at the operational level.

Practicing architects and engineers should also be targets of professional development. Because they were trained in an era of cheap energy, the mainstream of building design professionals in business today do not understand the basics of energy-efficient building design. A series of workshop modules, designed in cooperation with architectural and engineering societies, is needed to start with the basics and advnce through various lev els of sophistication.

Finally, similar professional development is necessary for educators, who will be needed to prepare new students to enter the workforce.

CHECKLIST OF STATUTORY CRITERIA

PROJECT CHECKLIST

A. GENERAL CRITERIA FOR PROJECT

1. FY 1985 Continuing Resolution Sec. 525; FAA Sec. 634A; Sec. 653(b).

(a) Describe how authorizing and appropriations committees of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or nor more than $1 million over that amount)?	(a) The Project is an extension and expansion of the ASEAN Energy Cooperation in Development Project (498-0272) The Committees will be advised of this extension/ expansion of ASEAN Energy Assistance via Congressional Notification. (b) Yes.
2. FAA Sec. 611 (a) (1). Prior to obligation in excess of $100,000, will there be (a) engineering, financial or other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?	Yes. See Project Paper details.
3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?	N/A

4. FAA Sec. 611(b); FY 1985 Continuing Resolution Sec. 501. If for water or water-related land resource construction, has project met the standards and criteria as set forth in the Principles and Standards for Planning Water and Related Land Resources, dated October 25, 1973, or the Water Resources Planning Act (42 U.S.C. 1962, et seq.)? (See AID Handbook 3 for new guidelines.)	N/A
5. FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project?	N/A
6. FAA Sec. 209. Is project susceptible to execution as part of regional or multilateral project? If so, why is project not so executed? Information conclusion whether assistance will encourage regional development programs.	Yes. Under ASEAN, six countries will benefit from component specific information and experience in energy saving techniques and energy management.
7. FAA Sec. 601(a). Information and conclusions whether projects will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; and (c) encourage development and use of cooperatives, and credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; (f) strengthen free labor unions.	The Project will help improve technical efficiency of industry and commerce and will foster private initiative.

8. FAA Sec. 601 (b). Information and conclusions on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).	Much of the Project funded training will be conducted by private and university sources in the U.S.
9. FAA Sec. 612(b), 636(h); FY 1985 Continuing Resolution Sec. 507. Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized in lieu of dollars.	ASEAN countries will contribute an estimated 30% of total project costs through local support costs.
10. FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and, if so, what arrangements have been made for its release?	No. N/A
11. FAA /sec, 601(e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise?	Yes.
12. FY 1985 Continuing Resolution Sec. 522. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity?	N/A
13. FAA 118(c) and (d). Does the project comply with the environmental procedures set forth in AID Regulation 16. Does the project or program taken into consideration the problem the destruction of tropical forests?	Yes. No environmental assessment is required according to AID's revised environmental procedures.

14. FAA 121(d). If a Sahel project, has a determination been made that the host government has an adequate system for accounting for and controlling receipt and expenditure of project funds (dollars or local currency generated therefrom)?	N/A
15. FY 1985 Continuing Resolution Sec. 536. Is disbursement of the assistance conditioned solely on the basis of the policies of any multilateral institution?	No.

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

a. FAA Sec. 102(b), 111, 113, 281(a). Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status, (e) lutilize and encourage regional cooperation by developing countries?	(a) The project will support self help efforts by ASEAN countries in energy conservation. It will promote the participation of women in the national economies and improve the status of women by making project training activities available to women on an equal basis. As an ASEAN activity it encourages and depends on regional cooperation.

b. FAA Sec. 103, 103A, 104, 105, 106. Does the project fit the criteria for the type of funds (functional account) being used?	Yes, Sec. 106 for technical assistance, energy, research. The project is specifically directed to the alternative uses of energy.
c. FAA Sec. 107. Is emphasis on use of appropriate technology (relatively smaller, cost-saving, labor-using technologies that are generally most appropriate for the small farms, small businesses, and small incomes of the poor)?	Yes. Development with application of appropriate technology and direct substitution of abundant resourcesd for petroleum products is the essence.
d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or is the latter cost-sharing requirement being waived for a "relatively least developed country)?	Yes.
e. FAA Sec. 110(b). Will grant capital assistance be disbursed for project for more than 3 years? If so, has justification satisfactory to Congress been made, and efforts for other financing, or is the recipient country "relatively least developed"? (M.O. 1232.1 defined a capital project as "the construction, expansion, equipping or alteration of a physical facility or facilities financed by AID dollar assistance of not more than $100,000, including related advisory, managerial and training services, and not undertaken as part of a project of a predominantly technical assistance character."	N/A. Not capital assistance.
f. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase of productive capacities and self-sustaining economic growth?	Yes.

g. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civil education and training in skills required for effective participation in governmental processes essential to self-government.	Insufficient renewable energy and the drain current fossil fuel imports placed on the ASEAN economies are serious constrains to development. The training and research activities financed by this project will seek to alleviate this problem. All project components will be implemented by ASEAN based on the preparation of annual work plans. tions, such as the universities.

2. Development Assistance Project Criteria(Loans Only)

a. FAA Sec. 122(b). Information and conclusion on capacity of the country to repay the loan, at a reasonable rate of interest.	N/A
b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete with U.S. enterprises, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?	N/A

3. Economic Support Fund Project Criteria

a. FAA Sec. 531(a). Will this assistance promote economic and political stability? To the extent possible, does it reflect the policy directions of FAA Section 102?	N/A
b. FAA Sec. 531(c). Will assistance under this chapter be used for military, or paramilitary activities?	N/A

c. FAA Sec. 534. Will ESF funds be used to finance the construction of, or the operation or maintenance of, or the supplying of fuel for, a nuclear facility? If so, has the President certified that such use of funds is indispensable to nonproliferation objectives?	N/A
d. FAA Sec. 609. If commodities are to granted so that sale proceeds will accrue to the recipient country, have Special Account (counterpart arrangements been made?	N/A

END

93