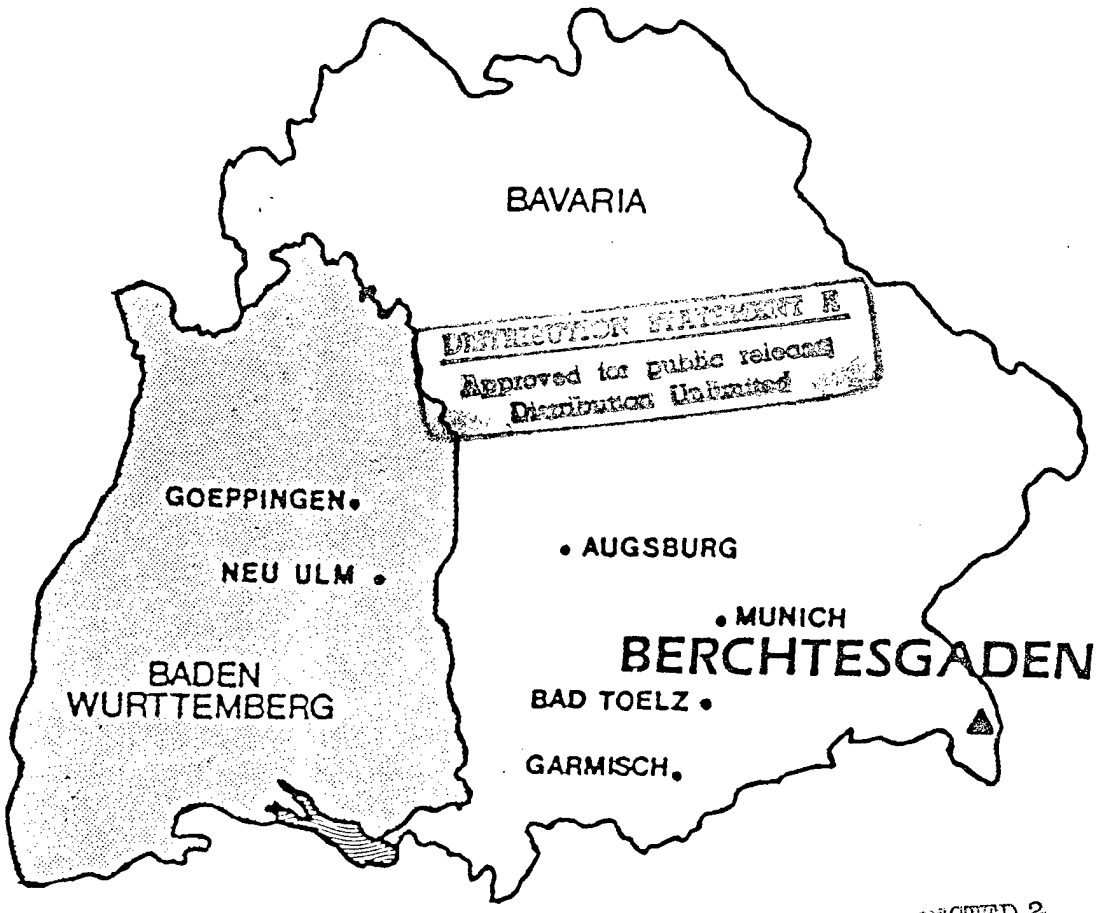
EEAP

PHASE III
EXECUTIVE SUMMARY



Berchtesgaden Military Community
28 April 1986

VVKR | SUTER + SUTER

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EXECUTIVE SUMMARY

I. PROJECT INTRODUCTION:

This document is the end result of the Energy Engineering Analysis Program (EEAP) at Berchtesgaden Military Community in West Germany. This EEAP was authorized by the U.S. Department of the Army, European Division, Corps of Engineers, headquartered in Frankfurt, West Germany, under contract No. DACA-90-83-6-0023. The ultimate goal of this effort is the reduction of energy consumption in compliance with the objectives set forth in the U.S. Army Facilities Energy Plan.

The scope of services for this study defines the project in three phases of work. Phase I involves data collection for all buildings at Berchtesgaden. The data collection phase includes utility data, determination and inspection of model buildings, assignment and review of similar buildings, and review of operating procedures. Phase II utilizes and relies heavily upon the information collected in Phase I. In this phase, energy conservation recommendations are developed to estimate related energy savings, as well as implementation costs for specific recommendations. Phase III of this project screened all energy conservation projects and provided programming documents for those projects which the community is requesting funding. By definition, any programmed project has a savings to investment ratio greater than one in compliance with the revised Energy Conservation Investment Program (ECIP) criteria dated June 1985. The three phases of work ended with no requests for funding. However, the first two phases of work compiled details of buildings and possible energy related modifications that can be used for future renovation activities.

II. PHASE I

Phase I of the EEAP consisted of "data gathering and inspection of the facilities in the field." During this phase, several GY areas were reviewed at this military community. Complete details of the data collection including energy use data, and all building survey data can be found in the Phase I Data Report.

A. Buildings Surveyed:

Under the EEAP Scope of Work, all ten of the GY areas in the Berchtesgaden master planning area were included in the requirement for data collection, review and analysis. These are as follows:

GY 821 General Walker Facility: which consists of a hotel, two lodges, tennis courts, a miniature golf course, and a ski slope.

ENG 76 Frasdorf and Hinterbrand Lodge: which consists of two guest lodges and associated facilities.

GY 820 Alpine Inn Hotel: which consists of hotels, recreational facilities, and a chapel.

GY 819 Accommodation Center: which contains one building that serves as a recreation facility.

GY 600 Strub Kaserne: which consists of FE maintenance and storage facilities, various workshops, a community center, and a commissary.

GY 349 Strub Family Housing: which consists of family housing and recreation buildings.

GY 818 Berchtesgadener Hof: which consists of hotel and recreational facilities.

GY 101 Stanggass Camp Area: which consists of administrative and community service facilities.

GY 535 Recreation Area Chiemsee: which consists of hotel and recreation facilities, and service and storage buildings.

GY 823 Berchtesgaden Community Center: which consists of one building that contains an Exchange Branch and a theater.

There were no GY areas at Berchtesgaden that were excluded from the EEAP scope of services. All heated buildings on all GY areas were considered under this contract.

Seven buildings surveyed at Berchtesgaden were designated "Annex A Buildings." These facilities were audited in great detail in order to complete a computerized analysis of current energy use, possible energy conservation opportunities and the performance of the existing heating and ventilating equipment. These Annex A Buildings surveyed at Berchtesgaden were as follows:

GY 821 General Walker Facility		
Bldg. No. 513	Recreation Billet Facility	200,050 SF
GY 820 Alpine Inn Hotel		
Bldg. No. 407	Recreation Billet Facility	6,500 SF
GY 600 Strub Kaserne		
Bldg. No. 211	Commissary	23,400 SF
GY 349 Strub Family Housing		
Bldg. No. 120	Family Housing	16,425 SF
GY 818 Berchtesgadener Hof		
Bldg. No. 301	Recreation Billet Facility	83,945 SF
Bldg. No. 302	Recreation Billet Facility	11,730 SF
Bldg. No. 307	Recreation Billet Facility	32,360 SF

All other heated buildings at Berchtesgaden were surveyed in Phase I as "walk- through similar buildings." That is, they were surveyed to discern the differences between them and an Annex A Building that they were judged similar to. Due to the wide variety of building types at Berchtesgaden, not all facilities could be made similar to one of the seven Annex A Buildings at Berchtesgaden. Since this EEAP contract encompasses six military communities, there was a total of 51 Annex A Buildings, 44 of which were located at other communities. These facilities were judged by the EUD Project Manager to be representative

of all facilities on all military communities under contract. As a result, some buildings at Berchtesgaden were judged similar to Annex A Buildings at another military community in order to provide computer simulation.

The list of these buildings at other military communities follows:

Community	GY	BLDG	USE
Augsburg	572	134	Child Care Center
Augsburg	572	125	Recreation/Shops
Augsburg	572	178	Shops
Augsburg	187	743	Family Housing
Augsburg	187	704	Family Housing
Augsburg	862	578	Family Housing
Augsburg	280	210	Mess Hall/Gym
Bad Toelz	283	24	Family Housing
Garmisch	730	840	Recreational Hotel
Garmisch	571	114	Office/Shops/Warehouse
New Ulm	696	263	Billets

During the computer analysis of the energy consumption of each boiler plant, each Annex A Building was reviewed as if it existed at Berchtesgaden, whether it did or not. That is, an Annex A Building from the Augsburg Military Community was analyzed with Berchtesgaden weather data in order to make the similar building's analysis more accurate. Complete information on all of these buildings can be found in the Phase I Data Report.

At each building, whether reviewed as an Annex A Building or a walk-through similar building, an ECO checklist for the specific building under consideration was completed. This checklist noted over 110 Energy Conservation Opportunities (ECO) that were reviewed at the facility. Each ECO was noted as "Completed" or "Not Completed" and if not completed, as "Feasible" or "Not Feasible." Based on this checklist, all energy conservation calculations were performed after incorporating the Phase I comments from both EUD and the military community. All

ECO's noted as "Not Completed," and "Feasible" were reviewed for implementation. This checklist was also verified against the current ECIP Project List and the Master Planning Documents at Bad Toelz so that their would be no duplication of effort for projects already recommended and slated for implementation.

B. Energy Consumption History:

As reviewed in the Phase I Data Report, the Berchtesgaden Sub-Community has steadily reduced its energy consumption since the peak year of FY 1975. By FY 1983, the total reduction since 1975 has been 27%, thus already exceeding the mandate established by the Department of the Army to reduce overall energy consumption by 20% from the FY 1975 levels. The energy consumption trends can be seen in the following chart from data provided by the VII Corps Headquarters in Stuttgart, West Germany:

Energy Consumption History (MIL BTU)

FY	Electricity	Heating Fuel	Total Fuels
1975	37,364	148,963	186,327
1976	36,563	94,745	131,308
1977	38,721	115,279	154,000
1978	40,275	129,100	169,385
1979	40,890	128,255	169,145
1980	42,166	110,144	152,310
1981	43,048	102,939	145,987
1982	46,470	96,931	143,401
1983	48,627	86,493	135,120

For complete data and information on the Energy Consumption History, refer to the Phase I Data Report.

C. Energy Conservation Efforts since FY 1975:

The reduction in the energy consumption at Berchtesgaden has been due to a number of factors. Perhaps the most significant has been the establishment of a Community - wide Energy Conservation Program by the Director of Engineering and Housing. This program has included an

educational effort to inform every individual and each family at Berchtesgaden of the importance of energy conservation. This program ultimately affects every aspect of life at Berchtesgaden. In addition, there has been an Energy Conservation Awards Program to recognize those individuals and groups leading the energy conservation efforts.

Since FY 1975, substantial energy conservation actions have been put into effect. These include the following measures.

General: Improved maintenance and control of boiler systems. Set back heating temperatures. Replaced radiator valves with thermostatically controlled valves. Installed heat reflectors behind radiators. Installed timers and day/night switches in electric lighting circuits. Replaced incandescent light fixtures with fluorescent units.

GY 101 Stanggass Camp Area: Replaced two warm water boilers and modernized heating system, Bldg. 101. Replaced defective boiler with boiler/heat pump system, Bldg. 112. Installed indoor/outdoor temperature controls.

GY 818 Berchtesgadener Hof: Replaced two warm water boilers and modernized heating system with indoor/outdoor temperature controls, Bldg. 301 and 307. Replaced single pane windows with double pane windows, Bldgs. 301, 302, and 307.

GY 600 Strub Kaserne: Replaced or repaired all heating distribution lines. Replaced or repaired all entrance doors on all buildings. Replaced single pane glass with thermopane windows, Bldg. 206, 215, 211. Repaired and insulated roof, Bldg. 223.

GY 535 Chiemsee Recreation Area: Replaced five LP steam boilers and radiators with water boilers and heat pump systems. Bldg. 701, 714. Installed insulated drop ceiling in dining room, Bldg. 701.

GY 821 General Walker Hotel: Repaired or replaced all entrance doors, Bldg. 513. Replaced four boilers, and modernized heating system with indoor/outdoor heating control, Bldg. 513.

GY 349 Berchtesgaden Family Housing: Installed indoor outdoor temperature controls, Bldg. 102-104. Replaced single pane windows with thermopane windows, Bldg. 235.

GY 820 Alpine Inn Hotel: Replaced all single pane windows with thermopane windows. Repaired and replaced small heat pumps with central heating plant.

NOTE: See Phase I Data Report for a listing of all currrent ECIP projects ongoing, in design, or under contract.

III. PHASE II

Phase II of EEAP consisted of "analysis of data (collected in Phase I), performance of feasibility and economic studies and the identification of proposed projects." More specifically, Phase II consisted of 1) verification of computer simulated buildings' energy consumption versus actual utility bills; 2) identification of proposed projects and calculation of savings, costs, and SIRs; and 3) deletion of projects, as requested by Berchtesgaden Military Community and required under ECIP criteria.

A. Methodology:

The basis of the analysis phase of this EEAP at Berchtesgaden is the computerized analysis of the Annex A Building at this military community and at several other communities which were judged similar to other buildings at Berchtesgaden. As noted earlier, the calculated energy consumption of each building at Berchtesgaden was based on the computer analysis of these facilities.

The computer program utilized for this analysis is entitled C-PARTS (Component Performance Analysis for Real Thermal Systems). This program was developed and copyrighted by VVKR Incorporated of Alexandria, Virginia and is designed to allow an accurate assessment of each energy sensitive element in an existing building. The program utilizes standard American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) heat transfer methodologies and thermal resistance values for building materials from the National Bureau of Standards (NBS) or ASHRAE. Since the program was specifically designed with the analysis of existing buildings in mind, it is based on an hour by hour analysis of a typical day each month, and provides outputs that can easily be compared with the actual utility consumption data of an existing facility.

In this manner, the C-PARTS analysis can be checked against a known factor, the utility consumption of the facility for accuracy. Any significant deviations between the C-PARTS output and the actual consumption point to a problem in the C-PARTS data input or analysis. As a result, the final C-PARTS outputs have been verified against real data rather than a simple estimate of energy consumption.

As reviewed earlier, the vast majority of buildings analyzed are walk-through similar buildings. Each of these facilities was made similar to an Annex A building, located either at this community or another. For each walk-through building, a variation checklist was provided to note the differences between that building and the Annex A building to which it was judged similar. For example, two buildings may be similar in respect to the basic construction and use, but one has 25% greater window area and 30% greater floor area than the other. These approximate variations have been noted for each walk-through building in respect to its associated Annex A building. All heat transfer coefficients, U-values, are assumed equal to those for the Annex A Building, unless noted otherwise.

After these analyses have been complete, each of the walk-through similar buildings at this community is analyzed by C-PARTS in relation to its associated Annex A building. The variations noted above are taken into account in the analysis process to derive an accurate estimation of the energy use at each individual walk-through facility.

B. Boiler Plant Verification Analyses:

The next procedure in the C-PARTS Analysis at this military community is the verification of the computed energy consumption against the actual energy consumption for the test year. There is no specific energy consumption data for each building. Rather, there is energy consumption data for central boiler plants which provide heat to a number of buildings, and for electrical substations, which provide power to a number of buildings.

After the energy consumption data has been calculated for all of the Annex A buildings and the walk-through similar buildings, the facilities are all grouped according to the central plants and substations or lowest metered source servicing them. The totals of these facility groupings are then verified against the historical energy consumption data.

There are several factors that can cause deviations between the ASHRAE computed loads of C-PARTS and actual consumption data. The major factors are as follows:

1. Distribution line losses and steam leaks.

2. Lack of heating system controls that cause building occupants to open windows for comfort and thus increase infiltration losses,

3. Doors that are left open for excessive time periods especially in repair and maintenance facilities,

4. Low boiler efficiencies, poor or non-existent controls, and low maintenance factors.

5. Non-scheduled or irregular use of a facility.

Whenever possible, corrections for these factors were introduced, based on additional data that was collected during the Phase I survey. This data includes the ambient air conditions on the day of the survey, the number of windows and doors found open, comments on leaking pipes, doors found open, poor heating system controls, building plans and blueprints and photographs of building conditions. With this additional information, and the ability of the C-PARTS program to rapidly re-evaluate the building loads, adjustments were made to account for the infiltration and other losses to verify the computer analysis with the actual energy consumption within reasonable limits.

C. Energy Conservation Opportunities:

The Energy Conservation Opportunities (ECOs) studies at this community was based on the Annex B requirements of the Scope of Services dated 20 January 1983. The ECO's noted in Annex B were those required by the Army for analysis. In addition to these, however, several additional ECO's were voluntarily added to the analysis procedure to provide a complete review of all feasible energy savings measures at this community. These additional ECO's also include some requested by various reviewing agencies after Phase I Data Report was submitted. Others requested were judged outside the requirements of this contract.

The ECO's proposed for review and analysis are divided into eight major groupings according to their building system. These groups are as follows:

		ABBREVIATION
1)	Building Envelope	(B)
2)	Cooling	(C)
3)	Heating	(H)
4)	Lighting	(L)
5)	Special Equipment	(S)
6)	Temperature Controls	(T)
7)	Ventilation	(V)
8)	Domestic Hot Water	(W)

Within these groupings, all ECO's under each Increment of study have been reviewed and analyzed. The analysis of each ECO was performed either by the C-PARTS program or by manual calculations, based on data derived from the C-PARTS analysis and Boiler Plant Verification Analysis.

Generally, the Building Envelope ECO's and Temperature Control ECO's were analyzed by re-running the C-PARTS load analysis for a specific building with revised inputs reflecting the ECO. For example, by analyzing the buiding first as existing, and then with additional roof insulation and comparing the two outputs, the energy savings associated with the roof insulation can be determined. These computer analyses were conducted on a full year's basis to obtain total savings in a year.

The manual calculations were based on data from the C-PARTS analysis of the facility or from the Boiler Plant Verification Analysis. All methods of the calculations were derived from ASHRAE or from several guidebooks provided by the U.S. Department of Energy.
The Master List of all Energy Conservation Opportunities that were reviewed at this community are as follows, though not all of these ECOs were applicable nor calculated.

BUILDING ENVELOPE

B-1 Insulation added to walls.

B-2.1 Insulation added to existing roof.

B-2.2 Insulation added with new roof.

B-3 Insulation added to basement ceiling.

B-4.1 Insulation added to attic floors.

B-4.2 Insulation added to usable attic.

B-5.5 Caulk and weatherstrip windows.

B-7.5 Caulk and weatherstrip doors.

B-8 Storm windows installed.

B-9 Storm doors installed.

B-10 Double pane windows installed.

B-11 Sun control screens or louvers added to windows.

B-12 Solar control film added to windows.

B-13.1 Glass area replaced with Spandrel panel

B-13.2 Glass area replaced with glass blocks

B-14 Automatic door closers installed.

B-15 Doors vestibuled.

B-16 Thermal barriers installed.

B-17.1 Double glaze skylights.

B-17.2 Remove existing skylights.

B-18 Loading dock doors sealed.

B-19 Air curtains installed.

B-20 Thermal/solar control shades installed.

COOLING SYSTEMS

C-1 Economizer systems provide free cooling during winter season.

C-2 Dual duct or multizone systems converted to single zone systems.

C-3 Cooling pipe lines and ductwork insulated.

C-4 Absorption cooling equipmment replaced.

C-5 Cooling equipment is serviced, cleaned and adjusted regularly.

C-6 Cooling of unoccupied areas is prevented.

C-7 Variable air volume systems installed.

C-8 Filters cleaned and inspected regularly.

C-9 Temperature of chilled water raised.

C-10 Solar assisted cooling equipment installed.

C-11 Reheat coils removed.

C-12 Heat recovered from refrigerant gas.

HEATING SYSTEMS

H-1 Combustion air to boiler preheated.

H-2 Fuel oil to boiler preheated.

H-3 Steam condensate returned to boilers.

H-4 Flue gas dampers installed.

H-5 Automatic ignition pilot lights installed.

H-6 Flue gas analysis and adjustment performed regularly.

H-7 Combustion is monitored and adjusted regularly.

H-8 Heating equipment converted from natural gas to oil or coal.

H-9 Steam, condensate and hot water piping insulated.

H-9.5 Insulate valves and fittings.

H-10 Unnecessary humidification removed.

H-11 Oxygen trim controls installed on boilers.

H-12 Heat recovery systems installed.

H-13 Solar energy heating system installed.

H-14 Reheat coils removed.

H-15 Temperature of hot water used for heating lowered.

H-16 Connected to district heating.

H-17 Turbulators installed in fire tube boilers.

H-18 Supply and return piping installed.

H-19 Spot heating installed.

H-20 Fluidized Bed Combustion System

H-21 Boiler Maintenance

LIGHTING SYSTEMS

L-1 Lighting fixtures removed.

L-2 Lamps and/or ballasts removed from fixtures.

L-3 Task lighting installed.

L-4 Lower wattage lamps installed.

L-5 Lamps and fixtures cleaned regularly.

L-6 Exterior lighting is reduced to minimum.

L-7 Lighting is off in unoccupied areas.

L-8 Photocell controls installed.

L-9 Automatic time clock controls installed.

L-10 Fixtures relamped on schedule.

L-11 Natural daylighting is utilized.

L-12 Incandescent fixtures replaced with fluorescent fixtures.

L-13 Exterior lighting replaced with low or high pressure sodium fixtures.

L-14 Mercury vapor fixtures replaced with high pressure sodium.

L-15 High efficiency ballasts installed.

L-16 Power reducers installed.

SPECIAL EQUIPMENT SYSTEMS

S-1 Time delay switches installed on elevator motors.

S-2 Motors and motor driven equipment are maintained and adjusted regularly.

S-3 Time clocks installed to turn off vending machines and drinking fountains overnight and during weekends.

S-4 Kitchen equipment and laundry equipment maintained and cleaned regularly.

S-5 Co-generation equipment installed.

S-6 Laundry waste air/water heat recovered.

S-7 Kitchen waste air/water heat recovered.

S-8 Individual metering of family housing installed.

S-9 Peak demand load controlled.

S-10 Electrical Load Replacement

TEMPERATURE CONTROL

T-1 Heating and cooling reduced to unoccupied areas.

T-2 Time clocks added to heating and cooling systems.

T-3 Tamperproof thermostats installed.

T-4 Thermostats set at 78° for cooling, 65° for heating.

T-5 Thermostats relocated from outside walls and from areas subject to drafts or direct sunlight.

T-6 Economizer controls added to heating and cooling system.

T-7 Temperature control system adjusted and recalibrated seasonally.

T-8 Automatic energy management systems installed.

T-9 Zone control implemented.

T-10 Thermostatic radiator control valves installed.

T-11 Night setback controls installed.

T-12 Outside air reset installed.

T-13 Duty cycling controls installed.

T-14 Heating monitoring devices installed.

VENTILATION SYSTEMS

V-1 Outside air reduced to minimum levels.

V-2 Exhaust systems balanced with the outside air intake systems.

V-3 Time clocks installed to shut down exhaust systems overnight and during weekends.

V-4 Outside air dampers sealed and adjusted to operate properly.

V-5 Exhaust hoods are equipped with make-up air systems.

V-6 Toilet exhaust fans wired to operate only when lights are turned on.

V-7 Heat recovery systems installed between exhaust air and outside air.

V-8 Maintenance Shop Exhaust system installed.

DOMESTIC HOT WATER SYSTEMS

W-1 Temperature of domestic hot water reduced.

W-2 Hot water piping insulated.

W-3 Storage tanks insulated.

W-4.1 Eliminate hot water use.

W-4.2 Time clocks installed to shut off water heaters overnight and during weekends.

W-5 Flow restrictors installed in faucets and shower heads.

W-6 Time clocks installed to shut off circulating water pumps overnight and during weekends.

W-7 System equipment is serviced, cleaned and adjusted regularly.

W-8 Solar hot water system installed.

W-9 Systems decentralized.

W-10 Hot water production supplemented by heat pump.

D. Projects Requested for Funding:

Of the complete list of ECOs reviewed, 66 were analyzed in detail, with calculations estimating energy savings and implementation costs. Of the 66 ECOs analyzed, no projects were requested for funding by the Milcom.

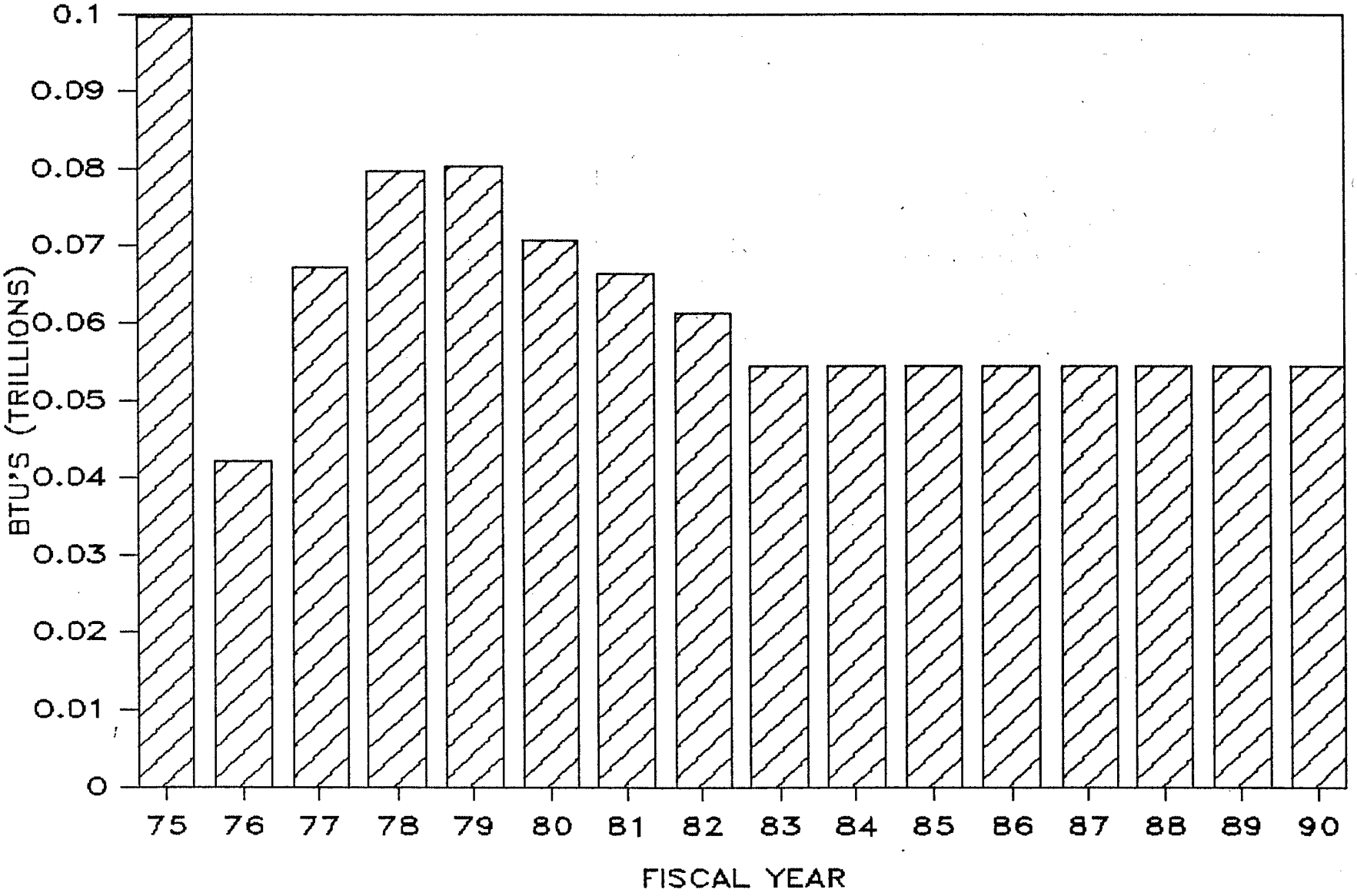
IV. PHASE III

Phase III of this study consists of preparing required programming documents, and preparing the Executive Summary. However, since Berchtesgaden Milcom did not request funding for any of the ECO's analysed, only the Executive Summary has been prepared. The findings of the Phase II Energy Report can be used as guidelines for future energy conservation renovations. It contains much useful information for determining impact on basewide energy use for different energy related modifications to buildings.

The following graphs tract the energy consumption for the different energy sources being used at Berchtesgaden Milcom. For years 1975-1983 actual consumption figures, provided by VII Corps, were used. For years 1983-1990 straight line projections from the 1983 consumptions were used. The last graph depicts the cost of different energy sources. Actual costs were utilized for 1983. However, for years 1984-1990 the fuel costs were modified based upon the most recent trends and projections.

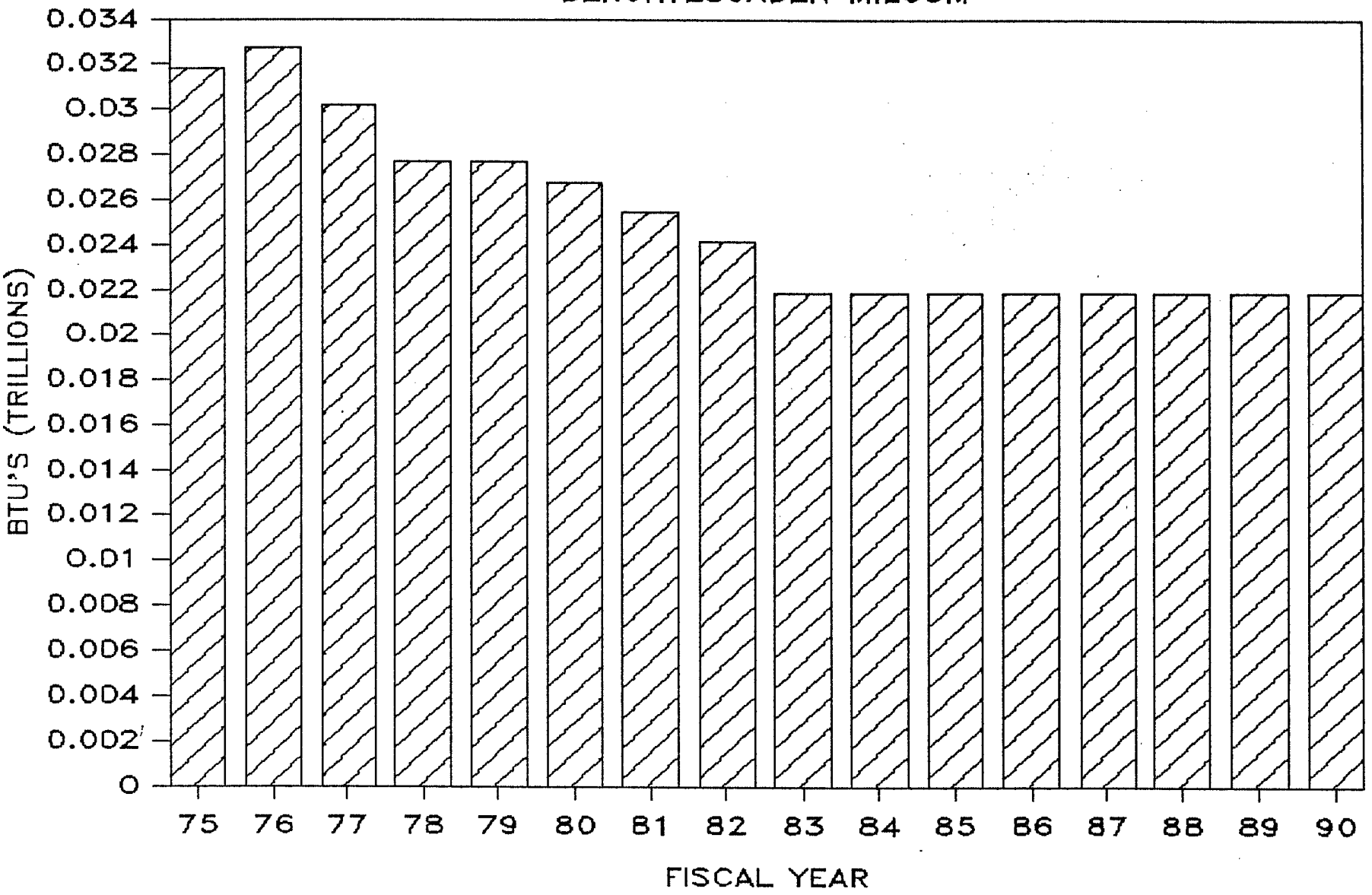
COAL CONSUMPTION

BERCHTESGADEN MILCOM



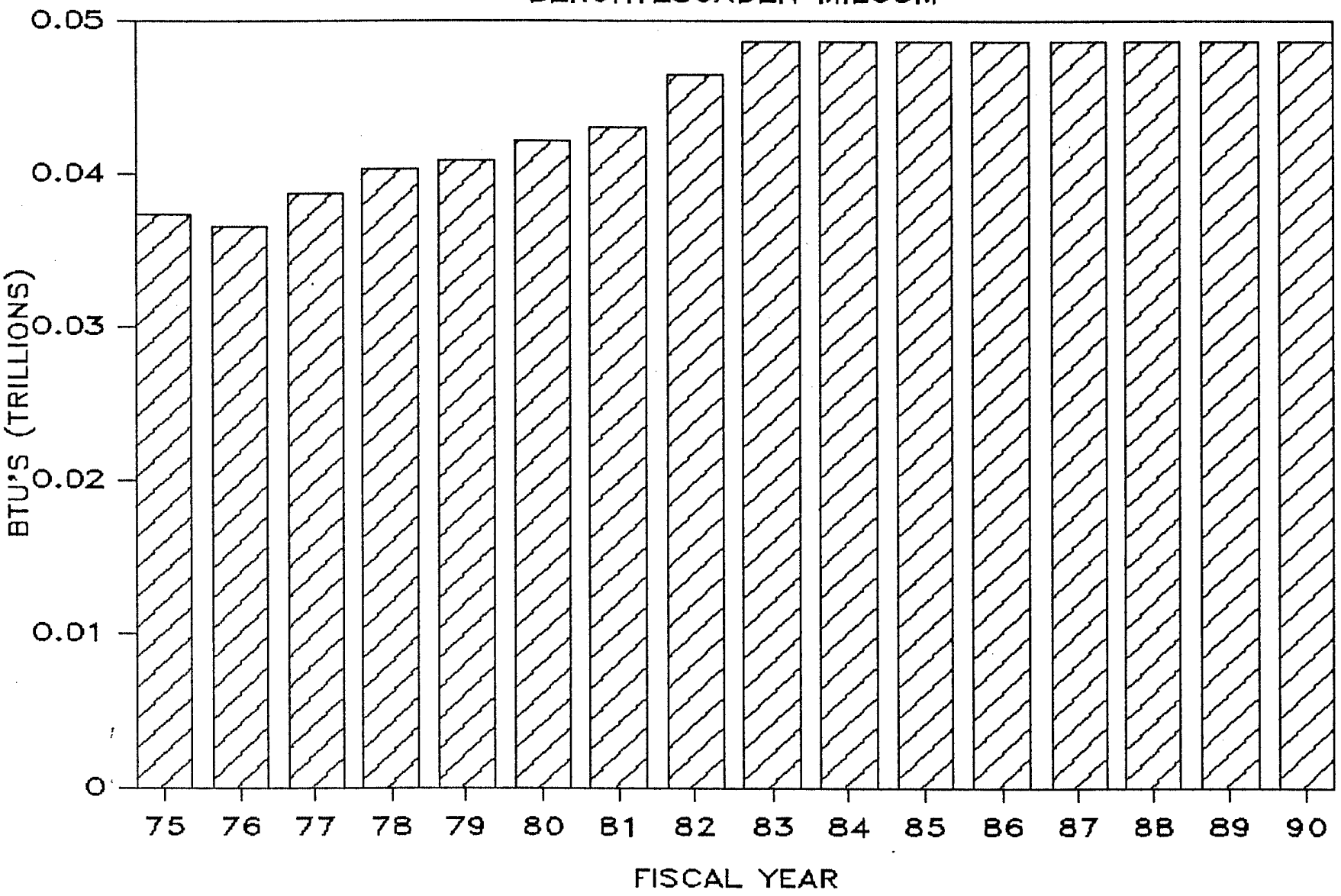
FUEL OIL CONSUMPTION

BERCHTESGADEN MILCOM



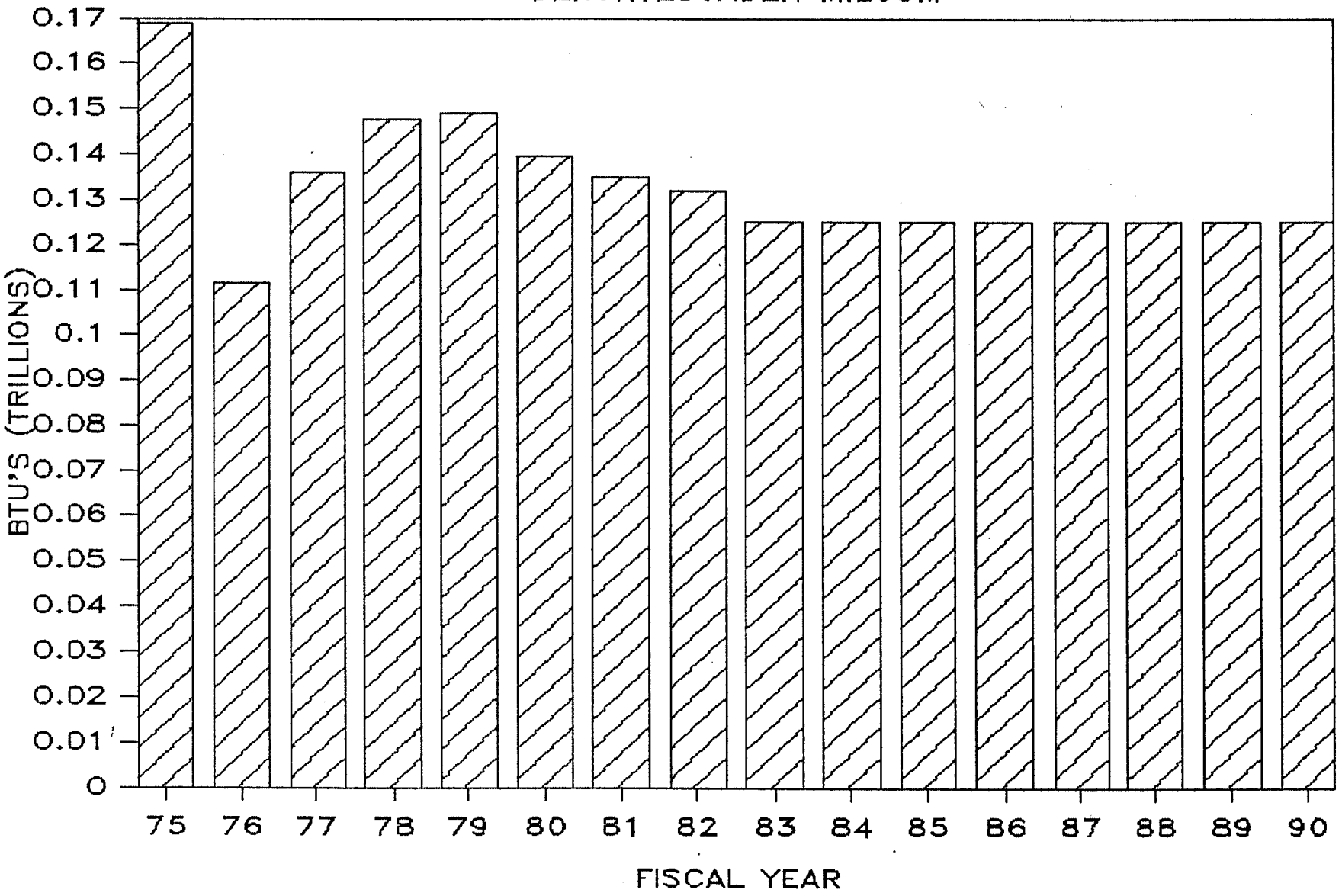
ELECTRICAL CONSUMPTION

BERCHTESGADEN MILCOM



TOTAL ENERGY CONSUMPTION

BERCHTESGADEN MILCOM



TOTAL ENERGY COSTS

BERCHTESGADEN MILCOM