AD-A093 757 ARMY SCIENCE BOARD WASHINGTON DC F/G 5/1

ARMY SCIENCE BOARD AD HOC SUB-GROUP REPORT ON ENERGY NEEDS OF T--ETC(U)

OCT 80 H M AGNEW, R A BEAUDET, A W BETTS

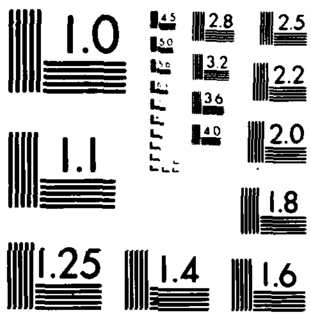
UNCLASSIFIED NL

END

DATE FILMED

2 81

DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

DEPARTMENT OF THE ARMY
ASSISTANT SECRETARY OF THE ARMY
RESEARCH, DEVELOPMENT, AND ACQUISITION
WASHINGTON, D. C. 20310

LEVEL II (12)

ARMY SCIENCE BOARD

AD A093757

AD HOC SUB-GROUP
ON
ENERGY NEEDS OF THE ARMY

OCTOBER 1980

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A093 757	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Army Science Board Ad Hoc Sub-Group Report on Energy Needs of the Army		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Agnew, Harold M.; Hartig, E. O.; Beaudet, Robert A.; Talley, Wilson K.; Betts, Austin W.		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Army Science Board, Office Assistant Secretary of the Army (Research, Development and Acquisition), Washington, D. C. 20310		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Army Science Board, Office Assistant Secretary of the Army (Research, Development and Acquisition), Washington, D. C. 20310		12. REPORT DATE October 1980
		13. NUMBER OF PAGES 24
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Energy	Synthetic Fuels
Installation Energy	Army Energy Consumption
Mobility Energy	Army Energy Future Needs

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This study examined future Army requirements for energy and development programs to assist in meeting anticipated energy needs. Specific items reviewed include current and projected mobility, weapons system, and installation requirements for energy in the Army; identification of research and development efforts which might alleviate projected shortfalls.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

411 0 1

TABLE OF CONTENTS

ARMY SCIENCE BOARD
Ad Hoc Sub-Group
on
ENERGY NEEDS OF THE ARMY

I. EXECUTIVE SUMMARY.

A. At the request of the Assistant Secretary of the Army for Research, Development and Acquisition, (ASA(RDA)) an Ad Hoc Sub-Group (AHSG) of the Army Science Board (ASB) was convened to address the following questions:

1. What are the current and projected mobility, weapons system, and installation requirements for energy in the Army? What management actions might be taken to reduce those requirements without degrading training, readiness, quality of life, or combat effectiveness?

2. What research and development efforts, both inside and outside the Army, might alleviate projected shortfalls? What alternative energy sources might realistically and economically substitute for scarce resources?

B. It came as a surprise to the AHSG to learn that the Army's peacetime energy consumption represented 18 percent of the total consumption of the Department of Defense (DoD) and that 83 percent of the Army's requirements were for facilities. The three Services' energy requirements for facilities are about equal, but the Air Force and Navy requirements for mobility fuels greatly exceed those of the Army. It was not expected that the relative requirements would shift drastically in wartime, but clearly the total amounts needed would increase. The AHSG was unable to assess adequately the impact of mobilization on Army energy needs.

C. The AHSG believes, therefore, that attention should be focused primarily on better use of energy in facilities. In addition, the Group supports the efforts of the Army to reduce its dependency on petroleum.

D. The AHSG strongly recommends that the Army explore the possibility of having its facility heating and steam requirements provided by local utilities -- either using waste heat from electrical generating plants or taking heat directly from thermal steam plants. Furthermore, the Army should always consider generating electricity as a topping cycle when steam is produced for facility heating.

E. Because many fuels can be burned efficiently in modern fluidized bed combustors, the AHSG urges the DoD to support the use of this type of combustor for coal and other organic materials ranging from sewage sludge to peat for central power stations.

F. The AHSG is concerned that, by direction, there is no ongoing Army work regarding nuclear power. The Group believes that there are unique requirements for central power stations in the range of 10 to 20 megawatt electrical (MWe) and 600 to 800 MWe to produce assured energy for facilities, mobilization, and tactical deployments. In particular, the AHSG is concerned that the State of Hawaii, with its potentially fragile supply line, has no nuclear plant to meet its vital defense needs in case of an extended interruption in its petroleum supply.

G. It is the AHSG's opinion that if synthetic fuels (synfuels) are to be used, they will be introduced by the present petroleum product distribution systems initially as blends and eventually as pure synfuels. Thus, the AHSG cannot justify any independent effort on the part of the Army to duplicate the production or distribution endeavors. The Group recognizes that Army research and development (R&D) efforts related to engines or combustors must allow accommodation of these fuels as they become available through the work of the private sector or the Department of Energy (DoE).

H. In the area of vehicle engine and transmission design and procurement, it is suggested that the Army consider using power plants that operate most efficiently under non-combat situations but which are capable of meeting the brief surge requirements which combat may require. This is a reversal of present policy. An analogy is the "low dash" requirement for aircraft, which is seldom used but which may impose severe cost, design and development, and operational constraints on the final product.

I. The AHSG feels that the use of mobile electrical power generation at fixed training sites should be limited to that required for personnel to learn to operate and maintain the equipment. Continuous power requirements should be met through hard wire sources, even if separate training power supplies are required.

J. Since the Army Corps of Engineers is one of the few organizations charged with building entire "communities," it should pioneer in the R&D needed for facility planning, particularly in the development and use of energy analysis tools with support computer graphics. Although much of the development of these systems and other technologies may be done by the DoE, the Army should maintain in its laboratory system the level of expertise which will allow effective transfer of DoE technologies into the Army design, procurement, and construction system, and which will assure that the Army energy requirements are being adequately addressed by the DoE. A close working relationship with DoE must, therefore, be maintained.

II. INTRODUCTION.

A. Objective of Study. This report has been prepared by an AHSG of the ASB in response to a request, dated 14 May 1980, from the ASA (RDA), who asked that the following questions be addressed:

1. What are the current and projected mobility, weapons system, and installation requirements for energy in the Army? What management actions might be taken to reduce those requirements without degrading training, readiness, quality of life, or combat effectiveness?

2. What R&D efforts, both inside and outside the Army, might alleviate projected shortfalls? What alternative energy sources might realistically and economically substitute for scarce resources?

B. The Army as an Energy User. Figure 1 shows both the relationship of the Army's energy consumption to that of the DoD and the United States, and the Army's energy consumption for facility operations and mobility. DoD takes only 1.8 percent of the energy used in the United States, with some 68 percent of that energy provided by petroleum. As is seen from Figure 1, the Army accounts for 18 percent of the DoD's energy consumption, or 0.3 percent of the United States' -- with the majority of the Army's consumption (83 percent) being used for facilities. The remaining 17 percent of Army use supports all military equipment, which depends solely on petroleum. (Note that it is necessary to introduce a scale factor of over 300 to show the Army's total energy consumption in a figure that includes the United States' consumption.) The three Services use about the same amount of energy for facility operations but differ significantly in the amount of mobility fuels used, with the difference being primarily for aircraft operations. Figure 2 shows how the Army uses, in its facilities and mobility operations, the various energy resources it purchases. Note that most of its petroleum use is in facilities operation, rather than in mobility.

C. Recognition of On-Going Efforts.

1. In approaching the subject of the Army's future needs for energy, and how those needs might be satisfied, the AHSG was made aware of the Army's extensive planning efforts that have addressed these concerns over the past few years. These efforts have involved not only the Army, but also other components of DoD and DoE. The AHSG commends these agencies for their cooperative work and was gratified to learn that such cooperation will be continued. The nature of these coordinated efforts was perhaps best expressed in the DoE and DoD's October 1978 Memorandum of Understanding (MOU) that identified two basic

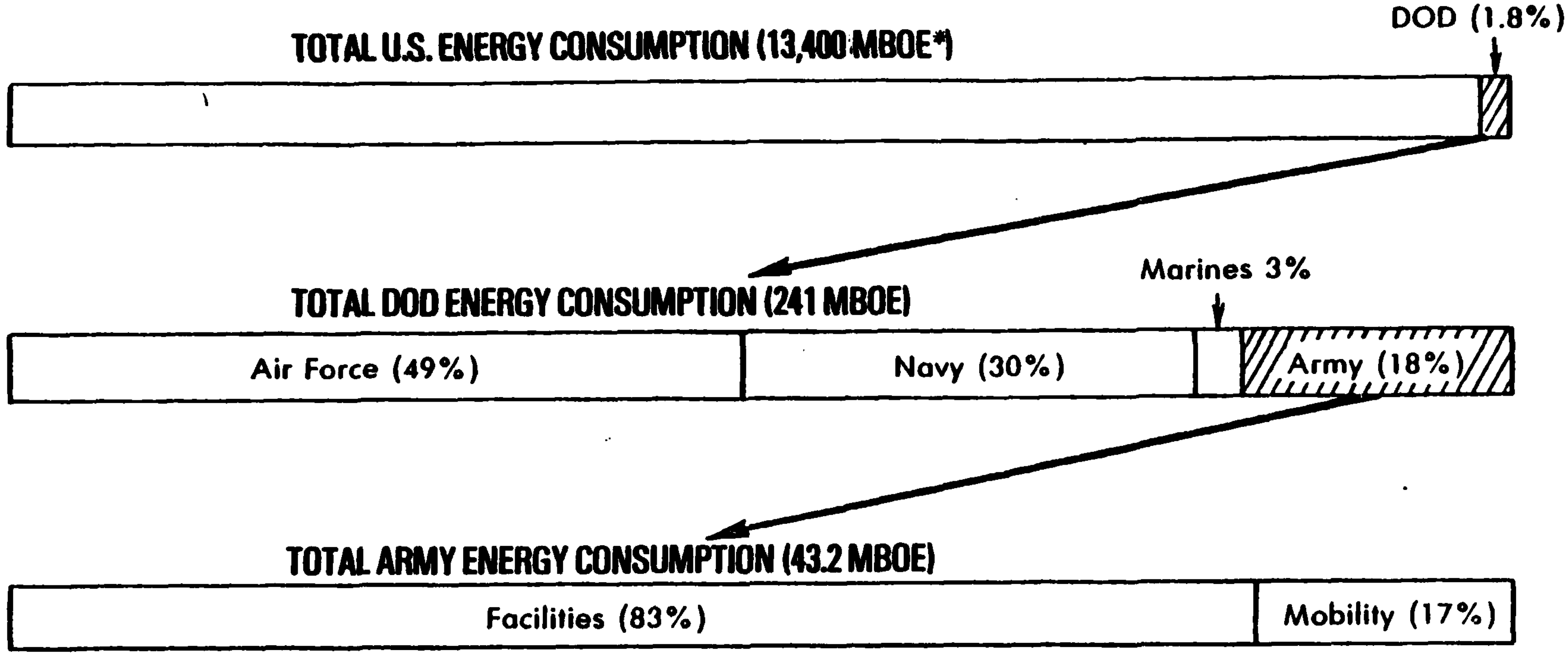


Figure 1. Peacetime U.S., DOD, Army, Annual Energy Consumption(1979)**

* MBOE=million barrels of oil equivalent

** Data from Army energy office

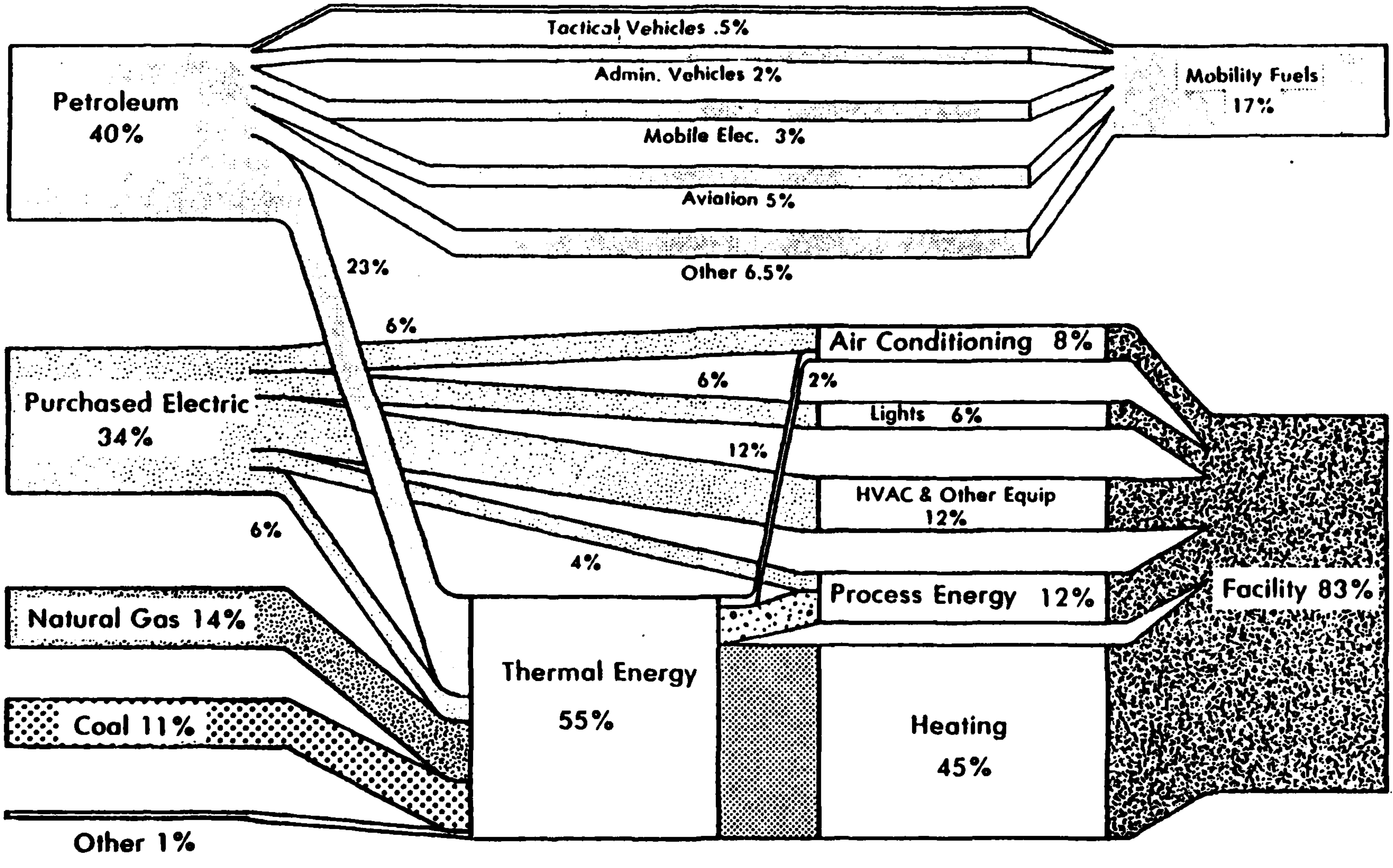


Figure 2. Army End Use Of Energy Resources

goals: "improving energy efficiency and availability within DoD, and utilizing DoD and DoE expertise and facilities to carry out projects of mutual interest."

2. In addition to this planning at the DoD/DoE level, the AHSG during a briefing by the Army Energy Offices, learned of an internal comprehensive, six-phase program to cut dependence on petroleum for operating Army facilities. The effort calls for reduction in usage; conversion to solid fuels such as coal, wood, or refuse-derived fuel; use of solar energy; use of wind power; use of low head hydroelectric power; and use of nuclear power. (The AHSG notes that, by direction, there is no on-going activity regarding nuclear power.) The Group also reviewed the Materiel Development and Readiness Command (DARCOM),Mobility Equipment Research and Development Command (MERADCOM) energy R&D program that seeks to make more efficient use of fuels, reduce dependence on non-domestic fuels, and use less expensive or more plentiful renewable resources.

3. Since 83 percent of overall Army energy usage (Figure 2) goes to facilities operations, it obviously makes good sense that any program to reduce energy usage in the Army needs to address -- as a matter of some priority -- heating, cooling, and other energy needs in support of an installation's operation. This concern is reflected in the emphasis being given to the joint DoD/DoE oil backout program, Federal Agencies Fuel Substitution Task (FAST).

4. The AHSG was unable to assess adequately the impact of mobilization on Army energy needs. It is quite clear that, while specific requirements in wartime will be highly scenario-dependent, certain features of mobilization plans are generally applicable. The Group has the opinion that neither general nor scenario-specific issues have yet been given enough attention.

III. FIXED INSTALLATION ENERGY PROGRAM.

A. Current Usage. Of all Federal facilities, 80 percent are operated by DoD. Since the Army manages about a third of DoD fixed facilities, about 25 percent of all Federal facilities are the responsibility of the Army. Further, the Army's mobility energy budget is a minor part of the DoD mobility requirements. Thus, it is not surprising to find that 83 percent of the Army's present usage of energy is in fixed installations.

B. Army Energy Goals for Fixed Installations.

1. In order to reach an overall reduction of 35 percent in energy consumption by the year 2000 (using Fiscal Year (FY) 75 as the base year), the Army has proposed that a 40 percent reduction in energy usage be achieved in facilities operations. An interim goal of a 20 percent reduction by 1985 has already produced a reduction of 15.7 percent in such energy usage through a combination of facility improvements and conservation. A goal of 45 percent reduction in energy consumption for new buildings has been set for 1985. In the area of alternate fuels, the Army has an FY 85 facilities goal to reduce petroleum use by 30 percent and to get 15 percent of its energy from coal, solid waste, biomass, and solar. The goal for the year 2000 is to reduce the use of natural petroleum by 75 percent and to replace natural gas with synthetic gas (syngas).

2. While the AHSG did not see the in depth analyses that led to selection of these goals, it sees no *a priori* reason to believe the goals cannot be achieved. Continued R&D would need to be pursued in order to apply current technology to new construction, facility modification, and facility management. This conclusion assumes that there is no large increase in the Army's manpower.

3. Now that the Army has firm programs to meet its goals, the AHSG suggests that it is possible and beneficial to review the goals to see whether they are appropriate. The present static and insular process should be replaced by an interactive and iterative process. It might be found that the *aim* of a particular goal can be achieved at a lower cost. For example, one goal states that (by 2000) syngas will replace natural gas. The Army has therefore programed efforts to implement syngas technologies at individual bases. Based on a DoE presentation to the AHSG, it is clear that such systems are uneconomical on that limited scale. Further, the Army buys most of its natural gas from public utilities and syngas will gradually replace natural gas in the pipeline as large-scale commercialization occurs. Thus, this goal is unnecessary and working for its implementation is inappropriate.

C. Recommended Technologies.

1. Fluidized Bed Combustion. Because coal and other organic materials ranging from sewage sludge to peat can be burned efficiently in modern fluidized bed combustors, the AHSG urges the DoD to support the use of this type of combustor for central power stations. Consideration should be given to requesting the DoE to fund research to adapt this technology to railroad locomotives and marine engines as a potential replacement for diesel engines. Of course, it should be recognized that for both fixed and mobile systems, R&D should be pursued to address the basic problems of how to clean the stack gases and how to improve the quality of solid fuels to minimize the production of pollutants.

2. Cogeneration. The Army should explore the possibility of having its facility heating and steam requirements provided by local utilities whenever possible, either using waste heat from their electrical generating plants or taking heat directly from thermal steam plants. In addition, the Army should always consider generating electricity as a topping cycle when steam is produced for facility heating.

3. Nuclear Power. Secure and assured energy for facilities, mobilization, and tactical deployment is not presently available. However, a low risk R&D program can provide it. The key is the development and use of two types of nuclear reactors: a 600 to 800 MWe power plant for joint public/Army-facility use, and a portable 10 to 20 MWe plant for tactical deployment (e.g., to beachheads) in the event of a conflict. The Army could then ask the Nuclear Regulatory Commission to "type-certify" both classes of reactors (as is the case with civilian aircraft), expediting passage through regulatory procedures. Operated at approximately 50 percent capacity, the stationary system would still provide more power than any peacetime Army facility can use. The surplus power would be available for surrounding civilian use. As these plants reduce the demand for petroleum by the civilian sector, some of that fuel could be made available to the Army for its mobility needs. In the event of an embargo or mobilization, the reactor would run at full capacity to make up for shortages and to allow the Army to meet expanded needs.

The AHSG notes that such systems resolve the problem of assured energy for territories that are strategic but vulnerable with respect to energy supplies [e.g., Hawaii, Guam]. Neither the civilian economy nor the military operations at such locations could survive a blockade at present. Thus, alternate and secure energy supplies must be made available. Because the need is immediate, only presently available technologies should be considered. This urgency rules out wind, ocean thermal, and solar, leaving only nuclear. While it would be at least a decade before substantial amounts of nuclear-generated electricity could be provided, that is a far shorter time than that needed for economical alternative sources to be developed, demonstrated, and installed.

These stationary reactors could be operated by local utilities, but sited on secure Army bases. Such locations offer increased security against terrorist actions, minimize siting problems, and can provide an exclusion zone at many bases in the unlikely need for local evacuation. The financing of the construction could vary from case to case and range from full utility funding, to government guarantee of utility loans, to a government-owned, contractor-operated facility. Other possibilities exist, but in any arrangement the utility would be guaranteed a steady consumer.

The portable 10 to 20 MWe systems would be used to supply power for forward bases and staging areas. Similar to the barge-mounted Army system used in Panama, they would be transportable by ships. Arriving in 25 to 30 days with Corps support troops and supplies, they could be emplaced quickly. If the vessel is submersible, the system could be sunk to improve its security. Thus one is led to consider using decommissioned nuclear submarines. No more vulnerable than conventional fuel depots and much more efficient than current generator sets, such a portable power supply could release petroleum for use in forward areas. This enhanced availability of front-line petroleum would ease the burden on the supply line from the continental United States. In turn, reduced lift requirements could translate to savings in the number of new C-5 or C-X aircraft needed. The 10 to 20 MWe is oversized for electrical production. However, even for a beachhead site, cogeneration can be useful. For example, the "surplus" energy could be well spent distilling seawater to produce potable supplies.

4. Rapid Installation Conversion to Coal. The Army has indicated a need for capital funds to permit rapid conversions of thermal power plants to coal. However, while a surge in "energy construction funds" would allow the needed conversions, it would also freeze the Army's methods of coal utilization at today's technology level. Thus the in-place high capital investment would hinder future adoption of more effective techniques sure to appear in the coming decades.

A more cautious approach, which the AHSG recommends, would be to test (at one or two facilities) each of the most promising half-dozen prospects and monitor the results in cooperation with DoE. The best of the technologies could then be installed at still other posts, monitored further, and so on. The end mix will have the majority of installations with the better of the intermediate technologies, a few with the very best, and a few posts with obsolete or inefficient plants which would be the first candates for investment with the appropriate technologies of the 1990's.

5. Coal-Oil Mixture (Interim Fix). One way to accelerate the oil backout program, FAST, is to take advantage of the developing technology for use of coal-oil mixtures as an interim means of converting to use of coal without the delay and expense involved in building new coal-fired systems. The AHSG was informed that mixtures of 40 percent coal and 60 percent oil have been burned successfully with relatively minor modifications to existing oil-burning facilities and with no significant problems.

6. Use of Local Power for Field Training. A limit on use of mobile electric generators should be encouraged at repeatedly used field troop training facilities. These generators should be used only enough to train personnel in their operation and maintenance in the field. Thus, after starting the generators, power should be switched to commercial power (which should be made available at all field training sites) and the generator turned off. This mode of operation will conserve petroleum products, prolong the life of the field generators, and, at the same time, satisfy all field training requirements.

7. Use of Interactive Computer Graphics for the Design of Individual Buildings and Entire Installations. At present, the designer of an individual building finds that the size, shape and orientation of the structure have been fixed by the master planner based on overall post layout without regard for the effects these decisions have on the individual building or installation energy consumption. The use of computers and interactive design techniques for installations and individual buildings would allow energy simulation models to be used during master planning (as well as during the design of the actual building), and would, in general, improve the efficiency of the design and construction process. The Army is one of the few organizations charged with building entire "communities". Thus, the Corps of Engineers will have to advance the R&D needed, particularly the development of energy analysis tools for use on small scale computer systems with support computer graphics.

8. Army Facilities Energy R&D Program. In order to achieve Army energy and cost reduction goals, an aggressive R&D program must be executed -- primarily by the DoE, as provided in the DoE/DoD MOU and in the charter of DoE. A large portion of this research program will have to come from industry. To complete the programs, however, the technology must be transferred from DoE to the Army. To effect that transfer, the AHSG does not recommend funding DoE to become conversant with Army needs and to spoon-feed R&D results to users. For a variety of reasons, such attempts have failed in the past and would -- at great expense -- fail here. An attractive, less costly alternative is to direct the Army to build and maintain expertise which will allow effective transfer of DoE technologies into the Army design, procurement, and construction system. A close working relationship with

DoE must be maintained to assure that the Army energy requirements are being adequately addressed by the DoE.

A modest and active R&D program can also speed up the technology transfer process for getting new energy technologies in place on Army installations. This rapid transfer of new technology is required if the Army is going to achieve its energy goals and bring energy costs into line with other expenditures. Thus even a limited R&D program will allow the Army to make intelligent selections among competing technologies, ensure that the Army does not prematurely implement new technologies, ensure that technologies are implemented in a cost-effective maner consistent with Federal procurement regulations, and preclude the new technologies from adversely affecting the operation and maintenance cost (i.e., time, manpower, and money) of the installations.

9. Mobilization Planning. The AHSG was not made aware of advance planning for personnel, facilities, and energy requirements in the event of a major mobilization. It would appear to the group that advance planning in this area could result in minimizing overall energy requirements. Since base heating and cooling can have a major impact on energy requirements, the interrelationship of geography, climate, and time of year should be considered in the sequencing of facility openings. With proper planning, the transcontinental movement of Service personnel and their families could also be minimal. Proper mobilization planning could have a salutary effect on morale and reduce the energy requirements for transportation, housing, and general base facilities. Modern computer technology suggests that preplanning could be accommodated at small expense and could be continously updated. An early computer exercise using recent draft registration data should be implemented.

10. Energy Use Management and Control. After taking steps to build energy-efficient new buildings and to improve the energy conservation of existing buildings, the Army should begin an aggressive management program to ensure that these buildings continue to operate in the energy-efficient mode for which they were designed or retrofitted. This should include a continuing monitoring program to check on the energy consumption of buildings, and extensive use of new technology for energy management and control, especially those technologies directed at the control and management of individual buildings. Because of the high cost of metering existing buildings, innovative metering techniques employing survey methods, portable and non-interruptive instrument systems, and subarea metering may have to be developed.

11. Unlimited Alternate Sources. The Army should keep abreast of commercial adaptations of solar, wind, geothermal, and ocean thermal technologies and employ them where cost effective. However, except for the use of passive solar in new construction, solar hot water heaters, or solar ponds, the AHSG does not believe these technologies hold much near-term promise for the Army. In particular, the Army should not spend R&D funds in these areas.

IV. MOBILITY ENERGY PROGRAM.

A. Current Usage. The Army uses only 10 percent of DoD petroleum fuels. As shown in Figure 2, more than half of this is used for facilities heating; mobility fuels account for only 17 percent of the Army's annual peacetime energy consumption. To put this in perspective, the Army's annual mobility usage represents less than one-half of the United States' oil consumption in a single day. The major portion of the Army's mobility fuels is used for aviation (helicopters), mobile electric power, and administrative vehicles. Only 3 percent of the Army's mobility fuels is used for ground combat or tactical vehicles.

B. Army Mobility Goals. The Army has set goals for a 10 percent reduction in mobility consumption by 1985, zero growth beyond that to the year 2000, and no loss of readiness. Additionally, the Army proposes to reduce dependence on non-renewable and scarce fuels by converting 20 percent of mobility petroleum usage to synthetic or alternate fuels, while increasing efficiency of energy-dependent mobility systems by 15 percent. No analysis was presented to the AHSG that would provide a basis for judging whether these goals are achievable. However, the Group was made aware of a well planned, comprehensive R&D program in pursuit of these goals -- a program that warrants continued support. Again, the AHSG feels that an interactive, iterative process (to reconsider goals in view of the programs proposed to achieve them) would be worthwhile.

C. Recommended Technologies.

1. Use of Simulators in Training. The AHSG recommends that the use of simulators be expanded. The need is obvious for such devices to reduce training hours in high fuel-usage systems (e.g., tanks, aircraft). However, by their nature, such systems are relatively few in comparison to moderate fuel-usage systems (e.g., TOW, ITV). Training in realistic simulators for such systems rather than in the actual systems could provide both readiness and considerable fuel savings.

2. Synfuels. One of the mobility goals of the Army is to develop the capability to use synfuels as they become available. The DoE has the Federal responsibility of research, development, demonstration, and commercialization of synfuels for civilian and military use. Of primary interest to the Army is synfuel produced from shale oil, since this technology is most promising for providing high-quality middle distillate fuels used in helicopters, tanks, and diesel equipment. The Army's near-term program on synfuels includes engine life and performance testing using early, experimentally produced shale oil fuels. While a limited amount of this early testing is desirable, it should be recognized that these early fuels may bear little resemblance to production fuels which are likely to be blended with natural petroleum products and other additives. While this testing can provide good preliminary guidance, it would be premature, based on

these early prototype fuels, to undertake engine modifications or new designs at this stage of development. As more typical synfuels become available, the Army needs to increase its test program and work closely with DoE to assure equipment fuel compatibility.

3. Vehicle Design and Modification. In the design of future vehicles and product improvement programs (PIPs) for present ones, a thorough review of the compatibility of mission/engine/transmission/ground contact must become a routine procedure rather than an extraordinary one. Some examples follow.

a. Clearly, the current 13 percent of mobility fuel devoted to administrative vehicles can be reduced by incorporating subcompact cars into the fleet. Present small diesel engines are attractive power plants for cars which routinely carry one or two people; advances in ceramic technology are making the adiabatic diesel a likely candidate for a still more efficient engine.

b. For larger vehicles, programs to optimize engines and transmissions may prove rewarding. An increase in the number of forward speeds to permit an engine to run nearer peak horsepower, or torque, is obvious, but the cost is ease of operation. Despite the fact that the entire transportation industry has the same problem, more than a simple monitoring of the industry's (United States and foreign) novel approaches will be required because of the unique nature of military equipment. In any event, a plan for fuel conservation through energy-efficient Army mobility systems should be implemented.

c. The standard practice in designing a combat vehicle has been to use an engine capable of sustained operation under battle conditions. Such engines push the state of the art and are traditionally hard to maintain. Further, most vehicles spend much of their lives running under loads far less than those imposed by combat. Designed to optimize peak performance, they are inefficient at lower power settings (the settings at which they are routinely operated). The AHSG urges exploration of engines designed for efficient operation in non-combat situations, but capable of meeting brief surge requirements. (An analog is the standard automobile starter motor -- far too small for continuous cranking, it serves very well for thousands of 10-second operations.) Flywheel technology, regeneration on braking, and other technologies should be explored. If the goal of novel power plants for the heaviest combat vehicles cannot be achieved, it may be that lesser successes will provide more efficient and maintainable administrative or transport vehicles. From the present patterns of energy use, it is clear that such "lesser successes" could yield the largest savings.

d. Finally, while on the topic of vehicle engines, the AHSG notes that the Army should continue to develop a capability to use synthetic/alternate fuels for mobility; this will require a concomitant development of fuel-tolerant engines.

APPENDIX A
TERMS OF REFERENCE

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, D.C. 20310

REPLY TO ATTENTION OF

14 MAY 1980

Dr. J. Ernest Wilkins, Jr.
Associate General Manager
EG&G Idaho, Incorporated
Post Office Box 1625
Idaho Falls, Idaho 83401

Dear Dr. Wilkins,

It is requested that you empanel an Ad Hoc Sub-Group of six Army Science Board members to examine future Army requirements for energy and development programs to assist in meeting energy needs. I would appreciate your participation in this assessment, if you could take time from your schedule.

Forseeable shortages of traditional energy sources and significantly increasing costs for fuel will require concerted research and development actions to meet anticipated Army requirements. In order to meet peacetime readiness needs, energy efficient equipment and facilities will be required; to meet potential combat needs, an even larger demand for mobility fuels will have to be satisfied. Alternative training techniques, such as wheeled and tracked vehicle operator simulators, could offer some economies. Heating, cooling, and power generation programs should take advantage of research and development outside the Department of the Army, looking to adopt innovative, yet practical, options.

The sub-group should address the following Terms of Reference:

1. What are the current and projected mobility, weapons system, and installation requirements for energy in the Army? What management actions might be taken to reduce those requirements without degrading training, readiness, quality of life, or combat effectiveness?

2. What research and development efforts, both inside and outside the Army, might alleviate projected shortfalls? What alternative energy sources might realistically and economically substitute for scarce resources?

The Ad Hoc Sub-Group should consider recent analyses, such as the DoD-DoE Workshop on Joint Energy Activities, in assessing the Army as an energy consumer and as a technology producer. While the focus of the sub-group should be on 1990 needs and means of meeting those needs, short-term options should also be identified. A draft report, for subsequent comment by the Army Staff, should be submitted by mid-September.

Sincerely,

Percy A. Pierre
Assistant Secretary of the Army
(Research, Development and Acquisition)

APPENDIX B

MEETINGS CONVENED

ARMY SCIENCE BOARD
Ad Hoc Sub-Group
Energy Needs of the Army

Room 3A486 - The Pentagon

AGENDA

MONDAY, 30 JUNE 1980

0800	Introductory Remarks (DASA(RD))
0815	DoD Approach to Energy Situation (OASD(MRA&L))
0900	Energy Impact on Army Strategy and Policy (ODCSOPS)
0945	Break
1000	Overview of Army Energy Program (ODCSLOG(Army Energy Office))
1045	Army Facilities Energy Management (OCE)
1115	Alternate Energy Sources for Army Facilities (OCE)
1200	Lunch
1300	Working discussion to evaluate current management practices and possible impact on ability of Army to perform defense mission
1600	Adjourn

TUESDAY, 1 JULY 1980

0800	DoD/DoE Joint Energy Activities (OUSDR&E)
0845	Army Mobility Energy R&D Program (DARCOM)
0945	Army Facilities Energy R&D Program (OCE)
1030	Energy Requirements of Future Weapons Systems (ODCSRDA)
1200	Lunch
1245	Summarize Findings and Plan Future Activities of Panel
1545	Adjourn

ENERGY NEEDS OF THE ARMY
11-12 August 1980

Planned Agenda

11 AUG, MONDAY - 3A486

0900-0930	General Discussion. Discuss letter report developed by Dr. Talley
0930-1200	Briefings by Dr. Brewer, Dr. Batchelor, Dr. Voelker on: DoE Nuclear Energy Program/ DoE Synthetic Fuel Program
1200-1300	Lunch
1300-1330	Briefing by Dr. Leveranz on: OCE Facility Energy R&D Plan
1330-1630	Working discussion to evaluate Energy Needs of the Army

12 AUG, TUESDAY - 3A486

0900-1230	Discussion/working session to prepare draft report
1230-1330	Lunch

NOTE: If it is necessary to continue after lunch, the participants will move to 2E673.

APPENDIX C

ARMY SCIENCE BOARD PARTICIPANTS
AD HOC SUB-GROUP
ENERGY NEEDS OF THE ARMY

DR. HAROLD M. AGNEW, CHAIRMAN
PRESIDENT
GENERAL ATOMIC COMPANY
POST OFFICE BOX 81608
SAN DIEGO, CA 92138
(714) 455-2080

DR. ROBERT A. BEAUDET
CHAIRMAN
DEPARTMENT OF CHEMISTRY
UNIVERSITY OF SOUTHERN CA
UNIVERSITY PARK
LOS ANGELES, CA 90007
(213) 743-2997

LTG AUSTIN W. BETTS (USA-RET)
VICE PRESIDENT FOR PLANNING
SOUTHWEST RESEARCH INSTITUTE
POST OFFICE DRAWER 28510
SAN ANTONIO, TX 78284
(512) 684-5111 x2202

DR. E. O. HARTIG
VICE PRESIDENT
RESEARCH AND ENGINEERING
GOODYEAR AEROSPACE CORPORATION
1210 MASSILLON ROAD
AKRON, OHIO 44315
(216) 794-7266

DR. WILSON K. TALLEY
PROFESSOR, DEPARTMENT OF
APPLIED SCIENCE
UNIVERSITY OF CALIFORNIA-DAVIS
LAWRENCE LIVERMORE LABORATORY
HERTZ HALL
POST OFFICE BOX 808, L794
LIVERMORE, CA 94550
(415) 447-8555

DR. DONALD J. LEVERENZ
DA STAFF ASSISTANT
CONSTRUCTION ENGINEERING RESEARCH
LABORATORY
P. O. BOX 4005
CHAMPAIGN, IL 61820
(217) 352-6511 x375

APPENDIX D

ACRONYM DEFINITIONS

AHSG	Ad Hoc Sub-Group
ASA(RDA)	Assistant Secretary of the Army (Research, Development and Acquisition)
ASB	Army Science Board
DARCOM	U.S. Army Materiel Development and Readiness Command
DoD	Department of Defense
DoE	Department of Energy
FAST	Federal Agencies Fuel Substitution Task
FY	Fiscal Year
ITV	Improved TOW Vehicle
MERADCOM	U.S. Army Mobility Equipment Research and Development Command
MOU	Memorandum of Understanding
MWe	mega watt electrical
PIP	Product Improvement Program
R&D	Research and Development
SYNFUELS	Synthetic Fuels
SYNGAS	Synthetic Gas
TOW	Tube-Launched, Optically-Controlled, Wire-Guided

DISTRIBUTION:

ADDRESSEE	COPIES
Office Secretary of the Army The Pentagon Washington, D. C. 20310	1
Office Chief of Staff of the Army The Pentagon Washington, D. C. 20310	1
Office Under Secretary of the Army The Pentagon Washington, D, C. 20310	1
Office Vice Chief of Staff of the Army The Pentagon Washington, D.C. 20310	1
Commander U.S. Army Materiel Development and Readiness Command 5001 Eisenhower Avenue Alexandria, Virginia 22333	1
Commander U.S. Army Training and Doctrine Command Fort Monroe, Virginia 23651	1
Commander U.S. Army Forces Command Fort Mc Pherson, Georgia 30330	1
Deputy Commander Materiel Readiness U.S. Army Materiel Development and Readiness Command 5001 Eisenhower Avenue Alexandria, Virginia 22333	1
Deputy Commander U.S. Army Training and Doctrine Command Fort Leavenworth, Kansas 66027	1
Deputy Commander U.S. Army Forces Command Fort Mc Pherson, Georgia 30330	1
Deputy Under Secretary of the Army for Operations Research The Pentagon Washington, D. C. 20310	1

ADDRESSEE	COPIES
Director Requirements Office Deputy Chief of Staff for Operations and Plans The Pentagon Washington, D. C. 20310	1
Construction Engineering Research Laboratory, Corps of Engineers P.O. Box 4006 Champaign, Illinois 61820	1
Office Deputy Chief of Staff for Operations and Plans The Pentagon Washington, D. C. 20310	1
Office Deputy Chief of Staff for Research, Development and Acquisition The Pentagon Washington, D. C.	1
Office Deputy Chief of Staff for Logistics The Pentagon Washington, D. C. 20310	1
Office Deputy Chief of Staff of Personnel The Pentagon Washington, D. C. 20310	1
Office Assistant Chief of Staff for Intelligence The Pentagon Washington, D. C. 20310	1
Office Assistant Chief of Staff for Automation and Communication The Pentagon Washington, D. C. 20310	1
DA Committee Management Office (SAAA-SS) Washington, DC 20310	1
FOR: Library of Congress	8
Defense Technical Information Center ATTN: DTIC-DDR Alexandria, VA 22314	12
Army Science Board Office Assistant Secretary of the Army (Research, Development and Acquisition) Washington, DC 20310	10

ADDRESSEE	COPIES
Defense Science Board Office Under Secretary of Defense, Research and Engineering Washington, DC 20301	1
US Air Force Scientific Advisory Board HQS US Air Force Washington, DC 20330	1
Naval Research Advisory Committee Office of the Secretary Washington, DC 20350	1
Dr. Harold M. Agnew President General Atomic Company Post Office Box 81608 San Diego, CA 92138	1
Dr. Robert A. Beaudet Chairman Department of Chemistry University of Southern CA University Park Los Angeles, CA 90007	1
LTG Austin W. Betts (USA-Ret) Vice President for Planning Southwest Research Institute Post Office Drawer 28510 San Antonio, TX 78284	1
Dr. E. O. Hartig Vice President Research and Engineering Goodyear Aerospace Corporation 1210 Massillon Road Akron, Ohio 44315	1
Dr. Wilson K. Talley Professor, Department of Applied Science University of California-Davis Lawrence Livermore Laboratory Hertz Hall Post Office Box 808, L794 Livermore, CA 94550	1

DATE
FILMED

8