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PROCEEDINGS

Conference on Energy Research at Historically Black Universities

June 17–19, 1980

Sheraton Patriot Inn
Williamsburg, Virginia

sponsored by

University of California,
Lawrence Berkeley Laboratory
and
Department of Energy

Prepared for the U.S. Department of Energy under Contract W-7405-ENG-48

DISCLAIMER

PROCEEDINGS

OF THE

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PROGRAM DIRECTOR'S SUMMARY

Harold Wilson
Lawrence Berkeley Laboratory
University of California
Berkeley, California

Beginning in October of 1978, the University of California Lawrence Berkeley Laboratory began a sustained program seeking to increase the involvement and productivity of a number of able scientists and researchers in minority institutions who have the capability of contributing to scientific programs which meet the Department of Energy's mission; and to assist in the establishment at a number of Historically Black Universities and Colleges the required infrastructure and financial support necessary to develop major research projects.

The objectives are as follows:

(1) To establish supportive relationships between the Department of Energy financed National Laboratories and Historically Black University research programs.

(2) To assist Historically Black Universities and Colleges in developing an understanding of their existing research capabilities as it relates to the research needs of the Department of Energy.

The Williamsburg meeting, and subsequent activities leading up to the publishing of the proceedings (early December, 1980) represents a continuity of effort focused on achieving the above stated objectives. As a direct consequence of this meeting and follow-up discussions with Mr. Richard Stephens, Director of Institutional Programs, Office

of Energy Research, Department of Energy, a representative group of Black college presidents were invited by the Secretary of the Department of Energy, Mr. Charles Duncan, to Washington D.C. on October 27, 1980 to discuss the Historically Black Institutions' increased involvement in DOE programs. The plan presented to the Secretary represents specific initiatives which provide directions to DOE for achieving our previously stated objectives (see plan in Appendix A).

These efforts represent an unprecedented attempt to provide scientists at Black institutions the means to participate in and direct major research projects and programs. I feel that if the Department of Energy responds positively to the Black College Presidents' initiatives, then the program began by the University of California Lawrence Berkeley Laboratory in October, 1978, will finally have its first real victory. The task before us once the initial funding is achieved is to move for sustained support, and to strengthen the capability of the Historically Black Colleges toward being competitive for resources outside the realm of set-asides.

OPENING REMARKS

Dr. William Lester
Conference Chairman
Lawrence Berkeley Laboratory
University of California
Berkeley, California

In order to meet the requirements of the nation's energy needs and the equally important national policy of full participation of all of its citizens, it is a necessity that the lack of participation of all our minority populations be addressed. In a 1975 National Science Foundation Study, it was reported that of the 207,000 Ph.D. recepients in science and engineering employed in the labor force, only 0.8% were native born blacks, 0.6% were latins, and 0.4% were Native Americans. The percentage of these minority scientists do not substantially improve when compared to the total scientific labor force at all levels. In the total labor force, there are 1.3 million people employed as scientists and engineers and of this number, only 1.6% came from black, hispanic, and Native American populations.

The Historically Black Universities and Colleges offer a rich resource to provide the required institutional framework to address the problem of minority underrepresentation in scientific and engineering fields and their participation in the nation's energy research programs. In a recent National Academy of Sciences study, it is reported that 22 of the top 25 institutions that produced black baccalaureate graduates in the sciences who later obtained Ph.D. degrees, were Historically Black Institutions. A similar analysis of data from the Engineering Manpower Commission shows that 23% of the blacks

receiving bachelor degrees in engineering were from 5% of the engineering departments in the country, and these are engineering departments of Historically Black Institutions.

More than several of the Historically Black Institutions have contributed to the research efforts of the nation and more specifically to the research goals of a number of agencies of the federal government including NASA, the Department of Energy, the National Science Foundation, and the National Institutes of Mental Health. On the other hand, the participation of black universities in research funded by federal agencies has been sufficient to build the infrastructure or strong research programs that could significantly increase minority participation. For example, of the $316,000 spent in 1978 by the Department of Energy in its grant programs for the support of research training, only 0.2% of the funds went to Historically Black Universities. Clearly the strengthening of the ability of these institutions to participate in research programs and parenthetically the strengthening of their graduate and undergraduate educational programs by the infusion of major research programs is an imperative, if the issue of participation is to have a ready and realistic solution.

In light of this background, and President Carter's executive memorandum of January, 1979 calling upon federal agency heads to insure that Historically Black Institutions participate fully in their programs, it is easy to understand why in August 1979 a group of black scientists: Professor Charlie Harper, Department of Physics,

California State University, Hayward; Professor William M. Jackson, Department of Chemistry, Howard University; Professor Harry L. Morrison, Department of Physics, University of California, Berkeley, and myself came together at the suggestion of Mr. Harold Wilson, Personnel Director at Lawrence Berkeley Laboratory, to discuss these matters. The outgrowth of these discussions was the preparation of a document entitled "A Proposal for a Response to the Presidential Memorandum on Support for Historically Black Institutions by the Department of Energy." This proposal was submitted to the Department of Energy by Dr. Andrew Sessler, Director of Lawrence Berkeley Laboratory.

On December 20, 1979, Department of Energy officials including Undersecretary, Dr. John Deutch; Deputy Director, Office of Energy Research, Dr. M. Douglass Pewitt; Director, Division of Institutional Programs, Dr. Richard Stephens, and Office of University Relations liaison, Dr. William Jones, met with Mr. Wilson and representatives from Howard University, Atlanta University, Jackson State University, and Texas Southern University to discuss this proposal. Dr. Deutch indicated support for the concept and directed Drs. Stewart and Stephens to work with the group in further developing the concept. Dr. Prewitt indicated that the earliest a request for support could be included in the DOE budget would be fiscal year 1982. Dr. Stephens requested that the group meet to define the concept further and develop a mechanism for including support for it in the FY 82 budget.

On January 15, 1980, the four universities and Lawrence Berkeley Laboratory representatives met with DOE staff members Stephens, Jones, Bowden, and May and the Argonne National Laboratory Director, Dr. Walter Massey, to discuss appropriate further steps to secure support from DOE for energy related research efforts at these institutions. This meeting established the basic groundwork for the preparation of a draft document to be submitted for consideration for the DOE FY 82 budget.

On February 7-9, 1980, representatives of the four universities, together with Mr. Ben Pope, Head of the Affirmative Action Department of Lawrence Berkeley Laboratory, and Mr. Wilson met in Jackson, Mississippi to draft the document for FY 82 budget. On March 11, 1980, the four university representatives met with DOE staff including Ms. Toni Joseph, Associate Director, Field Operations Management, Mr. Stephens and Dr. Jones. At this meeting Dr. Stephens agreed to take responsibility for modifying the document for inclusion in DOE's FY 82 budget submission. On March 24, 1980, Mr. Wilson and Dr. James Perkins, seated to my right, Head, Department of Chemistry, Jackson State University, met with Mr. Stephens and Mr. Jones to seek support for a conference on energy research at Historically Black Institutions.

It had become clear that if the Historically Black Universities are to be prepared to submit proposals to DOE for the FY 82 budget, it is imperative that they gain total awareness of how their research capabilities can best impact DOE's research needs. As a step to reach

this end, it was agreed to convene a conference of those Historically Black Institutions that have demonstrated a research capability meeting the following criteria:

- the capability of developing specific, scientific, technological and educational proposals related to specific DOE missions that will withstand the scrutiny of DOE's review system;
- the availability of faculty and research staff who have demonstrated the capability to conduct basic and applied research;
- an institutional commitment to support DOE-related research and development by providing release time for research and space;
- a willingness to support the reconfiguration and expansion of existing and planned administrative and support services for major basic research efforts;
- a plan to establish collaborative research programs on a reciprocal basis with national government-owned contract-operated laboratories, industries, as well as state and local organizations where appropriate;
- an existing or developing capacity to offer doctoral programs in the sciences and engineering and currently offering at least a master's degree in three or more areas of science.

This meeting will focus on the types of energy research in progress or planned in the Historically Black Institutions. There are resource persons from major DOE research projects, private industry, and government here to provide the opportunity for an interchange of ideas, discuss problems, and interact with other scientists and administrators having major responsibilities for DOE related research efforts. Briefly, the objectives of this meeting are to present and discuss:

- significant research and development in Historically Black Institutions, current and past,

- areas that show potential for inter-institutional collaboration and the sharing of facilities,

- existing capabilities to sustain funded research activities and future potential for expansion and enhancement,

- appropriate arrangements for maximum interaction with industry and government agencies.

This is a listing of our objectives and where we want to go. I think we can get there and move far along the line to these ends in the next funding.

MEETING SUMMARY AND RECOMMENDATION

Dr. James Perkins
Program Consultant
Jackson State University
Jackson, Mississippi

Sixty participants from 22 institutions, 19 of which were Historically Black Institutions, attended the Williamburg meeting. Fifty of these participants took an active part in small group meetings in the various energy research areas. Five national laboratories, the Department of Energy, and two majority institutions provided resource persons for each of the small group meetings. The detailed composition of these groups appears in the appendix.

The most important outcome of the meeting was the resulting benefits derived from interaction of scientists from Historically Black Institutions with scientists from industry, majority institutions, and national laboratories. The three days of intensive meetings provided an opportunity for meaningful exchange and has resulted in an assessment of the energy related research programs on-going or planned at Historically Black Institutions.

The meeting provided three examples of a successful interface between industry and a minority institution to perform energy related research. A program at North Carolina A&T University serves as an example of a major industry interfacing with a Historically Black College's research potentials.

> Beginning in about February, 1977, Rockwell International Corp. provided approximately a million dollars to develop a solid-state electronics program at this university. Rockwell has since been joined by NASA (Langley) in supporting the effort. Although

Rockwell had hoped to establish a Ph.D. program, only M.S. degrees in the relevant disciplines (Engineering, Electrical Engineering) are presently offered.

Stefanakos feels that the program has been quite successful in terms of publication (about 8 papers/reports) and continued funding. Other indications are the increasing diversity of cooperative work (Sandia, Varian, e.g.) and divergence of the research from that originally funded by Rockwell. The program has also provided good public relation for Rockwell.

The Fluidized Bed Combustion project of Howard University has been able to attract funding from the Department of Energy and represents the effort of a minority owned industrial firm and a minority institution. The objective of the research and development program is to develop the concept of multi-stage fluid bed combustion.

The joint venture between AMAF Industries and Atlanta University represents a third example of a successful venture between a minority institution and a minority owned business. This project is funded by the Nuclear Waste Storage Program Office of the Department of Energy.

The small groups (fossil fuel, solar, conservation, environmental impact, and policy research) brought together for the first time scientists from minority institutions with common research interests (energy related) to share their ideas, problems, and discuss possiblities of collaborative research efforts. The composition of these groups - coordinator (scientist from Historically Black Institutions), resource person(s) (most from Ph.D. grant institutions), industry (national laboratories), participant (scientist from Historically Black Institutions) allowed for meaningful inputs from various perspectives toward improving the research projects.

The resource persons, most of whom also served as invited speakers for open sessions, were chosen on the basis of: (a) demonstrated expertise in one or more of the areas represented by the small groups, (b) the potential resource that their affiliated institution could provide to this program, (c) individual willingness to participate in efforts like this meeting and the various followup activities which may result. The resource persons provided candid assessments of the various projects in the small group meetings. Hopefully, these inputs will impact on the directions and quality of the individual projects.

The majority of the on-going or planned energy related research projects in Historically Black Colleges are in the solar area. Projects in biomass, photovoltaics, solar thermal, and wind make up the bulk of these. The projects range from the impressive solar cell testing facility in photovoltaics at North Carolina A&T University and the biomass project at Morehouse College to produce methane from algae to the proposed elaborate wind project at Tuskegee Institute.

However, the activity at the Historically Black Colleges is in no way restricted to solar energy research. The section containing abstracts of the work on-going in the participating institutions demonstrate clearly the diverse, and in most cases sophisticated, nature of the research efforts. Without exception, the consensus opinion of the resource persons was to characterize the projects or programs as quality ones, deserving of continued support.

General Recommendations and Observations

(1) The Department of Energy should appropriate funds to select Historically Black Universities and Colleges to develop specific

energy interdisciplinary programs which will meet the programmatic needs of the Department of Energy. An example might be developing solar programs or to convert coal to liquid and gaseous fuels. The grants would be to define and identify projects rather than carry out the actual research. The funding cycle would be over a 3 year period.

(2) Funds should be appropriated for an outreach program in Consumer Affairs/Conservation which would grow incrementally over a five year period. An example of which might be carried out by an Historically Black College would be an appropriation to set up a Consumer and conservation information service within the region of a school that is primarily an undergraduate organization.

(3) Increase the budget of the Division of Institutional Programs to provide additional funding for individual research proposals awarded to scientists from Historically Black Colleges.

(4) Develop a cooperative program between the National Laboratories and Historically Black Colleges. Identify research projects in which Historically Black Colleges could be involved in joint research or provide research services for specific segments.

(5) Develop the same program as with national laboratories involving Historically Black Colleges and major private corporation subcontractors.

SMALL GROUP MEETINGS

Objectives

The objectives of the small group meetings were to:

1. Discuss the significant Research and Development current and past occurring in these institutions.

2. Discuss the areas that show potential for inter-institutional collaboration and the sharing of facilities.

3. Discuss existing capabilities to sustain planned or funded research activities and "future potential" for expansion or enhancement.

4. Discuss "appropriate" arrangements for maximum interactions with National Laboratories, other universities and private industry.

5. Discuss the mechanisms for obtaining support through the Department of Energy.

The abstracts of the projects or programs from the small group meetings in the areas of fossil fuel, solar, environmental impact, conservation, and policy are presented in the following papers.

SOLAR ENERGY RESEARCH GROUP

SOLAR ENERGY RESEARCH GROUP

DESCRIPTION OF PROJECTS

The Solar Energy small group was composed of participants providing contributions in the areas of photovoltaics, biomass, solar thermal, and wind.

SOLAR ENERGY RESEARCH PARTICIPANTS

Coordinator

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Specific Area of Research: Biomass

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Specific Area of Research: Photovoltaics

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Specific Area of Research: Photovoltaics

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SOLAR ENERGY RESEARCH GROUP

ABSTRACTS

A. Photovolatics

B. Biomass

C. Wind and Solar Thermal

A. Photovoltaics Abstracts

Solar Energy Research at Jackson State University

Dr. Hiroyasu Tachikawa
Department of Chemistry
Jackson State University
Jackson, Mississippi

Two lines of research related to solar energy conversion are currently carried out at Jackson State University. Those are (1) studies of energy collection and charge transfer processes in thin film systems, and (2) solar energy utilization by photosensitized electrode processes at semiconductor electrodes. The transport of electron and exciton movement in bulk and interfacial region of these systems are studied by using electrochemical and luminescence properties of the systems. Typical systems studied for the organic thin film photocells are either fluoranthane (FA) or perylene molecules dispersed in polystyrene (PS) matrices. Thin polymer films (200 nm - m) are formed on 1 mm thick glass plate (1"x1"). For the energy transfer reaction at the interface of the films, submonolayer perylene film is vacuum deposited on FA-PS film. Tetrabromo-o-benzoquinone (TBBQ) thin film is formed on either perylene-PS or FA-PS film in order to study the charge transfer reaction at the interface of the films. Time resolved resonance Raman (TR^3) spectroscopy is used for the studies of exciton movement and the formation of charge seperated species in organic thin film photocell systems.

Thin film phthalocyanines electrode has been examined as a semiconductor electrode for photoelectrochemical studies. The structural information of thin film phthalocyanines electrodes is examined by TR_3.

CHEMICALLY MEDIATED OPTICAL ENERGY CONVERSION

Dr. Arthur B. Ellis
Department of Chemistry
University of Wisconsin
Madison, Wisconsin

We presently are working on two projects which emphasize aspects of optical (solar) energy conversion. The first involves luminescent photoelectrochemical cells and is funded by the Office of Naval Research (ONR); the Solar Energy Research Institute (SERI) supports a second project concerned with the synthesis and electro-optical properties of cadmium sulfide/cuprous sulfide (Cds/Cu_2s) hetero-junctions. These systems exemplify "wet" and "dry" approaches to solar energy conversion, respectively.

PHOTOCHEMICAL SOLAR ENERGY CONVERSION

Dr. James Reed
Department of Chemistry
Atlanta University
Atlanta, Georgia

Our investigation in the area of photochemical solar energy conversion is predicated on the assumption that transition metals can be used as effective photocatalysts which an be used in solar energy conversion. To date few such conversions have been reported. Our group has been interested in the photodecomposition of metal azides to yield metal nitrenes. Several nitrene producing systems, which show potential of being photocatalytic, have been studied in detail. The solution photochemistry is well understood, and the quantum efficiencies as well as mechanistic information have been obtained. Polymer supported metal complexes are also being examined.

The oxidation-reduction photochemistry of metal complexes has potential in solar energy conversion as sources of exergonic redox couples or a source of reducing power. Several metal complexes have been studied in order to obtain detailed information about important photochemical and photophysical processes. Of the many processes of interest are: the fate of radicals produced during photolysis, the nature of the photoactive state (particularly its spin multiplicity), energy transfer and the correlation of quantum efficiency to ligand structure and choice of metal. Our investigations have been concerned with complexes of cobalt (III) and iron (II).

SOLAR CELL EVALUATION AND TESTING

Dr. E. K. Stefanakos and Dr. E. J. Collis
Department of Electrical Engineering
North Carolina A&T State University
Greensboro, North Carolina

It is the purpose of the proposed research to perform indoor (simulated sunlight) and outdoor (natural sunlight) measurements on solar cells supplied by Sandia Laboratories by means of the following:

(a) Carry out performance characterization measurements of Si and GaAs solar cells in order to determine the solar cell performance as a function of temperature (25°C to 150°C) and illumination (1 to 500 suns). The parameters to be measured include (i) current voltage characteristics, (ii) fill factor and (iii) conversion efficiency.

(b) Perform characterization measurements aimed at evaluating the stability of Si and GaAs solar cells. In particular, evaluate the effect of temperature cycling (-150°C to 200°C) on solar cell performance.

Current Status: Completed: Computerized systems for determining spectral photoresponse, I-V and conversion efficiency of solar cells in the 6° to 80°C temperature range.

In progress: Systems for testing solar cells under temperature cycling and sunlight concentration conditions.

An apparatus is being developed that will allow temperature variations and temperature cycling of solar cells under biased and illuminated conditions. This test unit used electric resistance heating and liquid nitrogen for cooling. Two quartz windows with N_2 circulating between them are used to prevent fogging.

The sunlight concentration solar cell test facility is almost complete. It is expected that testing of solar cells will take place within a month. This facility is located on the roof of the Electrical Engineering Building.

DEVELOPMENT OF POLYCRYSTALLINE GaAs SOLAR CELLS

Dr. E. K. Stefanakos, Dr. W. J. Collis, and Dr. J. W. McPherson
Department of Electrical Engineering
North Carolina A&T State University
Greensboro, North Carolina

The objective of the overall program has been the development of thin film polycrystalline solar cells with efficiency greater than 10%. Considerable emphasis has been placed on the physical mechanisms by which grain boundaries limit solar cell performance.

The focus of the research at North Carolina A&T State University has been on (a) the development of current controlled LPE for the growth of thin polycrystalline GaAs layers on low cost substrates, (b) the development of a model of grain boundaries in polycrystalline GaAs growth on low cost substrates; and (c) the investigation of impurity introduction into grain boundaries to neutralize the adverse grain boundary effects.

Current controlled LPE (CCLPE) was used to grow GaAs on n^+, p^+, and semi-insulating GaAs substrates. Optical and electrical characterizations (Nomarski contrast, SEM, Cathodoluminescence, C-V and Hall measurements) have shown that in some samples the epilayer is discontinuous at certain grain boundaries.[1] The growth of GaAs, by the CCLPE technique, on graphite and molybdenum substrates was not successful. Only small randomly occuring GaAs crystallites were observed on mechanically polished graphite substrates. Polycrystalline layers were deposited from Ga melts onto chemically etched Mo substrates. However, X-ray microprobe analysis showed these layers

to be recrystallized Mo or Mo-Ga compounds. Tin melts saturated with GaAs at 650°C were used to grow GaAs on electropolished (5% H_2SO_4 - 95% methanol) Mo substrates by LPE. These growths resulted in only a few scattered dentrites. In conclusion, LPE and CCLPE growth of polycrystalline GaAs on graphite and Mo does not yield satisfactory semiconductor layers for material characterization and/or device fabrication.[2]

The space charging properties of grain boundaries in GaAs were modelled by using an extended Read Dislocation model. Model calculations for medium to high angle grain boundaries showed that: (1) the core-site occupational probability for dislocation at the grain boundary is at least an order of magnitude lower than would be expected on the basis of the simple Read model; (2) due to strong core-core interaction of the dislocations, the depletion width W decreases with an increase of tilt angle θ; and (3) W is approximately independent of θ in highly doped ($N_D = 10^{17}$ cm^{-3}) material. The model predictions were compared with experimentally obtained results on the depletion widths of grain boundaries in GaAs.[3,4]

The zero biased band-bending properties of f-b interfaces showing pronounced rectifying characteristics in polycrystalline GaAs were investigated experimentally and theoretically.[5,6] A strongly rectifying g-b represents a potential barrier to the majority carrier leading to a large g-b resistance R_b. R_b for individual g-b s were determined by passing a constant current normal to the g-b and monitoring the voltage drop associated with the thermionic current.

A plot of k_B $n(R_bT)$ versus (1/T) gives a straight line whose slope is equated to an activated energy which is equal to the band bending b at T=0. The observed b decreased from a value of 1 eV at a donar density $N_D=4.5x10^{15}$ cm^{-3} to 0.19 eV at $N_D=5x10^{17}$ cm^{-3}. Furthermore, in agreement with theory, it was found that b was approximately temperature independent from 300-400 K.

Impurity diffusion experiments were carried out in order to neutralize (passivate) the adverse grain boundary effects. In the diffusion process, a small amount of K was allowed to diffuse for 75 minutes into a HaAs sample placed in an evacuated ampoule maintained at a temperature of 140°C. From the I-V characteristics and grain boundary resistance (R_b) measurements (before and after passivation), it was determined that the g-b resistance decreased and the strong rectifying characteristics diminished after the introduction of K into the g-b via vapor phase diffusion.

In the next three months, the research work will concentrate on the investigation of the introduction of monovalent and divalent elements (Na, K, Ca, and Ba) by diffusion with CVD growth thin film polycrystalline GaAs. The diffused material will be electrically characterized using Schottky barrier C-V, EBIC, and cathodoluminescence techniques.

References

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2. E. K. Stefanakos, et. al., "Development of High Efficiency Polycrystalline GaAs Solar Cells," quarterly reports to S.E.R.I. for Contract No. XS-9-8032-1, periods May 1 to July 31, 1979, and August 1 to October 31, 1979.

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4. E. K. Stefanakos, et. al., "Development of High Efficiency Polycrystalline GaAs Solar Cells," quarterly report to S.E.R.I. for Contract No. XS-9-8032-1, period November 1, 1979 to January 31, 1980.

5. J. W. McPherson, et. al., "Theoretical Analysis of the Band-Bending Properties of Grain Boundaries in GaAs," Southeastern Sectional Meeting of the American Physical Society, November, 1979.

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B. Biomass Abstracts

CATALYTIC CONVERSION OF BIOMASS TO USEFUL FUELS

Dr. Malcolm B. Polk
Department of Chemistry
Atlanta University
Atlanta, Georgia

This project focuses on selection and bench-scale testing of a variety of catalysts for conversion of biomass to useful fuels through increase of yields in gasification and liquification processes. Bench-scale studies using a tube furnace and analysis of products using a gas chromatograph are planned using a variety of inorganic catalysts.

KINETICS OF WOODY BIOMASS GASIFICATION

Dr. Kofi Bota
Department of Chemistry
Atlanta University
Atlanta, Georgia

The project is an investigation of the kinetics of biomass gasification by type and mode of operation of gasifiers. It includes a study of the applicability of previous work on coal gasification to biomass gasification. Gasification kinetics depends on a variety of parameters, some of which have not been adequately treated before. The primary parameters will be selected and modeled, and data from experimental work throughout the country will be collected so that results can be tested against bench-scale data.

H_2, N_2, and CH_4 PRODUCTION OF BIO-SOLAR SYSTEMS USING BLUE-GREEN ALGAE

Dr. Judith Bender
Department of Biology
Morehouse College
Atlanta, Georgia

The current project involves the natural selection of temperature tolerant strains of blue green algae to improve the overall production of algae strains toward a cost-effect level of efficiency. Growth rates of four thermophilic strains are being compared and selection for additional thermophiles will continue. The longer range goals are to develop a battery of strains that will form a cost effective multi-purpose system for wastewater treatment, fertilizer recycling, and direct energy production. Additional natural selection and selection via genetic manipulation will be done to maximize temperature tolerance, ease of harvesting, growth rate, and high H_2 production potential.

BLUE GREEN ALGAE ARE POTENTIAL ENERGY PRODUCERS

Dr. Judith Bender
Department of Biology
Morehouse College
Atlanta, Georgia

Dr. Thomas Norris
School of Medicine
Morehouse College
Atlanta, Georgia

The cyanobacteria (blue-green algae) are procaryotic organisms which derive their carbon-containing compounds and their energy from plant-like photosynthesis and which, in environments lacking NO_3^- and NH_4^+, derive their nitrogen-containing compounds from N_2 fixation. Environments containing NO_3^- and NH_4^+, derive their nitrogen-containing compounds from N_2 fixation. Environments containing NO_3^- and NH_4^+ (and perhaps other nitrogen-containing compounds) cause a reduction in nitrogen fixation with no reduction in growth rate. Associated partly with the nitrogen-fixing process and partly with other enzymology is the ability of the cyanobacteria to produce hydrogen gas. The cyanobacteria are thus of potential significance as energy producers via the biosolar production of hydrogen fuel, the bisolar production of nitrogen containing fertilizer, the biosolar production of nitrogen containing fertilizer, the biosolar production of animal feed, the biosolar purification (removal of nitrates and phosphates) of wastewater and the biosolar production of biomass.

Work in our laboratory is presently concerned with strain selection and adaptation to maximize growth and biomass and/or fuel

production. It is our thesis that considerable basic biochemistry and genetics remain to be done in conjunction with these organisms in order to maximize their potential energy producers.

A fundamental problem in solar thermal energy conversion has been the difficulty of storing large amounts of sensible heat. One solution to the storage problem is the conversion of the solar thermal energy to a fuel. Although straightforward in principle, conversion is beset by optical, materials, chemical, mechanical, and thermodynamic problems. Our laboratory, in conjunction with the Georgia Institute of Technology Experimental Station, is investigating the splitting of water by cyclic processes to produce hydrogen and oxygen. Direct water splitting require very high temperatures, thus direct solar thermal water splitting is not practical. Our laboratory is concerned with the examination of possible cycles for splitting water at lower temperatures.

AQUATIC PLANT BIOMASS IN PRODUCTION OF FERMENTATION ALCOHOL AND IN WASTEWATER RECOVERY

Dr. Charles Rhyne
Department of Biology
Jackson State University
Jackson, Mississippi

The dual purpose of this proposed research is: (1) Production of fermentation of fuel ethanol from starch and starch-like photosynthetic storage products of selected algae and aquatic vascular plants and (2) Recovery of reusable water through removal of inorganic nutrients from municipal wastewater. This would be accomplished by the cultured plants during growth and bioconversion of starch to serve as substrate for the fuel alcohol production.

Bioconversion of algae and vascular plant material is a controversial subject, particularly when energy is the sole end product. However, an integrated, multi-use system may well be a viable approach when photosynthesis, wastewater and fermentation are involved. The investigators hope to show that appropriate plants grown in a relatively inexpensive by nutrient-rich media can produce a highly valuable, practical and renewable energy product while removing excess wastewater nutrients.

The objectives of this research are based on the selection of appropriate algae and aquatic vasculat plants relative to their ability to (a) grow quickly, (b) remove maximum amounts of nitrates, ammonia and phosphates present in municipal wastewater, (c) maximize the amount of their starch or starch-like reserve products.

BIOMASS ENERGY CONVERSION OF PRODUCTS INDIGENOUS TO GEORGIA AND THE SOUTHEAST

Dr. Joe Johnson
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It is proposed in this research project that we utilize a combination of fermentation processes using a variety of methane-producing organisms to produce biogasses, principally methane and carbon dioxide, to generate a cheap source of fuel from organic waste matter indigenous to the Southeast. In addition, we can utilize the process of pyrolysis followed by fermentation in order to further increase the yield of gasses from organic matter.

Essentially we will be performing anaerobic fermentation of peanut shell hull and waste wood left on the forest floor during timber operations as the primary sources of organic materials. It is estimated that waste wood left on the forest floor alone would produce 50% of Georgia's energy needs, with the exception of transportation.

The pyrolytic oils produced by the pyrolysis of wood bark, sawdust, and peanut hulls has been a continuing project developed jointly by the Georgia Institute of Technology and Atlanta University. They have determined that the pyrolytic oil has energy value but tends to undergo an increase in viscosity over a period of time which makes processing difficult.

We propose to utilize the pyrolytic oils as a source of biomass material for further conversion into methane since this material contains an extremely high content of organic matter. In a fermentation

process that would further increase its energy value, we will perform anaerobic fermentation of the pyrolytic oil utilizing well known methane producing organisms, either individually or in combination. Once we have demonstrated that the pyrolytic oils can be converted to methane, then we will proceed to utilize peanut hull and waste wood products without going through a pyrolytic process.

The rationale for utilizing pyrolytic oils initially is that we can get a homogeneous solution that would increase the efficiency of methane production. Once we have worked out the optimum condition for converting pyrolytic oils to methane, we will utilize those optimum conditions of fermentation on peanut hulls and waste wood.

UTILIZATION OF AGRICULTURAL WASTES FOR PRODUCTION OF ETHANOL

Dr. B. Singh
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Normal, Alabama

The project proposes to develop methods to utilize agricultural wastes, especially cottonseed hulls and peanut shells to produce ethanol. Initial steps will involve development of methods to break down cellulose to a usable form of substrates for chemical or biological digestion.

The process of ethanol production will consist of (a) preparatory step to separate fibrous (cellulose) from ono-fibrous (non-cellulosic) compounds. The non-cellulosic residues may include grains, fats, or other substrates for alcoholic fermentation. The fibrous residues will be first pre-treated to digest cellulose with acid, alkali, and sulfur dioxide gas or other solvents. (b) The altered cellulose will be digested by suitable micro-organisms and cellulose enzymes before alcoholic fermentation. The digester and fermentative unit will be specially designed to develop a prototype for pilot plants for a continuous process.

The first phase of the project will be devoted toward screening of a suitable method for cellulose modification, separation of fibrous and non-fibrous residues, the micro-organism and enzyme preparations. The second phase will be devoted toward development of a continuous process for ethanol production.

The project will provide an opportunity for two graduate and two undergraduate students to work with energy-related problems. The Department of Food, Science, and Technology at Alabama A&M will benefit through this project by developing capabilities in studies related to agricultural wastes utilization for production of usable forms of energy.

C. Wind and Solar Thermal Abstracts

RECOVERY OF ABOVE-GROUND WOODY BIOMASS USING OPERATIONAL MODIFICATION OF CONVENTIONAL HARVESTING SYSTEMS

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Modified conventional logging systems offer an economical means of recovering above-ground woody biomass to include production of energy wood products. This project is divided into three studies:

(1) Operational Modification of Conventional Longwood Harvesting Systems to include Energywood Products. Presented in this study are production and fuel consumption rates for whole tree harvesting systems using various equipment and techniques. An economic analysis of these same systems is also included.

(2) Woody Biomass Weight Prediction Equations. Forty-eight equations were developed for hardwood trees associated with the oak-hickory forest type in the Southern Appalachian region. Sawlog weight equations are also presented for hardwood species and species groups.

(3) Energy Efficiency of Harvesting Systems. Fuel Consumption rates for various types of logging equipment and systems are presented in this study.

ADVANCED SOLAR THERMAL STORAGE MEDIUM TEST DATA AND ANALYSIS

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The primary objective of this paper is to present a comparative study of the experimental data of heat transfer and heat storage characteristics of a solar thermal energy storage bed utilizing containerized water and/or phase change material (PCM) and rock/brick. This experimental investigation was initiated to find a new usable heat intensive solar thermal device other than rock storage and water tanks which have been the basic storage used thus far. To serve this need, four different kinds of soup cans filled with water were tested. These cans were stacked in a chamber in different arrangements - vertical, horizontal, and random. Air is used as a transfer medium for charging and discharge modes at three different mass flow rates and inlet air temperatures, respectively. These results were analyzed and compared, which show that a vertical stacking and medium size cans with Length/Diameter (L/D) ratio close to one have better average characteristics of heat transfer and pressure drop.

TWO NOVEL APPROACHES TO WIND AND SOLAR POWER GENERATION

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A hyperboloidal light structure proposed by Professor C.A.E. Uhlig of Tuskegee may deliver 60 KW of solar and wind generated power in a wind-turbine generator. A proof of concept design of 80 ft. dia. at base and 150 ft. high tower surrounded by a 30 ft. wide ring of mirrors to augment convective air stream from ground insolation, represents a low capital cost proposal capable of scaling up to 20 MVA capacity, potential unit cost can be less than $500/KVA.

A 'Skypost' project advanced by Dr. C.A.E. Uhlig of Tuskegee Institute, in 1972 offers a tethered wind energy power station utilizing high altitude (4,500 meters) jet stream winds. Superior wind power density and relative constancy and availability in many parts of continental U.S. make this an appealing concept. Eventual skypost design may involve a 500 m.dia., 100 m. thick disk filled with helium and delivering 4,000 MVA from 194 turbine-generators. Preliminary designs developed over the 8-years since original concept suggest a formal feasibility study should precede a smaller-scale prototype of about 10-20 MVA size.

DEVELOPMENT OF SOLAR COLLECTOR TEST FACILITY AND SOLAR RADIATION HANDBOOK FOR NORTH CAROLINA

Dr. D. E. Klett
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Greensboro, North Carolina

A facility for performance testing hydronic solar collectors has been established at North Carolina A&T State University under a Department of Energy grant (Grant No. DOE-ER-78-6-05-6057). Under the same grant a Solar Radiation Design Data Handbook for North Carolina was developed. The objectives of these two activities were:

(1) To promote the development and utilization of solar energy in North Carolina by (a) providing a facility to aid manufacturers with the development of solar equipment and (b) providing a data base of solar radiation data in a form readily usable by designers, architects, and engineers.

(2) To provide broad exposure of North Carolina A&T to the solar energy community within and without N.C., thereby broadening our opportunities to attract further extramural funding in the area of solar energy.

Both objectives have been achieved.

The collector test facility is capable of performance testing two liquid type solar collectors simultaneously to ASHRAE 93-77 standards. Two altazimuth mounts are equipped with pyranometers, turbine flow meters and platinum resistance thermometers for determining efficiency parameters. Data collection and reduction is computerized through an HP 1000 16 bit, 32k core mini computer.

The Radiation Handbook contains climatological data pertinent to solar design and insolation values for a multitude of tilt and azimuth angles for seven North Carolina locations. Also included are sun angle data and north wall insolation values useful in heating and cooling load calculations. The book was developed in an easily used format using a modified version of the Solar Insolation Model (SIM) developed for NASA at Martin Marietta Corporation. Plans call for the handbook to be distributed by the State Energy Division. It has already found wide usage through copies distributed to interested parties by the University.

A SOLAR AIR POWER PLANT

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The problem of how to transform the solar energy to any usable energy simply, economically, and effectively (without sophisticated parts and rusty pipes) is one of the remaining unsolved obstacles of using solar energy today.

By applying a new idea of "Chimney effect," this problem might be easily solved (Fig. 1).

The solar energy will be accumulated into an Energy Collector/ Dissipator (which is built inside the wind chimney), through the plastic convex lens (may be Fresnel lens, see Fig. 2) built on the wall of the wind chimney. The Energy Collector will be heated to hundreds of degrees of temperature. A strong wind updraft potential is created due to a big temperature difference between inside and outside of the wind chimney. A turbine generator which is mounted on the top of the chimney will be powered by this updraft strong wind. The solar energy of the whole plant will be accumulated into the wind chimney through the mirrors and concave mirror built on the ground and around the wall. These mirrors can be made of aluminum foils pasted on the wooden boards. Since the temperature difference between the inside and outside of the wind chimney is of main interest, in effect, this power plant will work equally well for all four seasons.

FOSSIL FUEL GROUP

FOSSIL FUEL GROUP

DESCRIPTION OF PROJECTS

The three research projects reported on by participants of the fossil fuel group represent the results of our efforts to identify all the fossil fuel research that is currently being carried out at minority institutions. The projects are in the areas of (1) Fluidized Bed Combustion of Coal, (2) Coal Liquefaction, and (3) Oil Shale Pyrolysis. The projects are all funded by the Department of Energy, and all are in areas of national interest.

FOSSIL FUEL GROUP PARTICIPANTS

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Specific Area of Research: Countercurrent Cascade Staged Fluid-Bed Combustion

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Specific Area of Research: Use of Lasers in Fossil Fuel Research; Diagnostics of Fossil Fuels

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Specific Area of Research: Experimental & Numerical Investigation of Laminar Methane-Air Diffusion Flames

Participants

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Specific Area of Research: Enhanced Oil Yield from Oil Shale

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FOSSIL FUEL GROUP
ABSTRACTS

FLUIDIZED BED COMBUSTION

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The Fluidized Bed Combustion Project represents a joint effort between a minority university and a minority-owned industrial firm, namely, Howard University and Energy and Environmental Engineering, Inc. The objective of the research and development program is to develop the concept of multistage fluid bed combustion.

Fluidized bed combustion (FBC) is currently the most promising technology for getting energy from coal. The basic features of FBC of coal are: the upward flow of combustion air that maintains fluidization of a bed of coal and limestone; combustion of coal at a temperature of 1500^{o} to $1600^{o}F$ with the release of sulfur as SO_2; capture of the released sulfur by limestone forming $CaSO_4$; removal of the heat released during combustion and the heat from the hot combustion gases by boiler tubes immersed in the bed and boiling tubes located above the bed, respectively. Current state-of-the-art FBC boilers are typically designed for single stage operation.

Multistage fluidized bed combustion involved countercurrent staged contacting of the reacting solids coal and limestone with combustion air and gaseous products of combustion. This process offers significant advantages over single-stage combustors in solving problems associated with combustion efficiency, fuel and limestone feeding, erosion control, and heat transfer efficiency; all of which effect the economics of FBC.

The research program involves data gathering and computer modeling. A mathematical model of steady state multistage cascade FBC phenomena is being developed to predict stage area and heat transfer surface area. A three-stage test unit is being constructed to study fluid-particle mechanics and to determine the local outside heat transfer coefficient for boiler tubes that are partially submerged in fluidized beds. Data obtained will be incorporated into the process computer model to evaluate combustor performance. Results will subsequently be used to design a small demonstration boiler.

ON THE STRUCTURE OF METHANE-AIR DIFFUSION FLAMES

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Recent U.S. Energy policy combined with environmental issues has prompted extensive research concerned with understanding the various subscale processes which govern the combustion of pulverized and synthetic fuels. The diffusion flame is the flame characteristic of burning coal particles and oil droplets and, as such, an understanding of diffusion flame structure and chemistry is essential to the understanding of those factors which influence carbon burnout and pollution formation during the combustion of coal and coal-derived fuels. To this end, experimental and theoretical studies have been combined in order to examine the structure of methane-air diffusion flames. An analysis of the experimental and predicted concentration and temperature profiles established in a confined axisymmetric, laminar methane-air diffusion flame is the primary concern of this paper.

THE COAL LIQUEFACTION STUDY

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The Coal Liquefaction Study is being carried out at Howard University. Efforts are being made to develop a process to hydrogenate coal and processed coals such as solvent refined coal (SRC) under mild conditions of temperature and pressure.

The current coal liquefaction processes under development in the United States are extensions and variations of the German Processes of World War II Vintage. These processes involve the use of coal-derived hydrogen donar solvents under process conditions of 800°-900°F and 1000-3000 psi hydrogen particle pressures. Lower product yields, use of severe process conditions (high pressures and temperatures), material and equipment design problems in the handling of process fluids including separation of solids from liquid products are some of the factors that are inhibiting early commericalization of the present coal liquefaction processes.

In the present study, salt melt of zinc chloride is used to disperse coal particles, to act as a medium for homogeneous catalysts and to act as a catalyst itself. Batch experiments are being conducted in a bench scale stirred tank reactor under moderate H_2 partial pressures (less than 25 psia) and a temperature of 375°F. Reaction mixtures using only $ZnCl_2$ as a catalyst and using $ZnCl_2$ in conjunction with hydrogen donar solvents such as tetralin and hydroquionone have been studied.

The results indicate that $ZnCl_2$ melt alone as a solvent medium and/or a catalyst is not successful for further liquefaction of SRC. However, addition of tetraline has resulted in increased oil yield during the SRC hydrogenation.

AN INVESTIGATION OF THE EFFECTS OF SELECTED DISPOSABLES ON POWDERED OIL SHALE IN A LABORATORY RETORT

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The objective of the study is to determine the effect of several disposable (waste) items on the oil obtained from oil shale when these items are intimately mixed with oil shale in the retorting process. Some of the disposables to be considered are (a) polystyrene, (b) polyethylene, (c) SBR rubber (from tire carcasses), (d) cardboard boxes and (e) dried grass. Ultimately, synthetic mixtures of these and finally compacted garbage will be retorted with oil shale and these oils characterized. Oil yield will be compared for altered (shale plus disposable) and unaltered (shale alone) oil shale samples. Infrared, gas chromatographic, nuclear magnetic resonance, and mass spectrometric analyses will be run on shale oil. The data collected from this first phase of a three-phase research program will serve as the basis for the design and construction of a pilot scale retort, which will be the second phase. The third phase will be a feasibility and modeling study to determine the logistics of commercial operation.

The overall goal for the three-phase project is to identify certain disposable (waste) substances which will enhance oil yield in the oil shale retorting process without seriously altering the nature of the oils produced. Such a process could (1) conceivably reduce the overall cost of producing oil shale to the point where it would favorably compete with fossil oil and (2) allow one to "tailor" the oils produced for specific uses.

CONSERVATION RESEARCH GROUP

CONSERVATION RESEARCH GROUP

Description of Projects

The five research programs reported in this section range from a summer workshop on energy conservation for high school students, funded by the Department of Energy, to an investigation of the use of industrial waste heat for the greenhouse production of bedding plants and foilage plants conducted at Fort Valley College, Fort Valley, Georgia. Professor Goswani at North Carolina A & T presents an abstract on a solar energy and energy conservation research and demonstration project, and Professor Dybczak at Tuskegee Institute, Tuskegee, Alabama describes his project on energy conservation through efficiency and management. Dr. Henderson reports on a energy conservation program targeted at developing a model for educating low income familes.

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CONSERVATION RESEARCH GROUP

ABSTRACTS

ENERGY CONSERVATION THROUGH EFFICIENCY AND MANAGEMENT

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A methodology has emerged to improve energy efficiency of a medium-size campus physical plant from a comprehensive energy conservation program at Tuskegee. Steps involved were: calculation of heating and cooling loads of major buildings, analysis of energy availability (gas, oil, electricity), unit cost and alternatives, actual usage, and detailed measurement and adjustments of principal units. Boiler tests included orsal flue gas analysis, temperatures, combustion efficiencies, and computer generated potential savings. Following indicated corrective adjustments, much improved performance was documented. Preliminary savings in operation over the last 12 months exceeded $135,000 on a $900,000 gas utility bill alone. Performance tests of chillers are in progress, and energy management (including load staggering) is being generated for better campus energy efficiency, lower unit cost, and greater savings. Final results are to be disseminated to sister institutions and interested parties.

ENERGY SYSTEMS FOR LOW INCOME GROUPS

Dr. Chinella Henderson
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In Alabama, the Alabama A&M University, under the auspices of the Cooperative Extension Service, operates the EES outreach program for low-income groups. The program is staffed by a full-time energy conservation specialist and an assistant trained in home economics. In addition, the program uses selected low-income families as volunteers to help deliver services.

In general, the target audience for this program consists of all of the low income families in the state--approximately 850,000 persons. These families are predominantly black and reside, for the most part, in rural areas. Specifically, however, the program focuses on 50 "model families" that initially receive program service and then serve as outreach agents within their own communities.

This program makes energy conservation information available to low-income persons through the use of fact sheets, monthly newsletters, group lectures, slide shows, demonstrations in meetings and workshops, and mass media. Through a home audit, program staff provide personalized assistance to model families. In addition, families receive direct assistance from energy conservation specialists on energy conservation methods using low-cost and easily obtainable materials found around the house, e.g., plastic storage bags used for insulating windows from the inside and old bicycle tires to insulate water pipes. Families are motivated to adapt feasible

ways to minimize the loss of energy in their homes and benefit from information on how to save energy when cooking, laundering, driving, and gardening. These services demonstrate that individuals can live better and less expensively, saving energy as a consequence.

This low-income program is designed to provide services to model low-income families who will then set up an energy conservation workshop for their neighbors. It is hoped that through these workshops, the model families can convey what they have learned and can influence their neighbors to adopt energy conservation techniques. In working with the model families, the program has realized the significance of carefully selecting model families. Families who have already established themselves as community leaders were found to be the most successful in carrying out the duties of a model family. Thus, the program is now focusing on families who are well respected and able to influence others in the community.

SUMMER WORKSHOP ON ENERGY CONSERVATION FOR HIGH SCHOOL TEACHERS

Dr. Jerry R. Shipman
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Lawson State Community College in Birmingham, Alabama, in collaboration with Alabama A&M University, has obtained funds from the Department of Energy for a three-week summer workshop for 35 high school teachers in the area of energy conservation. The workshop took place on the campus of Lawson State from July 7 through July 25, 1980. Lecturers for the workshop were members of the Energy Task Force at Alabama A&M University in Huntsville and one member from the Lawson State science department.

The need for such a workshop is great in the Birmingham area. No high school teacher in the Birmingham or Jefferson county area is presently teaching a unit on energy conservation to any of the approximately 64,500 high school students. The directors of inservice for the Birmingham and Jefferson County Boards of Education expect the faculty members in attendance from their schools to: (1) serve as an energy expert in his/her school; (2) develop during the workshop and teach during the 1980-81 year an energy unit; and (3) enlist and lead high school students in Energy Conservation Clubs.

Participants will receive 3 hours of graduate credit at Alabama A&M University for their three weeks of intensive instruction, experimentation, and participation in demonstrations, films, field trips, and module development on Energy Conservation.

POTENTIAL BENEFICIAL USE OF INDUSTRIAL WASTE HEAT FOR GREENHOUSE PRODUCTION OF BEDDING PLANTS, CUT FLOWERS, AND FOLIAGE PLANTS

Dr. Isaac J. Crumbly
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Fort Valley, Georgia

This research project investigated the potential beneficial use of industrial waste heat for the greenhouse production of bedding plants and foilage plants.

The research facilities consisted of two plastic covered quonset greenhouses with dimensions of 30 feet by 72 feet. The plastic covering for each greenhouse consisted of a double layer of Monsanto 602-6-mil polyethylene plastic. One greenhouse was not modified and served as the control facility; it was heated and cooled in a conventional manner. The second greenhouse was modified and was heated and cooled by using warm water heated to simulate the temperature of effluent water coming from power generating plants.

Cultivars of the following 10 leading ornamental bedding plants were grown in each greenhouse during the winter and spring of 1979: Begonia, browallis, coelus, geranium, impatiens, marigold, pansy, salvia, and verbena. Tomatoes and peppers were grown as vegetable bedding plants. Cultivars of begonia, browallia, impatiens, marigold, pansy, salvia, and verbena showed no statistically significant difference in growth rate between the two types of greenhouses. Cultivars of coleus, geranium, tomatoes showed a statistically significant better growth rate when grown in the conventional greenhouse, whereas petunias showed a statistically significantly better growth rate when grown in the waste heat research greenhouse.

Ardisia humilis, Asparagua meyerii, Begonia caribbean mix, Dizyotheca elegantissima, Hypoestes songuinolenta, Philodendron pertussum. schefflera compacts, and Syngonium podophyllum were the species and cultivars of foliage plants selected to be grown in each greenhouse during the Summer of 1979. Syngonium podophyllum and Philodendron pertussum showed a statistically significant better growth rate when grown in the waste heat research greenhouse over those grown in the conventional greenhouse. Although the growth rate was not statistically significant, all other species of foliage plants with the exception of Ardisis humilis and Hypoestes sanguinolenta.

In regards to survival among the bedding plants, only cultivars of browallia and coleus showed a statistically significant better percent survival when grown in the conventional greenhouse. No significant different in survivability was noted among foliage plants grown in either greenhouse.

With a night time temperature setting of 15.6% ($60^{o}F$) and using water heated to $21.8^{o}C$ ($71.2^{o}F$) during the month of February, 1979, the waste heat research greenhouse maintained an average of $12.0^{o}C$ ($53.6^{o}F$) for a low night time temperature. This was $2.1^{o}C$ ($3.8^{o}F$) below the average low night time temperature maintained by the conventional greenhouse. The cooling in the waste heated research greenhouse was comparable to the cooling in the conventional greenhouse.

Economic data indicated that by utilizing waste heat for greenhouse plant production, a greenhouse operator can expect to save $11,470 to $33,790/acre ($28,330 to $83,461/hectare) over the use of natural gas and #2 fuel oil, respectively.

SOLAR ENERGY AND ENERGY CONSERVATION RESEARCH AND DEMONSTRATION PROGRAM AT NORTH CAROLINA A&T STATE UNIVERSITY

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North Carolina A&T State University is strongly committed to (a) research and development, and (b) demonstration of solar energy and energy conservation. This is evidenced from the projects undertaken by faculty and students and the development of special energy courses for both undergraduate and graduate students. My involvement has been in both the research and demonstration programs. In the past three years, I have been involved in the following research:

1. "Model Solar Home for Demonstration and Consumer Studies" Funded by North Carolina Energy Institute.
2. "Solar Collector Test Facility and Solar Radiation Design Handbook for North Carolina" Funded by Department of Energy.
3. "Potential Areas of Energy Conservation and Use of Alternate Energy Sources in Agriculture in North Carolina" Funded by the U.S. Department of Agriculture.
4. "Passive Cooling of Buildings" Non-funded research.
5. "Radiative Properties of Furnisings and Building Materials and other Interiors for Use in Energy Conserving Designs" Non-funded research.

The first two of these projects have been completed successfully and work on the rest is continuing.

The project "Model Solar Home..." demonstrates the active and passive use of solar energy and other energy conservation techniques on the Garret House, a house on the campus of N.C. A&T State University. The demonstration solar house was formally dedicated by

the Governor of North Carolina, Honorable James Hunt, on March 11, 1980. Since then, more than 1,000 persons have visited the house. A consumer education package was prepared to be given to everyone who visited the house. This retrofit solar house is serving a great need for people in the Greensboro area. The response of the people has shown us that there is a need for a new demonstration house to demonstrate the use of solar energy on new houses.

The second project, "Solar Collector test...," was funded by the Department of Energy to create a solar radiation design handbook for North Carolina and to develop a hydronic solar collector test facility. The handbook was completed in the Fall, 1979 and many copies have been distributed to interested persons in North Carolina and elsewhere who became aware of its existence through technical presentations and through word of mouth. Plans call for the handbook to be published and distributed by the Energy Division of the North Carolina Department of Commerce. The collector test facility is now complete and testing has begun. This is the only solar collector testing facility in North Carolina.

Work on "Energy in Agriculture" and "Passive Cooling" is underway. Radiative properties of certain furnishing materials and other interiors which are becoming important for passive solar designs was reported in a paper presented at the annual meeting of the American Section of the International Solar Energy Society. This work, although not funded, is being continued because of its importance to passive solar designers.

In all of these projects, student participation is strongly encouraged. Undergraduate and graduate students are involved in all the energy projects from the proposal preparations stage to the execution of the project.

ENVIRONMENTAL IMPACT GROUP

ENVIRONMENTAL IMPACT GROUP

DESCRIPTION OF PROJECTS

Two groups discussed impact on various energy systems on the environment. One group was composed of scientists concerned with the Physical and Chemical impacts and consists of contributions from the following areas: hydrological, geological, atmospheric, chemical, and meteorological. The second group presented papers and discussions relative to biological monitors and impact.

ENVIRONMENTAL IMPACT GROUP PARTICIPANTS

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ENVIRONMENTAL IMPACT GROUP

ABSTRACTS

A. Physical and Chemical

B. Biological

A. Physical and Chemical Abstracts

STRATOSPHERIC WARMING DYNAMICS

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The interaction between the dynamics of the stratosphere and that of the troposphere as it effects surface climate is complex and is not fully understood (Ramanathan and Coakley, 1978). The sudden stratospheric warming in which a large portion of the winter stratosphere may warm by as much as $50^{o}C$ in a few days is one phenomena which is under active investigation. My research involves the use of global satellite radiometric observational data as well as traditional rewindsonde and rocketsonde observations during the stratospheric warming of January-February, 1973. In my Ph.D. dissertation (Johnson, 1977), I carried out a preliminary study of the dynamics of that warming. My current research involves development of a dynamic model (cf. Holton, 1976), as well as additional diagnostic studies (cf. Van Meighem, 1978).

AIR POLLUTION STUDIES

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As a consultant to the Mississippi State Board of Pollution Control, I have been able to gain additional experience in this area by serving as a research collaborator in the Atmospheric Sciences Division at Brookhaven National Laboratory, Upton, L.I. I am participating in the evaluation of the environmental impact of the district heating proposal. District heating is defined as the distribution of thermal energy from a central source for residential and commercial hot water heating. An evaluation is being carried out of the impact on air quality of the replacement of the home and commercial heating plants with the central facility. The crucial "worst" case from a meteorological standpoint is the high impact on a cold clear morning during which stable atmospheric temperature profiles would yield high concentrations from low level sources and low concentrations from an elevated stack. Proper modeling of the impact will involve modeling the mixing depth and is to that task that I have been assigned. Initially we are developing a screening technique for calculating potential concentrations for a three to five year period in six different suburban locales near the following cities: Boston, New York, Chicago, Pittsburgh, Madison, and Minneapolis-St. Paul. Results of the screening procedure will aid in choosing a city with the greatest potential for a more detailed study.

IMPROVING AIR QUALITY IMPACTS METHODOLOGY

Dr. Thomas A. Carney
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My current research activities are sponsored by the Environmental Impacts Division of the Department of Energy under the task of improving air quality impacts methodology. The following description of the activities gives an overview of the type of problems addressed in this project and the method of approach to be used in some specific tasks.

The overall objective of these activities is to provide improved methods and data for assessing air quality impacts of energy development in national/regional assessments. Project activities include modeling inter-regional transport of air pollutants, evaluation and analysis of air quality models and data bases, and development and testing of advanced modeling technologies. In addition, the project includes participation in the Interlaboratory Working Group on Air Quality Analysis (ILWGAQA) to coordinate model and data work with other DOE laboratories and to assist in comparison and validation of air quality models through operation of BNL models.

Specific tasks for FY 1980 include:

(1) Development of inter-regional sulfur oxides transport matrices for January, April, and October using meteorology for those months in 1974 with the BNL long-range transport model, AIRSOX. The

matrices values represent transport of sulfur oxides from a normalized source in one region (a federally-designated Air Quality Control Region or a State) to another region. The matrices can be combined with varying emission inventories to assess the impact of many energy scenarios without additional runs of the air quality model.

(2) Computer runs of BNL AIRSOX to implement model comparison and validation tasks defined by ILWGAQA. Meteorology data for July, 1978 will be used in this task since the air quality data available for the validation study is augmented by data collected during intensive sampling periods of the Electric Power Research Institute (EPRI) Sulfate Regional Experiment (SURE).

(3) Analysis of the sensitivity of BNL AIRSOX and the derived transport matrices to meteorological variations and alternative values of physical parameters.

Existing Capabilities and Needs

A state-of-the-art review is required to describe existing capabilities within the task of improving air quality impacts. Although I will not attempt such a review here, it is safe to say that all of our current capabilities in this area could stand improvement. A complete "want list" would fill a book, so I limit myself here to just three areas of future interest to modelers of pollutant transport on a regional scale.

(1) Development of efficient models for regional-scale transports of pollutants that involve complex chemical reactions;

(2) Development of regional-scale models that include in-cloud dynamics and precipitation processes to facilitate assessments of acid rain impacts;

(3) Improved techniques for including the effect of the earth's surface on the transport, transformation and removal of pollutants on a regional scale.

REMOVING TOXIC SUBSTANCES FROM INDUSTRIALLY GENERATED POLLUTED EFFLUENT WASTEWATER

Dr. Curtis W. McDonald
Department of Chemistry
Texas Southern University
Houston, Texas

The primary objective of my research group's activities is to develop practical and economical processes for removing toxic substances from industrially generated polluted effluent wastewater. For the last eight years, we have concentrated our research on developing processes for removing toxic metal ions from aqueous solutions. These toxic metal ions include mercury, chromium, cadmium, lead, and nickel. The metal finishing, paint, munitions, and battery are among a number of industries which generate effluent wastewater containing these toxic metal ions. Our actual industrial wastewater investigations have been limited to the metal finishing industry. We have been particularly concerned with developing methods for the removal of chromium and cadmium from effluent wastewater generated at small electroplating shops. Adequate technology is available for the large metal finishing operations associated with the automobile and plumbing industries. This is not true for the small plating shops. To date, our methods and process development activities have been limited to laboratory scale operations. We do, however, make every effort to develop processes which are simple, efficient, rapid, economical, and can easily be scaled up for industrial utilization. We are considering initiating some pilot plant scale operations for some of the more promising methods in the near future.

This research provides useful information on and addresses questions which are centered around the following topics:

(1) the concentration of trace elements in water and in the bottom sediments of the lakes in the areas under study,

(2) the use of ion sensitive electrodes for efficient and reliable measurements.

(3) the use of ion sensitive electrodes for monitoring the aqueous environment,

(4) the use of the Gold Film Mercury Detector for efficient and reliable determinations of mercury in the aqueous environment,

(5) changes in the content of lakes which may be due to "acid rain" or changes in "acid rain" content itself.

ACID RAIN, HEAVY METAL POLLUTION, AND POLLUTION PROBLEMS RELATED TO BURNING OF FOSSIL FUELS

Dr. Rudolph R. Schwarzer
Geoscience Program - Department of Chemistry
Texas Southern University
Houston, Texas

My primary research interests are in the areas of acid rain, heavy metal pollution, and pollution problems related to the burning of fossil fuels, particularly coal.

We have been involved in studies on the environmental effects of an offshore oil field in the Northern Gulf of Mexico. In particular, we investigated the distribution of heavy metals in bottom sediments and suspended sediments in the field. At present, we are engaged in studies on the background levels of sulfur oxides in lake waters and heavy metals (Ba, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Ti, V, and Zn) in lake sediments surrounding Houston's first coal burning generating plant. This information will be used to evaluate the possible environmental effects of the plant in the future. We are using ion sensitive electrode techniques to measure sulfide and sulfate concentrations in aqueous samples, a gold film mercury analyzer for mercury and atomic adsorption for all other metals. We are also investigating the various parameters which influence the concentration of heavy metals in sediments such as sediment size distribution, iron oxide, manganese oxide and organic content. Multivariate statistical techniques such as cluster and ordination analysis

are being used in these studies. We hope in the near future to initiate an acid rain study of the greater Houston area by setting up rain stations and measuring the pH, sulfur oxides, and nitrous oxides of the precipitation over a period of two years.

B. Biological Abstracts

RELATION OF DIFFERENTIATION AND MALIGNANCY STUDIES WITH CELL CULTURE

Dr. Mina J. Bissell
Lawrence Berkeley Laboratory

Summary

"If there is one generalization that can be made from all the tissue and cell culture studies with regard to the differentiated state, it is this: since most, if not all, functions are changed in culture, quantitatively and/or qualitatively, there is little or no "constitutive" regulation in higher organisms; i.e., the differentiated state of normal cells is unstable and the environment regulates gene expression." (1)

The search for biochemical difference between cancer and normal cells is nearly as old as modern biochemistry itself. Despite many advances, as yet there is no single marker that defines a cancer cell. Our failure to identify such a marker stems in part from the fact that this is an absurd goal. Cancer is an exceedingly complex and multifaceted disease. Indeed, it may well not be one disease; to hope for a single universal marker is, at best, wishful thinking. However, our failure to define a cancer cell may stem also from our inability to define normal state. Given that every cell of an eukaryotic organism contains the complete genome of that organism, what causes a cell to become a liver or a muscle cell? And once a cell becomes a part of these tissues, what factors regulate the expression of liver-related or muscle-related functions? The former question is beyond the scope of this presentation. The importance of the latter question lies in the fact that if we could understand what is normal and we would have a chance to understand not only how a cell becomes cancerous and diseased, but also how to prevent and reverse such changes.

To study regulation of gene expression was one of the major aims of tissue culturists during the early part of this century. However, the challenge of growing pieces of tissue, and later, single cells proved to be all consuming and function was relegated to a secondary position in such attempts. Tissue-specific traits were altered so rapidly in culture and often in such unexpected ways that it was not always clear what one studied. This did not mean that there were not many attempts to study gene expression in cultured cells, but that the relation of such studies to regulation of function in vivo was not often clear. In the last ten years, however, an interest in model systems that have in vivo relevance has re-emerged and there are now many attempts to define conditions whereby functions can be retained in culture.

In our laboratory, we have developed two differentiated cell systems, one fibroblastic (avian tendon cells) and one epithelial (mammary epithelial cells of mice). The criteria used to define "tissue-specificity" is collagen production, (30% of total protein synthesis (2,3)) at the ability of tendon cells to make an extensive extracellular matrix (4). In the case of epithelial cells, morphology at the level of EM (5), milk specific components and metabolite patterns (6-8) are being utilized.

The availability of such systems allow us to ask meaningful questions with regard to physiological regulatory mechanisms. Additionally, by understanding what is "normal," one can hope to

better define the early and important changes which cause the cells to become cancerous. Energy technology is developed for the benefit of mankind. Accurate biological indications of hazard to man cannot be developed without understanding mechanisms that keep him healthy and functioning.

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TEST SYSTEMS FOR TUMOR PROMOTERS

Mina J. Bissell

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It is becoming increasingly clear that carcinogenesis is multi-causal and multi-step. The two-stage model of chemical carcinogenesis proposed initially by Berenblum (1) based on studies on mouse skin has gained wide acceptance and is being extended to other systems. The studies define at least two stages in carcinogenesis: "initiation" (usually by a compound that can bind covalently to DNA) and "promotion" (usually by active components of croton oil, mainly the phorbol esters). The most potent tumor promoter known is 12-O-Tetradecanoylphorbol-13-acetate (TPA).

It has been demonstrated in many laboratories that TPA and other tumor promoters "mimic" the action of tumor viruses when added to normal cells. In particular there are striking similarities between the action of TPA and the active product of the src (sarcoma-specific) region of Rous sarcoma virus (RSV), an avian RNA tumor virus.

In a recent paper, Bissell et al. (2) have proposed that viral carcinogenesis may also be multi-step process and that the active product of the src gene (a protein kinase) may indeed act analogous to a tumor promoter.

Studies using cells infected with RSV mutants temperature sensitive (ts) in the src gene at non-permissive temperatures demonstrate that such cells are very sensitive to the action of TPA and may provide a better test system for detection of tumor promoters.

Using either normal chick embryo cells or those infected with ts-RSV, at 41.5°C, we are now testing the active fractions of Euphorbia species, plants used in our Hydrocarbons and Energy from Plant program. We have shown that many fractions from the latex of the plant are indeed "positive" in that they behave in a fashion analogous to TPA in several criteria (for example, see Fig. 1). It is thus exceedingly important to verify that the final products, if and when they go to market, be free of such tumor promoting activity. Our tests indicate this to be the case. It is interesting to note that a program designed to elucidate the mechanism of action of tumor promoters and the role of viruses in cancer induction, i.e., a basic research program, can lend itself to an 'applied' area by providing a sensitive and suitable test system for a program designed to provide alternative sources of energy.

Additional evidence is presented to support the multi-stage model of viral carcinogenesis and the similarities between viral and chemical carcinogenesis (3,4). In addition, attention is drawn to the importance of tumor promotion in induction and progression of human cancer and a possible role for viral genes in either initiation or promotion of cancer.

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Acknowledgement: The studies in our laboratory were funded by the Division of Biomedical and Environmental Research of the U.S. Department of Energy under contract W-7405-ENG-48.

ISOLATED HEPATIC PARENCHYMAL CELLS AS A TEST SYSTEM FOR BIOHAZARDS

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In view of the need to investigate liver functions and their regulations more thoroughly, the present program of research was developed. Insolated hepatic parenchymal cells (cultured and non-cultured) will be used as a system for in vitro studies on parameters which affect metabolic processes and for studies to elucidate the mechanism of action of various biohazards (e.g., toxic, mutagenic, and carcinogenic agents). Homogeneous preparations of intact parenchymal cells isolated from one animal are ideal for the proposed investigation since they facilitate the study of many variables at one time while overcoming the varied disadvantages of heterogeneous systems. The studies to be performed will be both metabolic and morphological ones. The results of these studies will provide the information needed to obtain additional insights into the effects of biohazards on mammalian tissue.

POLYCYCLIC HYDROCARBON(S) INDUCTION OF CYTOCHROME P450 AS A PARAMETER OF MEASURING TOXICITY OF COAL GASIFICATION BY-PRODUCTS

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Polycyclic aromatic compounds such as 3-methylchloanthrene, -napthoflavone, or tetrachlodibezodioxin have been shown to be capable of inducing the translation of two or more specific forms of Cytochrome P450 in rabbit liver microsomes. In keeping with our present studies using phenobarbital as an inducer of Cytochrome P450LM_2, we are proposing herewith a parameter for measuring toxicity levels in polycyclic hydrocarbon by-products of coal gasification. Toxicity potentials will be measured by monitoring required de nova synthesis of the specific enzyme in cell free in vitro rabbit reticulocyte lysate and wheat germ systems. The levels of de nova protein synthesis, especially of forms LM_4 and LM_5 of Cytochrome P450 will serve as indicators of putative toxins.

POLICY RESEARCH GROUP

POLICY RESEARCH GROUP

Description of Projects

The policy research group was one of the largest groups at the conference. Four of the papers, 1) Policy Research Group Abstracts, 2) A Note on Energy Equity, 3) Energy Environment and Equity: Conflict in the Regulation of Electrical Utility Rates in Mississippi and 4) Energy Research at Texas Southern University Energy Policy: Impact on Urban Minorities; present a careful analysis of the "Equity" issues in the Energy Policy field. Another presents a model for examining the economic issues in looking at the interaction between energy technology and the state of the economy, while a fifth paper examines the "Institutional Contraints on Environmental Oriented Energy Policy."

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POLICY RESEARCH

ABSTRACTS

ENERGY PRICE AND EQUITY

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Assisting the poor hit by energy price is now preferred to controlling prices. What little research has been done on the energy and equity suggests that the share of energy purchases in total spending falls somewhat as income rises. The relation is pronounced for direct purchases of energy (gasoline, heat, electricity) but quite moderate when indirect purchases of energy (that is, energy incorporated in goods) are included.

The inclination of congress has been to provide income supplements, for easily identified consumers (supplemental social security and welfare recipients, low income taxpayers), who are made needier by energy price increases. Income supplements are preferable to energy stamps of other measures that make energy available directly at low cost, for they preserve the right of recipients to choose where to save: on energy, food, or medical services.

It is imperative to take a step toward market pricing which would increase demand and supply efficiencies (less would be demanded, more would be produced), eliminate the entitlement system with its subsidy to imported oil, and minimize the administrative costs and the burdens of regulation, both for government and industry.

Under decontrol, who suffers most? How to achieve equity in market pricing? The foci will be the poor, the rich, consumers, and producers.

INSTITUTIONAL CONSTRAINTS ON ENVIRONMENTALLY ORIENTED ENERGY POLICY

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If the use of energy is merely a means of quality of life objectives rather than some sort of end in and of itself, then energy policy should represent broader social goals. Among such goals, environment integrity would seem to rank quite highly, particularly if citizens are aware of the vital relationships between environmental integrity and such things as health and economic well-being.

At present, however, the nation is bent on a general energy strategy which is likely to raise serious problems in terms of environmental integrity. Therefore, it is desirable for environmentalists to bring environment and energy incongruity to the attention of administrative as well as legislative policy-makers.

This, however, is difficult, at best, under current institutional arrangements. The Environmental Protection Agency and the Council on Environmental Quality are too little to energy agencies and crisis at the national level, and state environmental agencies are too small to energy goals and agencies.

Environmental Impact Assessment (EIA) has not fulfilled the National Environmental Policy Act; it has been used for the devil to quote the bible. We should make EIA more sensible to the public and genuine assessment.

A NOTE ON ENERGY EQUITY

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Unequal opportunity from birth to death between the majority and minority members of this nation has been the major concern of equity in the last two decades. Now, the energy crisis adds another serious dimension - economic equity. Barry Commoner's study shows that the 23 to 25 million poor people in the United States spend between 15 and 50% of their disposable income (after tax income) on energy. The plight of the minority poor is further exacerbated by increases n food and medical care costs eaten up by energy price hikes. Energy is, therefore, the new frontier in civil rights, and in human rights.

President Jimmy Carter's energy policy reflects this sense of equity. For example, the President's $142 billion dollar crash ten year energy self sufficiency program includes a $88 billion synfuel program, a $16.5 billion mass transit program, a $5.6 billion conservation program, and a $2.4 billion low-income energy assistance program. The National Energy Conservation Act of 1978 has specifically the following provisions that relate to energy equity:

(1) Grants of up to $800 for low-income urban families for insulating or weatherizing their homes;

(2) Grants of up to $1500 for weatherizing homes of low-income rural families through the Farmer's Home Administration;

(3) Grants through HUD to finance energy conservation improvements for multi-family housing projects for the elderly, handicapped, and low or moderate income families. The ACT requires HUD multi-family houses and provides for new FHA housing;

The energy equity can be achieved only by the minority's all-out efforts. At the present time, energy issues have been discussed by scientists, technocrats, and techno-bureaucrats of physics, chemistry, and biology. Equity is not a scientific concept, it is an equity concept. Racial discrimination began with the wealth of the nation steadily growing in the 1950's with abundant inexpensive energy resources. The U.S. government had spent billions of dollars on highway projects which made white middle-class America run away to suburbia from the inner city and from the poor, and at the same time, another billion dollars was allocated to the urban renewal project. What a policy! Now, we are in a recession. The pain of recession can be cured by the redistribution of wealth belonging to the rich into the poorer communities. There is not other way to solve the energy crisis. Finite world and finite resources cannot be owned by a few rich people.

Any equity problems can be solved in an ethical framework. However, equity and justice-as-fairness described by John Rawls, are rapidly fading away. Still the barriers to equity are many: Lockean liberalism to social Darwinism, economic recession, and human bias and prejudice. The Lockean liberalism cherished individualism, not collective and public good. Social Darwinism before and after the revolution encouraged the survival of the fittest and weeded out the unfit. Economic depression may never help equity as a feasible policy.

Black and other minority leaders and citizens should evaluate all energy policy implementation strategies to the political leaders. Mississippi should be the best place to begin energy equity because the state has a much larger proportion of Blacks (37%) than the national proportion, and is the poorest state in the nation in terms of wealth (or per capita income for Blacks). We should also evaluate the state energy plans and implementation strategies. The state legislature has been resisting the national energy plan. A good example is a state building code which is mandatory according to the national conservation plan. The state legislature has not yet done this. The first step toward the energy equity is our active and meaningful participation in energy policy-making and its implementation not only for our welfare, but also for a better energy plan which will hopefully lead us to an energy independent nation.

ENERGY RESEARCH AT JACKSON STATE UNIVERSITY
MODELING THE ECONOMIC ISSUES

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The study of energy related issues is never complete without an assessment of how changes in energy technology/availability/cost will affect the economy. Similarly, economic analysis that ignores the constraints imposed by energy availability is limited in its usefulness. The interaction between energy technology and the state of the economy is a relatively understudied field.

The "energy crisis" of 1973 stimulated interest in the study of the economic impact of energy shortages and changing technology. Much of the current research concentrates on fairly broad, national-oriented issues. The differential impact across the regional sub-economics of a change in the energy environment has virtually been ignored.

Our long range research objective is to provide tools to assess the economic impact of changes in energy technology, energy cost, and energy policy upon regional economies in the United States. The focal point of such research is the development of an econometric model of th Southeast region of the U.S.--this model would serve as a tool for research on the Southeast economy and as a prototype for other regions of the U.S. The theory and use of such models is just now emerging.

Current research in the U.S. is being conducted along two fronts:

(1) the development of huge national econometric models which have a great deal of regional detail, but because of their complexity are of little use for regional policy makers, 1

(2) the development of regional-specific econometric models that are much more useful for regional policy makers, but are not realistic because they do not model inter-regional information, 2

The thrust of our research is to find areas of common ground between these two paths of research--to develop models useful by both groups. The Southeast is an ideal prototype area for such research. All states have some sort of state-specific econometric model in existence. The task at hand is to explore methodologies to:

(1) incorporate more energy detail into these models;

(2) link the models in some meaningful way so that inter-regional flows are not ignored.

Once constructed, the full Southeast regional model would be utilized to analyze the effects of proposed energy policies on the regional economy. An example of such a study would be conservation schemes that may be proposed to achieve DOE-mandated reductions in gasoline consumption. Hopefully, the simulation would suggest which scheme would be least harmful to the economy.

The methodology for the construction of such a model is fairly well established. The problem is that resources have never been directed at the true "regional" level. DOE support of this concept would make a great difference.

ENERGY, ENVIRONMENT AND EQUITY: CONFLICTS IN THE REGULATION OF ELECTRIC UTILITY RATES IN MISSISSIPPI

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Conflicts involving the energy and environmental issues concern the apportionment of environment-related higher costs among large and small-volume energy users, and the resistance of businesses to the revision of rate structures which they have traditionally benefited from. Utilities, as producers, add to this more continuous atmosphere by applying for rate increases more frequently than ever before. Conflicts involving the environment, energy, and equity issues result from the passing-on of the burden of higher costs to the most economically frail consumers. As profit-making entities, investor-owned electricity producers recoup higher energy costs from consumers--both large and small. In turn, large volume consumers such as businesses and governments pass on these costs to their customers and taxpayers, respectively. Small-volume residential customers in particular eventually get stuck with paying the highest share of these costs. While all households pay in the form of a reduction in the amount of disposable income, the poor sometime pay with their lives. Since 1974, Mississippi Power and Light (MP&L), as well as other investor-owned utilities producers, have applied to the Mississippi Public Service Commission (MPSC) for substantial rate increases. The proposed study examines the policy arena of structure design and its impact upon the environment and equity in Mississippi.

ENERGY RESEARCH AT TEXAS SOUTHERN UNIVERSITY
ENERGY POLICY: IMPACTS ON URBAN MINORITIES

Dr. Theo Herrington
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Selecting a specific set of strategies to achieve greater energy conservation is a complex and involved task. To this end, our research project proposes an analysis of energy reduction strategies and an evaluation of how they might impact on urban minorities. We are proposing a framework that provides for evaluating energy reduction (conservation) strategies ranging from voluntary initiatives to mandatory actions. A significant portion of the research effort provides for selecting specific policies and programs based on an evaluation of expected energy savings and costs in terms of economic and social impacts. Identifying the cost of implementing a specific energy conservation strategy is necessary for evaluating its cost effectiveness in terms of individual consumers as well as the administrative actions required for implementation.

Careful evaluation of factors such as (1) energy savings likely to be achieved from effective implementation of the strategy, (2) dollar as well as the strategy's administrative feasibility, (3) environmental implications, particularly health and safety, (4) economic impact, for example, inflation and unemployment, (5) burden on selected consumer groups will highlight the development of our effective package of energy conservation strategies for urban minorities:

(1) Examples of possible adverse impacts (on Houston) which have resulted from selected energy conservation strategies; particular attention will be given to petrochemical related industries;

(2) An evaluation of the environmental impacts of energy conservation strategies to identify any possible health, safety, and other risks associated with its implementation;

(3) Increased energy prices and their impacts on the urban minority consumer;

(4) Impact on energy efficient home tax credits; homeowners benefits vs. multifamily rental units (landlord enrichment vs. tenant benefits);

(5) Encouragement of the revision of state and local building codes to require that new residential structures meet certain energy efficient requirements.

Our primary research aim to promote the development of an energy conservation ethic with positive cost benefits for urban minority groups.

INVITED PARTICIPANTS

ABSTRACTS

U.S. ENERGY DEMAND AND SUPPLY SCENARIOS: A RETROSPECTIVE APPRAISAL OF CONAES*

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When the report of the National Academy of Sciences' study on nuclear and alternative energy systems (CONAES) was released in January, 1980, major media reviews were so diverse and inconsistent that many people wondered if they were reading about the same study. Examples are the New York Times lead story which was headlined "Science Study Urges Conservation as First Priority for Energy Policy," and the Washington Post story which was titled "Energy Analysis Stresses Use of Coal, Atom Power." This rapporteurial dichotomy was probably neither accidential nor idiosyncratic, but reflective of a corresponding basic dichotomy of views that had long characterized the energy debate in the United States.

The historically dominant domestic view of the energy problem focused on its supply side. According to this view, the problem resides mainly in the threat of havng "too little" energy: energy demand growth is, a priority, desirable and necessary to nourish a healthy economy, therefore, the principal solution to the growing

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* The U.S. National Academy of Sciences Study by the Committee on Nuclear and Alternative Systems.

domestic supply-demand imbalance should be found by increasing energy supplies. The opposite view focused on the threat of having "too much" energy (or, at least, too much of the wrong kinds). According to the latter view, the principal solution to the supply-demand imbalance should be found by reducing energy demand, i.e., by energy conservation.

After the 1973-74 "energy crisis," the forces in the U.S. energy debate tended to line up increasingly around these two poles, that is, according to whether primary reliance should be placed on policies that enhance domestic energy supplies or those that foster energy conservation. During the period when the CONAES study was initiated (1976), the polarization of these forces was perhaps at a maximum and the energy debate had become very derisive.

The National Academy of Sciences attempted to soften this divisiveness and raise the quality of the debate by internalizing these forces within the CONAES study. An equal platform was provided for prominent advocates of both the "supply" and "conservation" points of view, and CONAES became a unique microcosm of the real world energy debate, involving over 200 people representing almost the entire spectrum of institutional and private interests and views about energy. The CONAES process of trying to reach consensus from so diverse and divided a group was difficult and protracted, but it did not become a significant element in the evolution of the U.S. Energy debate. The CONAES process was both its greatest strength and greatest weakness; weakness because of the difficulty of reaching

agreement and speaking with a unified voice; strength because of the added policy significance of such agreements when they did occur. It is noteworthy that CONAES reached almost unanimous conclusions on some of the most important energy issues.

COAL COMBUSTION AND CONVERSION: RESEARCH OPPORTUNITIES

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Coal is the most abundant fossil fuel resource within the continental boundaries of the United States. It is estimated that our recoverable reserves range from 150 to 438 billion tons. This is sufficient coal to meet all of our energy needs at the 1977 level of consumption for the next 42 to 124 years.

The energy problem, however, is not resolved even with this great abundance of coal. Coal is a solid fuel and our demand is primarily for liquids and gases. Coals is a dirty fuel (ladened with ash, sulfur, nitrogen) and severe environmental insult will occur if it is consumed without cleaning or extensive application of pollution control devices.

These problems, then comprise the research opportunity: How to use coal to meet our existing energy demand pattern in an environmentally acceptable manner.

SHORT-TESTS FOR CARCINOGENS AND MUTAGENS

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Lawrence Berkeley Laboratory
Berkeley, California

A variety of rapid, sensitive *in vitro* methods for detection of chemical carcinogens and mutagens have been developed in the last 5-10 years. These methods are being applied in thousands of laboratories for testing environmental chemicals for potential mutagenicity and carcinogenicity. The most widely used of these methods is the Salmonella/Ames assay. This method uses several specially constructed strains of *Salmonella* bacteria for detection of carcinogens as mutagens. Eighty to ninety percent of the large number of chemical carcinogens tested in this assay can be detected as mutagens. In addition to screening environmental chemicals, the *Salmonella*/Ames test, and many of the short-term tests can be applied to a variety of risk assessment problems involved in the estrapolation from results of animal cancer tests to humans. For example, most of the *in vitro* assays can utilize human tissues for activation of carcinogens to their active mutagenic forms, and some *in vitro* assays can utilize human cells in culture, or can be applied to humans directly (e.g., by testing human body fluids for the presence of mutagens). We are establishing a potency scale of analyzed results from a wide variety of short-term tests, and are developing statistical procedures for the analysis of short-term test data. Our major goals are: (1) to

determine the extent to which results of short-term tests can contribute to the reduction of uncertainty in quantitative assessment of human cancer risk from exposure to environmental carcinogens and mutagens; (2) to provide a consistent analytical framework upon which regulatory agencies can base evaluation of short-term test data on regulated chemicals; and (3) to provide an ongoing comparative record of analyzed short-term test data that may be used as a background against which to evaluate the relative significance of results from the different short-term tests, used as a tool for designing short-term testing batteries.

ENERGY POLICY: MANAGING THE SOCIOECONOMIC DIMENSIONS: OPPORTUNITIES FOR PUBLIC POLICY RESEARCH

Dr. Lenneal J. Henderson, Jr.
School of Business and Public Administration
Howard University
Washington, D.C.

Since the 1973-74 embargo imposed by the Organization of Petroleum Exporting Counties (OPEC) on the United States, energy price and supply have exploded onto the consciousness of Americans. The last half of the 1970's saw exponential increases in petroleum, natural gas, coal, and electricity prices and rates. Americans failed to agree on the causes and culprits of such price rises. They saw prices rise as energy supplies fluctuated. They experienced maldistribution of home heating oil and natural gas, particularly during severe winter and summers in 1976-77 and 1977-78.

Federal policy intervention to address energy problems was sporadic and fragmented. Between 1974 and 1977, the Federal Energy Office, the Federal Energy Administration, the Energy Research and Development Administration, the Department of Energy, the Nuclear Regulatory Commission, the Federal Energy Regulatory Commission, the Community Services Administration, the Department of Defense, and the Department of the Interior all could claim responsiblity for a piece of energy policy.

This administrative proliferation could be reduced to three basic policy priorities:

(1) Reduction of American dependency on imported crude oil;

(2) Expansion of American production of energy from conventional fossil fuels, accelerated reliance on coal and use of alternative, renewable and synthetic fuels;

(3) Residential, industrial, commercial, and transportation energy conservation policies.

The combination of energy events and energy policy intervention reflected and induced widespread socioeconomic impacts and was induced by socioeconomic phenomena. These phenomena included:

(1) Regional, racial, ethnic, class, cultural, political, and other diverse characteristics of the American populace;

(2) Dynamic change in urban-suburban-non-metropolitan demographic configurations;

(3) Concommitant changes in the fiscal, natural, and human resources of public and private institutions,

(4) The variegated impact of national economic recession, inflation, and high unemployment on a diverse populace.

However, socioeconomic concerns are lower public policy priorities than national security, international posture, and domestic economic policies. Although the social systems is both an independent and dependent policy variable, its significance is not sufficiently understood by energy-related decision-making institutions.

On glaring example of the socioeconomic blind side in national energy policy is the distributional impact of energy events and policies on minorities and the poor. The demographic patterns, energy consumption and expenditure patterns, commuting and transportation characteristics, and family characteristics of populations generically classified as "nonwhite" and "poor" expose them to the severe impacts of the American energy dilema. When regional climate, educational

liabilities, environmental hazards, and other dynamics associated with the "structure of poverty and racism" are considered, it is clear that social equity is among the most severe challenges to national energy policy.

Particularly important is the interrelationship of race, class, and institutional dynamics as a context for energy policy-making. For example, blacks are more likely to fall into officially designated poverty classifications than whites. Black family median income was 59.2% of white family median income. Thus, income available for any household expenditures will be less for blacks and whites. Any precipitous increase in any item of the black household budget is therefore more likely to disrupt black households than whites, particularly given rising unemployment and diminishing real disposable incomes in black families.

When energy institutions, either through market place dynamics or through policy intervention, raise energy prices, poorer blacks are less able to adapt their household budgets than more prosperous black and white households. Poorer households can buy less energy for more money. Moreover, any other item in their budgets provided with substantial energy inputs will also increase in price. The results are regressive price structures (both racially and economically associated) and declining marginal utilities in poor black households.

Although data on these phenomena are gradually becoming available through models provided by the Ford Foundation, such as the Household Energy Expenditure Model, the models generated by the Committee on

Nuclear and Alternative Energy Systems (CONAES), the Comprehensive Human Resources Data System, and the Washington Center for Metropolitan Studies, vast research opportunities exist for historically black colleges and universities. Examples include:

-- Impact of alternative energy conservation scenaries on low-income, minority families;

-- Impact of state energy planning on municipalities with substantial minority population;

-- Higher price energy scenarios and minority business response modes;

-- Federal policy interface among programs designed to assist low-income and/or nonwhite households or institutions;

-- Evaluation of prototype energy conservation, research and development programs in poor and/or minority committees;

-- Use of zoning, regional planning, police powers, and other planning tools to induce changes in urban energy expenditure and consumption patterns.

Many more examples are possible. However, Historically Black Universities and Colleges will need to do the following to take maximum advantage of such programs:

(1) Inventory existing energy-related policies through review of the National Energy Plan II and III (now in preparation).

(2) Develop consortial research teams to undertake efforts.

PHOTOVOLTAICS RESEARCH PROGRAM AT THE SOLAR ENERGY INSTITUTE

Mr. Steven Hogan
Solar Energy Research Institute
Golden, Colorado

The U.S. Department of Energy has established a goal to replace 1 quad per year of primary fuels with photovoltaic energy by the year 2000. To accomplish this, intermediate cost goals have been established to gauge the progress towards this goal. In 1982, the cost of a photovoltaic module should be at $2.80/peakWatt, in 1986 at $0.70 Wp, and by 1990 at $0.15 to $0.50/Wp. The three photovoltaic technologies capable of meeting these goals are Flat Plate Silicon, High Efficiency Concentrator, and Low Cost Thin Film photovoltaic cells. The Department of Energy has tasked SERI with the Lead Center for Advanced Research and Development in Photovoltaic Technology. The SERI program objective is to develop advanced materials for commerical readiness in the 1990's. Five objectives have been established to successfully meet the 1990 readiness goal:

(1) Achieve 10% thin film cell efficiency in FY 80.
(2) Demonstrate technical feasibility for 4 material systems by FY 87.
(3) Achieve a 10% electrochemical cell efficiency by FY 82.
(4) Achieve 12% thin film cell efficiency in FY 82.
(5) Achieve 30% multijunction concentrator cell efficiency by FY 85.

The photovoltaics research program at SERI is divided into four branches. The Analysis and Evaluation Branch is involved with environmental, materials, and economics aspects of advanced materials.

It is also establishing a measurements facility to aid in the evaluation of subcontractors materials and devices. The Advanced Silicon Program Branch has established contracts to study polycrystalline silicon and amorphous materials. The Compound-Semiconductor Branch is involved with contracts on CdS Systems, GaAs, electrochemical cells, advanced concentrators, emerging materials, and innovative concepts. These three branches are program management oriented and handle close to $23 million in contracts to universities and businesses.

The fourth branch is the internal Photovoltaics Research Branch. The technical programs being pursued reflect a balanced approach to research in the three technologies of the flat plat silicon, concentrators, and thin films. A Semiconductor Theory group is examining the physics involved in surfaces, interfaces, and deep traps. The High Efficiency Cells group is looking at III-V compound fabricated by several methods. The Thin Film Cell Group is setting up facilities to produce amorphous silicon cells while the Silicon Preparations and Purification group is involved in a one-step SiO_2 to Si technique. A low cost advanced technique of growing silicon in ribbon form is being pursued by the Crystal Growth Group. The Thick Film Technology group is examining the screen printing of metal lization and II-VI compounds. Polycrystalline semiconductors and grain boundary effects are being studied by the Surface and Interface Analysis Group, and other measurement techniques are being handled by another group.

CURRENT AND FUTURE APPLICATIONS OF LASERS TO ENERGY RESEARCH

Dr. William M. Jackson
Department of Chemistry
Howard University
Washington, D.C.

Lasers have revolutionized the study of Physical Chemistry and atomic and molecular physics. It is likely that this revolution will not only continue, but accelerate. In this talk, the use of lasers for applied energy research will be discussed. First the unique characteristics of lasers will be pointed out with numerical examples of how these characteristics can alter the way chemists and physicists evaluate new experiments. Specific examples will be given of how lasers can be used as sensitive molecular detectors. Other examples will be discussed about how high powered lasers can be used to produce unique chemical environments. Future trends and possibilities will be pointed out with the ultimate goal of illustrating the broad applicability to a broad range of scientific problems.

APPENDIX A

BLACK COLLEGE PRESIDENT'S INITIATIVES

October 27, 1980

BLACK COLLEGE PRESIDENT'S INITIATIVES

These initiatives resulted from the inputs of two independent sources:

(a) Lawrence Berkeley Laboratory - Mr. Harold Wilson
Jackson State University - Dr. James Perkins, Dr. John A. Peoples, Jr.

(b) Prairie View University - Dr. Alvin Thomas, Dr. John Williams
Atlanta University - Dr. Cleveland Dennard
Howard University - Dr. Roger Estep, Dr. William Jackson

Eight black college presidents Dr. Cleveland Dennard, Atlanta University; Dr. Elias Blake, Clark College; Dr. Donald Stewart, Spelman College; Dr. James Creek, Howard University; Dr. Jesse Stone, Southern University, LA; Dr. Herman Branson, Lincoln University; Dr. Charles Taylor, Wilberforce College; Dr. John A. Peoples, Jr., Jackson State University, and Personnel Director of Lawrence Berkeley Laboratory, Mr. Harold Wilson, met at the Department of Energy in Washington on October 27, 1980 to draft a combined set of initiatives and presented them to Mr. Charles Duncan, Secretary, Department of Energy.

A RECOMMENDED LIST OF ACTION OBJECTIVES

Presented to
Secretary Charles Duncan
Department of Energy
on
October 27, 1980
by
Selected Presidents of the Historically Black College and Universities

The Presidents of the Historically Black Colleges and Universities respectfully request the implementation, by the Secretary, Department of Energy, of the following "Action Objectives" in support of Executive Order 12232 (Support for Historically Black Colleges).

Group A: FY 1981 Initiatives

A1. Establish a Historically Black College (HBC) Liaison Committee for the purpose of providing advice in all area relating to the mission and needs of the Department of Energy. In the interim, representatives from the HBC's should be included on each appropriate DOE advisory committee with a specific panel established under the Energy Research Advisory Board.

A2. Establish at the earliest possible date a Historically Black College Advisory Council to the Secretary of the Department of Energy.

A3. Establish a Memorandum of Understanding between the Black college community and the Department of Energy, outlining broad areas of mutual agreement.

A4. Establish Basic Cooperative Agreements between selected HBC's in areas relevant to the needs of DOE.

A5. Apply the principle of "specific goals" for energy programs and projects to be awarded to HBC's from the Department of Energy.

A6. Provide for exchange of (including administrative, management, specific, technical, etc.) personnel between the Department of Energy and the HBC's through IPA's and other arrangements.

A7. Develop a Department of Energy program to stimulate participation and involvement of private individuals and companies for the purpose of including and strengthening HBC's in the area of energy development.

A8. Establish implementation plans for Executive Order 12232 (Support for Historically Black Colleges) from each appropriate DOE officer for January 1, 1981.

A9. Establish a goal of $70 million in outlays to HBC's in addition to the FY 1981 minority procurement goals.

Group B: FY 1982 and 1983 Initiatives

B1. Establish a one percent minimum goal of total departmental outlays for FY 1981, 1982, and 1983 for HBC support in addition to existing and planned minority procurement/assistance goals.

B2. Establish a program for strengthening existing and developing new institutional energy research capabilities in HBC's (including faculty and studentprograms, new and renovated facilities, instrumentation and related support programs and services). A minimum of six institutions would be supported at an initial level of $850,000 per year, increasing to reflect four percent of total DOE university research outlays for FY 1983.

B3. Establish Regional Energy Demonstration and Technical Assistance Centers in at least six appropriate HBC's to provide a coordination and clearinghouse for HBC's in designated areas and to target on energy-related applied research, demonstrations, and technical assistance needed by the regions. These centers will also include the study of public policy and public programs and their impact on minorities. (Six centers @ $1,500,000 for 5 years totaling $9 million by FY 1983).

B4. Provide grants for technical assistance and demonstration programs to HBC's in cooperation with the six institutions described in paragraph B-3. ($1,500,000 annually beginning in FY 1982).

B5. Establish three Energy Experiment Stations at appropriate HBC's similar to State-Wide Engineering Experiment Stations which currently exist for engineering and agriculture. (Three centers @ annual cost of $250,000 each.)

B6. Establish at HBC research and/or demonstration units in alcohol and other renewable fuel production ($5 million).

B7. Provide grants to deliver energy extension outreach services through existing Cooperative Extension Programs at HBC's ($125,000 per year per institution.)

B8. Establish a series of small planning grants to be awarded to HBC institutions interested in energy but with currently marginal institutional capacity in the area of energy. (Twenty-five grants ranging up to $40,000 for a total of $500,000.)

B9. Provide for the development of consumer outreach programs focused on all areas relevant to the mission and needs of the Department of Energy (i.e., quality assurance, weatherization, contingency planning and utility workshops, etc. minimum of $3 Million funding.)

B10. Establish energy-related consumer education and career development programs at HBC's for low income and minority youth. Specific emphasis should be paced on relevant and meaningful careers including scientific, technical, and professional careers.

B11. Develop interagency programs (Department of Labor, Education, U.S.D.A., etc.) with DOE participation to provide the HBC's with support aimed at youth, adult and professional programs consistent with the DOE mission (e.g., internships, summer employment, retraining, cooperative education, and on-the-job training.)

B12. By March 31, develop formal cooperative agreements between the HBC's National Laboratories and other appropriate major Government-Owned Contractor Operated Companies (GOCO's) for the purpose of strenghening HBC capabilities in research, development, demonstration, and technical assistance. Each laboratory/contractor shall appoint a liaison with the HBC's.

Group C. FY 1984 and Out Year Initiatives

C1. Establish a line-item Congressional Appropriation to HBC's for the purpose of supporting programs dealing specifically with the impact of the energy crisis on low income and minorities (similar to U.S.D.A.).

C2. Develop a new "National Laboratory" at one of the HBC's in a programmatic area such as biomass, wind energy, alcohol, and other renewable fuels, etc.

APPENDIX B

PLAN FOR ESTABLISHING SIGNIFICANT RESEARCH EFFORTS AT MINORITY INSTITUTIONS

Contributions from Fossil Fuel Group
Williamsburg Meeting
June 16-19, 1980

PLAN FOR ESTABLISHING SIGNIFICANT RESEARCH EFFORTS AT MINORITY INSTITUTIONS

A large segment of the discussion in the Fossil Fuel Group meeting was devoted to establishing significant energy related research efforts at minority institutions. The specific topics covered in this discussion were:

a) The development of energy related Research Projects and Mechanisms to improve ones chances in obtaining funding;

b) The establishment of appropriate relationships between D.O.E. or National Laboratory project officers and minority groups seeking funding;

c) Establishing joint venture relationships between minority institutions (e.g., "8A" firms, universities);

d) Establishing appropriate institutional structures within "Black" universities to successfully conduct contract and grant research.

The conclusions arrived at in these topic areas are presented.

Development of Research Projects

There are a large number of energy related research topics that can be selected as worthwhile endeavors. However, many will not be funded by the Department of Energy or other funding agencies because they do not meet the agency's objective. Thus, before selecting a topic area and devoting a large amount of time to preparing a proposal several basic steps should be first accomplished.

Primarily, the target funding agency should be reviewed. Agency documents showing topic areas which were funded in the recent past should be read carefully. The mission and funding level for each program area should be clearly noted. Telephone calls and visits

with project officers to discuss their programs is highly encouraged. These discussions should include the current funding level for their programs and how much of their budget is still available to provide funding in the current fiscal year. The fraction of the remaining budget which is established for competitive and unsolicited proposals should be clearly established. A discussion of typical topic areas which program managers would consider funding should be pursued. Only after careful research of the agency, should an investigator proceed to consider possible topic areas for research.

Next, a few topic areas should be considered. Each topic area should be carefully analyzed in terms of the national impact the research would have, if successfully completed. This analysis should be presented in terms of barrels of oil saved annually in the nation, whenever possible. Out of the several research topics considered, the topic with the greatest national impact should be selected.

At this point your research topic should have the following attributes.

a) The research, if completed successfully, will have a significant national impact.

b) A funding agency and program area have been targeted for proposal submission.

c) The topic area lies within the mission of the funding agency and program area.

d) Funds are currently available within the agency to provide project funding.

It is next important to develop a preliminary working draft of your proposal. Technical and economic analysis of the concept should be included in the working draft. A research plan should be developed for effectively carrying out the research. Problem areas in conducting the research should be noted and possible methods for resolving these problems discussed. The resources you have available for conducting the research should be presented. These resources include personnel, equipment, laboratory space, and institutional support. Short comings in resources should be reviewed and possible joint ventures with other research groups to eliminate shortcomings should be pursued. The working draft developed for your research proposal should leave no fundamental questions unanswered which may provide grounds for refusal of the proposal. When this task is completed you are ready to "market" your concept.

Establishing Appropriate Relationships with Project Officers

Presumably one has already identified and made initial contact with a potential project officer in developing the working draft of the proposal. It is now time to sell him on the concept of the proposal using the working draft as the primary marketing tool. Arrange a meeting with the project officer allowing sufficient time to discuss all aspects of the proposal. It is up to the investigator to sell the concept. During the meeting highlight the salient points of the proposal. Include in the presentation:

1) National Impact of the program;

2) How it fits in with the project officers mission;

3) Uniqueness of the research concept;

4) Strengths of the research team;

5) Institutional support and committment.

Do not expect to be funded because you are a minority individual or represent a minority institution. Do not include this concept in your arguments for support. A project officer will always reply "Funding decisions are made purely on the technical merits of the proposal and strengths of the research team."

Solicit the project officers comments on the strengths and weaknesses of your proposal. If his initial reaction is negative, ask how the proposal may be improved. Include in your sales pitch how the project officers program and he personally will receive recognition in having funded a successful effort such as your proposal. In general, it is important to leave this meeting with the support of the program manager and his strong encouragement in submitting a proposal to his office. Be sure to include his specific suggestions and comments when writing your final proposal.

If you receive funding, follow these suggestions to insure you have the continued support of your project officer to improve your changes of obtaining continued funding.

1) Keep your project officer informed of your progress;

2) Submit interim and final written reports on time;

3) Invite your project officer to your research facility at least once and show him your research facilities and deliver a well planned presentation on the progress of your research. Introduce him to high level administrative personnel of your institution so that they might convey the importance of the research project to the institution and indicate appreciation for the project managers support.

Strengthening Research Capabilities Through Joint Ventures

A single institution, especially a small institution may not have all the resources necessary to gain funding or successfully conduct the research. Joint venture relationships should be sought to provide the necessary resources in facilities, equipment, and personnel. Larger institutions and minority owned businesses conducting research and development efforts are primary candidates for forming joint ventures. They should be selected based on the capabilities they can provide to your research efforts. In some instances, certain segments of the minority community have been designated to receive substantial support by funding agencies. Currently minority businesses are designated to receive substantial support from the Department of Energy. Use of these factors in forming joint ventures even if it requires that the institution serve as subcontractor rather than prime contractor.

Adapting Institutional Procedures to Provide Appropriate Support of Research

Many minority institutions have not had the opportunity to participate in significant energy related research for a variety of historical reasons which will not be discussed but are well documented. As a result mechanisms to provide institutional support of research has not been established in these locations. Rigid institutional policies which hamper conducting significant research should be reviewed by both faculty and administrators and modified to provide a more supportive environment. The proceeds received by the

institution to support its' overhead can in large measure be provided by research funds. Thus, it is well worth the effort to provide institutional mechanisms which will facilitate receiving funds and conducting research.

APPENDIX C

LIST OF PARTICIPANTS

BY ORGANIZATIONAL DESIGNATION

Atlanta University
- Kofi Bota
- Joe Johnson
- Tom Cole
- John Browne
- Rosannah Taylor
- Villian Boone
- James Reed

Chicago State University
- June Cook

Howard University
- Lenneal Henderson
- William Jackson
- Joe Cannon
- Paula Rhodes
- M. Gapola Rao
- William Ellis

Morgan State
- Julius Taylor

North Carolina Central University
- K. Kim

Prairie View A&M University
- John Williams

Texas Southern
- Theo Herrington
- Curtis McDonald
- Rudy Schwarzer
- Tandy Tollerson
- Bobby Wilson

Tuskegee Institute
- Z. W. Dybczak
- Margaret Tolbert

Alabama A&M
  Richard Evans
  Bhart Singh

Booie State
  G. T. Austin

California Institute of Technology
  Fred Shair

Fort Valley State
  Isaac Crumley

Hampton Institute
  D. Denable
  K S. Han

Jackson State
  Carl Brooking
  Yearn Choi
  Keith Johnson
  Marvel Lang
  Leslie McLemore
  Charles Rhyne
  James Smith
  Hirosayn Tachikawa

Morehouse
  Tom Norris

North Carolina A&T
  D. Y. Goswani
  David Klett
  E. K. Stefanakos

Spelman
  Wiliam Leflore

Virginia State
  G. W. Henderson

Virginia Union University
  W. R. Johnson

AMAF Industries
Carl Spight

Brookhaven
Tom Carney

Energy and Environment Engineering, Inc.
James Porter

National Academy of Sciences
Leroy Colquitt

Oakridge National Laboratory
Jack Ranney

Sandia Laboratory
Reginald Mitchell

Solar Energy Research Institute
Steven Hogan

Suny-Albany
Lonzy Lewis

U.S. Department of Energy
Barry Haley
William Jones
Richard Stephens

University of California, Lawrence Berkeley Laboratory
Mina Bissell
Maria Lupe Delgado
Jack Hollander
Gail Kato
William Lester
Joyce McCann
Tihomir Novakov
Ben Pope
William Siri
Harold Wilson

University of Wisconsin
Arthur Ellis

APPENDIX D

CONFERENCE PROGRAM

Conference on Energy Research at Historically Black Universities

June 17-19, 1980

Sheraton Patriot Inn
Williamsburg, Virginia

sponsored by

University of California, Lawrence Berkeley Laboratory and Department of Energy

MONDAY
June 16, 1980

6:00 p.m. - 11:00 p.m.

Registration

TUESDAY
June 17, 1980
1st Open Session

All Open Sessions Will Be Held In Patriot Conference/Ballroom

8:30 a.m. - 9:00 a.m.

Registration

9:00 a.m. - 9:30 a.m.

DR. WILLIAM LESTER *(presiding)*
Associate Director, Lawrence Berkeley Laboratory
Director, National Resource for Computation in Chemistry
University of California

Presentation: *"Introductions and Purpose"*

9:30 a.m. - 10:30 a.m.

DR. JACK HOLLANDER
Associate Director, Lawrence Berkeley Laboratory
University of California

Presentation: *"Analysis of National Academy of Sciences Report on National Energy Study"*

10:30 a.m. - 10:45 a.m.

Coffee Break

10:45 a.m. - 11:45 a.m.

DR. EDWARD A. FRIEMAN
Director
Office of Energy Research
Department of Energy

Presentation: *"Discussion of FY 80-81 Budget and Its Impact on Research"*

11:45 a.m. - 12:30 p.m.

DR. JAMES PERKINS
Program Consultant

Presentation: *"Schedule and Format for Small Group Meetings"*

12:30 p.m. - 1:30 p.m.

Lunch

1:30 p.m. - 2:00 p.m.

DR. CARL SPIGHT
Vice President
AMAF Industries, Inc.

Presentation: *"Opportunities for Research and Development Efforts with AMAF Industries"*

2:00 p.m. - 5:30 p.m.

Small Group Meetings

6:00 p.m. - 8:00 p.m.

Dinner Banquet in Patriot Conference Ballroom

8:00 p.m.

DR. JAMES PORTER
President
Energy and Environment Engineering Company

Presentation: *"Coal Combustion and Conversion: Research Opportunities"*

WEDNESDAY
June 18, 1980
2nd Open Session

9:00 a.m.

DR. WILLIAM LESTER *(presiding)*
Associate Director, Lawrence Berkeley Laboratory
Director, National Resource for Computation in Chemistry
University of California

9:00 a.m. - 10:00 a.m.

DR. JOYCE McCANN
Principal Investigator
Biology and Medicine Division
Lawrence Berkeley Laboratory
University of California

Presentation: *"Short-Term Tests for Carcinogens and Mutagens"*

10:00 a.m. - 10:15 a.m.

Coffee Break

10:15 a.m. - 12:30 p.m.

Small Group Meetings

12:30 p.m. - 1:30 p.m.

Lunch

1:30 p.m. - 4:00 p.m.

Small Group Meetings

4:00 p.m. - 5:30 p.m.

3rd Open Session
DR. WILLIAM LESTER *(presiding)*

Presentation: By Coordinators on Status of the Small Group Meetings

8:00 p.m.

DR. LENNEAL HENDERSON, JR.
Public Administration — School of Business
Howard University

Presentation: *"Energy Policy: Managing the Socio-economic Dimensions"*

THURSDAY
June 19, 1980
4th Open Session

9:00 a.m.

DR. WILLIAM LESTER *(presiding)*
Associate Director, Lawrence Berkeley Laboratory
Director, National Resource for Computation in Chemistry
University of California

9:00 a.m. - 10:00 a.m.

DR. LARRY KAZMERSKI
Acting Branch Chairman
Photovoltaics
Solar Energy Research Institute

Presentation: *"Research and Development in Photovoltaics at Solar Energy Research Institute"*

10:00 a.m. - 11:00 a.m.

DR. WILLIAM JACKSON
Chemistry Department
Howard University

Presentation: *"Current and Future Applications of Lasers to Energy Research"*

11:00 a.m. - 11:15 a.m.

Coffee Break

11:15 a.m. - 12:30 p.m.

Small Group Meetings

12:30 p.m. - 1:30 p.m.

Lunch

1:30 p.m. - 2:30 p.m.

DR. FRED SHAIR
Chemical Engineering
California Institute of Technology

Presentation: *"Atmospheric Tracer Techniques Applied to Energy and Environmental Problems"*

2:30 p.m. - 3:30 p.m.

Small Group Meetings

3:30 p.m. - 3:45 p.m.

Coffee Break

3:45 p.m. - 5:30 p.m.

5th Open Session
DR. WILLIAM LESTER *(presiding)*

Presentation: *"Final Reports on Small Group Meetings"*

5:30 p.m.

MR. HAROLD WILSON
Conference Director
Lawrence Berkeley Laboratory
University of California

Presentation: *"Meeting Summary"*

SMALL GROUP MEETINGS

Room A: Fossil Fuel Research

Coordinator:

Dr. Joe Cannon
Head, Chemical Engineering Department
Howard University
Washington, D.C.

Resource Persons:

Dr. James Porter
President, Energy and Environment Engineering Company
Cambridge, Massachusetts

Mr. William Jackson
Chemistry Department
Howard University
Washington, D.C.

Dr. Reginald Mitchell
Sandia Laboratory
Albuquerque, New Mexico

Room B: Policy Research

Coordinator:

Dr. Leslie McLemore
Head, Political Science Department
Jackson State University
Jackson, Mississippi

Resource Persons:

Dr. Jack Hollander
Associate Director, Research Planning
Lawrence Berkeley Laboratory
Berkeley, California

Dr. Lenneal Henderson, Jr.
Public Administration Department
School of Business
Howard University
Washington, D.C.

Dr. William E. Siri
Energy & Environment Division
Program Manager, Policy Analysis
Lawrence Berkeley Laboratory
Berkeley, California

Room C: Environmental Impact Group

Coordinator

Dr. Keith Johnson
Head, Meteorology Program
Jackson State University
Jackson, Mississippi

Resource Persons:

Dr. T. Novakov
Energy & Environment Division
Lawrence Berkeley Laboratory
Berkeley, California

Dr. Tom Carney
Brookhaven National Laboratory
Department of Atmospheric Sciences
Upton, New York

Dr. Fred Shair
Chemical Engineering Department
California Institute of Technology
Pasadena, California

Room D: Biomass Research

Coordinator:

Dr. Kofi Bota
Atlanta University
Chemistry Department
Atlanta, Georgia

Resource Person:

Dr. J. W. Ranney
Environmental Sciences Department
Oak Ridge National Laboratory
Oak Ridge, Tennessee

Room E: Solar Research

Coordinator:

Dr. H. Tachikawa
Jackson State University
Chemistry Department
Jackson, Mississippi

Resource Persons:

Dr. Larry Kazmerski
Acting Branch Chief
Photovoltaics
Solar Energy Research Institute
Golden, Colorado

Dr. Arthur Ellis
University of Wisconsin
Department of Chemistry
Madison, Wisconsin

Room F: Conservation Research

Coordinator:

Dr. Marvel Lang
Department of Geography
Jackson State University
Jackson, Mississippi

Resource Person:

Dr. William Jones, TBA
Department of Energy

Room G: Biological Research

Coordinator:

Dr. Joe Johnson
Atlanta University
Biochemistry Department
Atlanta, Georgia

Resource Persons:

Dr. Joyce McCann
Biology & Medicine Division
Lawrence Berkeley Laboratory
Berkeley, California

Dr. Mina Bissell
Chemical Biodynamics Division
Lawrence Berkeley Laboratory
Berkeley, California

Room H: Planning Group

Coordinator:

Dr. James Perkins
Program Consultant

Resource Person:

Dr. Tom Cole
Vice President, Academic Affairs
Atlanta University
Atlanta, Georgia

STAFF
María Lupe Delgado
Gail Kato
Lawrence Berkeley Laboratory
Berkeley, California

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