Report of the Advisory Committee On Agriculturally Derived Fuels To the Texas Energy and Natural Resources Advisory Council

MEMBERS OF THE COMMITTEE

Reagan V. Brown, Commissioner of Agriculture, Chairman
Bill Clayton, Speaker of the House of Representatives
Bob Armstrong, Commissioner of the General Land Office
Bill Walton, Chairman of the Agricultural Subcommittee, Texas Energy Advisory Council
Dr. Spencer Baen,Director, Center for Energy and Mineral Resources, Texas A&M University
Jack Carmichael, Director, Solid Waste Division, Department of Health
Raymond Cowley, Management Consultant, Rio Grande Valley Sugar Growers, Inc.
Joe Quick, Research Associate, DOW Chemical Company
Carl King, President, Texas Corn Growers Association
Elbert Harp, Executive Director, Texas Grain Sorghum Producers Association
Bill Nelson, Executive Vice President, Texas Wheat Growers Association
Ed Wagoner, Executive Vice President, Texas Forestry Association
Dr. Richard McDonald, Executive Director, Texas Cattle Feeders Association
Stan Swanson, National Gasohol Commission Contact

DISCLAIMER

TEXAS ENERGY AND NATURAL RESOURCES ADVISORY COUNCIL
800 EXECUTIVE OFFICE BUILDING, 411 WEST 13TH STREET, AUSTIN, TEXAS 78701

Co-Chairman:
William P. Clements, Jr.
Governor

William P. Hobby
Lieutenant Governor

Vice-Chairman:
Bill Clayton
Speaker of the House

Executive Director:
Edward O. Vetter

October 23, 1979

Dear Governor Clements and Members of the
Texas Energy and Natural Resources Advisory Council

Submitted herewith is the report of the Advisory Committee on Agriculturally Derived Fuels of the Texas Energy Advisory Council. The Committee was created by official action of the Council at its quarterly meeting on December 15, 1978. Meetings of the Committee have been held on January 16, 1979; February 13, 1979; March 15, 1979; June 16, 1979; the Technical Advisory Committee on Biomass, July 31, 1979; the Statewide Research Workshop held on August 16-17, 1979, and a final meeting on October 22, 1979, to approve the Committee report. The Committee is indebted to many people who have given generously of their time and expertise in helping the Committee to review in some depth the potential of the various biomass energy resources available in Texas. In the several meetings held or sponsored by the Committee, the responsibilities assigned by the Council have been addressed as fully as possible, including specific recommendations to the Council relating to appropriate policy measures and/or responses to federal programs and policy.

With the submission of this report, the Advisory Committee on Agriculturally Derived Fuels stands ready to proceed with such further activities as the Council may wish to assign.

On behalf of the Membership of the Committee, I wish to express appreciation to you, Lt. Governor Hobby, Speaker Clayton and the entire Membership of the Texas Energy Advisory Council for interest in and support of the activities of our group. It has been both a pleasure and an enlightening experience to have had the privilege of serving the Council and the State of Texas in this capacity.

Respectfully,

Reagan V. Brown

Reagan V. Brown
Chairman

RVB/wt

REPORT OF THE

ADVISORY COMMITTEE ON

AGRICULTURALLY DERIVED FUELS

to the

TEXAS ENERGY AND NATURAL RESOURCES ADVISORY COUNCIL

SEPTEMBER 3, 1979

AUSTIN, TEXAS

COMMISSIONER REAGAN BROWN

CHAIRMAN

ADVISORY COMMITTEE ON
AGRICULTURALLY DERIVED FUELS

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CREATION AND CHARGE OF

THE COMMITTEE ON AGRICULTURALLY DERIVED FUELS

On December 15, 1978 the Texas Energy Advisory Council, Lt. Governor William P. Hobby, Chairman, created a "Committee on Agriculturally Derived Fuels" for Texas. The motion to establish this body was introduced by Agriculture Commissioner Reagan Brown, and seconded by House Speaker Bill Clayton. A portion of the approved motion is reprinted below. Lt. Governor Hobby appointed Commissioner Brown Chairman of the new committee and accepted the suggested committee composition as reflected below.

> "The importance of the Texas Agricultural industry, including forestry, is well known to the members of this council. It is not only vital to the economy of the state and the well being of its people, but it is becoming apparent that this renewable resource also has the potential of becoming a significant producer of energy. Ethyl alcohol, methyl alcohol, and methane gas are already being produced from agricultural crops, crop residues, stressed grains, forestry residues and by-products, and animal wastes. The direct combustion of certain of these agriculturally and forestry derived products for steam and electric power generation also has merit. Furthermore, certain indigenous plant species and hybrid species can be produced in Texas to provide hydrocarbon feedstocks for the chemical industry or replacement of synthetic materials such as is used in the production of rubber. These endeavors have the multiple potential advantage of utilizing set-aside acreages from crops in surplus supply and certain previously unproductive lands while expanding market outlets and reducing dependence on energy from imported petroleum products which have resulted in disastrous trade deficits and posed serious national security risks.
>
> For these reasons, I propose that a special committee of the Council be established to be known as the Advisory Committee on Agriculturally Derived Fuels.
>
> The Committee would report to the Council and would be charged with the following duties: (1) reviewing the potential of various biomass energy resources available to Texas, (2) analyzing economic costs and benefits of various conversion technologies available, (3) determining whether a long-range plan for developing biomass resources is required to coordinate the different

aspects involved, (4) determining the salient feature of such a development plan, (5) communicating with other local, state, and national entities engaged in related biomass energy programs, and (6) recommending to the Council appropriate policy measures or responses to federal programs and policy. The Committee shall report to the Council at the September, 1979 meeting and at such other times as are deemed appropriate."

The following were appointed members of the Committee:

From the Council -

Commissioner of Agriculture, Reagan V. Brown, Chairman

Speaker of the House of Representatives, Bill Clayton

Commissioner of the General Land Office, Bob Armstrong

Chairman of the Agricultural Subcommittee, TEAC, Bill Walton

Additional Members appointed to the Committee -

Dr. Spencer Baen, Director, Center for Energy and Mineral Resources, Texas A&M University

Jack Carmichael, Director, Solid Waste Division, Department of Health

Raymond Cowley, Management Consultant, Rio Grande Valley Sugar Growers, Inc.

Joe Quick, Research Associate, DOW Chemical Co.

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Dr. Richard McDonald, Executive Director, Texas Cattle Feeders Assoc.

Stan Swanson, National Gasohol Commission Contact

ACKNOWLEDGEMENTS

The Committee thanks Dr. John Hutchison, Consultant, Texas Department of Agriculture; Dr. Spencer Baen, Director, Center for Energy and Mineral Resources, Texas A&M University; and Mr. Charles Galvin, Jr. and Mr. Jim Niewald of the Texas Energy Advisory Council for their invaluable assistance in the research, development and writing of the Report of the Advisory Committee on Agriculturally Derived Fuels.

EXECUTIVE SUMMARY

For the purpose of the Committee, biomass was defined as the volume of living material or residues of living material (organic material) available in Texas for conversion into energy. Statistical reports from the Texas Agricultural Experiment Station and other sources indicate that in addition to surplus and distressed grains and certain other crops such as sugarcane, sugar beets, sweet sorghum, promising non-traditional crops including guayule, jojoba and certain Euphorbia species, forestry products and residues, and such products from mariculture as algae and kelp, there are roughly 27 million tons of agricultural residues currently being left in the fields or at the processing plants after harvest. The average annual residue from five crops -- sorghum, corn, wheat, rice and cotton -- is more than 20 million tons with a theoretical heat value of 270 trillion Btus. This represents 64 percent of the total energy input for Texas agriculture in 1973. Additionally, 4.1 million tons of dry manure is economically recoverable from Texas feedlots which could be converted into 14 trillion Btus of energy each year in the form of methane gas.

Municipal solid waste, much of which is comprised of residues of living materials, currently amounts to about 13 million tons annually. Sixteen of the more populous counties of the state generate wastes in quantities that would provide for economical resource recovery. The potential energy available in the waste collected in these 16 counties represents about six percent of the state's thermal energy requirements for electric power for non-industrial use. (Municipal solid waste can also be combined with agricultural and forestry residues for use directly as a solid fuel).

The principal processes for converting the referenced resources into energy include: (1) Direct combustion -- using improved energy efficient combustors; (2) Fermentation -- to produce ethyl alcohol from any biomass product that is relatively high in sugar, starch or cellulose (the U.S. Department of Energy reported recently that ethanol is the only alternative liquid fuel commercially available now, and the only one likely to be available in quantity before 1985); (3) Gasification/Pyrolysis -- the chemical decomposition of substances by the action of heat in the absences of oxygen at atmospheric pressure to produce tar and oils, char, carbonaceous gases, and liquids of varying compositions; (4) Anaerobic Digestion - bacterial degradation of manure or sewage alone or in combination with plant material to produce methane gas and effluent by-products, this process can also be used to produce methyl alcohol from biomass; and (5) Petroculture - the production of certain non-traditional plants - Guayule, Jojoba and Euphorbia-tirucalli- capable of yielding respectively latex as a source of rubber, a wax which is nearly identical to sperm whale oil and a hydrocarbon chemically similar to crude petroleum.

Texas produces huge quantities of biomass, and has the potential of producing even more, which can be converted through various processes into significant quantities of usable energy to help meet the needs of the agricultural industry and the general public. Some of the technology required for the conversion processes is already sufficiently advanced to support immediate production and use while others will require additional research and development. The report which follows discusses the current level of development of the relevant technologies and an estimate of the potential contribution each can make as alternate sources of energy in Texas.

Summary of recommendations by the Advisory Committee on Agriculturally Derived Fuels for the development of biomass resources in Texas include:

1. That approximately $1 million of the available Energy Development Grants be considered for application to the biomass area.

2. That at least 75% of this amount be made available to stimulate the development of a small number of significant demonstration projects. These will include prototype small-scale alcohol distilleries (for on-farm and co-op use) located in different areas within the state to optimize the design and evaluate other variables associated with the operation and maintenance of the systems.

3. That approximately 15% of available development grants be directed toward appropriate policy-related research, especially agricultural policy, biomass development and environmental standards.

4. That about 10% be considered for research and development in the production, handling, and utilization of energy related crops such as jojoba, guayule, mesquite, etc. In addition to energy related crops, there should be applied research in the development of crop species and/or alteration practices which maximize both the energy and food or feed content of such crops in an efficient manner.

5. Demonstration projects should be constructed on a scale that will provide useful data for "on-farm" systems, farmer co-op systems, or community level applications as these entities are clearly in greatest need for renewable energy resources information.

6. There is need for establishing a clearinghouse for information on biomass where individuals can obtain the information they desire. We suggest that the Agricultural Extension Service be asked to undertake this task and report periodically to the Council.

Finally, it is the recommendation of the Committee that a standing committee on energy from biomass be established to advise the Council on continuing developments in the biomass area.

INTRODUCTION

The Committee on Agriculturally Derived Fuels initiated its efforts with acknowledged assumption that the energy crisis is real, that it was and would continue to impact heavily on Texas' vital agricultural industry and that there was a crucial need to explore fully the potential for developing all alternate sources of energy, with special emphasis on renewable resources. The Committee considers it imperative that we become energy independent in Texas and in the nation. Motivation and inspiration were drawn from research reports which indicated that agriculture (defined broadly to include forestry, marine and other developing systems for producing and handling biomass) could become a significant producer of energy over and above that which is inherent in the traditional products of food, feed, and fiber. Additionally, a number of opportunities exist for developing technology to reduce the cost and increase the reliability of energy sources for agricultural production.

At the first meeting of the Committee on January 16, 1979 each member was given an opportunity to brief the Committee on his activities, concerns and priorities. It was evident from the focus of the statements that there was a high degree of interest in various aspects of fuel alcohol production. However, it was generally agreed that the Committee's responsibilities were much broader in scope and should include as thorough an examination as possible of the potential for developing energy from biomass.

For the purpose of the Committee, biomass was defined as the volume of living material or residues of living material available in Texas for conversion into energy. Statistical reports indicating that in addition to surplus and stressed grains and other crops such as sugarcane, sugar beets, sweet sorghums, forestry products and by-products, and such products from mariculture as algae and kelp, there are roughly 27 million tons of agricultural residues currently being left in the field or at the processing plant after harvest. Feedlot wastes and municipal mixed refuse and sludge also constitute valuable feedstocks for energy production. On a national basis, the U. S. Department of Energy projects a maximum of 822 million dry tons of biomass resources available annually for alcohol production from wood, grains, sugars and food processing wastes and that this amount is likely to increase to 1148 million tons by the year 2000. Biomass plantations, including petroculture, revised cropping systems, and the systematic use of conservation practices were recognized as important contributors to a sound energy program.

Committee members were initially concerned to learn that it was illegal to manufacture alcohol in Texas under existing statutues. Immediate support of efforts to revise the Code to allow the production of fuel alcohol in the State was recommended.

A procedural format was adopted at the January 15, 1979 meeting involving invitations to qualified resource persons to address the Committee on subjects relating to the broad area of biomass conversion. Other methods suggested by the TEAC staff for obtaining essential information for use by the Committee included securing recommendations from the TEAC Technical Task Force and the convening of a research oriented workshop to secure information

from the scientists who were actively engaged in research, development and demonstration projects to assist in identifying technical and policy oriented issues essential to the further development and enhancement of biomass as an energy source and to provide a forum for interaction and information exchange. Copies of the agendas along with summaries of the minutes of the several meetings held or sponsored by the Committee are included in the appendix attached to this report. Among the resource persons, other than Committee members, who addressed the Committee or participated in the meetings were: Les Levine, Acting Director for Biomass, U.S. Department of Energy; Robert Soleta, Administrator of the National Gasohol Commission, Inc., Klauss Rokita, an international authority on the fermentation process of producing fuel alcohol, Bohler Brothers of America, Houston, Texas; Holly Hodge, President of the National Gasohol Commission, Inc.; Howard Hinton, Midwest Solvents, Inc.; representatives of the Energy Institutes at the University of Texas at Austin, Texas A&M University, Texas Tech University, and the University of Houston; and representatives of the U.S. Department of Agriculture.

Representatives of the Committee monitored legislation related to agriculturally derived fuels during the regular session of the Sixty-Sixth Legislature and of the U. S. Congress.

Because of the intense interest in the potential of alcohol fuels, the Committee sponsored a test demonstration of gasohol for State Officials. Midwest Solvents Corporation provided the required amount of 200 proof anhydrous alcohol to make 5000 gallons of gasohol. Dave Fellers, Executive Director of the Texas Oil Marketers Assn. assisted with arrangements for the test. Neal Petrofina Inc. of San Antonio provided the unleaded gasoline, the equipment and supervisory personnel for blending and dispensing the gasohol at their local station at IH 35 and Riverside Drive. Staff members of the Rural-Urban Business Standards Division of the Texas Department of Agriculture also assisted with the blending of the gasohol and general supervison of the test, which offered up to 20 gallons of gasohol to each member of the Legislature and to all State-wide Elected Officials. State Fire Marshall Vernon Ray assisted with plans to insure safety during the test-demonstration.

One hundred ninety two officials received 2986.8 gallons of gasohol or an average of 15.5 gallons each. The reaction of those using the gasohol was favorable with many reporting slightly improved mileage and smoother engine performance over regular unleaded gasoline. Only one poor experience was reported which involved an older model automobile which had been using regular leaded gasoline. Apparently, the solvent action of the alcohol loosened previously deposited matter and caused the strainer in the carburetor to "gum up" which resulted in the car stalling out. (This phenomenon has been reported in the literature relating to similar tests with gasohol following the extended use of leaded gasoline, but after the use of the first fillup of gasohol, no further problems were experienced.)

Committee Members wish to express appreciation to Governor Clements, Lt. Governor Hobby and other State Officials for their interest and support. Special appreciation is extended to Speaker Clayton, Representatives Forrest Green, Dan Kubiak, Bill Keese and Senators Raul Longoria, Bob Price and Bob Vale

for their participation in and support of activities of the Committee.

Appreciation is due also to the staff of the Texas Energy Advisory Council with special thanks to former staff member Bob King.

The Committee established liaison with the National Gasohol Commission, Inc., appropriate members of the U. S. Department of Energy, the U. S. Department of Agriculture and other relevant groups interested in agriculturally derived fuels.

The Committee endorsed the application of Midwest Solvents, Inc. and the Rio Grande Valley Sugar Growers, Inc. for a $15 million guaranteed loan under provisions of the Food and Agriculture Act of 1977 to build an Ethanol Manufacturing Plant at Santa Rosa, Texas. The loan was approved and it is expected that the plant will be completed by 1981 with a capacity to produce from ten to twenty million gallons of 200 proof ethanol per year using molasses (a by-product of the sugar mill), milo grain, culled fruits and vegetables from local packing sheds and canning plants and sweet sorghum as feedstocks.

Representatives of the Committee participated in conferences during the legislative session to effect a compromise between the beverage alcohol interests and the fuel alcohol interests to pass legislation amending the alcohol code to permit the production of fuel alcohol in Texas.

A summary report of activities of the Committee in each area assigned by the Texas Energy Advisory Council follows.

1) The Potential of Various Biomass Energy Resources Available in Texas

The importance of Texas agriculture is implicit in the fact that gross income from production agriculture has exceeded six billion dollars for each of the past five years. Gross income for 1978 was $7.8 billion and cash receipts for the first six months of 1979 were more than $800 million above those for the same period of 1978. The economic impact of the agricultural industry (not including forestry) on the State's economy as the raw agricultural products moved through the channels of trade in 1978, however, was $28.584 billion (using the multiplier factor developed by the Governor's Economic Planning Office in 1967 and updated in 1972.)

Texas agriculture is energy intensive and the spiraling cost of fuel poses a threat to the economic future of the industry. For example, irrigation costs comprise approximately 40 percent of the total cost of production on irrigated farms. Natural gas is the primary fuel used to power irrigation pumps and the increased cost of this fuel has already forced a large number of irrigation farmers out of business in Trans-Pecos Region and is nearing the "breaking point" in many areas of the High Plains Region. Spot shortages of diesel and other liquid fuels created some problems during 1979.

The development of alternate and more economical sources of energy for irrigation and other cultural, harvesting and processing practices are essential to the continued growth and development of this industry which is vital to the State's economy and the well-being of its people. Nearly 40 percent of the gainfully employed people in Texas are employed in some phase of the total agricultural industry, that is, production, processing, distribution and marketing. The failure to develop alternate sources of energy would result in reduced production and income, and would require major adjustments in cropping systems.

Fortunately, Texas produces large amounts of biomass which has considerable potential for use in developing alternate sources of energy for agriculture. Sources include large quantities of: food and feed grains; crop residues; sugar cane; sugar beets; sweet sorghum; forestry products; by-products and residues; hugh quantities of rangeland brush - especially mesquite; manure from commercial cattle feedlots and poultry operations; marine plants and an additional potential from biomass plantations. The following statistics provide some insight regarding the volume of biomass available:

Crop	Avg. Prod. 1974-1979 (000)	1979 (est.) (000)	In Storage Jan 1,'79 (000)	In Storage June 1, '79 (000)
Milo	161,006 cwt.	137,984 cwt.	103,561 cwt.	43,226 cwt.
Corn	138,222 bu.	136,500 bu.	87,725 bu.	33,089 bu.
Wheat	91,760 bu.	138,000 bu.	74,260 bu.	49,366 bu.
Sugar beets	403 tons	364 tons	--	--
Sugar cane	1,020 tons	969 tons	--	--

*Texas Crop and Livestock Reporting Service

A 1978 report published by the Center for Mineral and Energy Resources and the Texas Agricultural Experiment Station at Texas A&M shows that crop residues from five major crops - grain sorghum, cotton, corn, wheat and rice - produce about 20 million tons of residue which have a theoretical heat value of 270 trillion Btus. This amount approximately equals the amount of energy in fuel purchases for on-the-farm use in 1974 and 1.7 times the energy used in fuel for irrigation in that same year.

Obviously, it would be neither economically feasible nor desirable to convert all crop residues to energy but the volume suggests the potential is great enough to warrant full investigation into the amounts that could be utilized without adversely affecting the fertility and physical structure of the soil and the development of appropriate technology for accumulating and economically converting residues into usable energy.

Additionally, based on a Soil Conservation Service estimate in 1979, Texas has 3,715,000 acres of high production land, 10,749,000 acres of medium production land and 49,809,000 acres of marginal land now in pasture, range, forest and other uses that could be converted to cultivation, if needed for energy crops.

Four to five million head of cattle are currently being fed in the high plains area of Texas each year. Studies have shown that about 4.1 million tons of dry matter from livestock and poultry manure is recoverable. This amount of manure recovered annually could be converted into methane gas having an energy value of approximately 14 trillion Btus.

Recent estimates indicate that approximately five million tons of logging residues are currently available from annual forestry harvesting operations in Texas with this amount expected to double by the year 2004. An additional 45 million tons of rough and rotten trees in standing volume and two million tons of dead trees are available for harvest. Further, hardwood currently growing on sites suitable for pine could make available 17.5 million cords of hardwood in a reforestation of these sites back to pine to meet demand projections.

In addition to traditional agricultural crops, and forestry there is currently much interest in a group of plants capable of producing such hydrocarbons as oil, latex for rubber or other direct substitutes for hydrocarbon based compounds currently being produced from petroleum. The production of such plants is referred to as petroculture. The most promising of these plants are Guayule, Jojoba and Euphorbia.

Guayule is a native shrub of southwest Texas and northern Mexico and produces latex that is chemically and physically identical to that produced by the Asian rubber tree.

A Euphorbia species, E. tirucalli, produces latex which is a water suspension of a hydrocarbon with a molecular structure similar to that of crude oil.

The seed of Jojoba resembles a small green olive and contains as much as 60 percent by weight of a light, yellow odorless liquid wax. This wax is almost identical to the oil obtained from the sperm whale, a key industrial product in short supply.

Municipal solid waste offers the potential for recovery of valuable materials and can make a significant contribution to conservation and efficient resource utilization. Municipal solid waste in Texas now amounts to nearly 13 million tons annually. This represents a generation rate of slightly more than 5 pounds per person per day. According to Texas Department of Health, sixteen of the more populous counties in the state generate wastes in quantities that would provide for economical resource recovery. The potential energy available in the waste collected in these 16 counties represent about 6% of the state's thermal energy requirements for electric power for non-industrial use. There are systems becoming available that will extend this potential for recovery to localities that produce as little as 50-100 tons of solid waste per day, or for communities with a population of approximately 20-40,000 persons.

Municipal solid waste can also be combined with agriculture and silviculture waste to be used directly as a solid fuel. A threefold process of combining sewage sludge, municipal solid waste, and feedlot manure in a biological conversion system to produce methane gas offers not only the potential of gaining a useful fuel but also the additional benefit of reducing the disposal problem of each type of waste used in the process.

From the data cited above, it is evident that Texas has enormous and diverse biomass feedstocks. Economical methods of converting these renewable resources into usable energy forms should be pursued vigorously as a part of the over-all program to lessen our dependence on the importation of scarce, expensive petroleum from unstable sources.

2) Overview of Activities in Biomass Conversion

The technologies for converting biomass into energy vary widely. Many of the technologies are available for demonstration and use today while other technologies or components of them will come on line after further research and development. Technological breakthroughs could dramatically reduce the time in which these technologies come on line. Texas is fortunate to have large and diverse agricultural and forestry industries. Long-range planning is necessary to ensure that the vast amount of biomass resources available in the state are utilized in accordance with the most advanced technology, sound soil and water conservation and economic feasibility.

The long-range plans to utilize the available resources would be based on the best conversion technologies available.

A. Fermentation

According to a recent DOE report, ethanol is the only alternative fuel commercially available now and the only one likely to be available in quantity before 1985. Ethanol is produced through fermentation of any raw material rich in carbohydrate content. These raw materials include not only molasses and cereal grains, which are rich in sugars and starches, but also crop residues, forestry residues and cultivated biomass crops which contain cellulose as their principal component. However, in order for these latter materials to be used cellulose must be converted into glucose through acid or enzymatic hydrolysis (U.S. Dept. of Energy, The Report of the Alcohol Policy Review, 1979).

The basic fermentation technology has existed for centuries. Large-scale alcohol plants for beverage consumption have been in existence for decades and produced 30 million gallons in 1977. However, those distilleries designed for beverage rather than fuel alcohol, were built when energy costs were much lower than they are now and use more Btus of energy to make alcohol than are in the final product. Ethanol can be produced to yield a positive net energy balance and the production facilities can readily be designed to use fuel sources other than oil or gas.

More advanced technology for ethanol production is in the early stages of research and development. Innovations are being researched in the fermentation process, the distillation process and for the utilization of cellulosic forest and agricultural residues as a feedstock for alcohol production. It is estimated that these technologies should develop to commercial feasibility levels within the next five to ten years and could greatly expand energy production from biomass.

Small-scale technology has also been utilized for decades. However, no state of the art working demonstration exists. Work is needed on designing energy efficient plants and plants that can use non-conventional sources of energy. Various feedstock could also be tested.

B. Anaerobic Digestion

Manure and sewage alone or in combination with plant foods or residues, are potential feedstocks for methane production from anaerobic digestion. Under ideal conditions, animal wastes would be digested completely and in a short period of time would produce a high Btu gas effluent with high fertilizer value. In addition, an early step in the process involves screening the manure to remove fiber. This fiber can then be used as an ingredient in cattle feed.

Methane is the primary component of natural gas and has an energy content of 1,000 Btu per cubic foot. Bacteria degradation of manure under anaerobic digestion releases a gas composed of approximately 60 percent methane and 40 percent carbon dioxide along with some trace gases. This biogas has an energy content of 600 Btus per cubic foot. However, the carbon dioxide and trace gases can be removed at an additional cost yielding a pipeline quality gas.

The extraction of energy from wastes using anaerobic digestion to produce methane is not new and the general technology is well known. Sewage treatment plants constantly generate biogas (where the principal component is methane) from the sewage sludge as part of the sewage treatment processes. However, methane production from anaerobic digestion requires closely controlled facilities.

New developments in the application of this technology address the energy potential that can be extracted from agricultural wastes and, primarily, livestock manures. The primary barriers to more widespread use are the amount of management required due to the sensitivity of the digesters, the high initial investment required for equipment, and the fact that the wastes still must be disposed of after digestion. Research is in progress to make the process more practical for energy production. Scientists are investigating new strains of bacteria and culturing techniques for purchasing methane. Engineers are investigating digester design and operation to reduce construction and operational requirement and costs.

C. Direct Combustion

Combustion is an ancient conversion process that directly converts biomass into usable heat rather than into a secondary fuel. When sufficiently dried, all biomass will sustain combustion. However, wood and woody refuse have been and are the most feasible biomass feedstocks for direct combustion. In 1969, 73 percent of wood cut in the world was used for fuel (Solar Program Assessment: Environmental Factors, DOE, March, 1977).

Wood chips from wood residues have great potential as a fuel source to produce electricity. Most residues from logging or milling operations in the U. S. are either burned or buried. These large supplies of residues are available for electric generation anywhere there are substantial forestry operations, especially in the South. The residues can be burned as a supplemental fuel in powerplants originally designed for coal or lignite with at least as much energy output. However, due to the non-uniformity of wood sources, problems occur with variances in moisture, size, cleanliness, and Btu content. This can cause corrosion and slagging problems in the boiler.

As these problems are eliminated, wood will be increasingly popular as a fuel feedstock. Wood chips are economical as an energy source since it takes $2 worth of coal to purchase a million Btus of heat while the same amount of energy output could be purchased for about $1.25 in wood chips. In many cases, wood has a higher energy content than most forms of lignite and could make a significant contribution to our energy needs. (Murphey, 1979)

Research on the feasibility of small-scale, energy-efficient combustors and modular incinerators is in its early stages.

Stripper-harvesting is widely used for cotton harvesting in Texas and produces 700 to 1,000 pounds of cotton gin trash for each bale of cotton ginned. This trash has an energy content of approximately 7,000 Btu per pound. A gin operating at a rate of 15 bales per hour uses about 750 kw, but the trash that accumulates could be gasified or combusted directly and potentially produce 21,545 kw. (Hiler and LePori, "Energy From Biomass" in Alternate Energy Sources for Texas, 1978)

D. Gasification/Pyrolysis

Pyrolysis is the chemical decomposition of substances by the action of heat in the absence of oxygen at atmospheric pressure. When biomass is subjected to pyrolysis, three types of fuel are produced in various quantities: tar and oils, char, and carbonaceous gases. Feed-type, feed preparation, and reaction temperature determine the relative yields of each product, and the rate of heating can affect the composition of the gas; high heating rates correspond to an increase in carbon monoxide and decrease in carbon dioxide.

The use of pyrolysis in biomass conversion has largely been examined in connection with large-scale pyrolysis resource recovery projects. After separation from inorganic components, municipal waste is found to be quite similar to other biomass in cellulose content and has been proven in many working facilities. Laboratory studies have demonstrated the pyrolysis of various biomass materials, including manure, and crop and wood residues.

Gasification, or low Btu gas generation, is a variation of pyrolysis technology. With pyrolysis, biomass is burned in an environment of limited air. Partial combustion of the biomass takes place providing sufficient heat to allow pyrolytic reaction to occur. The result is a combustible solid (char) and a hot, combustible gas composed principally of carbon monoxide, hydrogen, nitrogen, carbon dioxide, and liquids of varying compositions. The hot gas is suitable for burning in a manner similar to natural gas if proper nozzles and filtering mechanisms are used, or after cooling it may be used in a small spark ignition or diesel engine.

Gas produced from pyrolysis has been used for decades. "Producer gas" was used extensively when many towns and cities had a "town gas" or "coal gas" plant which supplied gas for lighting and other residential and commercial uses. Gas producers using wood waste, straw, and ground corn cobs have been demonstrated both on large and small scales.

Gasification has some advantages over direct combustion for energy recovery. A gas-fired boiler is easier to control and has a slightly higher efficiency than a solid-fired boiler. Also, gasifiers can be used to generate electricity in small applications using internal combustion engines and gas turbines. This is not feasible for steam turbines operated from solid-fired boilers. A major advantage for gasification is to retrofit existing gas and oil-fired boilers. The Solar Energy Research Institute estimates that it is cheaper to install a gasifier in front of an existing boiler than to build a new wood-fired boiler.

Gasification/pyrolysis provides the only means to convert biomass to chemicals other than alcohol fuels. These chemicals include ammonia, ethylene, acetone and a whole range of chemicals that can be produced by pyrolysis (Beck and Parker, 1979).

At the present time, many small commercial gasifiers are available and many are being used in the forest products industry. Large gasifiers are not in current use because the demand is not present for the gas product at the price at which it is purchased ($3-$4 per million Btus). This is currently not competitive with natural gas, but as the domestic supply is depleted and the price of natural gas increases, wood gasification will become economically competitive.

E. Petroculture

In areas of low rainfall (5-6 inches per year) and low soil fertility, jojoba plants grow to 2-4 feet in height; with rainfall rates of 16 inches and medium soil fertility, the height may reach and even exceed 10 feet. Fruit forms and sets under both extremes, although the yield per plant is higher at the higher moisture levels, and has been recorded as high as 12 pounds of dry, clean seeds per plant. At 800-1,000 plants per acre, this represents a production potential of 10,000 pounds of seed per acre.

Maximum levels of fruit formation are achieved after the plants are four years old, which means that the growing of jojoba may require an operation more akin to citrus farming than to the growing of conventional crops such as cotton or wheat. The oil of the jojoba is extracted from the seeds by crushing them in equipment similar to that used for cottonseed oil extraction. The oil is very pure and requires almost no refining; it is resistant to oxidation and can be stored for several years.

Guayule grows well with 10-16 inches of rainfall per year. Harvesting of rubber occurs by either digging up the entire plant or by mowing off the tops, since rubber occurs throughout the plant except in the leaves. The rubber is extracted by crushing or finely chopping the plant material and treating it to a series of flotation and solvent processes. Since highest rates of rubber formation in guayule occur when the plant is about four years old, its production cycle will be similar to that of jojoba.

The Euphorbia tirucalli reaches maturity after several years. Harvesting of the tirucalli requires cutting it off near ground level, leaving the "stump" to resprout, then crushing the stems like sugarcane to remove the wax for further processing (Bragg, 1978).

Because guayule has not been produced on a large scale since World War II, the most appropriate production systems have not been developed. There is a commercial guayule plant in Satillo, Mexico, but they depend on labor intensive methods of harvesting the plant which is not acceptable for large scale commercial operations in the U.S. The same problems apply to other minimum tillage, water efficient crops such as jojoba and Euphorbia. Thus, there is an urgent need to update or develop suitable production, harvesting, and extraction systems if these crops are to become major agricultural crops in Texas.

A National Science Foundation and Border Commission supported program to investigate these potential Texas crops is under way at Texas A&M University. Additional State financial support, at this time, is not required.

3) Overview of Production Cost Estimates of Certain Biomass Technologies

There has been little work done on this area with specific reference to Texas. Costs within each conversion technology may vary significantly due to location, the types of feedstocks available, type of fuel used, etc. For example, blackstrap molasses or even raw sugar may be available for a feedstock and bagasse as a fuel source for alcohol production facility in the valley. And, corn or milo could be used as a feedstock for alcohol production and the by-product as a cattle feed in the Panhandle region. It is also possible to use "front-end milling" to remove the protein and oil from corn for direct human consumption before subjecting the starch indosperm to the fermentation process. An example of advanced technology in the fermentation process is claimed by Chemapec, Inc., Woodbury, N.Y. They claim a total energy recuperation process for producing ethanol from agricultural products which requires only 15,000 to 20,000 external Btus per gallon of ethanol produced. Chemapec, Inc. sets forth three conditions they believe essential to feasibility of producing fuel ethanol from agricultural products or by-products: (1)"The total energy input, especially the specific Btu input per gallon of alcohol produced, must be reduced to the economically feasible minimum and should not be higher than 20,000 Btus per gallon of alcohol for the complete process, from raw materials preparation until the final alcohol product is obtained. This energy should come from a domestically available source, preferably from renewable energy sources such as solar, bagasse, or agricultural wastes. (2) The attainable by-products, feed and food protein fractions, must be of first class quality, if possible, for direct human consumption, not only for economical purposes but also for ethical reasons. (3) The process must conform to the rules applicable for control of the environment with respect to both air and water." The Committee on Agriculturally Derived Fuels agrees with the referenced conditions.

Below are some microeconomic estimates of various conversion technologies. However, it must be emphasized that estimates of these technologies (taken from many sources) vary widely.

Estimates of economics of alternative conversion processes are as follows:

A-1. Alcohol - large systems using cellulosic feedstocks.
(by Dr. Ron Lacewell, Associate Professor Agricultural Economics, Texas A&M University)

Corn Stover - 21,227,000 gallons ethanol @ year
Investment $67.4 million
Costs per gallon of ethanol:

Fixed costs	.856
Materials	.747
Other	.117
Total	1.72 *

* The $1.72 is in 1978 dollars and includes by-product credits. It is a conceptional process postulated by Dr. George Tsao of Purdue and is a minimum estimate.

Corn Grain - 25,000,000 gallons ethanol @ year
Investment $29.4 million
Costs per gallon of ethanol $1.40 **

** Based on a corn price of $2.50 per bushel and includes no by-product credits. By-product credit is typically valued at $0.34 per gallon of ethanol, but also must have a cost of $0.16 per gallon of ethanol added for evaporating the water and drying the grain. (Co-location of the plant with a livestock feedlot of adequate size can reduce the cost of drying and handling the by-product.)

Sugar Cane - 25,000,000 gallons of ethanol @ year
Investment $37.6 million
Costs per gallon of ethanol $1.15 ***

*** Based on $13 per ton for sugar cane, a $0.06 per gallon credit for fuel and no other by-product credits.

Aggregate impacts of producing 12 billion gallons of ethanol (1/10 of gasoline consumption) from feed grains, food grains and residues is estimated to increase the price of feed grains from a base level of $2.46/bu. to $4.41/bu. or 79%. Food grain prices would increase from $3.22 to $4.69. The effect is a threefold increase in producers' surplus ($21 billion increase). Consumers' surplus decreases by about the same amount ($21 billion).

A-2. Alcohol - Small System-Archie and Alan Zeithamer, Alexandria, Minn. producing 160 proof to 180 proof ethanol from corn, sugar beets, potatoes (with plans to use some crops residues). Home built plant cost $10,000 for materials. Cost per gallon estimated at 50 cents per gallon.

(Dr. Chan Connally, Texas Agricultural Experiment Station, Weslaco, Texas, reports laboratory tests with sweet sorghum, in cooperation with Battelle Laboratories, Columbus, Ohio, estimate current costs at $1.15 to $1.25 per gallon of 200 proof ethanol.)

A-3. New York University engineering professor at the University's Westbury, L.I., N.Y. laboratories has built a one-ton-per-day demonstration plant to hydrolyze cellulosic waste continuously to glucose syrup. Plans at New York University are to increase the scale of the continuous hydrolysis of cellulostic waste to 20 to 50 tons per day. Current energy consumption is about 1600 Btu per pound of cellulose.

Projected cost of ethanol produced by this process is 85 cents to $1.00 per gallon. (From Chemical Engineering, October 8, 1979)

B. Methane Production

Based on 5,000 Head Farrow-to-Finish Hog Operation

- Net production of 1810 mcf to methane at $1.76 gives gross returns of $3,167.
- Cost of production including ownership costs, overhead and credit for fertilizer value is $2,715. This is owner installed.
- Net returns to unit are $452 per year.
- A 12,400 cubic foot digestor is required.

Turnkey systems indicate a size of 28,000 cubic feet are required to reach a cost of $2.00 mcf of methane gas produced. Cost to scrub the gas for introduction into distribution lines or an internal combustion engine are not included.

The Calorific plant near Guymon, Oklahoma, designed for the manure output from 100,000 head of cattle is reported to be producing pipeline quality methane at approximately $2.00 per mcf.

Farm sized production units are not yet available. Additional research and development are needed to develop and test economically feasible technologies for both commercial and farm sized systems.

C. Direct Combustion
(by Wayne Murphey, Head of Forest Science, Texas A&M University)

Below is a summary of estimated cost and the microeconomics of direct combustion. Full details are included in the appendix.

TYPICAL FUEL COST

Fuel Oil:

Cost per gallon	$ .49
Btu per gallon	125,000
Cost per million Btu	$ 3.92

Wood:

Million Btus per ton	
-w/ 15% moisture content	11.70
-w/100% moisutre content	5.70
Cost per million Btu (at $10.00 ton)	
-w/ 15% moisture content	$ .85-$2.13
-w/100% moisture content	$1.75-$4.38

COMPARATIVE ANNUAL FUEL COST (for 50 million Btu per hour and 8000 hours per year)

1. Boiler using fuel oil - $2,500,000
2. Boiler using wood - $1,360,000 (100% moisture content and at $10 per ton)

D. Economics of Biomass Gasification/Pyrolysis
(from "Assessment on Energy from Biological Processes, Engineering Aspects of Thermochemical Conversion", S. R. Beck and H. W. Parker, March, 1977)

All of the numbers included in this section are projections because no reliable data are available for commercial installations. Variations in type and cost of feedstock and method of financing have major impact on product selling price. A few representative examples are shown below. All cases assume a grass roots facility will be constructed.

Small gasifiers are not shown in Table 1 because a wide range of numbers can be found in the literature. The capital cost for small gasifiers can be estimated at about $20,000 per million Btu per hour of gas produced. These gasifiers generally operate at 50-60% efficiency which is defined as heating value of gas produced divided by heating value of feedstock.

TABLE 1A Gasification/Pyrolysis of Biomass

Process	Feedstock	Feedstock cost, $ Dry ton	Plant Tons/Day	Product	Capital Investment, SMM	Product Selling Price*
Air Gasification in Fluidized Bed	Manure	3.00	1000	Low-Btu Gas	22	$ 2.50/MMBTU
Gasification in a Dual Fluidized Bed	Wood	20.00	1000	Medium-Btu	29	$ 3.50/MMBTU
Gasification in a Dual Fluidized Bed	Wheat Straw	10.00	1000	Medium-Btu Gas	22	$ 2.90/MMBTU
Catalytic Liquefaction	Wood	10.00	1000	Fuel Oil	42	$35.00/Bbl ($8.80/MMBTU)
Gasification followed by Methanol Synthesis	Wood	20.00	1000	Methanol	58	$ 0.69/Gal ($10.70/MMBTU)

*All costs are based on 100 equity financing. If 67% debt financing is used, prices will be about $1.00 MMBTU less.

*September, 1979

E. Net Present Costs, Equivalent Annual Payments and Net Present Breakeven Price for Guayule: Wintergarden Region, Texas

Irrigation Practice	Interest Rate	Net Present Costs $/Acre	Annual Payment $/Acre	Net Present Price $/lb.
Irrigated	.05	400.38	112.91	.18
	.08	383.00	115.64	.19
	.10	372.50	117.51	.20
Dryland	.05	278.98	77.26	.12
	.08	259.58	78.38	.13
	.10	250.92	79.15	.14

* 1978 Data

TABLE 2. Net Present Costs, Equivalent Annual Payments and Net Present Breakeven Price for Guayule: Pecos Region, Texas

Irrigation Practice	Interest Rate	Net Present Costs $/Acre	Annual Payment $/Acre	Net Present Price $/lb.
Irrigated	.05	455.70	128.51	.21
	.08	435.38	131.45	.22
	.10	423.04	138.45	.23

* 1978 Data

4) Recommendations by the Advisory Committee on Agriculturally Derived Fuels for the Development of Biomass Resources in Texas

The Advisory Committee sponsored a state biomass research workshop on August 16 and 17, 1979 to assist in identifying technical and policy-oriented issues that must be addressed, researched, or developed to facilitate or enhance the use of biomass as a fuel source. Approximately 120 professionals from industry and universities attended the workshop which consisted of an overview of biomass research and policy at both the national and state levels as well as separate work sessions on alcohol production, anaerobic digestion, direct combustion, gasification/pyrolysis and petroculture. The individual sessions specifically formulate recommendations for research and policy issues for each of the conversion technologies (see Appendix I).

In the workshop and technical task force meetings, and in the survey of literature, special attention was paid to research, development and demonstration (RD&D) programs being conducted elsewhere in the country so that RD&D recommendations made for Texas did not unnecessarily duplicate efforts being undertaken elsewhere. While in some cases RD&D being done around the country is similar to areas in which recommendations were made, factors such as climate, crop species grown, the amount of biomass available, etc. are significantly different for this state and, therefore, the needs of Texas were not being addressed. (For a description of the breadth of RD&D being done nationally, and examples of them, see appendices.) Continued policy and economic studies are recommended by the committee.

On the basis of formal meetings of the committee, meetings of biomass technical experts, the detailed recommendations of the workshop, and a final review by the committee, the following recommendations are submitted to the Council:

1. That approximately $1 million of the available Energy Development Grants be considered for application to the biomass area.

2. That at least 75% of this amount be made available to stimulate the development of a small number of significant demonstration projects which should consist of the following:

A) Prototype small-scale alcohol distilleries (for on-farm and co-op use) located in different areas within the state to optimize the design and evaluate other variables associated with the operation and maintenance of the systems. Innovative uses of the by-product from the demonstration plants should be investigated as a possible human food supplement and/or animal feed and/or for use in an anaerobic digester to produce methane gas. Minimum modifications required to permit the use of 160-180 proof alcohols as engine fuels (without mixing with gasoline) should be identified.

B) The committee recognizes that the cost of alcohol derived from biomass can be reduced by improvements in alcohol production technology. Therefore, there should be new research which has the potential for developing breakthroughs in alcohol production technology. This includes, but is not

limited to, production of fermentable substrate from agricultural and urban wastes and lignocellulosic materials, new fermentation process designs and configurations, and new processes for removing water from alcohol (see appendices for report of research by Textile Research Institute, Princeton, New Jersey).

C) Agriculture and some closely related industries are dependent on diesel engine technology. There should be research and demonstration on the use of diesel and alcohol for farm machinery operation and to identify minimum equipment modification. This would include determining the performance of present engines on various blends and purity of alcohol and modification of present engines to provide satisfactory performance.

D) There should be a demonstration of anaerobic digestion applications utilizing different feedstocks (feedlot manure, municipal solid waste, etc.) allowing verification of economics and technology under present conditions.

E) Research is needed to determine how much crop residue i.e. corn stover, milo stover, small grain straw, etc., can be removed without adverse impacts on soil condition and fertility.

F) Information is also needed on methods of storing large amounts of crop residues and other feedstocks to provide a long-term supply of feedstock materials (for example the possibility of ensiling such materials).

G) Woody biomass and municipal solid waste have been recognized as useful sources of supplemental fuel for boilers. However, due to the non-uniformity of wood sources, boilers must deal with the variances in moisture, size, cleanliness, and Btu content which can cause design problems, safety problems, corrosion and high capital costs. Therefore, there should be further research in system designs of boilers to handle dirty, moist and non-uniform fuels. Fifty percent matching federal funds may be available for research on conversion of municipal solid waste.

H) A major advantage for gasification is to retrofit existing gas and oil fired boilers. There should be a retrofit demonstration project which will provide data on capital and operating costs, net energy balance, design criteria, feedstock options and environmental effects. It is particularly important that this demonstration address the problems of removing the tars and particulates in the gas before it is used in internal combustion engines.

I) A small-scale demonstration combustion unit with a waste heat boiler should be completed. The objective of this effort should be to permit utilization of selected agricultural wastes for on-farm energy use or for use in small, isolated, agricultural industries.

3. That approximately 15% of available development grants be directed toward appropriate policy-related research, especially agricultural policy, biomass development and environmental standards.

4. That about 10% be considered for research and development in the production, handling, and utilization of energy related crops. In addition to energy related crops, there should be applied research in the development of crop species and/or alteration practices which maximize both the energy and food or feed content of such crops in an efficient manner.

5. The Committee recognizes the importance of providing reliable information on biomass conversion technologies in an expeditious manner to Texas agricultural industries. Consequently, demonstration projects should be constructed on a scale that will provide useful data for "on-farm" systems, farmer co-op systems, or community level applications as these entities are clearly in greatest need for renewable energy resources information.

6. The Committee further recognizes that demonstration projects will not by themselves satisfy the ever increasing public demand for biomass information. Thus, there is need for establishing a clearinghouse for information on biomass where individuals can obtain the information they desire. We suggest that the Agricultural Extension Service be asked to undertake this task and report periodically to the Council.

Finally, it is the recommendation of the Committee that a standing committee on energy from biomass be established to advise the Council on continuing developments in the biomass area. The high cost of energy used in agriculture and the possibility of reduced availability of natural gas and fuels for agriculture is increasing production costs to the breaking point especially in areas requiring irrigation. In addition to the economic impact on the state as a whole, the urban sector also benefits from biomass development as the increasing population base in Texas accelerates the need for more energy efficient methods of disposal of municipal solid waste. Thus, a committee on energy from biomass that can bring together professionals from industry, government, and the universities to provide expertise on the production and handling of biomass for energy development for the Council's consideration is recommended.

SUMMARY OF CONVERSION PROCESSES FOR BIOMASS

	METHOD	RESOURCE USED	RESOURCE PRODUCTION TECHNOLOGY	CONVERSION PROCESS	APPLICATION OF END PRODUCT	RESEARCH NEEDS	COST COMPARISON WITH PRESENT FUEL USED	RECOMMENDATIONS
ALCOHOL PRODUCTION	Present Technology	Corn, wheat, milo, sugar cane, etc.	Conventional cropping methods.	Fermentation and distillation processes.	Use in internal combustion engines.	Efficient distillation and fermentation processes. Study of effects of using feedstocks in various cycles or combinations. Small-scale state-of-the-art distilleries. By-product utilization. Use of alcohol and diesel fuels. Use of cellulosic materials as feedstock. Expanded research of "unconventional" crops. Optimizing production technology.	Assuming retail unleaded gasoline is priced at $1.00 per gallon: Feedstock / Anhydrous Alcohol / Gasohol* Cornstover $1.72 $1.03 Corn 1.40 0.999 Sugarcane 1.15 0.987 * Includes 4¢ per gallon rebate of Federal excise tax, 20% investment tax credit and entitlement credit.	Fund efficient prototype small-scale alcohol distilleries located in different areas of the state. Investigate innovative uses of by-product. Investigate use of 160-180 proof ethanol as engine fuel. Research production of fermentable substrates through cellulose conversion and new fermentation process designs, new processes for removing water from alcohol.
	Developing Technology	Crop residues. Municipal solid waste. Any cellulosic matter. "Unconventional crops" such as sweet sorghum.	Conventional cropping methods. Generated daily. Conventional cropping methods and forestry harvesting methods. Experimental work to increase biomass content of conventional crops. Field Testing.	Pretreat feedstock by acid or enzymatic hydrolysis to "free" the available sugars which can then be fermented to alcohol. Conventional process.	Near term: gas turbines Longer term: boilers, utility fuel cells			
METHANE PRODUCTION	Present Technology	Livestock and poultry wastes.	Waste containment and entrapment, etc.	Anaerobic digestion.	Identical to natural gas uses-heat, fuel, etc.	Optimization of digestor design to reduce operation and management time of the high initial investment. Disposal of wastes after digestion completed. New strains of bacteria and culturing techniques for methane production. Use of feedstocks in varying combinations. Small scale digestors.	Natural gas - $1.76/mcf vs. $2.00 for gas produced by anaerobic digestion.	Demonstration of anaerobic digestion applications utilizing different feedstocks and allowing verification of economics and technology under present conditions.
	Developing Technology	Manure and/or sewage in combination with agricultural wastes and residues.	(Not Applicable)	(Same as above)				
GASIFICATION/ PYROLYSIS	Present Technology	Municipal solid waste, manure crop residues (e.g., cotton gin trash) and wood.	(Not Applicable)	Production of tars and oils, char and gases through chemical decomposition of substances by the action of heat in the absence of oxygen.	Chemicals produced from pyrolysis such as ammonia, acetone and other chemicals have industrial and various other uses. Oils produced can be substituted for heating oil and other low-quality fossil fuels. Gas produced can be used as boiler fuel or in engines.	Determination of optimal size of pyrolysis and gasification systems. Removing tars and particulates in gas before it is utilized in internal combustion engines. Assessing the problems of retrofitting existing oil and gas power plants and industrial boilers. Determining the optimal mixes of biomass with coal.	Feedstock / Process / Product Selling Price Manure — Gasification in fluidized bed — $2.50/MMBtu Wood — Gasification in dual fluid. bed — 3.50/MMBtu Wheat Straw — Gasification in dual fluid. bed — 2.90/MMBtu Wood — Catalytic Liquifaction — 35.00/Bbl (8.80/MMBtu) Wood — Gasification followed by Methanol Synthesis — 0.69/Gal. (10.70/MMBtu) As compared with natural gas at $1.76/MMBtu and fuel oil at $3.92/MMBtu.	Retrofit demonstration project which addresses problem of removing tars and particulates.
	Developing Technology	(See above)	(Not Applicable)	Commercial size gasifiers and pyrolysis units.	(Same as above)			
DIRECT COMBUSTION	Present Technology	Wood, wood residue, wood chips, and municipal solid waste.	Conventional forestry practice.	Burning fuel directly for heat.	Use as boiler fuel or direct heat.	Elimination of slagging and corrosion in boilers due to the non-uniformity of wood sources which result in variances in moisture, size, cleanliness and Btu content. Optimize production technology.	Fuel oil cost of $.49 per gallon or cost of million Btu $3.92 Cost per million Btu for wood: w/15% moisture content $.85-$2.13 w/100% moisture content $1.75-$4.38	Research in system designs of boilers to handle dirty, moist and non-uniform fuels. Small-scale combustion unit with waste heat boilder for utilization of agricultural wastes for on-farm use, or use in small, isolated agricultural industries.
	Developing Technology	Wood from "unconventional" sources (e.g., mesquite).	Conventional forestry practices and biomass produced under optimal conditions.	Use as supplemental boiler fuel.				
PETROCULTURE	Developing Technology	Jojoba, Guayule, Euphorbia	Developing cropping methods for these "unconventional" crops	Jojoba - crushing seeds. Guayule - crushing or chopping plant material. Euphorbia - crushing the stems.	Oil from jojoba, rubber from guayule, and hydrocarbons from euphorbia - many industrial uses.	Development of suitable production, harvesting and extraction systems. Economics or petroculture production.	Not available	Research and development in the production, handling and utilization of these crops. (as well as mesquite)

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APPENDICES

Meeting of the Special Advisory Committee

On

Agriculturally Derived Fuels

January 15, 1979

Department of Agriculture Conference Room
10th Floor Stephen F. Austin Building
North Congress and 17th Street
Austin, Texas

AGENDA

I. 10:00 a.m. Convene

II. Introduction of Committee Members and Others Present
Brief Remarks: Commissioner Brown
Brief Remarks: Dr. Milton Holloway, Executive Director, Texas Energy Advisory Council

III. Brief Report of Special Interests and Activities from Committee Members

IV. Development of Alternate Sources of Energy from Biomass - An Update: Klauss Rokita and Jerry Kroff, Bohler Brothers of America, Inc., Houston, Texas

DUTCH LUNCH -- SFA Cafeteria -- Speaker, Robert Soleta, National Gasohol Commission

V. Biomass: The National Perspective - Les Levine, Acting Director for Biomass, Department of Energy

VI. Discussion of Committee Priorities and Activities

VII. Other Business

VIII. Adjourn

COMMITTEE ON AGRICULTURALLY DERIVED FUELS

MINUTES

FEBRUARY 26, 1979

The February 26 meeting proved to be a most interesting one. Only one committee member was unable to attend and there were a large number of visitors.

You received copies of the papers on Guayule by Dr. Dan Bragg, Woody Biomass Plantations by Dr. Wayne Murphey and Municipal Solid Waste by Jack Carmichael at the meeting. A transcript of Bob Soleta's remarks on gasohol is attached. He presented some convincing facts regarding the potential of "fuel alcohol" from agriculturally derived feedstocks.

The "press conference" sponsored by Commissioner Brown, Representatives Dan Kubiak and Bill Keese for Mr. Soleta received excellent coverage via T.V., radio and newspapers.

Energy continues to be of increasing interest and concern. Evidence of this interest is indicated by the fact that 650 persons attended the National Gasohol Conference in Denver, Colorado on March 17, 18 and 19. Nearly every state in the nation was represented - 30 from Texas.

Three additional items of special interest: (1) The Rio Grande Valley Sugar Growers, Inc. and Midwest Solvents received notice of approval of their joint application for a $15 million guaranteed loan from the U. S. Department of Agriculture to build an ethanol production plant at Santa Rosa, Texas; (2) Midwest Solvents has notified the Texas Department of Agriculture that they would provide 500 gallons of 200 proof anhydrous ethanol to make Gasohol for a trial by the Governor, Lt. Governor, members of the Texas Legislature and other state officials. Approximately 20 gallons will be available for each official. Plans are being completed by Commissioner Brown, Representative Kubiak and others interested in the project; (3) A widespread shortage of diesel fuel - mostly in the High Plains area of Texas has been reported. The situation is being monitored by the Governor's Energy Office, the Texas Department of Agriculture and the U.S.D.A. Energy Office. Reports are not encouraging for an early end to the shortage. Commissioner Brown has appealed for cooperation among oil companies to prevent work stoppage during this critical period. The Federal set-aside and reallocation program expires on March 30, 1979, but indications are that it will be extended. Shortages should be reported to the Governor's Energy Office, attention Mr. John Huggins, (512) 475-5491.

COMMITTEE ON AGRICULTURALLY DERIVED FUELS

Minutes of Initial Meeting
January 15, 1979

At 10:00 Commissioner Brown called the meeting to order and welcomed the Committee members and observers. Everyone in attendance was asked to introduce themselves. In addition to Committee members attending (listed in Appendix A), Texas House Members Forrest Green, Bill Keese, and Dan Kubiak were present. Also present was Les Levine, Acting Director of Biomass Programs for the Department of Energy, Energy Technology Division, and Klaus Rokita and Jerry Korff of Bohler Brothers of America, Inc., one of the country's largest and most reputable alcohol manufacturing plant designers. Several observers representing Texas Farmers and Farm organizations including George Reeves, Ray Prewett, Sheldon Baker, Ed Dowty and Bob Williams attended. Staff present included John Hutchison, Special Energy Advisory to Commissioner Brown, Milton Holloway, Executive Director of the Texas Energy Advisory Council, Roy Ray, TEAC Energy Fund Administrator and Robert King, TEAC Coordinator of Solar Programs.

After initial introductions were completed, Chairman Brown summarized the goal of the Committee, referring each member to the motion by which the Committee was created. Challenging the Committee, Chairman Brown expressed his commitment that a significant biomass conversion demonstration facility be constructed in Texas in the next twelve months.

Dr. Milton Holloway also welcomed those present and briefly explained the relationship of this advisory committee to the Council itself. Each member of the Committee on Agriculturally Derived Fuels has been appointed by Lt. Governor William Hobby to the full Texas Energy Advisory Council Advisory Committee. (An organizational chart is attached as Appendix B.) The responsibility of the Committee on Agriculturally Derived Fuels is to advise the members of the Texas Energy Advisory Council, which represents both administrative and legislative branches of Texas government. Specifically the Council has requested that a final report of the Committee be submitted at the September 1979 Council meeting. It was agreed that specific matters or recommendations could be presented to the Council periodically, as appropriate, in addition to a final summary report.

During the remainder of the meeting each party present was asked to brief the Committee on his activities, concerns and priorities. The primary focus of this discussion was on various aspects of alcohol production. It was generally agreed that the Committee's responsibilities were much broader in scope than examination of alcohol production, and that other aspects should receive attention in future meetings.

Of particular interest was the presentation by Raymond Cowley regarding the Rio Grande Valley Sugarcane Grower's Association application for a $15 million loan guarantee. The support sought from the USDA would help obtain financing for a facility to convert blackstrap molasses, milo and eventually sweet sorghum to ethyl alcohol. The alcohol actually would be produced and distributed by Midwest Solvents, Inc. of Kansas. Although the proposal was one of the top four reviewed by USDA experts, a large number of barriers had been encountered in Texas law.

1. It is illegal to manufacture alcohol in Texas under current regulations of the Texas Alcohol Beverage Commission. The Commission feels new legislation is required to allow the manufacture of alcohol for fuels or feedstocks, and is willing to work on revising current law if requested to do so by a legislator or legislative committee.

2. As many as 36 permit requirements have been identified which would make it unnecessarily difficult to proceed on a timely basis with any construction plans for conversion of biomass to alcohol fuels.

3. Other related involvement with alcohol such as distribution in Texas require native ownership, thus presenting a barrier to construction and operation of a Texas plant by the Kansas firm, even if the barriers in 1 and 2 above could be overcome.

Representatives Green, Keese and Kubiak all agreed something could be done during this session to remove such barriers. Representative Green suggested that complete recodification could perhaps require a longer period, but, certainly for the present session, amendments to existing law could be introduced.

It was also noted that shipment of alcohol produced from agricultural or forestry products could be prohibited under present law. Joe Quick of Dow Chemical pointed out that mariculture such as production and harvest of algae or shrimp was not considered agricultural by the EPA for purposes of emmissions and this could severely limit the ability to engage in such activity. In addition, he pointed out that public bodies of water cannot be used for mariculture presently in Texas. Florida has apparently passed legislation to allow controlled use of public waters and estuaries for mariculture which has proven successful. Joe briefly described the Dow Chemical/TEAC project to convert algae to fuels and/or chemical feedstocks.

Also discussed was the recent decision by the EPA to allow alcohol use as an additive. The affirmative decision was based only on the fact that gasohol was marketed in such small quantities (roughly 200 gasohol stations nationally) that it was not yet a problem. According to Les Levine of DOE, there is no question that ethyl alcohol, when tested as prescribed by federal law as an additive, does not meet the Clean Air Act requirements. The particular problem involves increased evaporative emissions. Ford Motor Company and others have suggested that if the testing were performed with a

'gasohol' blend more closely resembling what would actually be marketed, that this problem would disappear. In addition, Levine noted, regular "summer-grade" gasoline also fails to meet the EPA evaporative emissions requirements. The Clean Air Act only requires testing and approval of "new additives", however. John Hutchison noted that this could be a significant disincentive. It was pointed out, however, that the National Gasohol Commission was pursuing the matter vigorously.

It was generally agreed by the Committee and other experts present that while it is premature to recommend, much less require, a massive move toward alcohol fuels, such production can provide an economic alternative in certain specific situations. The primary feedstocks for the near-term are corn, milo, sorghum and sugar. Primary resources available in the near future include: (1) surplus grains (approximately 50 million bushels per year of corn and wheat alone), (2) 8 million gallons of molasses per year, (3) potential production from set-aside lands (approximately 9 million acres, representing a potential of 500 million bushels or more of grains or sugar-equivalent), and (4) spoilage (representing approximately 60 million bushels of corn and wheat lost annually in the field alone).

Resources for future conversion (assuming advances of technology) would include a portion of the roughly 27 million tons of agricultural residues presently left in the field or at processing plants after harvest. Also discussed briefly was the potential conversion of feedlot wastes and municipal mixed refuse and sludge. It was pointed out that a fermentation facility in close proximity to a feedlot offered special advantages. Methane from manure could be used to run the distillation process, while digester residues together with distiller-grains could be re-fed to cattle, hogs or poultry. It was also recognized that manures, municipal waste and sludge could offer a valuable resource for soil improvement.

Les Levine, U.S. Department of Energy (DOE) representative stated that a DOE policy statement on alcohol fuels would be issued sometime in January or February, and would be forwarded to the Committee. He also described the DOE research program including long-term research on direct and economic biological conversion of cellulose to alcohol. He stated, although the properties of ethanol are preferable to methanol, that methanol can be produced more economically and efficiently and the DOE is exploring potential uses for both alcohol fuels.

Stan Swanson presented some information on behalf of Robert Soleta, Director of the National Gasohol Commission. Mr. Soleta had hoped to attend in person, sent his regrets at missing the initial meeting and hopes that he can attend a future meeting.

Although many of these issues will undoubtedly require further investigation, the Committee was able to arrive at several conclusions:

1. That the State should increase financial support for research and development of technologies for conversion of biomass to energy, fuels

and feedstocks. Research and development support should also cover related problems identified such as the amount of crop or forestry residues which can be removed for energy purposes without deteriorating soil condition. (Motion by Bill Walton, second by Spencer Baen.)

2. That the State should sponsor the construction of a demonstration facility (particularly given the benefits already derived from pioneering efforts of the sugarcane growers and Dow Chemical Company in terms of identifying barriers). Conceptual support was expressed for Representative Kubiak's legislation which would finance construction of a prototype plant for biomass conversion. Not having available the specific wording of the bill, however, two alternatives were suggested as possible means for achieving the same ends. First, Bill Walton proposed that, if the State could not finance the entire facility, the State could provide the approximately $300,000 required for feasibility and engineering design studies prior to construction to a competitive bidder that would then privately construct and operate the facility. Second, it was suggested that either in conjunction with State financing of all or a portion of the plant, or as an independent incentive for construction of such a plant, the State could offer to purchase alcohol produced by such a plant on a 10 year contract. Purchased alcohol could be used in state vehicles or resold to a distributor. (Several members commented afterwards that this guarantee alone could possibly be sufficient to motivate capital.)

3. That the Legislature specifically should remove with deliberate speed the present barriers to the manufacture, distribution and sale of biomass-derived alcohol in Texas. The TEAC and Agriculture Department staff was asked to follow-up on identifying in detail the barriers outlined by Raymond Cowley, and to propose specific action. (Motion by Raymond Cowley, second by Carl King.)

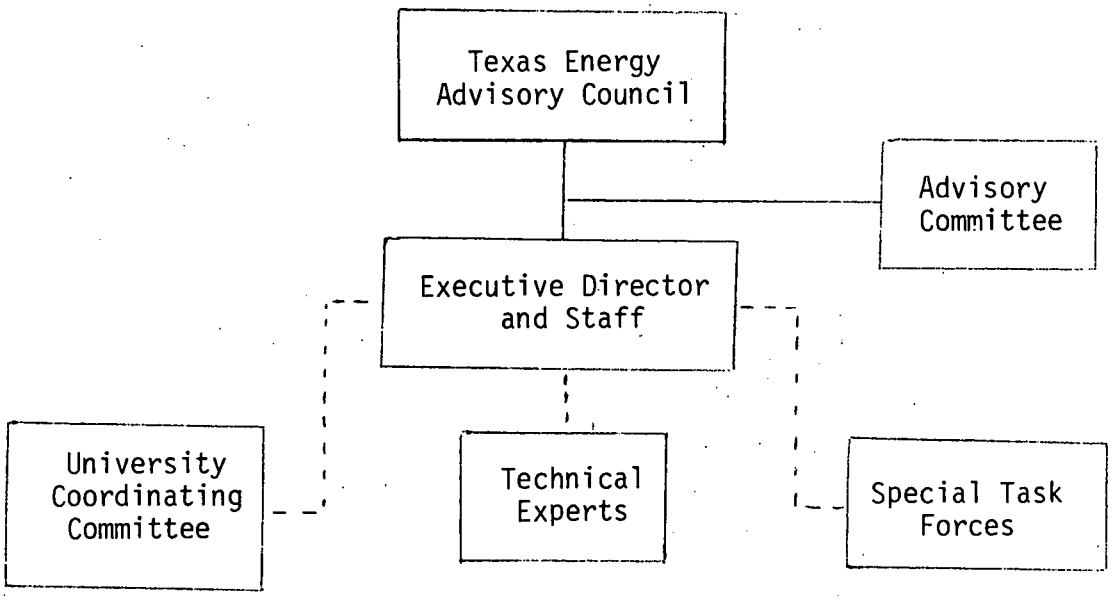
4. That the State should remove the present gasoline tax on 'gasohol' as defined by the Keese bill (at least 10% agriculturally derived alcohol and up to 90% unleaded gasoline) or at least a portion of that tax. No consensus was reached regarding whether a time limit should be included for the exemption. It was agreed that the exemption should not include imported (non-domestic) alcohol fuels. (Motion by ?, second by ?)

5. That the Committee should affiliate with the National Gasohol Commission. It was agreed that such affiliation would be an expression of support but would not limit the scope of the Committee's activities in biomass, nor would the Committee be responsible or liable for independent action of the National Commission (motion by Stan Swanson, second by Bill Nelson.)

It was agreed that Committee meetings would have to be held fairly frequently in order to fulfill the obligations of the Committee to the TEAC. Commissioner Brown adjourned the meeting and promised to call another meeting within the next several weeks.

ORGANIZATIONAL STRUCTURE

EPPA calls for the establishment of three groups to make up the primary organizational structure: the Advisory Council, the Executive Director and Staff and the Advisory Committee. The following chart indicates the relationships among the three groups. Three additional groups, the University Coordinating Committee, Special Task Forces and Technical Experts, are important to the organization and are indicated by dotted line connections.



THE COUNCIL

The Texas Energy Advisory Council consists of ten voting and two non-voting members. The membership is designated as:

Voting Members:
- Lieutenant Governor, Chairman
- Speaker of the House, Vice-Chairman
- Attorney General
- Railroad Commissioner
- Public Utility Commissioner
- General Land Office Commissioner
- Agriculture Commissioner
- Comptroller of Public Accounts
- One state Senator appointed by the Lt. Governor
- One state Representative appointed by the Speaker of the House

Non-voting Members:
- Chairman of the Advisory Committee
- Vice-Chairman of the Advisory Committee

MEETING OF

TECHNICAL TASK FORCE ON BIOMASS

MINUTES
JUNE 24, 1979

The attached Recommendations were developed by the Technical Task Force and staff of the Texas Energy Advisory Council for consideration by the Advisory Committee on Agriculturally Derived Fuels.

We wanted you to have these Recommendations for review in advance of the July 31 meeting. You will, no doubt, have additional suggestions for consideration at the meeting.

BIOMASS TASK FORCE MEETING

JUNE 20, 1979

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RECOMMENDATIONS BY THE BIOMASS TASK FORCE

A. Alcohol Fuels

1. There has been little or no work done on blending alcohol with diesel fuel. Since most farm machinery runs on diesel, research and demonstration needs to be done to make alcohol fuels more applicable to farm use.

> Therefore, the Biomass Task Force recommends that there should be research and demonstration on the mixing of diesel with alcohol for farm machinery operation and on equipment modification.

Comments: _____

2. Small-scale distilleries can be used by farmers or cooperatives to produce alcohol which can be used for heating, to produce electricity, to run machinery, etc. However, no state of the art working demonstration exists presently.

> Therefore, the Biomass Task Force recommends that there should be one or more prototype small-scale distilleries (less than 1000 gallons per day) located in different areas within the state to optimize the design and evaluate other variables associated with the operation and maintenance of the systems.

Comments: _____

3. There has been interest expressed by the agriculture community to build small-scale distilleries on their farms. However, the plans for constructing and operating a distillery are not currently available.

Therefore, the Biomass Task Force recommends that the experience from the prototype distilleries systems (mentioned in number 2) should provide information for manuals to be distributed by the Agriculture Extension Service to interested individuals. Development of prototype systems would provide the necessary training for personnel of the Agriculture Energy Extension Service to assist farmers, cooperatives or other groups in the construction and operation of alcohol stills.

Comments: _____

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4. Basic distillation technology has been around for decades, but energy efficient distillation processes need to be investigated. Also, advanced processes for conversion of cellulose should be developed. Advances in technology made through nationally funded research should be assessed and monitored by the Texas Energy Advisory Council staff to avoid duplication. Areas where research is not to be conducted but is needed should also be identified.

Therefore, the Biomass Task Force recommends that an investigation and assessment of advanced energy efficient distillation processes be made. Cellulose fermentation processes should also be assessed and investigated.

Comments: _____

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5. The by-products of distillation generally have a high protein content. Effective utilization of the residue could make alcohol distillation more economical and lower, or stabilize the cost. Possible uses of the by-products include use as a livestock or human food supplement or for use in an anerobic digester (with manure) to produce a low grade gas.

Therefore, the Biomass Task Force recommends that the marketability and innovative use of distillers grain be investigated.

Comments: _____

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6. Sweet sorghum and grain sorghum are recognized as having potential for use in alcohol production. An investigation of harvesting and preprocessing of these plants for fermentation is needed. (A $220,000 appropriation in the budget for the Agriculture Experiment Station at Texas A&M for research in this area was not authorized.)

> Therefore, the Biomass Task Force recommends that a field evaluation of sweet sorghum and grain sorghum harvesting and preprocessing for fermentation be conducted.

Comments: _____

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B. Direct Combustion

1. There has been considerable research and commercial development in the area of direct combustion of solid fuels.

> Therefore, the Biomass Task Force recommends that the TEAC keep abreast of new developments in this area. Little research is currently needed (via TEAC).

Comments: _____

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2. Many municipalities, other local governments and industries have expressed interest in biomass as a fuel source. Many municipalities and counties do not have staff members with the expertise to advise in the planning, financing and construction of power plants to utilize biomass.

> Therefore, the Biomass Task Force recommends that the TEAC contract for the services of a professional to work with one or more municipalities, other local governments, or industries in developing local biomass resources. These professionals would make case studies and assess the potential for broader applications. This information would then be disseminated to all other interested local government and industries. (Actual financing of biomass conversion systems would be the responsibility of the user.)

Comments: _____

C. Gasification

1. Research to date has shown that there have been problems with gasifiers in that the quality of gas produced is environmentally unacceptable.

> Therefore, the Biomass Task Force recommends that there should be more applied research (in agricultural and municipal applications) to remove the tars and particulates in the gas before it is used in internal combustion engines.

Comments: _____

2. A large number of oil and gas power plants and industrial boilers exist in Texas which might derive their fuels from biomass via gasification. The potential benefit to be derived is that the fuel supply is stabilized and useful plant life is extended.

> Therefore, the Biomass Task Force recommends that an assessment of the problems of retrofitting existing oil and gas power plants and industrial boilers is needed and potential applications and/or possible demonstrations should be identified.

Comments: _____

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3. There are several forms of biomass that may be suitable for mixing with coal for boilers (e.g., cotton gin trash, municipal solid waste).

> Therefore, the Biomass Task Force recommends further research in the determination of optimal mixes of biomass with coal in various locations within the state and particularly emphasizes the need for active participation by utilities and industries.

Comments: _____

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D. Anaerobic Digestion

1. The agriculture community recognizes the potential of cattle, hog, chicken and other animal manures as a fuel source. Recently there has been indication that chicken manure from caged layers offers an especially unique opportunity as a potential fuel source.

Therefore, the Biomass Task Force recommends that there should be one or more prototype small-scale anerobic digesters located in different locations within the state to optimize the design and to evaluate other variables associated with the operation and maintenance of the systems.

Comments: _____

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2. There has been interest expressed by the agriculture community to build small-scale anerobic digesters. However, the plans for constructing and operating state of the art anerobic digesters are not available.

Therefore, the Biomass Task Force recommends that the experience from the prototype digester systems should provide information for manuals to be distributed possibly by the Agriculture or Energy Extension Service to interested individuals. Development of the prototype systems would provide the necessary training for personnel of the Agriculture or Energy Extension Service to assist farmers, cooperatives or other groups in the construction and operation of anerobic digesters.

Comments: _____

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3. The Task Force recognizes the important role that the Energy Extension Service (EES) provides in disseminating information to the public.

Therefore, the Biomass Task Force recommends that there should be more coordination between the EES and the Agriculture Extension Service to inform farmers of the potential of on-site renewable energy systems where applicable.

Comments: _____

4. Presently, there are several problems associated with the process of anerobic digestion which include detention time, variable composition of animal manure and other factors which interrupt the anerobic digestion process.

> Therefore, the Biomass Task Force recommends that research is needed in improving the biological process of anerobic digestion as well as developing more efficient physical plant designs.

Comments: _____

E. Production

1. The agriculture community recognizes the detrimental effects of brush and mesquite which absorbs 30% of the water in the state and spreads over nearly 30 million acres of rangeland. However, research has shown the potential value of these brush-woods as a fuel feedstock because of their highly combustible Btu content.

> Therefore, the Biomass Task Force recommends that ongoing programs on woody biomass, such as those at Texas A&M and Texas Tech, should supplement research on irradication of brush and mesquite respectively to emphasize energy aspects (i.e. collection, harvest, transport and possible innovative use of the wood).

Comments: _____

2. Although wood has been collected for building materials in East Texas woodlands for many years, more efficient methods for collecting wood as an energy source have not been developed.

> Therefore, the Biomass Task Force recommends that there should be research on developing more efficient methods for wood harvesting and collection of timber in East Texas woodlands for energy.

Comments: _____

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3. For the last twenty-five years, agriculture research has focused on reducing the quantity of biomass associated with food crop production.

> Therefore, the Biomass Task Force recommends applied research be done to develop crop species and/or cultivation practices which maximize both the energy and food or feed content of such crops in an efficient manner.

Comments: _____

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TEXAS ENERGY ADVISORY COUNCIL

COMMITTEE ON AGRICULTURALLY DERIVED FUELS

STEPHEN F. AUSTIN BUILDING - ROOM 618

JULY 31, 1979

AUSTIN, TEXAS

AGENDA

10:00 A.M. Call to Order - Reagan V. Brown, Chairman

- Remarks and Introductions
- Plans for Preparing the Report on Development of Biomass Resources in Texas

10:30 A.M. The National Energy Program Today-An Overview - Dr. Milton Holloway, Executive Director Texas Energy Advisory Council

11:00 A.M. Energy from Biomass-An Overview - Dr. Spencer Baen, Director Center for Energy and Mineral Resources Texas A&M University

11:50 A.M. Dutch Lunch - S.F.A. Cafeteria - Speaker: Holly Hodge, President National Gasohol Commission Lincoln, Nebraska

1:15 P.M. Potential Market for Carbon Dioxide as a By-Product of the Alcohol Distillation Process - W.W. (Bill) Walton, President W. W. Oil Company and Committee Member

1:40 P.M. Plans for a Seminar on Biomass Technology - Jim Niewald, Staff Member Texas Energy Advisory Council

1:50 P.M. Suggestions for Committee Report: Development of Biomass Energy Resources in Texas

2:45 P.M. Other Business

3:00 P.M. Adjourn

TEXAS ENERGY ADVISORY COUNCIL
COMMITTEE ON AGRICULTURALLY DERIVED FUELS
MEETING JULY 31, 1979

MINUTES

Chairman Reagan V. Brown called the meeting to order at 10:00 a.m. with all members present except Dr. Richard McDonald who was unable to attend. Special guests included Holly Hodge, President of the National Gasohol Commission, Lincoln, Nebraska; Kenneth R. Milam, San Antonio and Joe Pate, Lubbock, Texas.

Chairman Brown reviewed with the group the specific responsibilities assigned the Committee at the time it was established by the Texas Energy Advisory Council. These assigned responsibilities are:

(1) Reviewing the potential of various biomass energy resources available to Texas.

(2) Analyzing economic costs and benefits of various conversion technologies available.

(3) Determining whether a long-range plan for developing biomass resources is required to coordinate the different aspects involved.

(4) Determining the salient features of such a development plan.

(5) Communicating with other local, state and national entities engaged in related biomass energy programs.

(6) Recommending to the Council appropriate policy measures or responses to federal programs and policy.

The Chairman reviewed some of the activities of the Committee, including the monitoring of legislation pertaining to biomass during the 66th Legislature. Bills passed included H.B. 1803, Gasohol Loan Program, Representative Kubiak, signed by Governor Clements 6/7/79. This Bill provides loans to build gasohol plants but was passed with no appropriations; H.B. 1986, Representative Keese/ Kubiak, Commercial Production of Ethanol, signed by Governor Clements 6/7/79, effective that date; other relevant legislation, including a bill to exempt gasohol from the State Tax did not pass.

The Chairman called to the attention of members a U. S. Department of Energy document released in June, 1979, entitled The Report of the Alcohol Fuels Policy Review. This report was considered encouraging - specifically reporting: a positive net energy balance for ethanol when the latest technology is utilized in the manufacturing process, oil replacement value of ethanol, and value of ethanol as an octane enhancer, as a fuel, and states "...ethanol is the only alternative fuel commercially available now, and the only one likely to be available in quantity before 1985." This Report coincided with President Carter's emphasis on the development of alternate sources of energy from biomass.

Dr. Milton Holloway, Executive Director of Texas Energy Advisory Council, discussed "The National Energy Program Today - An Overview." Dr. Holloway prefaced his remarks on the national energy program with a brief review of the reorganization of TEAC in accordance with the provisions of SB-921, passed by the 66th Legislature, mandating the combining of Texas Energy Advisory Council with the Natural Resources Council and the Governor's Office of Energy Resources. The combining of the referenced entities will occur on September 1, 1979. Dr. Holloway stated the new Council would be similar in structure and concept but is larger than TEAC. The new Council will be chaired by Governor Clements and Lt. Governor Hobby as Co-Chairman. New members added to the previous list of ten include Chairman of the Department of Water Resources, Chairman of the Texas Air Control Board, Chairman of the Department of Parks and Wildlife and the Director of the Bureau of Economic Geology. Additionally, four legislative members, two from the House and two from the Senate - in addition to Speaker Clayton and Lt. Governor Hobby - will be added but, to date, have not been appointed. The new Council is mandated to include broader natural resource type of issues and responsibilities.

Dr. Holloway presented information summarizing significant things going on at the national level with regard to energy. He stated that 48 Bills are currently before Congress dealing with synthetic fuels. Thirty-four Bills deal with alcohol related issues. The President responded in April, 1979 with new initiatives which pointed directions for a new synthetic fuels industry development and a member of other programs to reduce dependence on crude oil. Apparently that response was considered inadequate and the President has come forward with some additional programs. All of these, including the President's initiatives and most major Bills in Congress fall into two major areas - the development of the synthetic fuels industry, and another known as "fast track" legislation. The "fast track" Bills would give someone authority to override existing bureaucracy and push important energy projects through at a much faster rate.

The general consensus is that bureaucracy, both at the Federal and State levels are so impinging on the ability to site and develop new facilities for producing and transporting energy that we have made little headway in the last five years.

A second major area of consensus - after the Iranian crisis and the new increase in crude oil prices up to probably $22 per barrel (most people expect it to go to $28 per barrel over the next three or four years), that we have to break the back of OPEC's ability to inflict these kinds of rapid escalation in fuel oil prices.

Dr. Holloway provided each member with a summary of what the President expects under the July 16 initiatives and of the various Bills that have been introduced into Congress. (If you did not keep your copy, we will be glad to provide you another copy, upon request.)

Dr. Spencer Baen, Director, Center for Energy and Mineral Resources, Texas A&M University presented "An Overview of Energy from Biomass." Dr. Baen reviewed the magnitude of renewable resources from agriculture, forestry and municipal wastes, which "will eventually be extremely important in meeting our energy requirements." Other renewable resources include fresh water algae and open ocean resources including Kelp beds. We must use all available technologies - microbiological, anaerobic digestion, fermentation (alcohol), thermochemical (gasification), liquification, direct combustion, photochemical (production of hydrogen from algae, etc.). He cited the methane gas plant at Guymon, Oklahoma -

using cattle feed-lot waste as a perfect example of what can be done by free enterprise utilizing a waste resource. He reviewed the various research and educational programs under way at Texas A&M by the Center for Energy and Mineral Resources, the Texas Agricultural Experiment Station and the Texas Agricultural Extension Service to develop alternate sources of energy, enhance energy production and to effect energy conservation. The Center for Energy and Mineral Resources which Dr. Baen heads was funded about four years ago to help the State develop a resource center where research is done in developing capabilities, facilities, equipment testing and the ability to solve problems in the state. Some of the projects currently under way include the development of improved varieties of sweet sorghum for use as a feedstock in ethanol production, assess the economic feasibility of chip manufacturing as a source of boiler fuel, the production of low BTU gas from various biomass sources to power turbine and diesel engines, testing a blend of 15 percent alcohol and diesel in diesel engines (reported it ran fine).

Dr. Baen emphasized that we need to attack the energy problem on all fronts i.e., increase domestic exploration and production of oil, develop and use safe nuclear power, capitalize on coal and lignite and develop and use all alternate forms of energy.

Dr. Baen identified several areas where additional research and development are needed. These included examining ways to use alcohol to best advantage (optimum mixtures or blends) vary the proof of alcohol in various engines and test with various oils in diesels, investigate spark conditions for engines using alcohol blended fuels, explore best ways to modify engines, develop more information on how much water can be tolerated in fuel blends before phase separation takes place, accelerate research on producing alcohols from cellulose, and others that are included in the Task Force report of recommendations.

Holly Hodge, President of the National Gasohol Commission spoke on the work of that organization. He said the National Gasohol Commission is nation-wide, non-profit corporation, headquartered in Lincoln, Nebraska. The IRS recognizes contributions to the National Gasohol Commission as having tax exempt status. He described the purpose of NGC as that of accumulating and disseminating information on alcohol fuels and on the gasohol program. There are three types of membership: 1) State membership (they are looking forward to Texas becoming a fully affiliated member of the Commission) at a fee of $5000 per state, 2) Contractual membership - commodity organizations such as the wheat check-off program in some states can contribute to NGC to perform certain responsibilities and duties in carrying out the gasohol program, and 3) Special sponsor memberships for interested individuals at a fee of $25. The NGC sends out packets of information on gasohol and provides a check list to sponsor members for use in requesting additional information.

Mr. Hodge emphasized that the importation of foreign oil has placed a great economic burden upon this nation and every citizen has an important stake in the development of alternate sources of energy from domestic sources. He feels that the production of alcohols from renewable resources affords an effective and patriotic way of helping our nation solve the energy crisis. He feels agriculture will have no problem in reaching and exceeding the goals established by President Carter. He feels the NGC can be effective in helping to coordinate the development and passage of state and national legislation needed to shift from the concept of alcohol basically for beverage purposes to fuel alcohol.

He urged each state to establish a State Commission to help guide the development of alternate fuels from agriculture and forestry. He said that the Nebraska Commission was funded by 1/8 cent of the motor fuel refund to farmers for off-the-road use. He emphasized that he considered some form of a tax exemption for gasohol at the State level to be an essential incentive in getting this new industry established which can be of great benefit to both farmers and all citizens. There are currently about 200 service stations selling around two million gallons of gasohol per month in Nebraska.

President Hodge stated that a primary purpose of his visit to Texas was to look into the possibility of holding the next meeting of the National Gasohol Commission in Texas. He expressed appreciation to Commissioner Brown for his interest and stated that he was impressed with the work of the Committee on Agriculturally Derived Fuels - and with their obvious knowledge and grasp of energy problems and directions for meeting the crisis. He said each state has its own unique resources and approaches for developing them.

(In response to a question, Raymond Cowley explained that there appeared to be a serious problem relating to the interpretation of the provisions of H.B. 1986 by the Alcoholic Beverage Commission with regard to the project by Midwest Solvents and the Rio Grande Valley Sugar Growers at Santa Rosa. He stated the Midwest Solvents representatives were very discouraged.)

Mr. Hodge concluded his remarks with a summary on national legislation affecting gasohol programs which need to be closely monitored and supported "we have studied it, researched it, had some educational work and what is needed now is implementation." Energy from renewable resources is the only answer to the short-term fuel supply situation.

Bill Walton, Committee Member from Breckenridge discussed the market potential for carbon dioxide as a by-product of producing ethanol by fermentation. He stated the "Oil industry had opened up a new and exciting potential market for carbon dioxide. Carbon dioxide injected into oil reservoirs is the present answer for our tertiary recovery of oil and gas. Demand created by the oil industry far exceeds the supply of CO_2. Three major oil fields are actively engaged in tertiary recovery of oil by injecting CO_2. There are at least 25 other projects in the State of Texas. From producing oil fields, generally expect to recover about 25 percent of the oil in place in reservoir rock. Secondary recovery methods - flooding with water can recover another 24 percent. With tertiary method using CO_2, we can recover another 25 percent.

A bushel of corn, wheat, milo, etc. as the feedstock for producing ethanol, the process yields 18 lbs. of ethyl alcohol, 18 lbs. of CO_2 and 18 lbs. of protein livestock feed. About $7.00 per ton to the plant is approximately what we could expect to realize from carbon dioxide. There is no problem in marketing the carbon dioxide."

Jim Niewald, Texas Energy Advisory Council staff member outlined plans for a research conference or workshop on energy from biomass scheduled for August 16 and 17 at the LBJ Center in Austin, Texas. He stated the idea for workshop originated from the Technical Task Force and would have the sponsorship of the Committee on Agriculturally Derived Fuels, the Technical Task Force, the Center for Energy and Mineral Resources at Texas A&M, the Texas Agricultural Experiment Station, the Texas Agricultural Extension Service, Texas Department of Agriculture, Center for Energy Research, Texas Tech University, and the

Center for Energy Studies, University of Texas. He emphasized the conference was research oriented and attendance was by invitation. Jim explained the conference would help to more clearly identify research and policy needs to further development of the State's energy potential from biomass. This information will assist the Committee on Agriculturally Derived Fuels in finalizing its report to the Texas Energy Advisory Council in early September.

The Chairman then reviewed with and asked for suggestions on the recommendations submitted to the Committee by the Technical Task Force on Biomass.

All Members of the Committee on Agriculturally Derived Fuels are invited and encouraged to attend the 1979 Biomass Research Workshop on August 16 & 17.

Meeting adjourned.

1979 TEXAS BIOMASS RESEARCH WORKSHOP

AUSTIN, TEXAS

AUGUST 16-17, 1979

PURPOSE

The 1979 Texas State Biomass Workshop will present a balanced picture of the role that biomass can play in meeting the energy needs of Texas and arrive at specific recommendations for RD&D and state policy to facilitate or enhance the use of biomass.

OBJECTIVES

1. Present an overview of the research development and demonstration projects being conducted at both the state and national levels.
2. Specifically identify technical and policy-oriented issues that must be addressed, researched or developed to facilitate or enhance the use of biomass as a fuel source.
3. To provide a forum for interaction and information exchange among people interested in the biomass field.

SPONSORS

1. The Committee on Agriculturally Derived Fuels, the Texas Energy Advisory Council (TEAC)
2. Texas Agricultural Extension Service, Texas A&M University
3. Texas Agricultural Experiment Station, Texas A&M University
4. Center for Energy and Mineral Resources, Texas A&M University
5. Texas Department of Agriculture
6. Center for Energy Research, Texas Tech University
7. Center for Energy Studies, University of Texas

AGENDA

Texas Biomass Research Workshop
held at
LBJ School of Public Affairs
University of Texas
Sid Richardson Hall
EAST CAMPUS LECTURE HALL
Austin, Texas
August 16-17, 1979

August 16 - 9:00-12:00

Welcome. . . . . Reagan Brown
Commissioner of Agriculture

Role of Texas Energy Advisory Council. . . . . Dr. Milton Holloway
Executive Director

Role of Energy Development Fund. . . . . Dr. Roy Ray
Administrator, Energy Development Fund

Overview of Biomass Conversion
Technologies. . . . . Dr. Bill Huffman
Batelle Laboratories, Columbus, Ohio

National Overview of Research and Policy

U.S. Department of Energy . . . . . to be announced

Solar Energy Research Institute . . . . . to be announced

U.S. Department of Agriculture. . . . . to be announced

Farmers Home Administration. . . . . Carl Larson
Deputy Associate Director

State Overview. . . . . Dr. Spencer Baen
Director, Center for Energy and Mineral Resources
Texas A&M University

LUNCH 12:00-1:00

CLASSROOM SESSIONS 1:00-5:30

I ALCOHOL PRODUCTION

Co-Chairmen
Dr. Wayne A. LePori
Carl King

1:00-1:05 - Session Introduction. . . . . Dr. Wayne A. LePori

1:05-1:30 - Overview of DOE Alcohol Efforts

1:30-1:55 - Alcohol from Sugarcane Waste Products and Sweet Sorghum. . . . . Raymond Cowley

1:55-2:20 - Location, Design, and Construction Consideration for Alcohol Plants. . . . . Howard Hinton

2:20-2:45 - Alcohol from Grain Economics and Other Considerations. . . . . Douglas Lapins

2:45-3:00 - Plant Breeding for Biomass Production. . . . . John Clark

3:00-3:15 BREAK

3:15-5:30 - Development of Recommendations Concerning Research Needs, Programs, and Public Policies. . . . . Group Discussion

II ANAEROBIC DIGESTION FOR METHANE PRODUCTION

Co-Chairmen
Dr. John M. Sweeten
Dr. Richard P. McDonald

1:00-1:20 - Overview of Methane Production Potential in Texas. . . . . Dr. John M. Sweeten

1:20-1:50 - Farm-Scale Production and Utilization of Methane from Livestock and Poultry Wastes. . . . . Dr. Ed Fulton

1:50-2:30 - Commercial-Scale Generation and Marketing of Methane from Biomass. . . . . Chester Brooks, P.E.
G. W. Meckert, Jr.

2:30-3:00 - Discussion

3:00-3:15 - BREAK

3:15-5:30 - Development of Recommendations Concerning Research Needs, Programs, and Public Policies. . . . . Group Discussion

III DIRECT COMBUSTION

Co-Chairmen
Dr. Wayne Murphy
Ken Rogers

1:00-1:30 - Municipal Solid Waste, Agricultural and Forest Residues Use as Fuel. . . . . Dr. Wayne Murphy

1:30-2:00 - Problems of Direct Combustion Technologies. . . . . Al Buffington

2:00-2:30 - Economics of Direct Combustion. . . . . Joe Hobart

2:30-3:00 - Legal Aspects of Direct Combustion. . . . . Texas Air Quality Control Board

3:00-3:15 - BREAK

3:15-5:30 - Development of Recommendations Concerning Research Needs, Programs, and Public Policies. . . . . Group Discussion

IV PETROCULTURE

Chairman
Dr. Daniel M. Bragg

1:00-1:30 - The Energy Potential and Significance of Petroculture. . . . . Dr. Daniel Bragg
Dr. Ron Lacewell

1:30-2:00 - Plant Breeding and Systems Operation. . . . . Dr. Daniel Bragg

2:00-2:30 - Legal and Economic Aspects. . . . . Dr. Ron Lacewell

2:30-3:00 - Total Program Requirements. . . . . Dr. Daniel Bragg

3:00-3:15 - BREAK

3:15-5:30 - Development of Recommendations Concerning Research Needs, Programs, and Public Policies. . . . . Group Discussion

V GASIFICATION/PYROLYSIS

Chairman
Dr. Steve R. Beck

1:00-1:10 - Introduction. . . . . Dr. Steve R. Beck

1:10-1:40 - Multi-Solid Fluidized Bed Gasification. . . . Dr. Herman F. Feldman

1:40-2:10 - Gasification. . . . . Dr. Ray Anthony

2:10-2:40 - Biomass Pyrolysis. . . . . Dr. Ed Soltes

2:40-3:00 - Gasification of Agricultural Residues. . . . . Dr. W. P. Walawender

3:00-3:15 - BREAK

3:15-5:30 - Development of Recommendations Concerning Research Needs, Programs and Public Policies. . . . . Group Discussion

August 17 - 9:00-12:00

Each Chairman from the classroom sessions will take approximately 30 minutes to present the recommendations of the sessions to the workshop attendees. The workshops will recommend policy options for the state and suggested courses of actions for (a) municipalities, (b) co-ops, and (c) individual farmers.

WORKSHOP SPEAKERS AND CO-CHAIRMEN

I ALCOHOL PRODUCTION

Dr. Wayne A. LePori
Department of Agricultural Engineering
Texas A&M University

Carl King, President
Texas Corn Growers Association

Raymond Cowley, President
Rio Grande Valley Sugar Growers, Inc.

Howard Hinton
Midwest Solvents, Inc.
Atchison, Kansas

Douglas Lapins, General Manager
AMSTAR
Dimmitt, Texas

Dr. Fred Miller
Texas A&M University

II ANAEROBIC DIGESTION FOR METHANE PRODUCTION

Dr. John M. Sweeten, P.E.
Texas A&M University

Dr. Richard P. McDonald, Executive Director
Texas Cattle Feeders Association
Amarillo, Texas

Dr. Eugene Fulton
Tarleton State University

Chester Brooks, P.E.
Banyon Engineering and Management Co.
Oklahoma City, Oklahoma

G. W. Meckert, Jr.
Banyon Engineering and Management Co.
Oklahoma City, Oklahoma

III DIRECT COMBUSTION

Dr. Wayne Murphy, Director
Forest Science Department
Texas A&M University

Ken Rogers, Wood Technologist
Texas Forest Service

Al Buffington, Combustion Engineer
Houston Power and Light Co.

Joe Hobart
J. S. Serrine Co.
Houston, Texas

IV PETROCULTURE

Dr. Daniel M. Bragg
Industrial Economics Research Division
Texas A&M University

Dr. Ron Lacewell
Agricultural Economics Department
Texas A&M University

V GASIFICATION/PYROLYSIS

Dr. Steve R. Beck
Department of Chemical Engineering
Texas Tech University

Dr. Herman F. Feldman
Battelle Columbus Laboratories

Dr. Ray Anthony
Department of Chemical Engineering
Texas A&M University

Dr. Ed Soltes
Texas A&M University

Dr. W. P. Walawender
Department of Chemical Engineering
Kansas State University

MINUTES

BIOMASS RESEARCH WORKSHOP

AUGUST 16-17, 1979

RECOMMENDATIONS FOR CONSIDERATION

ANAEROBIC DIGESTION

1979 TEXAS BIOMASS RESEARCH WORKSHOP

AUSTIN, TEXAS

RESEARCH AND DEVELOPMENT:

High Priority

1. Demonstration - all species
2. Hybrid Integrated System - optimization
3. Preprocessing, materials collection and handling
4. Municipal Solid Waste Feasibility Study - (50% match)
5. Broiler Litter
6. Integrated Waste Streams and CH_4 Systems

Medium Priority

1. Waste Characterization
2. Inhibitory Agents
3. Selective Extraction (Optimizing outputs)

Low Priority

1. Wet Gas Meter
2. Dewatering Systems
3. Optimum Design of Feeding Operations
4. Microbiology and Enzymes and Solar Aqua Cells

Anaerobic Digestion

POLICY AND PROGRAMS:

High Priority

1. Guaranteed federal and state loans
2. Funds and staff for education programs

Medium Priority

1. Integrated resources (agriculture and num. and technical expertise)
2. State sales tax exemptions on construction materials
3. Tax incentives
   - A. Energy credits
   - B. Investment tax credits
   - C. Accelerated Depreciation
   - D. Pollution Tax Credit

INFORMATION DISSEMINATION:

High Priority

1. Methods:
   - A. Full scale demonstration
   - B. Technical assistance programs
     - (1) Clearinghouse of information (e.g. Gasohol Commission - state level)
     - (2) Training programs (short courses)
     - (3) Design teams
     - (4) County-level expert
2. Translation of German literature
3. Content
   - A. Value of waste
   - B. Financial incentive package
   - C. Selective extraction

RECOMMENDATIONS FOR CONSIDERATION

PETROCULTURE

1979 TEXAS BIOMASS RESEARCH WORKSHOP

AUSTIN, TEXAS

OBJECTIVES:

1. Improved balance of trade
2. Energy adequacy
3. Economics

Petroculture

RESEARCH AND DEVELOPMENT:

1a. Classification and characterization of plants as to potential value.

1b. Proceed with development of known promising plants (guayule, jojoba, E-lathyrics, algae, etc.).

A. Agronomics

B. Economic

C. Marketability

D. Processing.

1. Agronomic factors in production of guayule. Funds for breeding, planting, fertilization, pest management, irrigation, and harvesting of these crops is essential to establishing feasibility.

2. Acreage available and quantity of products that could be produced in Texas with impact on other crops and farmer income needs to be established.

3. Efficient processing systems maximizing use of all products are needed.

4. Harvesting machinery is not available for many of these crops. Design and construction and testing of appropriate machines and equipment for harvesting and transportation is needed.

2. Selection from step 1a. for further study and development.

3. Commercialization

A. Acreage available

B. Impact on cropping patterns.

RECOMMENDED POLICIES:

1. Government programs to support and encourage petroculture
   A. Loan programs
   B. Price support (subsidies, etc.)
   C. Stock piling
   D. Research support
   E. Demonstration/extension support
   F. Enabling legislation (permissive, punitive, regulatory)

RECOMMENDATIONS FOR CONSIDERATION

ALCOHOL PRODUCTION

1979 TEXAS BIOMASS RESEARCH WORKSHOP

AUSTIN, TEXAS

1. Many alternative raw materials have the potential to become sources of a fermentable substrate. However, no significant work has been done on how to handle these products, yields, by-product status and composition.

   RECOMMENDATION: Provide funding for establishing of a pilot plant that can simulate a commercial operation for processing these alternative materials to determine answers to questions like those given in the consideration.

2. Information on various aspects of alcohol production needs to be accumulated, scrutinized and disseminated.

   RECOMMENDATION: Establish an individual as a clearing center for information on alcohol energy through the Texas Energy Advisory and Natural Resources Council.

3. Much information and misinformation is being disseminated concerning alcohol production from agricultural crops. Considerable interest in making alcohol has been generated in agriculture and closely related industries.

   RECOMMENDATION: Sponsor a major systems analysis study to evaluate alcohol production from various feedstocks in Texas. This study would include:

   A. Comparison of small-scale and large-scale production

   B. Analysis of energy budgets.

   C. Evaluate environmental considerations.

   D. Evaluate economics

4. Several technologies may be combined to integrate alcohol energy production and other systems. Methane production from livestock wastes used to make alcohol with by-products being used as feed is an example.

   RECOMMENDATION: Initiate feasibility study to combine other technologies with alcohol production to provide integrated energy and by-product use systems.

5. Small-scale, on-farm alcohol production has received considerable attention in the media and much interest has been created in a "Do-It-Yourself" approach. However, little local experience is available to analyze this concept.

   RECOMMENDATION: Install a small-scale alcohol demonstration facility and develop information on successful operation of the unit to be disseminated to interested individuals.

6. The price of alcohols derived from biomass can be reduced by improvements in alcohol production technology. This technology has not benefited from the intensive research devoted to petroleum processing during the bygone era of low petroleum prices. New research is needed to improve processes for converting biomass into alcohol.

   RECOMMENDATION: Support new research which has potential to yield breakthrough in alcohol production technology. This includes, but is not limited to, production of fermentable substrates from waste and lignocellulosic materials, new fermentation process designs and configurations, and new processes for alcohol separation.

7. Various agricultural crops and waste products have been proposed as feedstocks for fermentation but little consideration has been given to genetically adapt these feedstocks for alcohol production. The Texas Agricultural Experiment Station and Seed Companies have major breeding programs with genetic stocks which might either increase production from present sources or provide new feedstock material.

   RECOMMENDATION: Supplement present breeding programs to initiate development of appropriate feedstocks for alcohol production.

8. Considerable research is being done at various locations in the United States to develop technology to convert cellulose to alcohol. To make substantial impacts on national energy needs by substituting alcohol, cellulose conversion technology will be required.

   RECOMMENDATION: Monitor development of technology to derive alcohol from cellulose and initiate demonstration of this technology when developed.

9. Present use of alcohol as a fuel is primarily through gasohol. Agriculture and some closely related industries are dependent on Diesel engine technology. Methods to use alcohol as the major component of fuel in these and other engines would provide energy independence in these industries.

   RECOMMENDATION: Initiate studies to develop methods to use alcohol and alcohol blends as the major fuel constituent in internal combustion engines. This would include:

A. Determine performance of present engines on various blends and purity of alcohol.

B. Develop modifications to present engines to provide satisfactory performance.

10. Considerable quantities of by-products could be generated from alcohol production. The markets for wet stillage consumes large quantities of energy. Present uses are for cattle feed but methane generation has also been considered.

RECOMMENDATION: Support studies on uses of distillation by-products.

11. Considerable number of permits must be secured from various agencies for alcohol plant construction. Some of the agencies do not have adequate staff to technically evaluate the plant proposal.

RECOMMENDATION: Provide help to applicants in securing permits and legal authorization of alcohol plant construction.

12. Alcohol production is presently based on cropping practices developed for food and feed production. If crops are grown for alcohol, some modifications of cultural practices may be needed.

RECOMMENDATION: Support development of cultural practices which minimizes energy inputs for biomass alcohol feedstocks.

13. Harvesting and handling procedures for certain biomass crops such as sweet sorghum for energy have not been developed. Harvesting and preprocessing equipment must be developed and work has been initiated by the Texas Agricultural Experiment Station.

RECOMMENDATION: Provide funding for development of equipment to harvest, clean and preprocess biomass for alcohol. This would specifically include sweet sorghum and green cane harvesting equipment.

RECOMMENDATIONS FOR CONSIDERATION

GASIFICATION/PYROLYSIS

1979 TEXAS BIOMASS RESEARCH WORKSHOP

AUSTIN, TEXAS

1. Partial (but significant) funding demonstration — moderate-scale. Preliminary work.
2. Comparison of options for Texas based on:
   - A. Feedstock(s) availability
   - B. Conversion technology and state of the art
   - C. Desired application
   - D. Size
   - E. Location

     Possible locations:
     - Austin
     - College Station
     - Houston
     - Lubbock
     - Diboll (Eastex)
     - Valley

   - F. Economics — Capital and operating costs and comparison with other sources
   - G. Net energy
   - H. Design
   - I. Environmental
   - J. Study of funding mechanism

Gasification/Pyrolysis

PHASES	FUNDING
1. Planning	1. TEAC
Stop-No ◇ Is it feasible? Yes	
2. Procure funding and detail design; single contractor (Turnkey)	2. TEAC, Federal, Private (beneficiary)
3. Construction	
4. Operation	
5. Data analysis	
6. Technology transfer	

SCHEDULE:

Gasification/Pyrolysis

3. Assessment of existing and proposed processes — uniqueness of technology.
4. Hardware research for process improvements.
5. Gas cleanup - removal and characterization of tars and particulates.
6. Chemicals and liquid fuels from biomass by gasification/synthesis or pyrolysis.
7. Explore gasification for farmers or ranchers on individual basis.
8. Identification of distinct biomass gasification opportunity areas in Texas.
9. Fuels for internal combustion engines by thermal degradation.
10. Integrated alternative energy systems.

POLICY RECOMMENDATIONS:

1. Texas Energy Advisory Council lobby for extension of 10% investment tax credit and loan guarantees (after 1982) for biomass (a small company based in Texas).
2. Propose state tax incentives (property tax exemption) and bond financing.
3. Publicize gasification for retrofit.

RECOMMENDATIONS FOR CONSIDERATION

DIRECT COMBUSTION

1979 TEXAS BIOMASS RESEARCH WORKSHOP

AUSTIN, TEXAS

POLICY RECOMMENDATIONS:

1. Fuel
    - A. Refine definition of municipal solid waste.
    - B. Examine wood for domestic heating (take advantage of existing wood - lot development program)
2. Process
    - A. Not product development
3. Economics
    - A. Ambient temperature standards.
    - B. Prizes to encourage innovative solutions to specific problems. (PR)
4. Legal
    - A. Protection of fuel source at free market.
    - B. Dedicate acreage so investment is protected.
5. Technology transfer
    - A. Accurate consumer guidance
    - B. Quantity of availability materials

Direct Combustion

RESEARCH RECOMMENDATIONS:

1. Best production of biomass - genetics, etc.

2. Assess biomass availability

3. Co-generation:

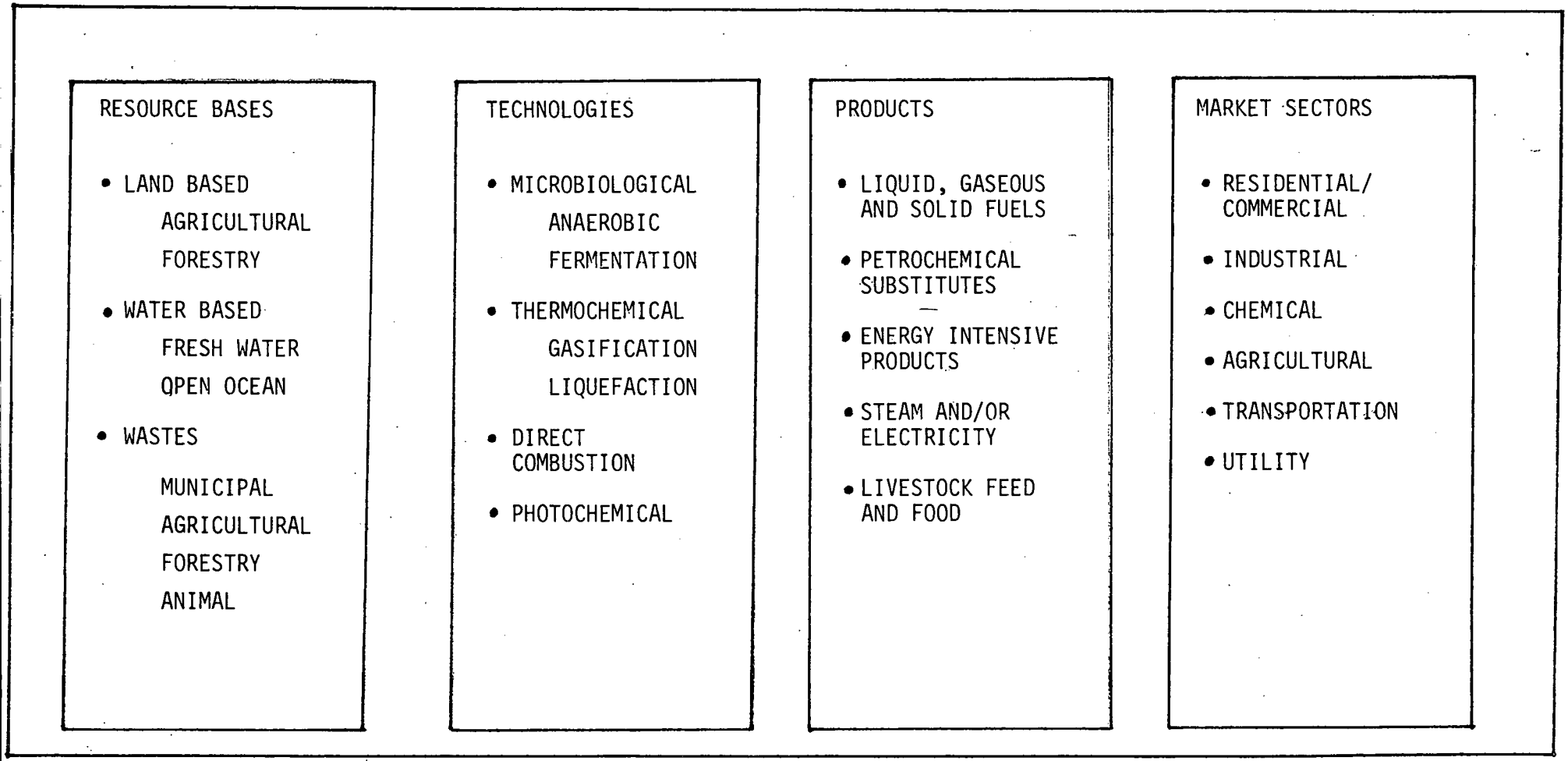
   Think small - improve small

4. Best processes - to clean fuels, uniformity, etc.; systems can handle less uniformity. For dirty fuel, moist fuel and ash - energy-efficient combustor. Cost effective. Integrated systems (use residues from residues).

5. Stability of source (site-specific)

BIOMASS - TECHNOLOGY OVERVIEW

Spencer R. Baen, Director
Institute of Energy & Mineral Resources, Texas A&M University



STATEMENT
JACK C. CARMICHAEL, P.E.
DIRECTOR, DIVISION OF SOLID WASTE MANAGEMENT
TEXAS DEPARTMENT OF HEALTH

TO: The Energy Advisory Council

The Texas Department of Health has the overall responsibility in Texas for management of all aspects of municipal solid waste. Municipal solid waste in Texas now amounts to nearly 13 million tons annually. This represents a generation rate of just over 5 pounds per person per day.

Our primary method of disposal is by landfilling. We have not in Texas yet reached the point where land is so scarce that we cannot find available land area to accommodate our solid waste disposal. However, we have found increasing public opposition to landfill operations in areas near urban centers that provide for economical disposal. This means our large cities that have not made adequate long range provisions for landfill operations will be faced with transporting waste for longer distances at ever increasing costs.

The way out of this dilemma is to be found through alternative waste disposal processes, or waste reduction. The Texas Department of Health will, over the next eighteen months, be searching for alternate solutions to our solid waste problems as we develop a comprehensive state municipal solid waste plan. In this effort, we will work closely with the Department of Water Resources as they develop a companion plan for industrial solid waste.

Municipal solid waste offers a potential for recovery of valuable materials and can make a significant contribution to the energy programs. Programs that enhance solid waste management practices can complement energy programs.

A basic goal of solid waste management is to reduce the rate of waste generation. Various methods of waste reduction are being studied or implemented by governments and the private sector. Some of these call for reduction in packaging requirements, prohibition, or restrictions on sale of one-way beverage containers, and of course we are familiar with the automobile weight reductions being carried out to meet the gas mileage requirements mandated by Congress. In the newspaper industry, some papers are reformatting their paper from eight columns to six. This simple conversion gives a yearly savings in newsprint by about 5%. These reductions to our waste stream results in saving energy that otherwise would be required to produce the items we would be throwing away.

We in the municipal solid waste management program are also interested in reducing the post consumer waste that enters the waste stream. Methods practiced by some communities to reduce their waste stream include both source separation and recycling. Both systems are low-technology and provide recovery of valuable materials. Over 200 communities in the United States have or have experimented with source separation programs where recyclable materials are set aside at their point of generation for segregated collection. Ninety percent of the nearly 10 million tons of materials recovered annually through source separation practices is comprised of waste paper and cardboard. In Texas we have had at least five cities to practice some source separation collection. The City of West University Place in Harris County currently practices a full separation of

garbage into newsprint cans by metal type, and glass by colored and clear. The operations of recycling centers have met with varying degrees of success. It is estimated that approximately 25% of the aluminum cans produced in the United States are collected through recycling centers.

Cities using source separation techniques experience reduction of from 10 - 25% in their waste disposal requirements. This is also important to the energy program. The energy requirements to convert recyclable materials into products versus the production from raw materials is reduced significantly.

For instance, the energy required to produce aluminum cans from recycled aluminum is only 5% of that required for the production using raw materials. For newsprint the energy requirement is only 30% and for steel products 35%. The Texas Department of Health will also be looking at high-technology programs for recovery of materials and energy from our solid waste. There are advanced systems available today that gives opportunity for economical resource recovery programs.

We did a preliminary assessment for TEAC of the potential municipal solid waste has for successful energy programs. We found that sixteen of the more populous counties in the state generate wastes in quantities that would provide for economical resource recovery. The potential energy available in the waste collected in these 16 counties represent about 6% of the State's thermal energy requirements for electric power for non-industrial use. There are systems becoming available that will extend this potential for recovery to localities that produce as little as 50-100 tons of solid waste per day, which represents a population of approximately 20-40,000 persons. This will extend economical energy recovery systems to many more counties in the state.

Municipal solid waste has an important role in the biomass energy systems. It not only has the potential as sole fuel source, but it may become an important consideration where it can be combined with agriculture and silviculture waste to be used directly as a solid fuel. The City of Jasper has applied for a HUD grant to construct a 25 megawatt generating plant using wood product wastes as a fuel source with plans to incorporate municipal solid waste derived fuels into the system.

Conversion of agriculture waste to energy such as operations to combust cotton gin trash and sugar cane bagasse can possibly be enhanced and the economic feasibility improved with the addition of municipal solid waste. The Valley cities are prime candidates for consideration of such systems.

A three-fold process of combining sewage sludge, municipal solid waste, and feedlot manure in a biological conversion system to produce methane gas offers a potential of not only gaining a useful fuel but offers the additional benefit of reducing the disposal problem of each type of waste used in the process. The City of Pompano Beach, Florida has under construction a 50 ton per day digester that utilizes sewage sludges and municipal solid waste for methane production. Such systems have the capability to incorporate animal waste. This is an EPA demonstration project.

Eleven cities/counties within the State have applied for resource recovery study grants from EPA under the President's Urban Renewal Program. These cities plus at least five others have an interest in developing resource recovery programs utilizing high-technology, capital-intensive systems. We feel that in planning resource recovery systems all options must be considered. We stress this because of the rapidly changing technology and the economics involved in the waste management system.

I believe this committee affords us an excellent opportunity to aid in integrating and coordinating the Municipal Solid Waste Management Plans with the State Energy Plan.

Current Research Being Conducted Nationally on Biomass and Its Conversion Technologies

The Bio Energy Directory is a quite comprehensive annual publication that lists and describes research development and demonstration being conducted nationally on biomass and its energy conversion systems.

In the energy production section, abstracts are presented showing the work in photosynthesis, terrestrial biomass, terrestrial biofluids that are rich in hydrocarbons, aquatic biomass, and refuse-derived fuels.

Another section discusses microbial conversions and these are divided into two parts according to the two principal products generated, methane and ethanol. The methane portion deals with production from animal sources, sewage and refuse, landfills, plant matter and system studies. For example, the California Energy Commission is investigating the installation and operation of a full-scale commercial solid fuel boiler-steam generator to make a large poultry operation energy self-sufficient. Colorado Energy Research Institute is conducting research on enhancing the gas yield in bacterial digestion.

The ethanol portion describes efforts being made to improve fermentation processes and to hydrolize cellulosic materials into fermentable sugar through the use of acid and enzymes. For example, the University of California at Berkeley is examining the enzymatic decomposition of lignin which blocks access to the cellulose in plant matter which can be hydrolyzed into sugars. Also, researchers at Purdue University are using solvents which separate the cellulose, hemicellulose and lignin and allows the capture of nearly 100 percent of the fermentable sugar from cellulose. Gulf Oil Company is investigating the conversion of cellulose to chemical and protein animal food supplements using bio-chemical processes. (This process has recently been given as a grant to the University of Arkansas at Fayetteville for further research and development.)

New York University, under the direction of Professor Walter Brenner at the university's Westbury, L.I., New York, laboratory has a one-ton-per-day demonstration plant to hydrolyze cellulosic waste continuously to glucose syrup.

Continuous hydrolysis of cellulose is part of an Environmental Protection Agency project for conversion of solid waste to fuels.

New York University plans to increase hydrolysis of solid waste project to 20 to 50 tons per day in the near future. Projected costs are for 85 cents to $1.00 per gallon of ethanol. Future plans also include mobile plants for processing solid wastes into glucose syrup for shipment to fermentation plants.

The process used is known as the twin-screw extruder device for high-temperature acid hydrolysis for conversion of newspaper and wood pulp to glucose.

The direct combustion section covers the range of burning techniques, burning biomass with coal or oil and replacing coal, oil or gas facilities with those that use only biomass. For example, the University of Oregon is establishing facilities to utilize wood residues to co-generate electric power and heat for the campus. And, the California Energy Commission is burning local cotton gin trash and other agricultural residues as fuel to produce electricity for the City of Needles.

The section on pyrolysis deals with research being conducted on the conversion of agricultural residues, woods and wood residues and municipal solid wastes into low Btu gasses and liquids. For example, a farm in Iowa is converting corn cobs into gas for seed corn drying. Union Carbide Corporation is converting municipal solid waste, sewage sludge, agri-wastes, biomass and other organic materials into a low Btu gas and liquid fuels.

Finally, the alcohol technology section discusses nonmicrobial research on alcohol fuels and their uses. For example, the Agricultural Products Industrial Utilization Committee of Nebraska tested the use of gasohol (10% ethanol and 90% gasoline) in a two million mile road test. The University of Montana is examining the possibility of converting cellulosic materials to glucose and glucose derivatives through pyrolytic means.

Biomass

Characterization of Pyrolysis Oil Products

Ed J. Soltes (Forest Science)
845-2523

A promising approach to the generation of energy and chemical products from forestry and related residues is pyrolysis. Pyrolysis is a thermal degradation process that breaks down the complex structures found in wood and agricultural residues to produce less complex gaseous, liquid oil and solid char products. Although the products derived from various pyrolysis processes have been characterized as to their fuel properties, this is the first comprehensive effort aimed at studying the chemical composition of the liquid oil product to better define fuel and chemical opportunities. Of the three types of products formed in pyrolysis, chemical values of interest are most likely to be found in the oil phase.

To date, emphasis has been on the study of an oil produced from pine waste by Tech-Air Corporation of Georgia. This process was selected because it is a relatively low temperature process (<1000° F) with good energy efficiency.

Examination of this oil indicates that it is composed of about 35 percent phenolic materials, 35 percent neutral substances, 10 percent water, 5 percent acids and 15 percent unknown unextractables. Cross composition by functionality, volatility and water solubility have been determined. Distilled fractions have been characterized. The acids present which are responsible for the corrosivity of the oil have been identified. Over 25 components in known concentrations have been characterized.

Further work on composition is necessary, and is being conducted, before processing sequences can be identified to produce transportation fuels and chemical feedstocks. A laboratory reactor is being constructed (completion date Spring 1978) and will be used to study the effect of operational parameters, and the effect of various forestry and agricultural residue feedstocks to pyrolysis, on product composition and qualities.

The Bioconversion of Agricultural Wastes to H_2 by Photosynthetic Bacteria

Chauncey R. Benedict (Plant Sciences) 845-7311

Photosynthetic bacteria converting wastes into fuel may be one answer to this nation's growing dependence on foreign oil. Such bacteria in the presence of sunlight can efficiently convert organic wastes in H_2 and CO_2. This method essentially mimics nature where photosynthetic bacteria convert organic compounds to cellular material and H_2. We have demonstrated that a culture of anaerobic photosynthetic bacteria Rhodospirillum rubrum will produce H_2 from cotton-gin trash. The H_2 has been identified on a gas liquid chromatograph using a molecular sieve column. Current studies on the cost analysis and energy balance of the laboratory hydrogen converter will be used in the design of a large-scale model for industrial use.

Microbial Conversion of Animal Wastes to Methane
Donald H. Lewis (Veterinary Microbiology) 845-5941

The project was designed to optimize methane production from animal wastes and related materials by selecting appropriate conditions and bacteria involved in methanogenesis. A two phase experimental approach was utilized. The first phase involved small scale controlled laboratory digester experiments designed to determine optimum conditions for methane production and test various bacteria for methanogenic potential. The second phase involved designing and fabricating a pilot-scale digester for application of laboratory-derived principles to simulated field conditions. Investigations utilizing small-scale digesters have established that (1) the rate and ratio of methane/carbon dioxide (and other gases) produced during anaerobic digestion is closely related to activities which occur during the initial digestion phases, and (2) the microbial ecology of the digester can be manipulated if certain strains of Bacillus sp. can be established during the early digestion phase. These findings suggest that a greater quantity of gas production with a higher quality of gas (increased methane content) is feasible by designing conditions appropriate to certain kinds of bacteria.

Several strains of bacteria have been isolated which are capable of degrading macromolecular compounds to acetate, the principal ingredient for methane production by methanogenic bacteria. One such organism, an autotrophic anaerobic bacterium was recovered from marine mud, which, when grown in a slurry of reduced medium and powdered lignite produced methane. Studies are underway to evaluate the feasibility of microbial degradation of lignite in conjunction with anaerobic digestion of animal and other agricultural waste products.

Renewable Hydrocarbon Resources from Algae
Elenor R. Cox (Biology) 845-3116

The objective of this project is to investigate several unicellular and colonial freshwater algae which are possible sources for the production of hydrocarbons and wax esters. The production of these compounds, their structures, and yields are being determined in the various developmental stages of the algae. The three algae under intensive investigation are Neochloris oleoabundans, Chloroccum oleofaciens, and Botryococcus braunii (Division Chlorophyta). Studies have been made to determine factors producing maximum growth of the algae such as light intensity, nutrient concentrations, aeration rate, and temperature. Experiments have been performed with several liters of alga culture prior to large-scale growth experiments in 1500 liter tanks. Extractions of the non-polar lipid fractions of these algae in logarithmic and senescent cultures have been done; analytical thin layer chromatograms made and visualized with several reagents; preparative thin layer chromatograms based on these results made; and the various classes of lipids isolated and analyzed on a gas chromatograph. These data will yield information concerning the feasibility of large-scale experiments. In addition, the ultrastructure and ecology of natural populations of Botryococcus braunii are under investigation to relate hydrocarbon and oil production in this alga to cellular structure and environmental parameters.

Energy from Biomass for Texas Agriculture

Edward A. Hiler, Charlie G. Coble, Wayne A. LePori, Donald L. Reddell
(Agricultural Engineering) 845-3931
Rayford G. Anthony (Chemical Engineering) 845-3361
Francis W. Holm, Tom R. Lalk (Mechanical Engineering) 845-1251
Ed J. Soltes (Forest Science) 845-2523

The objective of this research is to design, develop and demonstrate a working prototype system which uses agricultural residue to provide usable power for agricultural operations such as irrigation pumping and cotton ginning.

The successful development of a system to produce power for irrigation pumping, cotton ginning and other stationary agricultural processing applications could reduce the use of fossil energy used in Texas agriculture by over forty percent. This would provide a significant contribution toward energy independence for Texas agriculture.

Current technology will be applied to develop a prototype system to supply power for on-farm and agricultural processing applications. Preliminary work on the design of a direct combustion system to convert the energy in agricultural residues into mechanical energy indicates that a small-scale system can be designed with existing technology. Fluidized-bed technology has shown considerable promise for combusting low-quality materials. The proposed design will use this technology to combust gin trash and crop residue. Compatible steam generation and electrical generating equipment will be selected to recover the heat energy in the form of electricity which can be used to power motors for irrigation pumps and gins.

The system will be demonstrated by using it to operate a cotton gin. Possibilities exist at many gins to operate the power-generating system for four to six months per year to furnish power for the gin and to pump irrigation water in the vicinity during the growing season. A system which proves to be feasible could have an impact on a large portion of the over-900 gins and over-70,000 irrigation pumps in Texas.

This project is funded by the Texas Agricultural Experiment Station, the Texas Engineering Experiment Station, and the Center for Energy and Mineral Resources.

Construction and Operation of an Anaerobic Digester on a Poultry Farm

E.L. Fulton (Tarleton State University, Stephenville, Texas)
(817) 968-2332

Large poultry operations are highly mechanized and handle more than 100,000 and frequently more than one million birds. Both of these problems may be alleviated by anaerobically digesting the manure.

A major energy requirement for commercial poultry farms in Texas occurs during the summer because of the need for cooling. Studies of digesters show that maximum bio-gas production occurs when the digester is maintained at 35° C. The warm Texas temperatures would enhance digester operation because little or no part of the energy produced would be needed to maintain operating temperatures.

The objectives of this work are to design and construct a practical anaerobic digester that can be integrated into commercial livestock operations in Texas, and to develop methods of utilizing the energy produced that are feasible and economical under conditions found on most Texas farms and ranches.

Foregoing not a complete list - Projects begun last year 1978-79 include:

Sweet Sorghum Cleaning Approaches for Efficient Biomass Utilization
C. Cobley and R. C. Dillon (Agricultural Engineering)
(713) 845-1131

Economics of Chip Manufacturing for Energy in the South
W. K. Murphey (Forest Science)
(713) 845-3711

Low BTU Gas to Power Turbines and Diesel Engines
T. R. Lalk (Mechanical Engineering)
(713) 845-3923

Talk Before Texas Energy Council

Spencer R. Baen

Biomass as an Energy Source

Separates into two phases 1) Production 2) Conversion

Production a) Plant materials - wood from forests
b) Waste materials

Conversion a) Heat
b) Solid fuels
c) Liquid fuels
d) Gases

Production:

1) Increased stocking of forest lands
2) Genetic improvement of plant materials
3) Fertilizers, irrigation

Conversion:

1) Separation of cellulose from lignocelluloses
cellulose to glucose to ethanol
2) Anaerobic digestion - Giogas - Methane
500 to 800 Btu/Scf
3) Thermochemical gasification
synthetic gas, hydrogen and carbon monoxide
catalysts (cost ?)
4) Thermochemical liquefaction
flash pyrolysis - CO + biomass slurry
in an aqueous carbonate
result in heavy fuel oil

Of 132 pilot plant, demonstration or commercial plants

39 - direct combustion
24 - anaerobic digestion
26 - separation of municipal wastes
remainder - low volume systems (43)

Estimates of biomass in form of forests

In terms of immediate usable heat

(Timber could yield 300 quads
(Natural gas reserves are 290 quads
(Oil reserves 200 quads
(Coal reserves 4000 quads

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SUGGESTED LEGISLATIVE INCENTIVES FOR CONVERSION OF SOLID WASTE TO ENERGY

Prepared for

THE SPECIAL ADVISORY COMMITTEE ON AGRICULTURE AND FORESTRY DERIVED FUELS
TEXAS ENERGY ADVISORY COUNCIL

Jack C. Carmichael, P.E.
Director, Division of Solid Waste Management
TEXAS DEPARTMENT OF HEALTH

February 26, 1979

The Texas Department of Health is in the process of developing a State-wide plan for municipal solid waste. The plan will address all aspects of solid waste management, to include the use of solid waste as an energy source through bioconversion and as an energy conservation measure through reclaiming materials.

The State plan will identify legislation that will encourage the development of resource recovery and resource conservation practices as the preferred means of solid waste management whenever technically and economically feasible. Legislation is needed to provide incentives for local governments to enter into a new management process that is capital intensive and may not be economically feasible in all cases.

In the recent EPA solicitation for applications for resource recovery feasibility studies, nine applicants from Texas submitted proposals. The EPA announced on February 23, 1979, that Tarrant County and the City of Waco were selected for funding.

Tarrant County will study a county-wide resource recovery system, which will include both waste to energy and material recovery. The City of Waco will further develop its plans for the use of waste as a primary fuel source for the production of steam for industrial use. The other seven applicants submitted worthwhile proposals that should be pursued through local State funding. In addition to the cities and counties that submitted proposals to EPA, a number of others are known to have interest in resource recovery projects. It is the intent of the Texas Department of Health to provide technical assistance and leadership to local governments in developing resource recovery programs.

We feel there is an overall interest in conversion of waste to energy both in the public and private sectors. The attached suggested legislative incentives for resource recovery through biomass conversion of solid waste to energy are presented for consideration by this committee. These legislations may also have application to other biomass systems and certainly, where solid waste, agriculture and/or silviculture energy sources can be combined to form a viable energy source, every advantage should be taken to do so.

We will be most happy to work with the TEAC staff and the appropriate legislative committees in developing these suggested legislations.

Suggested Legislative Incentives for

Conversion of Solid Waste to Energy

1. State Agency Provisions:

A. . The Public Utility Regulatory Act, Article 1446C, should be amended by including in Article VII, Certificates of Convenience and Necessity, the requirements:

(1) The Public Utility Commission shall determine and establish procedures for assuring that all proposals for new electric power plants include consideration of the use of fuels derived from agricultural or silvicultural porducts and solid waste.

(2) It shall be the policy of the Public Utility Commission to require the maximum use of such fuels where technically and economically feasible.

B. The Public Utility Regulatory Act, Article 1446C, should be amended by including in Article VI, Proceedings before the Regulatory Authority, the requirement:

The regulatory authority is empowered to consider "fuel credits" and "waste disposal credits" when evaluating rates of public utilities contracted to use fuels derived from agricultural or silvicultural products or the conbustible fraction of solid waste.

2. Tax Incentives:

Tax incentives constitute one means of using the State's fiscal powers to stimulate the development of energy recovery from bio-mass.

A. Sales Tax:

Complete exemption from the 5 percent State sales tax (4 percent State and 1 percent optional in municipalities) shall be allowed for sale, lease or rental of equipment utilized to convert agricultural or silvicultural products and solid waste to fuel for energy resource.

B. Ad valorem Tax:

Ad valorem taxes on equipment for the conversion of solid waste or agriculture or silviculture products to energy shall be exempt for 50% of the first ten-million dollars ($10,000,000)of the value.

3. Appropriations for Feasibility Studies and Development Plans

The appropriation bill shall appropriate the sum of $2,000,000 from the General Revenue Fund for FY 80-81, for purposes of conducting feasibility studies and developing plans and programs for the recovery of energy and materials from municipal solid waste and to conduct studies and develop plans for the use of solid waste and agriculture or silvicultural products as a fuel source. The funds shall be administered by the Texas Department of Health. Funds are to be allocated as authorized by the Solid Waste Disposal Act, Article 4477-7, V.T.C.S.

4. Used Oil Recycling Act

The intent of this act is to collect and recycle used oil to the maximum extent possible, by means which are economically feasible and environmentally sound and in order to conserve irreplaceable petroleum resources. A model Used Oil Recycling Act prepared by the Federal Energy Administration provides legislative guidelines and commentary on provisions of the model act. The model act provides for:

(1) Definitions
(2) Legislative findings
(3) Policy statement
(4) Safe collection, transport, storage, etc.
(5) Public education program
(6) Collection facilities
(7) Licensing of collectors, recyclers, etc.
(8) Disposal
(9) Administration
(10) Product specification

Used Oil Recycling Act

Federal Energy Administration

Office of Conservation

State Programs

July 1977

FEA/D-77/210

Energy Conservation Now

Introduction

This pamphlet contains a model bill, with commentary, designed for state and local governments interested in adopting programs for recycling used oil.

Today half of the more than one billion gallons of used oil generated annually in the U.S. is lost from a resource recovery point of view. Increased collection and recycling would make an important contribution to both energy conservation and environmental protection efforts.

Because of your interests in conserving environmental and energy resources I thought you would like a copy of the model bill. It was prepared with the support of the Federal Energy Administration as part of its energy conservation program. Although FEA has not yet officially endorsed the bill as policy, it sponsored its preparation in the hope that it would be useful to state and local governments in promoting the recycling of used oil.

Earlier drafts of the model bill benefited greatly from constructive comments by dozens of persons whose views cover the range of perspectives on used oil recycling issues. The final draft represents an effort to achieve a balanced approach to these issues which should serve as a useful point of departure.

The law is designed to be adaptable for both state and local governments. The full bill would provide a comprehensive system for flexible control over used oil recycling. But a local government might wish to defer to the state for licensing of used oil collectors and recyclers. In that case a law consisting only of sections 1-7, 11(a) and (f), 12, and the standard sections 13-16 would offer the foundations for an effective program for promoting used oil recycling.

Additional copies of the pamphlet may be obtained from the Institute or by writing Used Oil Recycling Program, Conservation and Environment, Federal Energy Administration, Washington, DC 20461. In addition, Rep. Charles Vanik inserted the bill and commentary in the Congressional Record; reprints from that source may be obtained by writing Rep. Vanik's office, U.S. House of Representatives, 2371 Rayburn Building, Washington, DC 20515.

Your comments, suggestions or questions about the bill are welcome.

Sincerely,

William A. Irwin
Institute Fellow
Environmental Law Institute

Washington, DC
August 1976

A Bill

To encourage recycling of used oil.

Short Title

SECTION 1. This Act may be cited as the "Used Oil Recycling Act."

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Definitions

SECTION 2. As used in this Act:

(a) "used oil" means a petroleum-based oil which through use, storage or handling has become unsuitable for its original purpose due to the presence of impurities or loss of original properties;

(b) "recycle" means to prepare used oil for reuse as a petroleum product by refining, rerefining, reclaiming, reprocessing or other means or to use used oil in a manner that substitutes for a petroleum product made from new oil, provided that the preparation or use is operationally safe, environmentally sound, and complies with all laws and regulations;

(c) "Director" means the [chief executive officer] of [the agency for environmental protection];

(d) "person" means any individual, private or public corporation, partnership, cooperative, association estate, municipality, political or jurisdictional subdivision, or government agency or instrumentality.

Commentary:

(a) "Used oil" is preferable to "waste oil" since it indicates possibilities for further use rather than readiness for disposal. Used oil includes, but is not limited to, crude oil, fuel oil, lubricating oil, hydraulic oil, electrical oil, refrigeration oil, cutting oil, oil emulsion, kerosene, diesel fuel, and other non-chlorinated industrial oil, that are discarded as waste or recovered from oil separators, oil spills, tank bottoms or other sources. Used oil does not include an insoluble or partially soluble organic chemical or petroleum derivative which requires special handling precautions because of toxicity, composition, or flammability including but not limited to gasoline, a petroleum solvent, a chlorinated solvent or oil, an aromatic, organic pesticide, polychlorinated biphenyl, and a low-boiling ketone, alcohol or ether.

(b) "Recycle" is now a popularly understood word for recovery and reuse of resources. Recycling of used oil is defined as any preparation for reuse or use in place of new oil which is operationally safe (*i.e.*, will not pose risks of fire or explosion), environmentally sound (*i.e.*, will not endanger public health or environmental quality), and complies with all laws and regulations.

The listed means of preparation, *i.e.*, refining, rerefining, reclaiming and reprocessing, have more or less defined vernacular meanings:

> The term "refine or rerefine" means to use refining technology in the treatment of used oil to remove physical and chemical contaminants and enhance used oil quality so as to produce lubricating oil or other petroleum products that are similar to new oil intended for the same purpose. The technology includes, but is not limited to, the use of distillation, chemical treatment, oil additives, hydrogen treating, and various physical treatments.
>
> The term "reclaim" means to use physical methods, short of those used in rerefining, to cleanse used oil for further use for its original or similar purpose. The methods include settling, heating, dehydration, filtration and centrifuging and may entail use of oil additives.
>
> The term "reprocess" means to use minimal physical methods to remove water and suspended solids from used oil in preparation for its use primarily as a fuel or fuel supplement. The methods may include settling, chemical pre-treatment, filtration, and dehydration.

(c) The director of an agency responsible for energy conservation or public health could also be named.

Findings

SECTION 3. The [legislature; council] finds that [millions] of gallons of used oil are generated each year in the [State; municipality]; that used oil is a valuable petroleum resource which can be recycled; and that, in spite of this potential for recycling, significant quantities of used oil are wastefully disposed of or improperly used by means which pollute the waters, land and air and endanger the public health and welfare.

Commentary:

As the following table shows, in all states the amount of industrial and automotive used oils generated exceeded one million gallons in 1971. For local jurisdictions the amounts would depend on population and industrial characteristics.

Although dirty and contaminated, used oil is composed mostly of lube oil fractions, a small but valuable portion of a barrel of crude oil, and has high heating value.[1] Used oil can be rerefined into lubricating oil[2] or used as a feedstock in the manufacture of other petroleum products. It can be reclaimed and used again for its original purpose, can be reprocessed to fuel oil and, under controlled conditions, can be safely burned untreated.[3]

The best estimate of the ultimate fate of the 1.1 billion gallons of used oil generated annually in the United States is: 480 million gallons (43 percent) used as fuel, treated or untreated; 90 million gallons (8 percent) rerefined to lube oil; 200 million gallons (18 percent) used as road oil or in asphalt; and the fate of 340 million gallons (31 percent), including the 30 million gallons of rerefining wastes, is unknown. Better estimates of the ultimate fate of used oil are not possible because of the lack of means of accounting for it across the fragmented collection, rerefining and disposal systems.[4]

Most used oils contain heavy metals and organic compounds which are toxic and, in some instances, carcinogenic, if ingested or inhaled.[5] Disposal on land contributes to water pollution either directly or by leaching, and may make the land unproductive and result in ground water contamination.[6] Incineration or uncontrolled burning releases metallic oxides, principally lead, to the air; the Environmental Protection Agency has determined that concentrations of certain airborne metals, including lead, endanger public health.[7]

References:

1. Waste Oil Study: Preliminary Report to Congress, U.S. Environmental Protection Agency, April 1973.

2. Report to Congress: Waste Oil Study, prepared by the Environmental Protection Agency, Washington, D.C. 20460. April 1974, Section VI.

3. *Id.*, Section VII.

4. *Id.*, page 25.

5. *Id.*, Section IV. *See also*, Irwin and Liroff, Used Oil Law in the United States and Europe, U.S. Government Printing Office, EPA-600/5-74-025, July 1974, pages 16-20.

6. *Id.*, p. 33.

7. *Id.*, pages 66-67. The EPA regulations requiring reduction of lead in gasoline were upheld by the District of Columbia Court of Appeals on March 19, 1976 (*Ethyl Corp. v. EPA*, 6 ELR 20267).

Table I:
Used Oil Generation by State (1971 Data)

State	Automotive (gallons)	Industrial (gallons)
Alabama	12,182,640	4,719,11
Alaska	1,395,900	190,92
Arizona	6,358,600	1,279,08
Arkansas	8,008,590	3,085,10
California	72,034,320	20,021,63
Colorado	8,229,900	1,920,62
Connecticut	6,743,770	3,652,71
Delaware	1,624,870	435,65
Florida	14,445,970	5,056,98
Georgia	14,495,260	6,442,54
Hawaii	1,857,600	*
Idaho	3,435,230	392,54
Illinois	37,263,020	26,383,74
Indiana	17,722,970	12,991,23
Iowa	11,103,710	2,400,12
Kansas	14,381,400	2,979,82
Kentucky	14,075,660	639,30
Louisiana	15,163,310	12,070,64
Maine	3,339,070	822,17
Maryland	7,286,110	3,102,48
Massachusetts	13,404,420	6,129,55
Michigan	37,488,000	19,571,15
Minnesota	14,533,400	3,213,53
Mississippi	9,185,500	2,707,69
Missouri	19,701,790	4,283,71
Montana	4,191,070	503,28
Nebraska	8,846,970	1,633,03
Nevada	2,381,820	257,64
New Hampshire	4,680,430	257,76
New Jersey	18,071,960	18,459,03
New Mexico	4,760,980	1,548,79
New York	32,016,880	15,546,67
North Carolina	13,832,020	4,585,15
North Dakota	4,046,060	271,25
Ohio	36,627,970	29,795,77
Oklahoma	12,295,480	4,249,73

State	Automotive (gallons)	Industrial (gallons)
Oregon	12,020,320	2,977,082
Pennsylvania	35,728,740	27,823,461
Rhode Island	1,912,560	770,858
South Carolina	6,432,670	1,678,776
South Dakota	4,400,210	203,592
Tennessee	12,665,700	10,442,178
Texas	47,222,230	32,778,546
Utah	4,647,950	1,062,643
Vermont	1,330,400	190,565
Virginia	10,839,430	3,017,776
Washington	11,047,210	2,845,560
Washington, DC	1,638,780	*
West Virginia	6,530,830	7,432,560
Wisconsin	17,262,010	5,073,985
Wyoming	2,563,700	470,723

* Not available

Source: GCA Corporation, *Waste Automotive Lubricating Oil Reuse as a Fuel*, published report EPA-600/5-74-032, Environmental Protection Agency, September 1974.

Policy

SECTION 4. Used oil shall be collected and recycled to the maximum extent possible, by means which are economically feasible and environmentally sound, in order to conserve irreplaceable petroleum resources, preserve and enhance the quality of natural and human environments, and protect public health and welfare.

Commentary:

The statement of policy provides a general purpose and constitutional foundation (protection of public health and welfare), two principal components of that purpose (resource conservation and environmental protection), two means for achieving the purpose (collection and recycling) and two flexible concepts for implementing the means for achieving the purpose (economically feasible and environmentally sound).

Subsequent sections of this Act empower the Director, through a system of rules, licenses, special permits, and prohibitions, to execute this policy.

The implementation of this policy in a particular area will depend on what the environmental constraints and economic markets are. From the viewpoint of environmental soundness, if air pollution standards are stringent and hazardous waste disposal facilities for recycling wastes are available, more used oil may flow to rerefining or reclaiming or both. Conversely, if environmental standards permit, more used oil may flow to other uses.

Economic feasibility is the other key concept. An activity is economically feasible if the revenues from it are at least equal to the costs of doing it, including a competitive return on the investment in the activity.

The amount of used oil collected depends on many factors, including, but not necessarily limited to, the concentration of used oil collection sites within an area, the quantities of used oil available, the type and quality of used oil to be collected, and, most importantly, whether a market exists for the collected oil.

Prohibitions

SECTION 5. (a) No person shall collect, transport, transfer, store, recycle, use, or dispose of used oil in any manner which endangers the public health or welfare, or violates any law or regulation.

(b) Disposal of used oil by discharge to sewers, drainage systems, surface or ground waters, watercourses, or marine waters; or by incineration or deposit on land, unless in accordance with a special permit authorized by section 10, is prohibited.

Commentary:

The means of disposal named here are those which are most clearly wasteful and harmful to the environment. The general prohibition is intended to cover other uses or means of disposal which endanger public health, such as emissions or residues from recycling and depositing used oil in one's garbage. Applicable environmental and other laws and regulations are also included.

Public Education

SECTION 6. The Director shall conduct a public education program to inform the public of the needs for and benefits of collecting and recycling used oil in order to conserve resources and preserve the environment. As part of this program, the Director shall:

(a) adopt rules, in accordance with section 11(a), requiring sellers of more than 500 gallons of lubricating or other oil annually in containers for use off the premises to post and maintain at or near the point of sale durable and legible signs informing the public of the importance of proper collection and disposal of used oil, and how and where used oil may be properly disposed of, including locations and hours of operation of conveniently located collection facilities;

(b) establish, maintain and publicize a used oil information center that will explain local, state and federal laws and regulations governing used oil and will inform holders of quantities of used oil on how and where used oil may be properly disposed of; and

(c) encourage the establishment of voluntary used oil collection and recycling programs and provide technical assistance to persons organizing such programs.

Commentary:

Public education is potentially a very effective component of the Director's used oil program.

Signs posted where those who change their own oil purchase it informing them of the location of the collection facilities established in accordance with section 7 would promote both the establishment of the facilities and public knowledge of why and how they should be used.

Public understanding of the law is important to the acceptance and success of the Director's program and should be a part of his public education efforts. Provisions of federal law, such as EPA rules for

abels on oil containers concerning proper lisposal of oil after use (when that requirement of section 383 of the Energy Policy ind Conservation Act becomes effective) should also be explained.

Public information and education functions—such as telling a member of the public or commercial generator where the nearest used oil deposit facility is or who the collectors in an area are—could best be coordinated and performed by a member of the staff responsible for a used oil information and education center. Some state agencies have such personnel; they are also available from extension services.

Technical assistance for voluntary recycling programs would include providing local groups with materials which contain a how-to-do-it manual for creating community recycling programs, along with a suggested brochure, poster and bumper sticker and case histories of successful local programs, and would stimulate interest and effort which complement the state or municipal regulatory activities.

In addition, brochures could be provided for distribution by all retailers of oil and by the department of motor vehicles in conjunction with drivers' licensing or testing or vehicle registration. Used oil units could be prepared for inclusion in driver or automotive education courses.

Collection Facilities

SECTION 7. The Director shall by rule adopted in accordance with section 11(a) prescribe means for the provision of safe and conveniently located collection facilities for the deposit of used oil by persons possessing not more than 5 gallons at one time at no cost to those persons. The Director may require public persons or sellers of more than 500 gallons of lubricating or other oil annually in containers for use off premises, or both, to provide or contract for the provision of such facilities.

Commentary:

Within the last ten years, there has been a significant upturn in "do-it-yourself" oil changes. This trend is reflected in the large volume of retail automotive lubricating oil sales in mass-market retail stores. It is estimated that retail sales today of lubricating oils at non-service station outlets constitute between 40 and 60 percent of all automobile lube oil sales, and few provide facilities for return of used oil. For lack of an alternative, individuals who change their oil, in doing so, often discard the used product where they can—in the garbage, down storm sewers, and in vacant lots. Such disposal wastes a valuable resource, and may create a fire hazard or produce water pollution. Many "do-it-yourselfers" interviewed in a recent survey conducted for EPA indicated a willingness to return used oil, provided a convenient mechanism for doing so existed. This section is designed to require the provision of convenient places for the deposit of small quantities of used oil.

Creation and maintenance of collection facilities could be the responsibility of those who retail oil, or of municipal governments (*e.g.*, fire stations, sanitary landfills, etc.) or of state government, or of a combination of any of these. The responsible persons could of course contract for the provision of the facilities.

Collection facilities should be located as conveniently as possible for the benefit of those who change their own oil. Those who change their own oil will probably neither travel far nor pay anything to deposit their used oil. The Director's rules could require that private and public facilities combined be made available on a per capita or per square mile basis.

The limitation on gallons deposited at one time is designed to prevent overloading of facilities. Those who generate larger amounts of used oil should create their own storage facilities and arrange for regular pick-up by collectors licensed in accordance with section 8.

Whoever maintains collection facilities should secure them from theft, tampering or threat of fire and should post a sign at each site stating clearly that they are only for used oil, not for paints, solvents, gasoline, pesticides, or other wastes.

Licenses for Used Oil Collectors

SECTION 8. (a) A person who transports more than 500 gallons of used oil annually over public ways, hereinafter referred to as a used oil collector, or any storage facility that receives more than 10,000 gallons of used oil annually from one or more used oil collectors, also referred to as a used oil collector, shall do so in accordance with a license issued by the Director.

(b) A licensed used oil collector shall transfer used oil only to another used oil collector licensed under this section; a recycler licensed under section 9; a person with a valid special permit issued under section 10; or a person outside the [State; municipality].

(c) A licensed used oil collector shall provide a receipt to any person to whom used oil is transferred; maintain a complete record of all such transactions, documented by reproducible receipts, for two years; and make fully available to the Director, upon request, all records and copies of receipts for the purpose of review and audit.

(d) A licensed used oil collector shall submit an annual report to the Director on his activities during the calendar year based on the records kept in accordance with section 8(c). The report shall state simply the quantities of used oil possessed at the beginning and end of the reporting period, the total amount collected and the amounts transferred during this period. The amounts transferred shall be itemized as follows: to collectors, recyclers and special permit holders in the [State; municipality], and by State or foreign country for those persons outside the [State; municipality].

Commentary:

A used oil collector is defined to exclude those who transport only on their own property or who transport small amounts. Licensing of collectors should limit the number of unreliable or unscrupulous "gypsy" operations which flourish when used oil is in demand. The 500 gallon threshold permits storage and transport by persons not in business to collect used oil.

Subsections (b), (c) and (d) are designed to permit control of the flow of used oil

into approved uses and to provide information which will enable monitoring and eventual management of those flows.

In many metropolitan areas collectors pick up oil in one jurisdiction and deliver it in another. In order that receiving states are notified of the amount and locations of delivery, out-of-state as well as intra-state information should be recorded on the collector's annual report and the Director should send to his counterparts in another state the information contained in the reports pertaining to that state.

Licenses for Used Oil Recyclers

SECTION 9. (a) A person who recycles 5,000 gallons or more of used oil annually shall do so in accordance with a license issued by the Director.

(b) A licensed used oil recycler shall provide a receipt to any person from whom used oil is received; maintain a complete record of all such transactions, documented by reproducible receipts, for two years; maintain records on the quantities of used oil recycled; and make fully available to the Director, upon request, all records and copies of receipts for the purpose of review and audit.

(c) A licensed used oil recycler shall submit an annual report to the Director on his activities during the calendar year based upon the records kept in accordance with section 9(b). The report shall state simply the quantities of used oil possessed at the beginning and end of the reporting period, the total amount received, and the amounts recycled during this period. The amounts recycled shall be itemized as follows: prepared for reuse as a petroleum product; consumed in the process of preparing for reuse, including wastes generated; and other uses, specifying each type of use.

Commentary:

This section authorizes licensing of those who recycle used oil in order to provide outlets for the oil collected and to control potential adverse environmental effects of recycling or its byproducts. In addition, these persons should be identified in conjunction with section 12 dealing with recycled oil products.

The 5,000 gallon threshold could be different, depending on the desired trade-off between scope of coverage and administrative burden.

Subsections (b) and (c) are designed to complement sections 8(c) and 11(e).

Special Permits for Other Uses or Disposal

SECTION 10. (a) A person who uses or disposes of more than 55 gallons of used oil annually by means other than recycling, including

but not limited to road oiling, incineration and landfilling, shall do so only in accordance with a special permit issued by the Director.

(b) A special permit holder shall provide a receipt to any person from whom used oil is received; maintain a complete record of such transactions, documented by reproducible receipts, for two years; maintain records on the quantities of used oil used or disposed of; and make fully available to the Director, upon request, all records and copies of receipts for the purpose of review and audit.

(c) A special permit holder shall submit an annual report to the Director on his activities during the calendar year based on the records kept in accordance with section 10(b). The report shall state simply the quantities of used oil possessed at the beginning and end of the reporting period, the total amount received, and the amounts used and disposed of during the period. The amounts used or disposed of shall be itemized as follows: type of use and method of disposal.

Commentary:

In certain circumstances, for example, where it would be unreasonably expensive to bring used oil in for recycling, or where the capacity for recycling is not available, other uses or means of disposal may be permitted provided that they are environmentally sound, even though they may involve the loss of resource.

This section provides the Director necessary flexibility in implementing the Act's policy, that is, in determining economic feasibility and environmental soundness.

Use or disposal of less than 55 gallons a year does not require a special permit. This would exempt several uses of used oil on the farm or in small shops, for example.

Subsections (b) and (c) are designed to complement sections 8(c) and 11(e).

Administration

SECTION 11. (a) The Administrative Procedure Act [or other appropriate statute or ordinance governing rule making and adjudication] applies to all actions taken under this Act.

(b) The Director shall adopt rules in accordance with section 11(a) governing contents of and fees for applications for licenses and special permits under this Act and procedures for review of applications and for issuance, renewal, denial, and revocation of licenses and special permits. These rules shall provide for joint licenses or special permits for persons requiring more than one authorization under this Act or other acts administered by the Director. The Director shall also adopt rules prescribing provision of receipts, the keeping of records and the filing of reports by license or special permit holders.

(c) The Director shall issue a license or special permit upon determining that the proposed means for collection, transport, transfer, storage, recycling, use, or disposal is operationally safe, environmentally sound and consistent with the policy of this Act and shall impose terms in a license or special permit requiring the license or special permit holder to install or effect controls, processes, or practices necessary to insure continuous compliance with existing laws and regulations.

(d) A license or special permit shall be valid for one year, but may be renewed upon application.

(e) The Director shall prepare and submit an annual report to the [legislature; council], based in part on information submitted in accordance with sections 8(d), 9(c), and 10(c), summarizing information on used oil collection and recycling, licenses and special permits, analyzing the effectiveness of the Act's provisions in implementing the policies of section 4, and making recommendations for necessary changes in the provisions or their administration.

(f) The Director shall fully implement all sections of this Act as soon as practical, but in no event later than two years after the effective date of this Act.

Commentary:

(a) Adherence to an administrative procedure act, in addition to ensuring due process, makes administration of this Act consistent with existing statutes.

(b) The extent of information required on an application may vary among states and kinds of activities applied for. The Director's rules could call for name and address; kind and capacity of recycling facilities (or location of site and means of proposed disposal or use under special permits); amounts of used oil to be recycled, used or disposed of; kinds and amounts of wastes generated and waste management practices, etc.

Fees for applications should not be so high as to discourage entering the business; other means of funding this program are available.

Keeping of records enables monitoring and evaluation of practices and programs designed to regulate them.

(c) Whatever the recycling, use, or disposal authorized, the authorization should require compliance with all current laws, regulations and environmental standards. Licenses could prescribe a schedule for achieving compliance by a facility needing time to do so.

(d) The term of a license or permit could be shorter or longer. The relatively short term of a year is suggested as an accommodation between the ease of administration of a longer term and the greater flexibility of control of a shorter term.

Recycled Oil Products

SECTION 12. (a) A person may represent any product made in whole or in part from used oil to be substantially equivalent to a product made from new oil for a particular end use if substantial equivalency has been determined in accordance with rules prescribed by the Federal Trade Commission under section 383(d)(1)(A) of the Energy Policy and Conservation Act, P.L. 94-163, or if the product conforms fully with the specifications applicable to that product made from new oil. Otherwise, the product must be represented as made from previously used oil.

(b) All officials of this [State; municipality] shall encourage the purchase of recycled oil products represented as substantially equivalent to products made from new oil in accordance with section 12(a).

Commentary:

This section is designed to facilitate the sale of recycled oil products of sufficient quality to meet their intended uses and to proscribe misrepresentation of recycled oil products. There have been numerous alleged instances of selling used oil which has merely been decanted as "home heating oil;" burning such oil poses risk of damage to furnaces.

State and local officials should encourage the purchase of recycled oil products by public and private persons in order to provide a market for them and an example of their utility.

Enforcement and Penalties

SECTION 13. (a) The Director shall enforce compliance with the provisions of this Act and with the terms of licenses and special permits issued in accordance with this Act.

(b) The Director is authorized to employ the following means of civil enforcement: inspection of the operations of a license or special permit holder; issuance of an administrative order directing specified actions in accordance with a specified schedule; imposition of a civil administrative penalty of up to $500 per day for each violation; revocation of an issued license or special permit, after providing an opportunity for a hearing; and a civil action seeking equitable relief or civil penalties of up to $1000 per day for each violation or both.

(c) A person who violates sections 5 or 12, or any term of a license or special permit issued under this Act, is guilty of a misdemeanor and may be fined up to $5000 per day for each violation.

Commentary:

Enforcement is essential to the credibility of any regulatory system and is therefore required of the Director. A selection of administrative actions and civil enforcement techniques is authorized in order to provide the flexibility needed to tailor an enforcement action to the nature of the violation. Civil administrative penalties, although not so common at the state level as at the federal, have proved effective where states have employed them, *e.g.*, Illinois, Pennsylvania, and Connecticut. Violation of the central provisions of

the Act is made a misdemeanor for each day of violation.

Where state law requires, the Director would utilize the authority provided in this section in collaboration with the office of the attorney general.

Severability

SECTION 14. If any provision of this Act or the application of it to any person or circumstance is held invalid, the invalidity does not affect other provisions or applications of the Act which can be given effect without the invalid provision or application, and to this end the provisions of this Act are severable.

Commentary:

This section enables the continued validity of the remainder of the Act if a part of it is found unconstitutional.

Repeal

SECTION 15. The following acts are repealed:

Commentary:

Sections of existing law which conflict with provisions of this law should be specifically referred to and expressly repealed in order to avoid questions of interpretation.

Effective Date

SECTION 16. The effective date of this Act is 90 days after the date of enactment.

Commentary:

This section postpones the effective date of this Act 90 days in order to provide the Director time to organize implementation. This section ties in with section 11(f), in which the Director is allowed a maximum period of two years after the effective date to fully implement all provisions.

AGENDA
ADVISORY COMMITTEE ON AGRICULTURALLY
DERIVED FUELS
October 22, 1979
10:00 A.M.
Room 618
Stephen F. Austin Bldg.

I. STATUS OF ALCOHOL PRODUCTION IN TEXAS - COMMISSIONER REAGAN V. BROWN

II. REVIEW OF REPORT OF ADVISORY COMMITTEE ON AGRICULTURALLY DERIVED FUELS AND SUGGESTIONS FOR ADDITIONS, DELETIONS OR OTHER CORRECTIONS

III. FUTURE OF THE COMMITTEE

MINUTES

ADVISORY COMMITTEE ON AGRICULTURALLY DERIVED FUELS

OCTOBER 22, 1979

10:00 A.M.

Meeting was called to order by Chairman Brown at 10:00 a.m.

Chairman Brown brought the Committee up to date on the status of alcohol production in Texas.

The Report from Committee to Texas Energy and Natural Resources Advisory Council was reviewed page by page with suggestions and corrections noted for inclusion in the final copy. Chairman Brown entertained motion for presenting report to the Advisory Council. Dr. Spencer Baen so moved. Motion was seconded by Jack Carmichael.