Approved January 13, 1983
Date

MINUTES OF THE Senate COMMITTEE ON Energy and Natural Resources.

The meeting was called to order by Senator Charlie L. Angell at
Chairperson

8:00 a.m./~~p.m.~~ on Wednesday, January 12, 1983 in room 123-S of the Capitol.

All members were present ~~except~~:

Committee staff present:

Ramon Powers, Research Department
Don Hayward, Revisor's Office
LaVonne Mumert, Secretary to the Committee

Conferees appearing before the committee:

Paul R. Dick, Commissioner, State Corporation Commission
Barbara Sabol, Secretary, Kansas Department of Health and Environment
James F. Aiken, Jr., Director, Division of Environment, Kansas Department of Health and Environment

Senator Feleciano moved that the Minutes of the January 11, 1983 meeting be approved. Senator Werts seconded the motion, and the motion carried.

Phil R. Dick distributed a chart entitled, "Natural Gas Production, Hugoton Field and State Totals" (Attachment 1) and reviewed the document. He said the decline in production is a result of gas being substituted from other areas plus the severely depressed market nationwide. He stated from 1976 to 1978 or 1979 most wells were put on a take-or-pay basis, but newer wells are not. In answer to a question, Commissioner Dick said that gas prices in Kansas now range from about 27¢ to $3.20, with the average being in the 40¢ to 50¢ range. He said three principal companies in the Hugoton field have reduced their production and want little or no gas at all. Answering a question from Senator Werts, Commissioner Dick testified that the State Corporation Commission has no stated policy which would favor either increased production in Kansas or increased conservation, but he believes there should be at least some additional production in the Hugoton field and that the field should be depleted relatively the same as comparable fields in other states. He went on to say we are now seeing substitution of oil. Commissioner Dick stated he would anticipate a major drop in production during 1983.

Barbara Sabol stated she is committed to fulfilling the mission of the Kansas Department of Health and Environment (KDHE) and will provide whatever assistance she can to the Committee. She said KDHE's presentation would be made by Jim Aiken.

James F. Aiken distributed his written presentation (Attachment 2) and reviewed it. He introduced KDHE personnel present. He explained the Department's purpose and activities, and discussed groundwater pollution, hazardous wastes and legislative proposals. They propose separating hazardous and radioactive waste legislation, amending the Central States Low-Level Radioactive Waste Compact to include South Dakota as an eligible state and legislation for the Kansas Water Authority to implement the Kansas Groundwater Quality Management Plan, as follows: requiring all governmental agencies to comply with KDHE regulations on construction and abandonment of wells, increasing the limit of pollutant discharge cleanup fund, broadening KDHE's authority to deal with polluters and amending the groundwater use control law to allow KDHE to identify contamination of groundwater resources. Mr. Aiken testified the Environmental Protection Agency (EPA) designated four areas in Kansas as non-attainment areas with regard to air pollution. KDHE expects downtown Wichita to be the only area which will remain designated as such. Replying to a question from Senator Rehorn, Mr. Aiken said the citizens in the Furley area are still unhappy with KDHE but the Department is continuing to maintain communications with them. Mr. Aiken distributed to the Committee the following: a sheet of excerpts from Kansas Environment (Attachment 3), "Resource Recovery from Municipal Solid Wastes (Attachment 4) and the Memorandum of Agreement Between the State Corporation Commission and the Kansas Department of Health and Environment (Attachment 5).

The Committee decided to hold hearings on the four abandoned hazardous waste sites prioritized by EPA: Tar Creek in Cherokee County, the refinery near Arkansas City, a sludge lagoon in Wichita and a landfill in Johnson County.

Meeting adjourned.

Unless specifically noted, the individual remarks recorded herein have not been transcribed verbatim. Individual remarks as reported herein have not been submitted to the individuals appearing before the committee for editing or corrections.

Senate Energy & Natural Resources
Jan. 12

Name		Organization
Barbara Sabol		KDHE
Dick Morrissey		KDHE
Ed Reinert		League Women Voters
Don Jacka		Ks. State Board of Agric.
Guy E. Gibson	Div. Water Res.	" " " " "
Bill Bryson		KDHE
Jim Aiken		KDHE
James Power		KDHE
Roy D. Shenkel		K.C.P.&L.
Don Schnacke		KIOGA
Jan Meyers		Senate
John Blythe		Ks Farm Bureau
Della Wray Blythe		———
Gyula F. Kovach		KSDH&ENV.
Lon Stanton		Kansas Power & Light
BILL PERDUE		" " "
TERRY L. OLIVER		Empire Dist Electric Co.
Jerry Conrad		KG&E
Mitchell Gray		Div of Env.
Marvin Glotzbach		KDHE
WALTER DREWN		EKOGA
DAVID FURNAS		Wichita Chamber
Scott McGinley		Western Power
G. W. Allen		KDH&E
D. WAYNE ZIMMERMAN		THE ELECTRIC CO's ASSOC OF KS.

Attachment 1
EXHIBIT 1

NATURAL GAS PRODUCTION

HUGOTON FIELD AND STATE TOTALS

(1)	(2) Hugoton Field Production (MCF)	(3) Total Kansas Production (MCF)
1963	556,067,168	773,373,504
1964	567,981,458	810,069,686
1965	574,014,829	808,788,878
1966	608,766,800	856,421,989
1967	628,749,488	881,138,736
1968	595,454,070	848,380,950
1969	641,659,770	888,038,529
1970	652,062,194	909,413,281
1971	650,026,539	894,450,803
1972	652,773,807	898,618,234
1973	639,087,182	902,189,763
1974	640,672,818	894,307,867
1975	594,355,629	850,786,261
1976	565,998,996	836,205,709
1977	515,516,082	787,916,974
1978	556,952,720	862,099,086
1979	496,771,481	804,534,623
1980	417,699,964	741,272,555
1981	370,546,552	645,337,671
1982*	215,000,000	421,000,000

*Based upon 11 months actual production and estimated December production.

Atch. 1

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

DIVISION OF ENVIRONMENT

James F. Aiken, Jr., Director
January 12, 1983

The Division of Environment has statutory authority for control of most environmental contaminants and conditions relating to human health and welfare, aquatic flora and fauna, plant and animal life, and the soil. The division has grown steadily throughout the years with additional legislative changes to the point that balanced, yet interrelated, comprehensive environmental control programs have been achieved. The environmental goals within specific statutory responsibilities are to maintain a healthful environment free from disease-causing agents; reduce and prevent irritants affecting the enjoyment of life and property; preserve our natural resources; and develop environmental control programs which are responsive to the needs of Kansas in a cost-effective manner.

To achieve the environmental goals and legislative mandates, our activities are primarily regulatory in nature; however, the division also provides consultation services to individual citizens, municipalities, and industry. These activities and services are provided through technical review of plans and specifications, not only to indicate probable compliance with standards but additionally to indicate and suggest better and more cost-effective alternatives if possible. Counsel is provided on safe and effective methods of handling a wide variety of chemicals and hazardous wastes. Publications and guidance are provided to local agencies and citizens on construction of effective rural sewerage systems and water supply wells. Training programs are provided to operators of municipal and industrial water supplies, waste treatment plants, and solid and hazardous waste facilities so that compliance, efficiency, and economy will result.

Over the next several years, expanded environmental concern will relate to --

(a) groundwater pollution from increased petroleum activity;

(b) control, management, storage, and disposal of hazardous wastes and sources of radiation; and

(c) environmental toxicology.

Groundwater Pollution

The state water quality management studies were developed under Section 208 of the Federal Clean Water Act and are commonly referred to as the "208 studies." The plan was submitted to the 1979 session of the Kansas Legislature. After extensive committee deliberation, the Kansas Water Quality Management Plan was adopted. Later that year, both Governor Carlin and the Environmental Protection Agency Regional Administrator put their approval on the plan. The Kansas Legislature, in adopting the plan, directed the Kansas Department of Health and

Environment to continue its work on development of a statewide groundwater quality management plan and report to the Legislature in 1981. The plan was submitted to the 1982 session of the Legislature. During this session, the Legislature spent considerable time and effort dealing with that portion of the plan to control and regulate the oil and gas field pollution problems in Kansas. The result of this work was passage of Senate Bill 498. This bill provided statutory authority to implement that portion of the plan. During the last year, the Kansas Corporation Commission and the Kansas Department of Health and Environment have been working on implementing the legislation.

1. Joint district offices are established.
2. Field staffs are integrated.
3. New rules and regulations have been adopted by KCC.
4. The management plan is being finalized.

The remaining elements of the Kansas Groundwater Quality Management Plan were deferred until this session. As a result, Governor Carlin requested the Kansas Water Authority review and make recommendations on the remaining elements. In early July, state agencies met to formulate recommendations on eleven items proposed by the Kansas Department of Health and Environment. The Authority will be making its recommendation during the session.

1. One item will be deferred for consideration by the Authority in development of its master plan.
2. Four items will be introduced for legislative review.
3. Two items involved rules and regulations.
4. Four were handled by interagency agreements.

Hazardous Wastes

In 1981, the Legislature created a new hazardous waste act by extracting provisions from the Solid and Hazardous Waste Act and by adding new sections. The end result was separate solid and hazardous waste programs. The hazardous waste legislation deals with hazardous and radioactive wastes. The Kansas Department of Health and Environment will be recommending legislation to separate these two issues. During this last year, the following has been accomplished:

1. First meetings of the Hazardous Waste Disposal Facility Approval Board were conducted.
2. Cleanup of the hazardous waste site near Furley is progressing smoothly and efficiently with the work expected to be completed within the next three months.

3. U.S.E.P.A. prioritized four abandoned hazardous waste sites as top candidates for continuing study and remedial action -- Tar Creek area in Cherokee County; a refinery near Arkansas City; a sludge lagoon from an old waste oil recovery site in Wichita; and a landfill in Johnson County.

4. KDHE has entered into a contract with a private consulting firm to examine the alternatives to land disposal of selected hazardous wastes.

The last session of the Legislature passed the Central States Low-Level Radioactive Waste Compact and legislation to implement the compact. Since that time, the state of Louisiana has ratified the compact. Indications are Nebraska, Oklahoma, and Arkansas Legislatures will consider and probably ratify the Central States Compact. Missouri, Iowa, and Minnesota will consider the Central and Midwest States Compacts. The Central States Compact should be ratified by a sufficient number of states by midyear to allow transmittal to the U.S. Congress for its ratification.

Legislative Proposals

There are three items which will require legislative review this session. These are:

1. The separation of the hazardous and radioactive waste legislation (K.S.A. 65-3430 through 3448 and K.S.A. 48-1601 et seq.). KDHE requests that the proposed legislation be introduced as committee bills.

2. A minor amendment to the Central States Low-Level Radioactive Waste Compact. The state of Louisiana included South Dakota as an eligible state. Kansas will need to ratify that change. KDHE will request that one of the committees introduce the bill.

3. The Kansas Water Authority will be requesting legislation to implement the Kansas Groundwater Quality Management Plan.

   (a) All governmental agencies would be required to comply with KDHE regulations on construction and abandonment of wells (new section in K.S.A. 82a-1201 et seq.).

   (b) Increase the limit of pollutant discharge cleanup fund (K.S.A. 65-171w).

   (c) Broaden KDHE's authority to deal with polluters not regulated by KDHE (K.S.A. 65-170d).

   (d) Amend the intensive groundwater use control law allowing the KDHE to identify deterioration of contamination of groundwater resources (K.S.A. 82a-1036).

In 1979, the Kansas Legislature passed Senate Concurrent Resolution 1640 which directed KDHE to report back to the Legislature in 1984 on the state's water quality management plan. The department will be pulling together the various studies this next year and preparing a policy plan for consideration next January.

Resume

Kansas is blessed with a healthy environment relatively free of major pollution problems. The state has been, and still is, a leader in identifying, preventing and correcting environment problems as they occur. This does not mean we are without problems.

Program costs associated with these expanded areas of concern and the others that continue to need to be addressed are rising. Both the state and supplementing federal fiscal resources that have been available to meet these costs are becoming increasingly limited. Perhaps the greatest environmental control challenge that will need to be faced during the next several years will not be what needs to be done, but how, and how much of it, can be done. The key element in making this determination in an effective manner will continue to be the thoughtful and purposeful execution of the responsibilities for the development of sound statewide environmental management control programs that we all share.

Ex s from KANSAS ENVIRONMENT, Division of Environment Newsletter, Kansas Depa nt of Health and Environment, Winter 1983 Issue 11

Toxicology Committee & Bureau Established

The Kansas Department of Health and Environment recently announced steps to deal with the complex area of chemical exposure to the public. Joseph F. Harkins, KDHE Secretary, announced the formation of a permanent Toxicology Advisory Committee and a reorganization within the Department.

"We recognize the increasingly complex problem associated with the contamination of the environment and the exposure of the public to chemicals of all kinds," Harkins said in making the announcement. "The degree of hazard, in many cases, is unknown and needs evaluation by the most informed experts available. For this reason, KDHE has formally established the Toxicology Advisory Committee, comprised of the state's leading experts in the field of toxicology."

In announcing the appointment of the committee, Harkins noted Dr. Joseph Hollowell, Director of KDHE's Division of Health, will be the permanent chairman of the committee. Other members of the Toxicology Advisory Committee are Dr. John Doull, Professor of Pharmacology, Dr. Wayne Snodgrass, Assistant Professor of Pediatrics, Dr. John Neuberger, Assistant Professor of Community Health, Dr. R. Neil Schimke, Professor of Medicine, Dr. Fred Holmes, Professor of Medicine, all of the University of Kansas Medical Center, Kansas City; Dr. James Bridgens, Shawnee Mission Medical Center, Shawnee Mission; Dr. William Eckert, St. Francis Hospital, Wichita; Dr. Sechin Cho, University of Kansas Medical Center, Wichita; and Dr. Fred Oehm, Professor of Veterinary Medicine, Kansas State University, Manhattan.

Dr. Hollowell noted the committee will convene on a regular basis to discuss toxicological problems and research needs. Members will also meet on a subcommittee basis to investigate the hazards associated with specific incidents such as chemical spills or public water supply contaminations.

"This is a unique joint venture between KDHE and professionals, both in private practice and on university faculty, which will give the best possible service regarding complex matters," Hollowell stated. "I am pleased these persons, who have such

(TOXICOLOGY)

superb academic and professional backgrounds, have agreed to assist KDHE in making the best informed decisions relating to the health and safety of all Kansans."

In conjunction with the announcement of the appointments, Harkins announced the formation of a permanent Bureau of Environmental Toxicology within KDHE. The bureau will be headed by John Irwin, formerly of KDHE's Occupational Health Section.

"John Irwin has highly specialized training in occupational health and has years of experience in assisting industries throughout the state in evaluating the degree of hazards involved for employees," Harkins said. "His expanded responsibilities now will include assisting and consulting with professionals within the Department and across the state."

A direct link between the Toxicology Advisory Committee and the new bureau exists in that the more complicated problems will be referred to the advisory committee for assessment.

"These steps build an effective bridge between the environment and health so that in cases of environmental problems, questions of danger to humans will be dealt with in an effective manner," Harkins noted.

Both the appointment of the committee and the reorganization take effect immediately.

NIES Cleanup Continues

Cleanup of the hazardous waste site near Furley, Kansas is progressing smoothly and efficiently with the work expected to be completed within the next three months.

The National Industrial Environmental Services (NIES) site was closed by KDHE on January 18, 1982 when contamination was found in a spring located north of the site. Further geological studies indicated that two zones of groundwater existed beneath the site located 35 and 45 feet, respectively, below the surface. The first zone (Level A) was discontinuous and had been contaminated by chemicals leaching from the treatment ponds. It has

(NIES)

been determined through the extensive hydrogeological studies that no hydrological connection exists between the two zones of groundwater. Migration of chemicals is restricted to Level A and these chemicals are the same as those found in the spring near Prairie Creek north of the site.

Last spring, cleanup plans were outlined which included a series of drainage trenches to drain contaminated liquids and elimination of the evaporation and treatment ponds that had treated liquid wastes on site.

The drainage trenches excavated at the north and south ends of the treatment ponds are eliminating the groundwater mound below the site. An estimated 50 thousand gallons of contaminated liquid has been retrieved and placed into the nearby evaporation pond for treatment. No liquids remain in the four treatment ponds on site.

The areas of the site where wastes are presently buried have been reworked and recovered with a three foot layer of clay mixed with flyash to prevent the clay from shrinking, thus preventing infiltration of water runoff.

The new disposal cell where solidified sludges from the treatment and evaporation ponds will be placed has been completed. The new disposal cell is lined with compacted clay over which has been installed a polyethylene (plastic) liner, resistant to chemicals and moisture. Sump pumps will be installed to help remove any liquid that may accumulate. This new area has the capacity for 40,000 cubic yards of material.

An injection well permit for deep disposal has been submitted to KDHE. Chemical Waste Management, owner of the site, has requested that the liquid wastes from the ponds be delisted as non-hazardous waste and gravity fed into the injection well for placement in the Arbuckle Formation, an estimated 3,500 feet below ground level.

Further cleanup will involve construction of the injection well if approved, draining the liquid wastes currently in the evaporation ponds for disposal in the injection well and solidifying the remaining wastes for placement in the new disposal cell. p.p.

Atch. 3

Attachment 4

RESOURCE RECOVERY
FROM
MUNICIPAL SOLID WASTES

February 1982

This report was prepared by Joseph E. Cronin, P.E., and Charles H. Linn, P.E., Staff Engineers, Engineering and Sanitation Section, Bureau of Environmental Sanitation, Kansas Department of Health and Environment.

Kansas Department of Health and Environment
Bureau of Environmental Sanitation
Topeka, Kansas 66602

Atch. 4

RESOURCE RECOVERY STUDY

INTRODUCTION

Solid waste generation is an inevitable fact of economic life. However, it is apparent that society has a broad range of choices regarding the types and quantities of residuals we produce and the manner we deal with them afterwards. It is basically these choices, relating to the non-disposal aspects of solid waste management, that are the subject and focus of this report.

Kansas households and commercial sources generate about 1.4 million tons of solid waste annually. An estimated two or three percent of this post-consumer municipal waste is recovered for productive uses. The rest is disposed of in the state's landfills or littered on city streets or county landscapes. In addition, sewage sludge, demolition and construction refuse, unrecycled junked autos, etc., add futher substantial burdens to the municipal waste problem.

There are two basic alternatives to disposal of solid wastes and its attendant problems, "waste reduction" and "recycling." Waste reduction involves waste prevention or diminishing the quantity of solid wastes generated. Society can accomplish this by redesigning products or by changing its consumption habits so that reduced quantities of materials are used to satisfy our wants. More durable and longer lived products; reusable rather than throwaway or single use products and packaging; improvements to the materials themselves so that less material is needed to accomplish the purpose; redesigning products and packaging systems to reduce material requirements; and shifting buying habits toward a less materials intensive mix of goods and services, are all examples of waste reduction approaches.

On the other hand, the term "resource recovery" is a general concept which refers to any productive use of what would otherwise be a waste material requiring disposal. This concept can be redefined in more specific ways as follows:[1]

"Reuse" - utilizing a waste in its original form and for its original purpose such as reuse of a beverage container.

"Material conversion" - utilizing a waste in a different form of material, such as compost from wastepaper or road-paving material from auto tires.

"Energy recovery" - capturing the heat value from organic waste, either by direct combustion or by first converting it into an intermediate fuel product.

"Recycling" - reprocessing wastes to recover an original raw material; for example, the steel content from tin cans or the fiber content of wastepaper.

This report will examine the source reduction and the recycling issues and make recommendations as to the role state government should take in furthering each of these objectivies.

In October 1970, the U.S. Congress enacted the Resource Recovery Act of 1970 which included, among its purposes the demonstration, construction and application of solid waste management and resource recovery systems. During the 1970's, a number of issues concerning the recycling and resource recovery systems arose. The federal government sponsored numerous symposia, funded an impressive list of research and demonstration projects, encouraged private industry to begin resource recovery activities, and ordered federal agencies to initiate recycling activities. The Resource Conservation and Recovery Act of 1976 established a Resource Conservation Committee comprised of several departments of and agencies of the federal government. In 1980, Congress enacted the Energy Security Act of 1980 which constitutes another step in the efforts to increase recycling. The initial expectations were that recycling would reduce or eliminate the solid waste problem and, as a side benefit, would conserve valuable material and energy resources.[4]

SO WHAT IS THE PROBLEM?

Interest in resource recovery springs from two major sources. One was a concern that landfills were a source of health and environmental degredation. When state and federal regulations decreed that landfills must be "sanitary," communities complained that they no longer wanted landfills in their backyards. New sanitary landfills were located farther from populated areas and became expensive to haul to. Landfills became more expensive to build and maintain.[2]

During this period the public became more resource and recycling conscious. Partially because, in many people's minds there is a belief that a mass consumer-mass disposal society simply makes no sense; and partially because, OPEC publicized our petroleum shortfall which logic extends to many other strategic materials.[3]

Resourcists began to look at every segment of our economy for sources of materials which could be salvaged and recycled. Municipal residential and commercial solid waste streams carried a huge potential for such materials. The solution became quite obvious, municipal solid wastes appeared to be an "Urban Gold Mine", which divided itself into a four point theory. (1) If materials could be extracted from solid wastes; (2) they could be sold at a profit; (3) waste disposal costs would fall to zero; (4) landfill volumes would be reduced.

As we begin the 1980's, we find that the optimism of 1970's in regard to the role of resource recovery changed to at least a mild pessimism. Conflicting reports on the success or failure of recycling materials and energy projects have the public and all levels of government in a very real quandry over what, if any, projects should be undertaken. The confusion stems from a mixed bag of social, economic, technological, and institutional problems that are barriers to the growth of resource recovery. These include such things as: 1) lack of demand and available markets for reclaimed materials; 2) inadequate and undependable supply of wastes; 3) conflicting public policies such as tax laws and transportation regulations favoring the use of virgin materials; 4) institutional impediments; 5) the failure of markets to recognize the true economic and environmental externalities of the land disposal of solid wastes; 6) increasing scarcity of mineral resources; and, 7) the general lack of national overall energy and materials policies. A basic understanding of these problems is essential to formulating public policy which encourages alternatives to land disposal of solid wastes.[4]

WHAT ARE THE SOURCES OF SOLID WASTE?

A generalized overview of materials flow and its relationship to the production, disposal, and recovery of solid wastes is illustrated in Figure 1. The principal components of the materials cycle include:[5]

> Extraction. Virgin raw materials enter the economic system through the mining, forestry, agriculture, and fishing industries. Several billion tons per year are involved, of which the major part is stone, sand, gravel, clays, and other non-metallic minerals. Although difficult to define and estimate, solid waste generation on a national basis by these industries (including mine tailings and spoils, forest residues, and crop residues) is probably about 2 to 3 billion tons per year. These solid wastes are usually disposed of on land near the point of production and do not, as a rule, enter the solid waste management system. These wastes contain few wastes that could be considered hazardous wastes.
>
> Material refining. Most crude material goes through one or more stages of purification, chemical refinement, physical forming, or cleaning on the way to becoming a "finished" raw material (steel from iron ore, lumber from saw logs, wood pulp from pulpwood). These include the heavy processing stages for most materials, generating very large volumes of solid wastes that often contain a large percentage of those solid wastes defined as hazardous wastes may be the most difficult to control. Industry increasingly directs its efforts to produce by-product raw material or

energy materials from these wastes and to reclaim and recycle processing chemicals, solvents, and other materials. Solid wastes from material refining, usually are self-managed by the producing industry and, as a general rule, are not managed by the community solid waste management system. Land disposal is the most commonly used disposal method.[5]

Finished product converting, fabricating, assembling. Including semi-finished and final product manufacturing and the construction industries, this sector currently uses over 2.5 billion tons of raw materials annually to produce the economy's output of finished capital and consumer goods. For the most part, these represent "lighter" industries; usually with much lower volumes of waste relative to finished product, than the crude material refining and processing industries. These activities produce most of the hazardous waste.[5]

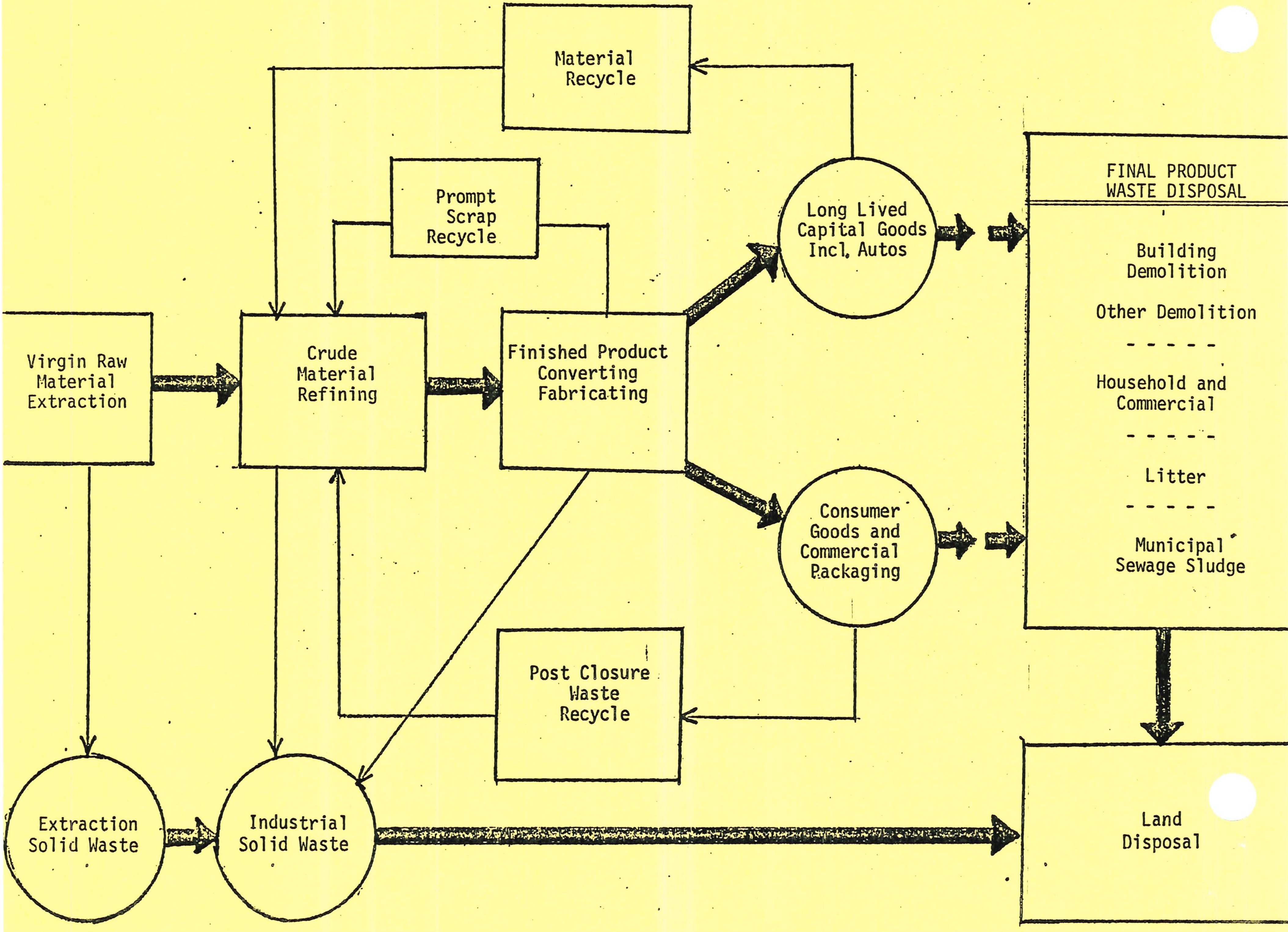
In certain industries, particularly the metal working and paper product converting industries, a very large percentage (possibly over 90 percent) of the scrap waste generated is recycled as so called "prompt" or "new industrial" scrap. Recent estimates place scrap metal recycling from this sector at over 20 million tons, and paper and paperboard converting scrap recycling at over 5 million tons per year.[5]

Most solid wastes from these activities enter the community solid waste management system by private solid waste service companies.

Final "consumption". Households, business firms, and government agencies are all purchasers of final products. In physical terms, by far the greatest volumes of final products are in the form of long-lived capital goods: industrial plant and equipment, transportation systems (highways, railways, bridges) and equipment, military requirements, homes, and office buildings. There is very little accurate or comprehensive data on average lifetimes and ultimate disposition of capital goods. As a practical matter, some last "forever" (monuments, shrines) and some are simply abandoned to decay. Most are eventually subject to demolition, either for systematic salvaging of valuable materials or to clear space for new construction or equipment. Current estimates of "old scrap" consumption indicate that about 26 million tons of metals (over 90 percent ferrous) are recovered from salvaging capital goods, including junked autos and other transportation equipment, railroad rails, and other structures and equipment.[5]

Durable and nondurable household consumer goods, office supplies, and packaging materials together currently account for about 115 million tons of the economy's final product, non-food output.

Figure 1. MATERIAL FLOWS IN THE NATIONAL ECONOMY



Correspondingly, 1978 household, commercial, and government office activities together generated about 100 million tons of post-consumer product solid waste, of which about 11 million tons is currently recovered for material recycling and another small fraction burned for energy recovery.[5]

In addition to the material flow system there is a similar and related energy flow system, supplying direct (fuel) and indirect (electrical) energy for heat, light, and power for all the sectors of the economy. In 1978, the U.S. economy consumed, as energy sources, 618 million tons of coal, 1,120 million tons of petroleum, and 434 million tons of natural gas. All of this fossil fuel material, together with the air combined in combustion, became waste in the form of fly and bottom ash, air-borne particulates, and gaseous emissions from industrial and powerplant boilers, homes and office buldings, and from auto, truck, and other transportation uses. In addition, the total energy value of this fuel - almost 72 quadrillion Btu's in 1978 - ultimately resulted in the generation of waste heat, after performing its useful energy functions. Of the total primary energy consumed, about 36 percent is currenly used in the industrial sectors, 38 percent for residential and commercial heat and light, and 26 percent for transportation in all forms.[5]

In summary, virgin raw materials and fuels enter the economy through the extractive industries. Some of the material is accumulated in the economy in the form of long-lived durable goods and as an inventory of periodically recycled scrap materials. Aside from these stock accumulations, most of the original raw material leaves the economic system in the form of solid, liquid, and gaseous waste which is disposed of into the land, water, and atmosphere.

ENVIRONMENTAL EFFECTS OF LAND DISPOSAL OF SOLID WASTES

As can be seen, the principal method of waste disposal practiced through the materials cycle is land disposal. Several techniques for managing wastes by disposal are available but the principal method used is some variation of land burial commonly known as landfilling. Although proper landfilling is a controlled method of land disposal, adverse environmental safeguards, and maintenance of high quality daily operations are ongoing concerns. The major problems associated with improper landfilling that need to be addressed are possible groundwater pollution, air pollution, surface water pollution and public health and safety hazards.

As solid wastes in a landfill degrade, chemical and biological reactions produce a variety of solid, liquid, and gaseous products. Biological activity within a landfill generally begins with aerobic degradation and produces carbon dioxide, water, sulfates, nitrates, and a broad mix of organic and inorganic compounds. When the available oxygen supply is depleted, anaerobic microorganisms predominate; and, consequently, generate methane, carbon dioxide, alcohols and organic acids, and a variety of other substances. Significant amounts of these inorganic and organic substances and microbial agents can be leached from decomposing refuse by moisture produced in and/or infiltrating through the landfill. The resulting liquid solution, consisting of dissolved and suspended solids, is called leachate.

Groundwater and surface water pollution can result from landfill leachate percolating into subsurface soil and water systems. The composition and quantity of leachate produced is important in determining the effect on resultant water quality. Leachate characteristics vary with the solid waste composition and time as decomposition reactions proceed. The quantity of leachate also varies with time, waste type, incident precipitation, and operational controls. In order to minimize or control water pollution from landfill sites, it is advisable to reduce the production of leachate and to prevent or minimize the movement of contaminants away from the landfill sites.

A fraction of waste decomposition product includes a gaseous mixture composed of methane and carbon dioxide, with traces of nitrogen, oxygen, and hydrogen sulfide. The level of gas production depends primarily on the amount and type of organic material in the wastes, moisture content, and temperature variations in the landfill. In the early stages of aerobic degradation, carbon dioxide is the most commonly produced gas with only small amounts of methane being generated. Concentrations of carbon dioxide decrease when anaerobic degradation begins to dominate the decomposition process, resulting in increasing amounts of methane production.

These gases are important considerations in evaluating the environmental effects of a landfill because they migrate outward from the site, and can travel short distances laterally through permeable soils. Methane represents a pollution and safety hazard because it is explosive when present in air at concentrations between 5 and 15 percent. In addition, damage to surrounding vegetation can be caused by low oxygen concentrations in the root zone when CO_2 and other gases replace the oxygen normally occupying the interstices of soil.

Another potential source of water pollution from landfill sites is surface runoff. Direct runoff from the active face and uncontrolled runoff from incident precipitation may erode the soil cover and entrain solid wastes, as well as other suspended or dissolved solid matter. These contaminants may ultimately be received by adjacent surface water systems.

An improperly constructed or inadequately maintained landfill can pose additional health and safety hazards. If decomposing solid wastes are left accessible, they can attract rodents, flies, and other carriers capable of transmitting pathogens. Other safety considerations which may affect site employees and visitors include explosion and fire hazards.[6]

At its best the sanitary landfill as designed and operated by state of the art procedures is a containment device, widely dependent on the climatic and geological conditions surrounding the facility. Given a sufficient amount of time and sufficient precipitation to exceed the field capacity of the stored solid wastes release of the decomposition products contained in the solid waste is inevitable. Having decided what degree of release is tolerable, society is then faced with the task of designing an infrastructure to provide that degree of containment. These are factors that have not yet caught the eye of technical professions in comparing the costs of land disposal vs resource recovery.

A common argument is that regardless of the method of resource recovery chosen, land disposal methods will still be needed. This is an undisputed fact. However, a wide spread movement toward resource recovery could reduce the dependence on land disposal by at least one order of magnitude when the effects are carried back through the materials flow cycle.

CHOICES - WHO MAKES THEM AND WHAT ARE THEY?

Everyone involved in the functioning of an economic system has a variety of choices which are made both as individuals, acting alone, and as individuals making up various groups within the economy.

As individuals, we purchase and use a huge array of products packaged in a wide variety of ways. Most of the packaging is discarded immediately and when the product is used only a small fraction is set aside for recycling or reuse. Although individuals do have opportunities to change this pattern through selective buying, reuse and increased recycling, these opportunities are generally limited unless the individual lives in a community where private groups have made the services available. Recovery decisions are made solely by individual choice and few incentives are made to encourage those prorecovery options.

The business community generally decides what combination and quantities of materials go into their products and packaging and the ultimate disposition of material left from the manufacturing process. Prices and customer perferences dictate these choices.[5]

Local governments decide what to do with municipal solid wastes: whether materials and energy will be recovered from and how and how much the residents of the community will pay for the waste management services. Cost accounting methods, revenue sources and land use policies help determine these choices.[5]

State governments generally regulate the collection transportation and disposal of solid wastes. The regulatory climate influences resource recovery by exerting economic pressure on the disposal facilities. Resource recovery cannot compete economically with lax disposal regulation. As local governments are creatures of the state, state laws governing competitive bidding, prohibitions against cities entering into long-term contracts; the relative ease of obtained declaratory judgements, flow control, state purchasing policies toward buying goods made from recycled materials and the general overall, climate for economic development and mechanisms such as "bottle bills", states litter taxes, all influence consumer choices.

The federal government makes decisions about taxes, trade policies, subsidies, and regulations which broadly affect the choices by individuals, private companies, and local government officials to produce, consume, recycle, and dispose of materials. The full range of national goals and objectives enter into these decisions, and tradeoffs must be made among conflicting objectives.[5]

STATE ROLES IN RESOURCE RECOVERY

There are some 17 states that now have some form of a statewide resource recovery program. These range from statewide authorities, as in Connectuicut, Rhode Island, and Wisconsin to state grant or loan programs as in Minnesota, New York, Illinois, Pennsylvania, and Tennessee.

Still, the amount of waste being recovered today is small compared to the total volume of waste generated, and may not even be keeping up with the rate of increase in waste generation.

Obviously then, resource recovery _is_ a viable concept, but there are certain barriers presently preventing its wider-scale implementation. These include, among others:

> _Technological barriers_ - or the risks of implementing new and unproven technologies for resource recovery at economical capital and operating costs;
>
> _Marketing barriers_ - or the risks of investing in capital-intensive systems for resource recovery with little or no quarantees that the products or outputs will be capable of being marketed; and
>
> _Institutional barriers_ - or the existence of those financing, legal, and organizational arrangements necessary for implementing large-scale systems for resource recovery.

Together, these barriers represent certain problem areas that _must_ be addressed by programmatic solutions if resource recovery is ever to proceed at a more rapid rate.

With respect to technical and marketing barriers, traditionally it has been the role of the federal government to advance the state of the art and assume the risk of developing new technology. In this regard, the Environmental Protection Agency has over the years funded several demonstration projects and is now conducting evaluations of these new systems.

With respect to institutional barriers, however, while the federal government might assist in overcoming them to a limited degree, the ultimate authority and capability for resolving these barriers rests with the states; both because local governments are creatures of the state and because the states have the ultimate authority for controlling both land use and solid waste. Hence, in summary, while the federal government has the primary responsibility for overcoming technological and marketing barriers, the states have the primary responsibility for overcoming institutional barriers limiting resourse recovery.

Having defined the states role, let's take a look at specific program alternatives that a state can choose from to fulfill this role.

ALTERNATIVE STATE RESOURCE RECOVERY PROGRAMS[7]

Essentially, there are six basic program approaches that a state can pursue to fulfill its role of creating an institutional environment conducive to resource recovery. These are as follows: a statewide authority approach; a state public works approach, a state encouraged regional approach; a state grant or loan program to assist local governments; a state program of incentives and disincentives; or a state regulatory program to reduce wastefulness. Following are brief descriptions of each:

1. A statewide authority - A statewide authority is an independent state agency that is self-financing and self-governing within certain broad limits set by the state. Generally, such an authority is empowered to: (1) issue bonds; (2) acquire or condemn real property; (3) plan, design, construct, and operate facilities; and (4) charge user fees for any services it performs.

   The Connecticut Resources Recovery Authority is an example of a statewide authority. Created in 1971 as a result of a plan developed by the Connecticut Department of Environmental Protection, the authority is presently carrying out the implementation of the plan which calls for the construction of ten resource recovery facilities by 1985 which will process eighty-four percent of the state's waste.

   Other states with statewide authorities include: Rhode Island, Ohio, and Wisconsin.

   Advantages of the statewide authority approach are that:

   a. Local governments do not have to pledge the full faith and credit of their assets to secure a resource recovery system, nor do they have to draw upon their statutory debt limits. Instead, the authority does all the long-term debt financing.

   b. The authority provides for flexible decision-making since it is independent of the state's procurement and personnel procedures. At the same time, however, the authority must still conform to all state and federal environmental regulations, including obtaining all permits.

c. The authority provides for an integrated statewide system of resource recovery plants as opposed to an inefficient and uncoordinated system of local efforts, thus allowing for regionalization and economies of scale.

Disadvantages of the statewide authority approach, however, are that:

a. Decision-making is removed from local governmental control.

b. Until resource recovery is better proven, it would be difficult for an authority to secure financing, and if it were successful it would probably be at a higher interest rate than if such financing were secured through the use of state or local general obligation bonds.

2. A state public works approach - This is where a cabinet level state agency is given the power to construct and operate facilities, either mandating that local governments participate in the state program, or making such participation voluntary. Unlike a statewide authority, however, revenue bonds floated by a state agency do pledge the full faith and credit of the state, thus allowing for lower interest rates.

An example of a state public works approach is that of the commonwealth of Massachusetts. In the Massachusetts example, such implementation powers are given to the Bureau of Solid Waste Disposal, which has only recently issued a request for proposals for the construction of its first regional system in the Greater Lawrence area.

Another state pursuing this approach is the state of Michigan.

Advantages of this approach are that it utilizes a statewide systems orientation while securing financing at the best-possible interest rate.

The disadvantages, however, are that it lacks the flexibility and marketing capabilities of an independent authority while also introducing political considerations into its decision-making. In this regard, it is the opposite of a statewide authority.

3. A state encouraged regional approach - A state encouraged regional approach has several variations. One, it can either be a mandated regional approach - for example, legislation requiring county governments to implement resource recovery program. Two, it can be enabling state legislation to allow local government to establish either regional authorities or interlocal agreements. Or three, it can be a program of incentives for regionalization - as an example, a grant or loan program for regional resource recovery projects.

One example of a state encouraged regional approach is the California Solid Waste Management and Resource Recovery Act, enacted in 1972, which establishes a State Solid Waste Management Board and which requires all counties to adopt solid waste management plans to be approved by the state board and to be consistent with a state resource recovery plan. Such a plan has been adopted by the state and is now being used in the review and approval of county plans along with the preparation of additional implementing state legislation.

Other states using some variation of this approach are New York and Tennessee.

Meanwhile, advantages of this approach are that it allows a decentralization in the implementation of resource recovery while still encouraging regionalization, and that it promotes a cooperative state, local and regional solution to the problem.

Disadvantages, however, are that it does not provide a mechanism to insure that the various sub-state regions will actually implement resource recovery, nor does it guarantee local and regional cooperation.

4. A state grant or loan program to assist local governments - Perhaps the easiest approach for a state to implement without interfering with the present functions of local government is to establish a grant or loan program to financially assist local governments - assuming, of course, that the state has the funds necessary to support such a program.

   One example of a state utilizing this approach is New York which has a $175 million grant program for resource recovery. To date, $116 million has actually been set aside for specific resource recovery projects, with actual grant awards to be made once communities have selected contractors.

   Other states using this approach include: Illinois, Tennessee, California, Pennsylvania, Maryland, Minnesota, and Washington.

   Advantages of this approach are that it does not pre-empt local decision-making, but instead it financially motivates local governments to implement resource recovery on their own.

   A disadvantage, however, is that it does not actually improve the technical capabilities of communities to implement resource recovery.

5. A system of incentives and disincentives - Essentially, the purpose of this approach is to influence the economics of resource recovery by either providing tax incentives for resource recovery, by providing land for recovery plants, or by regulating land disposal so as to make it more expensive and comparable in cost to resource recovery.

A state that has set aside land for resource recovery and has considered various tax incentives for promoting capital investment in resource recovery is the state of Hawaii. The state of Minnesota has experimented with a disposal tax and a strong regulatory program as a disincentive to land disposal. Other states pursuing this approach includes Connecticut, New York, Illinois, and California.

Advantages of this approach are that it allows for private initiative and investment while internalizing environmental costs and requiring minimal state funding.

Disadvantages, however, are that it can lead to profit windfalls for existing resource recovery industries while not necessarily leading to an organized statewide solution.

Meanwhile, an additional aspect of this approach is the potential for a state to eliminate existing legal barriers affecting the procurement of resource recovery systems by state or local governments. As an example, in many states, laws exist which prevent government from entering into turn-key or full performance contracts. In still other states, laws exist which prohibit anything but competitive bidding - even where cost should not be the primary consideration. While there is no good example of a state pursuing this problem area, it is nonetheless an area that is constantly being brought up by those actually attempting to implement resource recovery systems.

6. A state program to encourage waste reduction - The primary purpose of this approach is to control the generation of waste so as to reduce the magnitude of the solid waste problem and to conserve energy inherent in the production and use of any goods. This can be accomplished either through a materials use tax, direct packaging controls, or voluntary industry standards for either conserving resources or utilizing recycled materials as opposed to virgin materials.

   An example of a state that has implemented this approach is the state of Oregon, which has pioneered in the area of banning nonreturnable bottles and cans.

   Advantages of this approach are that it reduces waste generation while costing little to implement and conserving energy.

   Disadvantages, however, are that it can potentially cause economic dislocations if not adopted to an area's own unique needs and problems, and it does not solve the entire solid waste problem.

THE DEPARTMENT'S ROLE IN RESOURCE RECOVERY (OUR VIEWS)[8]

Resource recovery is a basic economic activity which has functioned in one form or another since the dawn of civilization. As an economic activity, recovery cannot be achieved by environmental well-wishing. The same economic principles which govern other enterprises also govern resource recovery activities. That is, the level of recycling that can be achieved and maintained is determined by the demand for these materials as inputs for the manufacture of new products. Collection of waste products is not resource recovery. To simply recover products without regard for a market for these products is tantamount to operating in an economic vacuum. The end use of recyclable materials determines the amount that can be recovered and even determines the form in which they must be recovered.

Historically, solid waste management planning stems from the environmental concerns of government. In this context resource recovery planning should be regarded as a high form of solid waste management. We believe that the conservation ethic should be added to the environmental ethic and that resource recovery planning proceed from these two motives even though the implementation of these plans is industrial in character and scope.

At this time, resource recovery, directly from mixed municipal refuse, does not appear economically viable in any ongoing operation in this country. However, in its defense if one looks at the numbers for many pollution control facilities, one could not possibly argue the viability of a complex power plant scrubber or tertiary sewage treatment. But, the nation and the states made the decision that they would pay for clean water and clean air regardless of the cost. That same kind of decision needs to be made regarding resource recovery and until it is we will not see resource recovery. There are many imaginative ways to get resource recovery stimulated. Unfortunately though, there is a lack of courage at both state and federal levels to make it happen.

In addition to positive environmental benefits and possible economic benefits, resource recovery offers a tremendous potential for clean industrial growth. In Kansas it appears that with a very few exceptions resource recovery will have to be developed on a regional basis to have any chance of having economic success. As a consequence we feel that resource recovery needs to become a major public policy issue requiring participation from all those sectors involved in planning, developing, and operating regional enterprises.

These can best be accomplished through a statewide comprehensive resource recovery planning process carried out under a legislative mandate. The state's role should be to establish a policy, a plan to implement the policy, and an agency and/or instrumentality to implement the plan. Planning should be an interdisciplinary effort requiring equal participation from the physical and social sciences, by business and public administration. It should address all systems and institutional elements and should be able to provide sensible rationale to concerns that arise. It must also be sensitive to intergovernmental and intersectional relationships.

Legislative participation is necessary at the present time to supply the initiative necessary to begin the planning and implementation process. Even though the private sector has the technical competence necessary to do the basic system and institutional design work and can operate the system, industry cannot assume the risks. The requirement for adequate institutional arrangements to insure flow of waste into the system and market the recovered products, establishes a need that industry cannot fill.

At the present time, resource recovery planning can deal only with concepts and strategies. We really know too little about large scale resource recovery; there is little recorded experience about successful regional resource recovery systems and equally skimpy experience about the successful operation of small scale projects.

A state resource recovery plan should address the following key issues:

1. Adequate waste mobilization, waste processing and market reliability. Regional and statewide resources recovery operations require the mobilization of reliable supplies of waste in large quantities, and waste mobilization requirements usually transcend the barriers of political boundaries.

2. Cost-effectiveness, comprehensiveness, and equitability in overall programming. Because the present public liability of waste can rapidly become more of a public asset, through resource recovery, the plan should provide the motivation and means for continually increasing productivity, lowering costs and achieving greater revenues, in order to satisfy the public interest.

3. Reduction of risk and uncertainty. The utilization of practically all the ingredients of waste as raw materials is a relatively new concept. Governmental aegis and guarantees are necessary incentives for the adoption and operation of this process; government and industry are mutually involved and should mutually share the risk of the enterprise.

4. Successful harmonization of interests between levels of government and government and industry. There is need for establishing arenas in which the public and private sectors may meet in ways that will capitalize on the skills and knowledge of both while minimizing the risks to each.

Other key issues are:

1. Should there be compulsory or voluntary participation by local government in the state's program?

2. What should be the extent of public financing for resource recovery as compared to traditional disposal methods, and by who?

3. How can markets be stimulated for resource recovery?

4. How should strict disposal regulations be used to stimulate resource recovery?

5. Ultimately, who is to take the risk of implementing resource recovery?

6. How can the state not only recover its wastes, but also reduce its wastefulness?

The Department of Health and Environment should assume a leadership role in making the planning process a viable one. Legislation to mandate a resource recovery program should be prepared. In preparation for favorable consideration by the legislature, comprehensive planning guidelines for resource recovery programs should be prepared by the department.

In the preparation of this report, several solid waste management/resource recovery plans were examined. The conclusion is that in almost all cases the planners have failed to research the political economic and geographic aspects of their subject thoroughly. There seems to be an almost universal lack of concern for local attitudes, traditions, and political climates in feasibility studies. Political acceptability of resource recovery and the method of creating a regional facility or agency are major factors. Political structures vary. Some regions are more volatile than others in turnovers; some are politically stable. This kind of analysis is important background knowledge in selling the need for a resource recovery study as well as for the political ramification that can result when the study is complete.

The planner needs to be sensitive to the characteristics, demographics, and fiscal aspects when it comes down to the final steps in gaining acceptance of the plan. The usual premises of the "environment" and the "thing to do" are useful in motivating the planning, but selling the program on these ideas or its engineering aspects is not the way to go. A first priority of the planning effort can be no less than a thorough understanding of all aspects of the community if resource recovery is to become a reality and an acceptable project for design, construction, and operation.

The following is a listing of short term goals which the department should attempt to complete by 1984.

1. The department should research and develop a comprehensive resource recovery legislative package which should be ready to be considered by the Kansas Legislature in the 1983 Legislative Session. The legislation should address the concerns outlined in the proceeding section and should call for an active state role in supervising and funding the effort.

2. The department should strengthen its regulatory policies regarding land disposal of solid waste, particularily as these relate to the long-term care of closed disposal sites. The cost of long-term care of disposal sites should be reflected in the unit cost of the sites operation, we doubt that it is. Resource recovery should not have to compete with inadequately financed, poorly planned disposal.

3. The state of Kansas should work toward various waste reduction methods. One area which appears promising is beverage container legislation. As a practical matter, the contribution of beverage containers is only a percentage of the total solid waste mix; however, a principal contribution of this approach is in the form of a symbolic gesture which we believe would increase the development of a conservation ethic in our citizens. Passage of container deposits is a very difficult proposition. The beverage and container interests are well organized; have almost unlimited funds to spend to defeat "deposit" legislation; and these interests have a surprising success rate considering that a majority of Kansas citizens, as evidenced by editorial support, will admit that they think deposit legislation would be a good thing. The voluntary centers operated by the beverage distributors help, and we concede, remove many of the recyclable containers which end as litter. The non-recyclable containers lay where they are discarded until they are broken or rust away. Many containers, recyclable or otherwise, are used in commercial and residential untis and our observations are that most of these end up in the landfills LOST. The goal for the 1980's should be to get them all back.

4. State government should set an example for its citizens. Resource recovery being an economic activity will not develop into a viable alternative to disposal until reliable markets for recovered materials are available. The state should focus part of its efforts toward expanding the state and local economic demand or need for these materials, which in turn will sustain growing levels of recycling. One way this could be done is by coordinated educational efforts designed to encourage the public, business, and state institutions to use more products made from recycled materials. The department should work toward an examination of state controlled purchasing specifications to see if those descriminate against products made from recycled materials. Paper products, lubricating oil, and cleaning solutions are obvious beginnings. The department has no direct influence over the selection of those products; however, it would seem entirely appropriate to encourage the governor to issue an executive order to request one or the other legislative body to enact a resolution calling for such a review.

5. The department should work with the Kansas Department of Economic Development in its industrial development efforts (traditionally conducted to lure new or expanded industrial capacity to the state) to focus a portion of its interest specifically on industries and companies to use recycled materials.

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RESOURCE RECOVERY STUDIES

FOR

THREE KANSAS COMMUNITIES

by

U.S. Environmental Protection Agency, Region VII

PEDCo

Kansas Department of Health and Environment

March 1982

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INTRODUCTION

An increasing number of cities/counties are looking at resource recovery. The primary reasons for considering resource recovery are the diminishing space in existing landfills and the revenue required to operate them. The effects of inflation on energy (fuel) and labor have made the operation of the landfill an increasingly expensive venture. Some counties, that have landfills nearing completion, are now trying to site new disposal facilities. This siting is difficult due to the negative public response about landfills. It is also costly to develop plans and operating procedures which are required by state permits. The RCRA "Open Dump Inventory" has required a more rigorous set of criteria that landfills must meet. This makes the siting and operation of an environmentally safe landfill a more difficult (and therefore a more expensive) task.

The Environmental Protection Agency (EPA) implemented the Technical Assistance Panels program to aid state and local government to investigate the possibilities of resource recovery. Under this program a local community could be helped in their study by a TA panel consisting of people with expertise in the field. These people would typically come from: EPA; EPA contractor; state agencies; local government and community leaders.

Under the Technical Assistance program the local government was aided in conducting a study to see if resource recovery was economically feasible. These studies had the following focus: review the types of resource recovery and determine which is most applicable to the specific community; estimate quantity of solid waste generated; identify potential energy customers; determine economic feasibility of resource recovery.

Studies were conducted for the following Kansas communities: Hutchinson-Reno County; Topeka-Shawnee County; Greater Southwest Regional Planning Commission (19 counties). These areas are shown in Appendix A. This report will give a summary of the results of these three studies.

The general discussion of the review of resource recovery types, the solid waste generation, the steam survey, and the economic analysis are similar for each study and will be presented as separate sections. The remaining part of the report will identify the specific aspects of solid waste generation, steam survey, and economic analysis details for each particular study.

REVIEW OF RESOURCE RECOVERY TECHNOLOGY

A. Refuse Derived Fuel

The purpose of refuse derived fuel (RDF) systems is to prepare a fuel that can be burned and which does not contain a large fraction of unburnables. Pelletized RDF or Fluff RDF are the products from this process. "RDF containing about 10 million BTU's per ton can be produced from between 55-85% of all refuse received."[1]

RDF plants mechanically separate the organic fraction from the non-combustible fraction of the waste. All plants use essentially the same processes, although in different combinations. The current processes used are shown in Table 1.[2] A schematic of RDF facility is shown in Figure 1.[3] The basic processes are: shredding (size reduction); air classification (density separation); mechanical separation. The mechanical separation can be magnetic (ferrous removal) or screening. A trommel (rotary screen) is often used prior to the initial shredding to remove bulky wastes that do not burn. Glass particles are also removed by the trommel to prevent abrasion in the process equipment. Methods of aluminum recovery and glass recovery are practiced at some plants.

The dollar/ton cost of RDF is high when compared with other technologies. The RDF process requires plants that are capital-intensive. Another disadvantage is the lack of a firm market for RDF. Companies are reluctant to use this fuel in expensive boilers due to the variability in quality, the tendency to slag, and the possibility of corrosion.

B. Mass-Burn Incineration

Mass-burn units are usually waterwall incinerators but they can be refractory lined chambers followed by a waste heat boiler. The waterwall incinerator has a combustion chamber that is lined with tubes which circulate the water as it is being heated to steam. This design of boiler is typical of that used in the electric production industry.

Solid waste is unloaded on a tipping floor where it can be inspected for large bulky items that are not suitable for combustion. A front-end loader or a crane transfers the refuse to a chute that charges the furnace. Stoker or travelling grate boilers are usually used for this type of system. A typical installation is shown in Figure 2.[2] The refuse is burned as it travels up the inclined travelling grate. Underfire air is blown under and through the refuse to provide combustion air. Steam or electricity are the end products to be marketed.

The advantage of this type of resource recovery process is that electricty is an easily marketable commodity. This type of facility could be easily sited, since the major requirement would be close proximity to an electrical grid system.

TABLE 1. PROCESS STEPS USED IN PRODUCTION OF REFUSE-DERIVED FUEL[a]

Process	Function
1. Trommel	Separate small, heavy objects (such as glass) from burnable portion
2. Primary shredding	Reduce feed to handleable size
3. Air classification	Separate heavies from lights
4. Magnetic separation	Remove ferrous metals
5. Screening	Separate various size fractions and classify materials (disc screens, rotating screens, etc.)
6. Secondary shredding	Reduce product to usable size
7. Pelletizing	Press or extrude RDF into usable, "coallike" pellets

[a]Not all steps are used in every production plant.

Reference 2

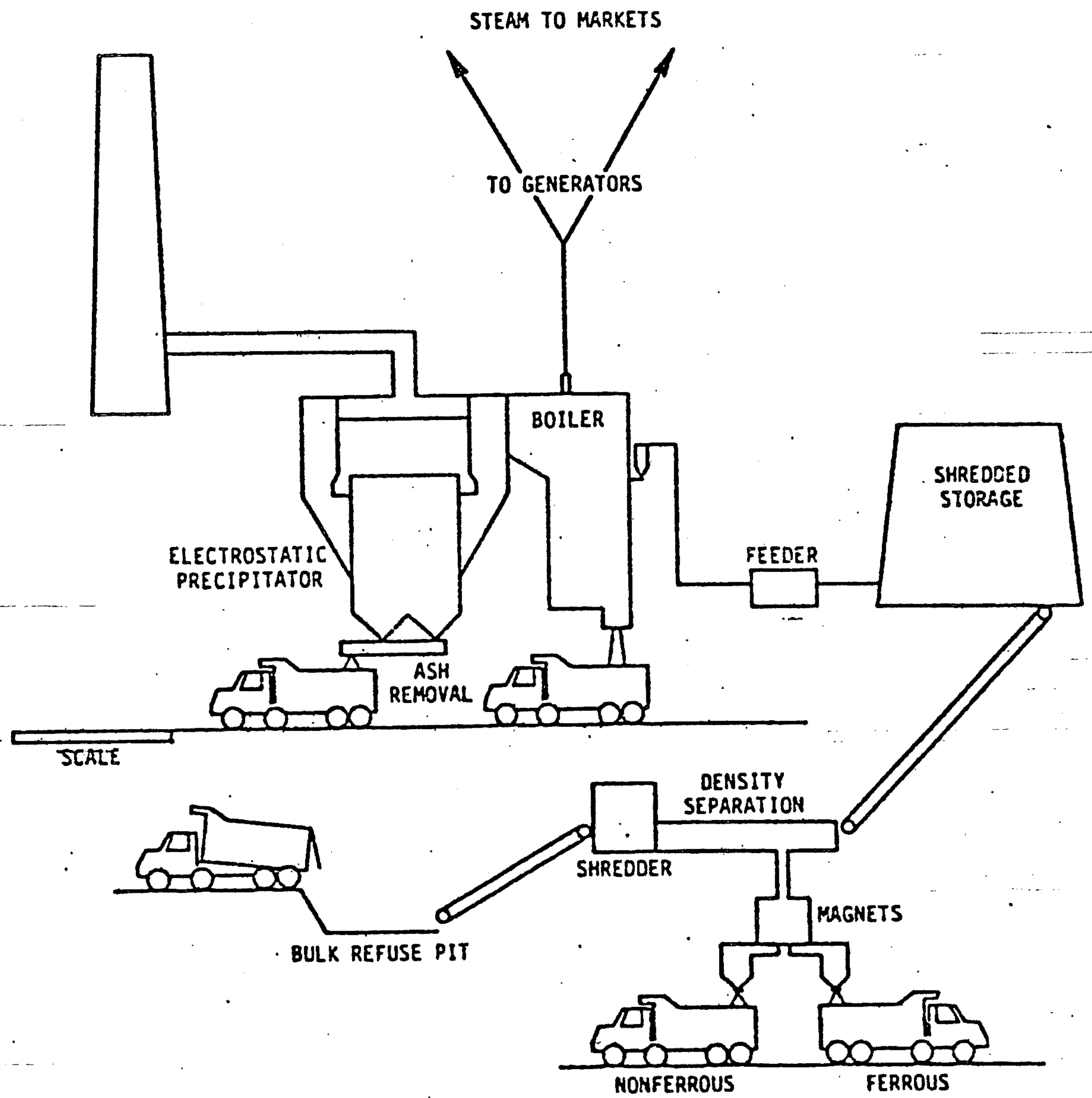


Figure 1. Schematic of a refuse-derived fuel (RDF) facility.

Reference 3

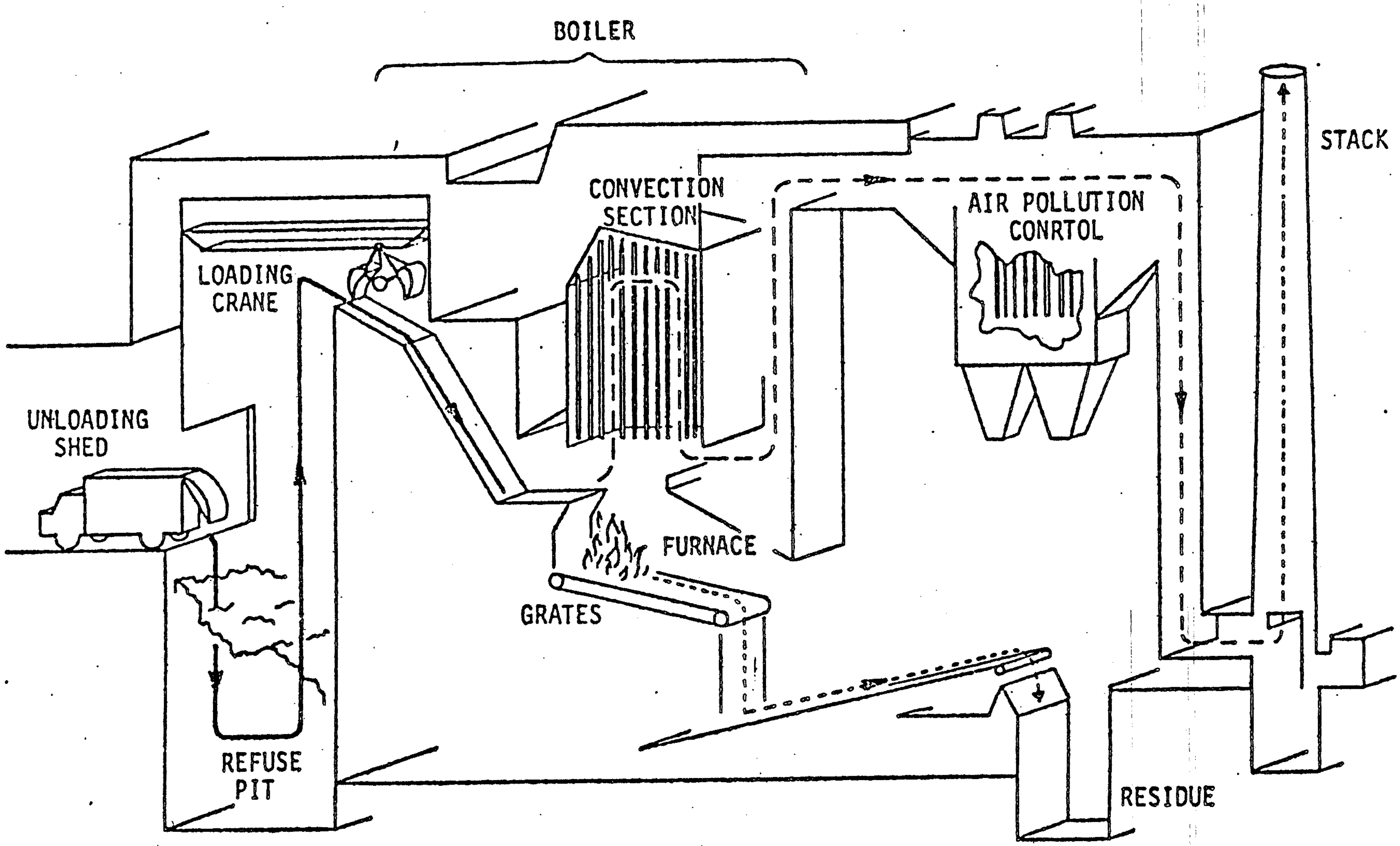


Figure 2. Typical waterwall furnace for unprocessed solid waste.

Reference 2

The disadvantage of this type of resource recovery is that these boiler systems are capital intensive. The dollar/ton cost of processing is high when compared with other refuse disposal options. Two major installations have an average capital cost of $50,000/ ton/day capacity.[4]

C. Pyrolysis, Codisposal, Composting

Pyrolysis is a form of starved air incineration that involves the distillation of the carbonaceous matter of solid waste into char, liquids, gases, and ash. The pyrolytic (oxygen deficient) reaction produces products that have a heating value. Whereas, solid waste that is combusted with sufficient air produces carbon dioxide, water vapor, and sulfur dioxide.

The pyrolysis process technology has not reached a state of operational reliability. Capital costs are high when compared to mass burning systems.[3]

Codisposal involves the landfilling or incineration of solid waste that has been mixed with sewage sludge. This process is in the experimental stage and is not a proven technology.[3]

Composting is the aerobic or anaerobic decomposition of solid waste. Aerobic systems are usually used to control odors. Solid waste is mixed with a bulking agent (woodchips, etc.) and windrowed. The waste material biologically degrades to a humus material that can be used as a soil conditioner.

The composting technology has been established. The major disadvantage of composting is establishing a market for the product. The lack of adequate financial market makes the dollar/ton cost higher than other disposal options.

D. Modular Incineration

A modular conbustion unit is a self contained incinerator designed to handle small quantities of waste. These units are usually used for small scale energy recovery while waterwall incinerators are used for large scale projects. Modular incinerator modules range in size from 10 tons/day to 100 tons/day. Several of these modules can be grouped together in order to obtain the required disposal capacity for the plant. A grouping together of smaller modules to obtain a design capacity is often used. This results in a redundancy that provides a built in back-up system. If one of the modules is in need of maintenance, other modules can continue to process the waste.

Municipal solid waste is dumped onto a tipping floor so that large bulky items can be separated. A small skid-steer front-end loader pushes the waste into a loading hopper. As the waste is burned in the incinerator, the heavy unburned fraction settles to the bottom. Most incinerators have an automatic ash conveying system. The ash is conveyed through a water quench and is discharged to a hopper for disposal. The remaining ash is 10-20% of the original volume and 25-40% of the original weight of the incoming refuse.

A typical modular incinerator is shown in Figure 3.[2] The incinerator has two combustion chambers which control the air-to-fuel mixture (sub-stoichoimetric). The gases and unburned organics rise to the secondary combustion chamber. The secondary chamber combusts the gases and particulates in an excess air condition. This chamber usually has a burner which insures that complete combustion takes place.

This type of double chambered incinerator has the effect of limiting the particulate emissions in the exhaust gases. Since the primary chamber is operated in a lean air-to-fuel mode, it has a low air velocity which does not cause turbulence. This lack of turbulence reduces the number of particulates that would be entrained in the exhaust gases. The secondary chamber is operated with excess air for combustion. This complete combustion burns all of the organic particulates and reduces the particulate emissions in the exhaust gas.

Auxiliary fuel is used in the primary chamber to initially ignite the waste; it is usually not needed during operation. Auxiliary fuel is used as needed in the secondary chamber to maintain complete combustion. This is usually ascertained by monitoring the exhaust gas for emissions.

Energy is recovered by passing the hot exhaust gases through a heat exchanger which is located after the secondary chamber. The recovered energy is usually in the form of steam, but can also be hot water or hot air. The typical system is equiped with a dump stack that by-passes the heat exchanger. This allows the incinerator to be operated if steam is not needed or if the heat exchanger is in need of maintenance.

The disadvantages of a modular incinerator is the unproven technology. Most manufacturers claim a 20 year life expectancy; however, these units have not been in operation long enough to have a proven track record.

The advantages to modular incineration is the capital cost. This form of resource recovery has the lowest initial cost. Capital cost is the primary criteria used by most governmental units. The availability of a market for the energy is usually not difficult, but it is an important part of the feasibility study.

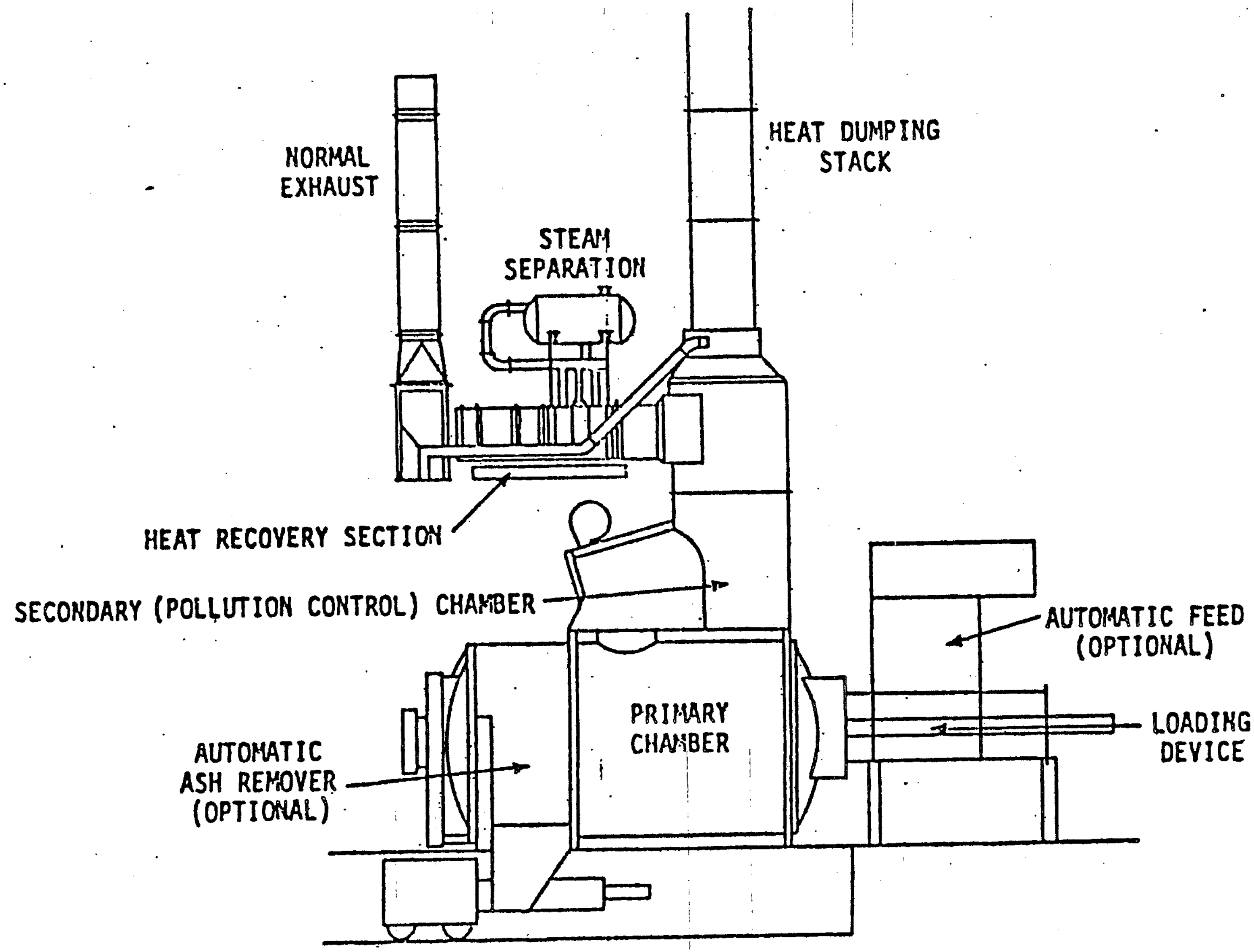


Figure 3. Typical modular incinerator with heat recovery.

Reference 2

Modular incinerators usually comply with air quality regulations without needing pollution control devices.

E. Summary of Technologies

Table 2[3] shows the relationship between population, MSW, and energy recovered from varous types of resource recovery systems.

Table 3[2] shows the cost associated with various solid waste disposal or resource recovery options.

Refuse Derived Fuel systems are capital intensive and the technology is not yet reliable. It is difficult to develop a market for the fuel. Pyrolysis systems are capital intensive and the technology is not reliable. Composting has not proven successful in this country due to problems in establishing a market for the product. These types of systems are not recommended for the Kansas studies.

"Waterwall and modular incineration are the two most cost effective and most proven technologies."[3] Waterwall incinerators are more capital intensive than modular incinerators. They are usually proposed for communities that will have 500 tons per day or larger solid waste volumes.

Modular incinerators are the most cost effective form of resource recovery for communities generating between 50-300 tons per day.[5] Therefore, the modular incinerator technology was used as the resource recovery option for the studies undertaken in Kansas.

TABLE 2. ENERGY RECOVERY FROM MUNICIPAL SOLID WASTE

Population (1000)	MSW generated assuming 3.5 lb/person/day (tons/day)	Steam[a] produced by mass burn incinerator (lb/hr)	RDF[b] produced from MSW (tons/day)	TPD feed[c] rate of co-fired boiler RDF/coal	Co-fired[d] steam production lb/hr	Co-fired[e] boiler size (MW)
20	35	7,300	25	25/59	44,000	4
40	70	14,600	49	49/118	87,900	9
60	105	21,900	74	74/176	131,900	13
80	140	29,200	98	98/235	175,800	18
100	175	36,500	123	123/294	219,800	22
120	210	43,800	147	147/353	263,700	26
140	245	51,100	172	172/412	307,700	31
160	280	58,400	196	196/470	351,600	35
180	315	65,800	221	221/530	395,600	40
200	350	73,100	245	245/588	439,500	44
220	385	80,400	270	270/647	483,500	48
240	420	87,700	294	294/706	527,500	53
260	455	95,000	319	319/764	571,400	57
280	490	102,300	343	343/823	615,400	62
300	525	109,600	368	368/882	659,300	66
320	560	116,900	392	392/941	703,300	70
340	595	124,200	417	417/1000	747,200	75
360	630	131,500	441	441/1058	791,200	79
380	665	138,800	466	466/1117	835,100	84
400	700	146,100	490	490/1176	879,100	88
420	735	153,400	515	515/1235	923,000	92
440	770	160,700	539	539/1294	967,000	97
460	805	168,000	564	564/1352	1,010,900	101
480	840	175,300	588	588/1411	1,054,900	105
500	875	182,600	613	613/1470	1,098,900	110

a
- 150 psig sat. steam with feedwater return at 60°F
- 4500 Btu/lb heating value for MSW
- Thermal efficiency of 65 percent
- 24-hr/day operation

b 70 percent of MSW is recovered as RDF.

c
- Total Btu input is 20 percent by RDF and 80 percent by coal
- 6000 Btu/lb heating value for RDF
- 10,000 Btu/lb heating value for coal

d
- 850 psia superheated steam with turbine recycle supplying feedwater at 349°F
- Thermal efficiency of 75 percent
- 24-hr/day operation

e 1MWe = 10,000 lb/hr steam.

Reference 2

TABLE 3.

OVERVIEW OF SOLID WASTE DISPOSAL OPTIONS

Option	Reliability	Waste volume reduction	Time required for implementation (years)	Applicable size range (TPD)	Approximate cost/ton (net $)
Resource recovery					
Mass burn	High	High	2-4	200-3000	$15-30[1,2]
Production of RDF	Low-medium	High	3-5	200-3000	$17-35[1,2]
Modular incineration	High	High	1-2	5-50 in modules	$12-30[1,2]
Source separator					
Paper	Medium	Medium	1	25-250	$8-15[3]
Metals	Medium	Medium	1	35-250	$8-15[3]
Baling	High	Low-medium	1	50+	$5-12[2] plus landfilling
Transfer stations	High	Low	1	all[a]	$4[b,4] plus landfilling
Landfilling	High	Low	1	all	$6-20[2]

[a] Transfer stations are applicable in situations of long round trips for collection trucks to landfill sites.

[b] Additional cost of transfer station operation and transportation to disposal site - this does <u>not</u> include savings to collection trucks using the transfer station.

References

1. Small-scale and Low Technology Resource Recovery In Municipal Solid Waste: Resource Recovery Proceedings of the Fifth Annual Symposium. EPA-600/9-79-023b. August 1979.
2. Solid Wastes Management. August 1979.
3. Weighing Small-Scale Resource Recovery. Waste Age. March 1979.
4. Solid Waste Collection Practice. American Public Works Association, 1975.

Reference 3

ENERGY RECOVERY FROM MODULAR INCINERATORS

"Steam can be produced at pressures from 15 to 400 psig."[5] The standard modular heat exchanger produces steam at 150 psi and at saturated conditions. Any higher pressures required by a user would necessitate special equipment which increases the cost of the system. Steam customers requiring 150 psi or less were the primary contacts when conducting the market survey.

The quantity of steam produced from a modular incinerator ranges from 1 to 3 pounds of steam per pound of municipal solid waste burned.[5] Table 4[5] shows the relationship between population, MSW generated, and steam produced from a modular incinerator. The table assumes 2 lb stm/lb MSW and 4,500 BTU/lb heating value for the solid waste.

The relative heating values of some common fuels are listed in Table 7[5] in Appendix B. Table 8[6] in Appendix B shows the lower heating values of various products.

Some manufacturers rate the modular incinerators according to the type of waste to be burned. Reference 5 rates incinerators for municipal waste (4,500 BTU/lb) and for industrial waste (7,000 BTU/ lb).

TABLE 4. STEAM PRODUCTION FROM MODULAR INCINERATOR BURNING MUNICIPAL SOLID WASTE

Population	MSW generated (based on 3.5 lb daily per capita), tons/day	Steam production,[a] lb/day
20,000	35	140,000
40,000	70	280,000
60,000	105	420,000
80,000	140	560,000
100,000	175	700,000
120,000	210	840,000
140,000	245	980,000
160.000	280	1,120,000
180,000	315	1,260,000
200,000	350	1,400,000

[a] Based on production rate of 2 lb of saturated steam per pound of MSW at 150 psig, with 75% condensate return at 180°F.

Reference 5

SOLID WASTE GENERATION

An important aspect of the study is the need to know the quantity of fuel available for use in the modular incinerator. This requires a knowledge of the quantity of refuse produced and the composition of the waste. As seen in the modular incinerator section, the steam generator rating capacity is based on the BTU/lb quality of the waste that is burned. Figure 4 shows an analysis of solid waste and the relationship to recovered resources and fuel. The composition of a typical municipal solid waste that would produce 4,500 BTU/lb is shown in Table 9,[5] Appendix C.

It is also important to know exactly how much solid waste is generated and available for use in the incinerator. The Kansas Department of Health and Environment requires (Regulation 28-29-23)[8] each sanitary landfill to provide an annual estimate of the solid waste disposed. This information is compiled in KDHE Bulletin 4.10.[9]

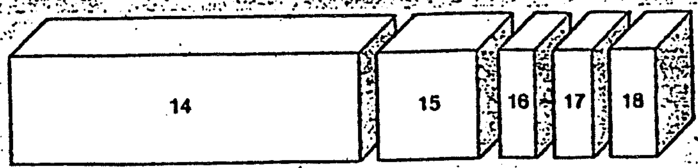
These quantities are usually estimates and are not necessarily accurate. Some landfill operators have estimated the number of trucks and their size. An estimate of the compaction ratio must be made in order to arrive at a weight of refuse. Solid waste texts give average figures for compaction ratios. Typical values are listed in Appendix C, Table 10.[10] At other landfills the operator estimates the volume of landfill space that was used. There is an error associated with the judgment of the volume used (usually not surveyed). Again, an estimate of the compaction ratio of the refuse in the landfill must be used. These values are reported in solid wastes texts (see Appendix C), however each landfill is different due to the operation.

Another method of estimating the quantity of solid waste is to use typical per capita generation rates. These rates in pound MSW/capita/day are multiplied by the community population to yield the amount of solid waste. Typical values are published as seen in Appendix C, Table 11.[10]

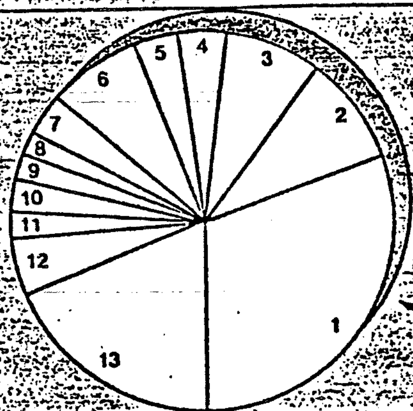
Some of the studies summarized in this report used estimated quantities of solid waste. Each of these studies served as a rough estimate or a screening process to ascertain if modular incineration was feasible. If the studies conclude that modular incineration may be feasible, then the community should conduct a more extensive evaluation of the solid waste. More accurate figures for composition and quantity of solid waste will be needed.

The only good way to quantify solid waste is to weight it at the landfill. Due to the price of scales and operational costs, only a few Kansas counties weigh at the landfill. To complete a weighing program, portable scales may be used. The proper techniques for weighing representative samples must be used.

ANALYSES OF MUNICIPAL WASTE



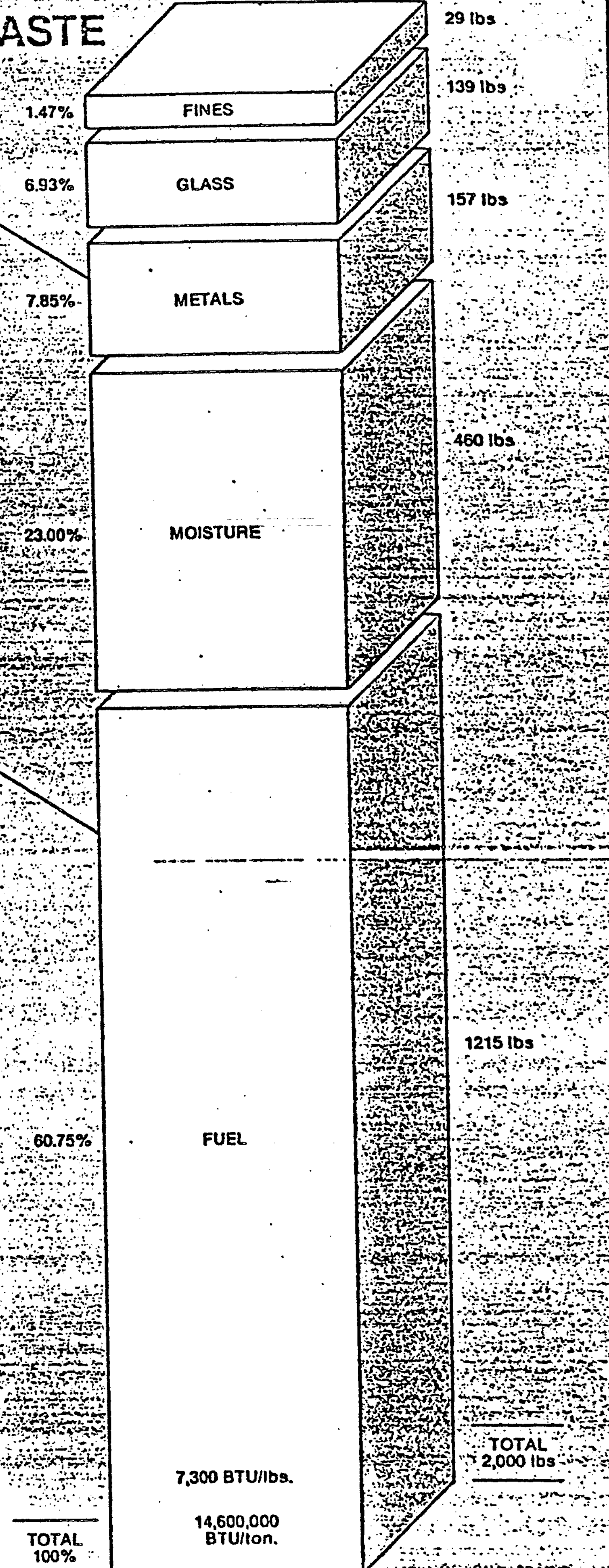
RESOURCES RECOVERED METALS	Percent-Weight in one ton of Resources Recovered %	Wt.	Percent-Weight in one ton of Municipal Waste %	Wt.
14. Ferrous Metals	60	1200	5.85	117
15. Aluminum	20	400	1.00	20
16. Other Metal	6	120	.30	6
17. Copper, Brass	4	80	.20	4
18. Non-Metals	10	200	.50	10
	100%	2000 lbs	7.85%	157 lbs



RESOURCES RECOVERED FUEL COMPOSITION	Percent-Weight in one ton of Fuel %	Wt.	Percent-Weight in one ton of Municipal Waste %	Wt.
1. Corrugated Paper Boxes	31.17	623.4	18.94	378.8
2. Newspaper	10.70	214.0	6.50	130.0
3. Magazines	8.48	169.6	5.15	103.0
4. Mail	4.10	82.0	2.49	49.8
5. Paper Food Cartons	3.06	61.2	1.86	37.2
6. Paper (Wrapping)	6.56	131.2	3.99	79.8
7. Tissue Paper	2.96	59.2	1.80	36.0
8. Wax Carton	1.15	23.0	.70	14.0
9. Plastic, Rubber	2.23	44.6	1.36	27.2
10. Wood	2.54	50.8	1.54	30.8
11. Textile	1.28	25.6	.77	15.4
12. Food Waste	6.25	125.0	3.80	76.0
13. Yard Waste	19.52	390.4	11.85	237.0
	100.0%	2000 lbs	60.75%	1215.0 lbs

ANALYSIS OF MUNICIPAL WASTE

	Percent With Moisture	Percent Without Moisture
1. Corrugated Paper Boxes	25.80	18.94
2. Newspaper	8.86	6.50
3. Magazines	7.01	5.15
4. Mail	3.39	2.49
5. Paper Food Cartons	2.53	1.86
6. Paper (Wrapping)	5.44	3.99
7. Tissue Paper	2.45	1.80
8. Wax Carton	.95	.70
9. Plastic, Rubber	1.85	1.36
10. Wood	2.10	1.54
11. Textile	1.05	.77
12. Food Waste	5.18	3.80
13. Yard Waste	16.14	11.85
14. Ferrous Metals	5.85	5.85
15. Aluminum	1.00	1.00
16. Other Metal	.30	.30
17. Copper, Brass	.20	.20
18. Non-Metals	.50	.50
	100.00%	77.00%



ROSS HOFMANN, ASSOCIATES

Reference 7

The composition of the solid waste can be determined by analyzing representative samples taken at the landfill. The procedures for performing this analysis are given in Reference 11.

STEAM SURVEY

The average amount of steam that could be generated was calculated by using the quantity of solid waste available and the modular incinerator specifications. A match of steam produced with steam used was investigated for the local industrial/commercial establishments.

A list of potential industrial steam users was compiled by using several sources of information. Local leaders (such as planning commission members, city-county officials) have good knowledge of the local industry. The Kansas Department of Economic Development publication of Manufacturers and Products[12] lists industry by area and by product.

The prospective industrial users were surveyed to find the quality and quantity of steam used. A sample survey sheet is shown in Appendix D. Other important information needed relates to the type of steam demand: maximum and minimum flows; continuity of flow by day/week/month/year.

After reviewing the completed forms, plant visits and interviews were scheduled. The purpose of the visits was as follows:

1. Ascertain if information on reporting form is correct.
2. Assess plant site.
3. Determine interest.

The plant site must be able to accomodate the modular incineration facility. References indicate that the maximum steam line length is one mile. The Kansas studies required plants to have adjacent property for construction of the facility. Finally, the industry must be interested in joining this venture.

The potential customer must have a process that uses steam at a temperature and pressure equal to or lower than what can be produced by a typical modular heat exchanger. The ideal process would use steam 24 hours per day for 6 to 7 days per week and not have any major swings in demand. A process that uses significantly more steam than an incinerator can provide may be the best match. The modular incinerator steam could be piped into the system of a larger boiler. The boiler's instrumentation could sense any swing in flow and adjust its firing accordingly. The larger boiler could also pick up the entire load if the modular incinerator failed and not cause the process to be curtailed. A modular incinerator providing 100% of the steam needs may pose a reliability problem. If it suffered an outage, the process boiler would need sufficient time to start up. During this time the process would be down; some process are very sensitive to unplanned down time.

ECONOMIC ANALYSIS

Using the size facility previously determined, a size or combination of modules can be selected. Vendors can be contacted to give quotes on the cost of a specific modular incinerator system. These costs should include purchase price and operational costs. Operational costs would include electricity, fuel, water, etc. A rule of thumb figure for total cost is $35,000 per ton of capacity.[5]

The initial cost of the incinerator and the operating costs are brought to an annual cost by using economic analysis methods. The annual sale of steam is subtracted from this to yield a net annual cost. This value is divided by the quantity of solid waste which gives the disposal cost in dollar/ton.

The landfill budget can be divided by the quantity of refuse to give a dollar/ton disposal cost. Care should be taken that the budget reflects all of the costs. This may include the purchase price of a new landfill site if the present site is nearing completion.

The two disposal costs can be compared and the most economicaly feasible system may be chosen.

One should recognize that the analysis makes assumptions and that the results are only as good as the assumptions. Some factors that change the economic picture are the rate of inflation, price of fuel, cost of labor. These are not always easy to predict. However, these costs are usually increasing. As the landfill cost increases, the prospective resource recovery system becomes more and more attractive.

RESOURCE RECOVERY STUDIES

A. Hutchinson-Reno County

This study originally encompassed the counties of the Mid-State Regional Planning Commission, i.e. Rice, McPherson, and Reno (see Appendix A). However, due to the location of industry in Hutchinson and the cost of transporting refuse, the study focused on Reno County.

The solid waste available for the facility was estimated to be 41,000 ton/year. This was computed by assuming a 3.5 pound/capita/day generation which was multiplied by the population estimates provided by the regional planning commission. The data supplied by the landfill did not correspond with national averages and was not used. This amount of waste, when burned on a six day week, would require a 125 ton per day incinerator. This size facility could produce 22,000 pound steam/hour according to vendor information.[6]

The industries surveyed included: three salt manufacturers, a paper manufacturer, an equipment manufacturer, and four food or meat processors. The steam survey revealed that the three salt companies would be good potential customers. The salt companies use low pressure steam to evaporate brine for the production of salt. The steam demand is fairly constant over a 24 hour period and the process is operated seven days per week. The plants use considerably more steam than the amount provided by the incinerator. This would allow the solid waste incinerator to be a supplemental steam source that would fit well into the existing steam system. Each of the three potential plant sites had sufficient area to easily accomodate the construction of a modular incinerator facility.

The projected cost of disposal at the landfill for 1982 was $11.90 per ton (current $9.00). The economic analysis indicated that the net disposal cost (after sale of steam) for an incinerator was $17-34 per ton. The range of values was due to different vendor and different equipment. An $8-10 million bond would be required for the initial capital outlay. The comparison shows that the resource recovery option is not yet feasible compared to landfilling.

B. Topeka-Shawnee County

Shawnee County was originally interested in a resource recovery facility due to decreasing disposal space at the county landfill. Other interests were on supplying steam to a downtown heating loop that the local utility did not want to operate anymore.

Solid waste in Shawnee County is disposed of at a county landfill and at a private landfill. The private landfill primarily handles industrial and commercial wastes. Waste amounts are recorded by volume. The county landfill primarily handled residential refuse from the City of Topeka. The county landfill weighed all refuse prior to disposal with in-place scales.

These data indicated that the total amount of refuse available would be 115,000 tons/year. This annual amount of refuse would compute to a generation rate of 3.8 lb/c/day based on the community population. This generation rate is within the range of accepted figures that are published. A 360 ton/day modular incinerator could burn this amount of refuse on a six day/week basis. Approximately 75,000 pounds/hour of steam would be produced by this facility.

The steam survey revealed that it was not practical to use the downtown steam heating loop. The industries surveyed were: tire manufacturer, two food processors, cellophane plant, electric utility and water utility. The survey of industries indicated that only one plant used more steam and at compatible temperatures and pressures. This was the Goodyear Plant which uses process steam for the manufacture of tires. The plant used considerably more steam than the incinerator facility would produce. This would allow it to be easily tied into the existing plant steam distribution system. The existing boiler would still operate and handle variations in load. The Goodyear flow rates were usually steady but depend on tire production needs and the number of shifts working. The plant site would accomodate the installation of a refuse facility.

The Goodyear Plant also produces high BTU/pound wastes from tire production. These wastes include rubber and solvents. This waste could be included in the county incinerator study. These wastes could increase the size and steam capacity of the unit.

The projected cost of disposal at the landfill for 1982 was $6.50 per ton. The economic analysis indicated that the net disposal cost for an incinerator was $17-27 per ton. This includes the sale of steam at $3.60 per thousand pounds.

The range of values was due to different vendors. A bond issue of approximately $25 million would be required. The comparision shows that the resource recovery option is not yet feasible compared to landfilling.

C. Southwestern Counties

The original study encompassed nineteen counties (Appendix A) represented by the Greater Southwest Regional Planning Commission. The original proposal was to use solid waste to provide fuel for an electric generating plant that was being planned. The study concluded that the electric utility's plant was too far along in design to be changed. Other factors are the utilities willingness to use RDF as a fuel. The percentage of total fuel contributed by the RDF would be small and not economically feasible to alter the boiler. There are also technology problems with using RDF in a boiler.

The study also concluded that it was not cost effective to use a multi-county approach. These counties covered too large an area and did not generate sufficient refuse. The study focused on the three largest city/counties: Dodge City - Ford; Garden City - Finney; Liberal - Seward. The study focused on using the refuse from a county for a facility in that county.

The amount of refuse generated in these counties was in the same range - about 22,000 tons per year. The Ford County landfill has scales installed and weighs prior to disposal. When computed on a per capita basis, this yields 4.4 lb/c/day. This figure is somewhat high when compared to other Kansas rates, but is believed to be accurate due to the scales.

Since the three counties are similar in population, this amount of refuse was used for each. A modular incinerator operating on a six day/week basis would burn approximately 75 tons/day. This size of facility would produce about 9,000 pounds steam/hour.

The industries surveyed were: electric utility, helium plant, grain and food processors, and beef processor. The steam survey concluded that the most logical candidate for the steam was the MBPXL Plant in Dodge City. This beef processing plant uses steam in their process cookers. The plant uses considerably more steam than that produced by the waste facility. This would allow the waste boiler to be tied into the existing plant steam distribution system. There was sufficient land available adjacent to the plant to allow construction of the waste facility.

The community landfill costs are summarized in Table 5[13] below:

TABLE 5. SUMMARY OF ESTIMATED DISPOSAL COSTS BY SANITARY LANDFILLING, 1981

County	Net cost, $/ton
Finney	6.20
Ford	14.30
Seward	5.90

The differences are significant and the high cost at Ford County may reflect a more detailed budget. The cost of the modular incinerator was estimated to be 32-40 dollar/ton waste disposed. A bond issue of $2-3 million would be needed to finance this facility. The landfill is the most economical disposal method.

CONCLUSION

The study indicated that in each community there was an industrial steam user interested in purchasing steam from a modular incineration facility. The price of the steam had to be competitive with that already being produced by the industry. Each industrial plant had sufficient area available to allow construction of the waste processing facility.

The results of the study, as shown in Table 6, indicate that the cost of landfilling is much lower than disposal by modular incineration. Generally, resource recovery plants cannot compete cost-wise with a properly operated landfill.[13] The data shows that each ton of solid waste processed would have to be subsidized by about $10.00. Communities and local government officials are not willing to finance these subsidies. The use of a modular incinerator for solid waste disposal is not economically feasible for the Kansas communities studied.

As stated earlier, the studies make assumptions in order to prepare an economic analysis. A "sensitivity study" investigates the change in the results of a study by varying the assumptions that were made. The parameters that were varied include: operating expenses; capital expenditure; operating revenues; interest rate. A sensitivity study for Topeka-Shawnee County was performed. It indicated that the cost of landfilling and the cost of modular incineration would become equal in approximately ten years.[14]

These results would indicate that one should monitor the critical parameters that can have an effect on the economic feasibility of resource recovery systems. These systems will become feasible in the future.

TABLE 6

KANSAS REFUSE TO ENERGY STUDIES

Item	Topeka-SN. Co.	Hutchinson-RN. Co.	Southwest
Incinerator Size (ton/day)	450	125	75
Steam Generation (lb/hr)	75,000	22,000	9,000
Net Cost For Steam ($/1,000 lb)	3-14	4-7	——
Net Cost For SWM ($/ton)*	11-17	17-34	34-41
Landfill Cost ($/ton)	6.50	9.00	6-14

*Steam sale at $3.60/1,000 pounds steam.

APPENDIX A

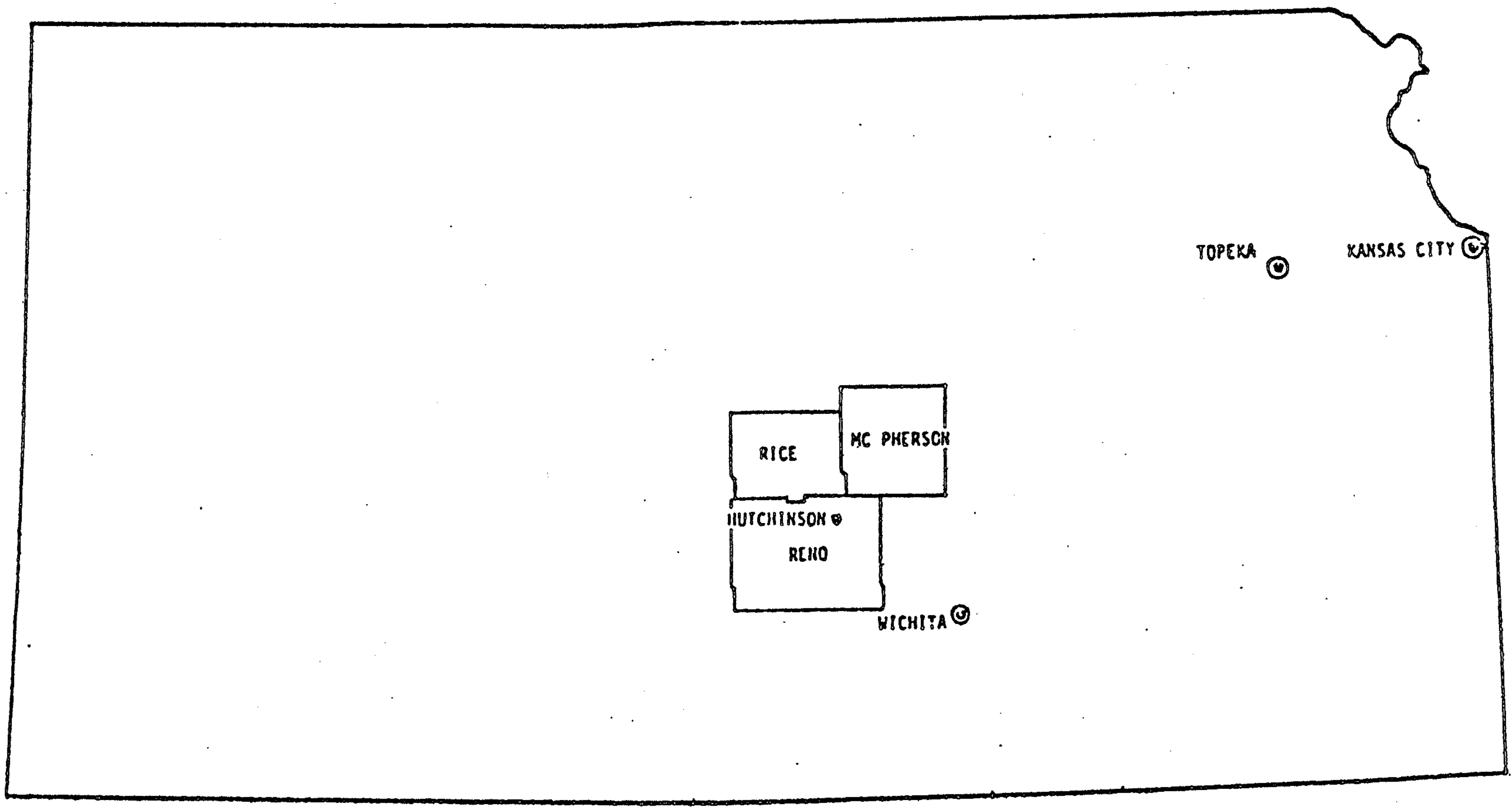


Figure 5. Reno and surrounding counties in the study area.

Reference 3

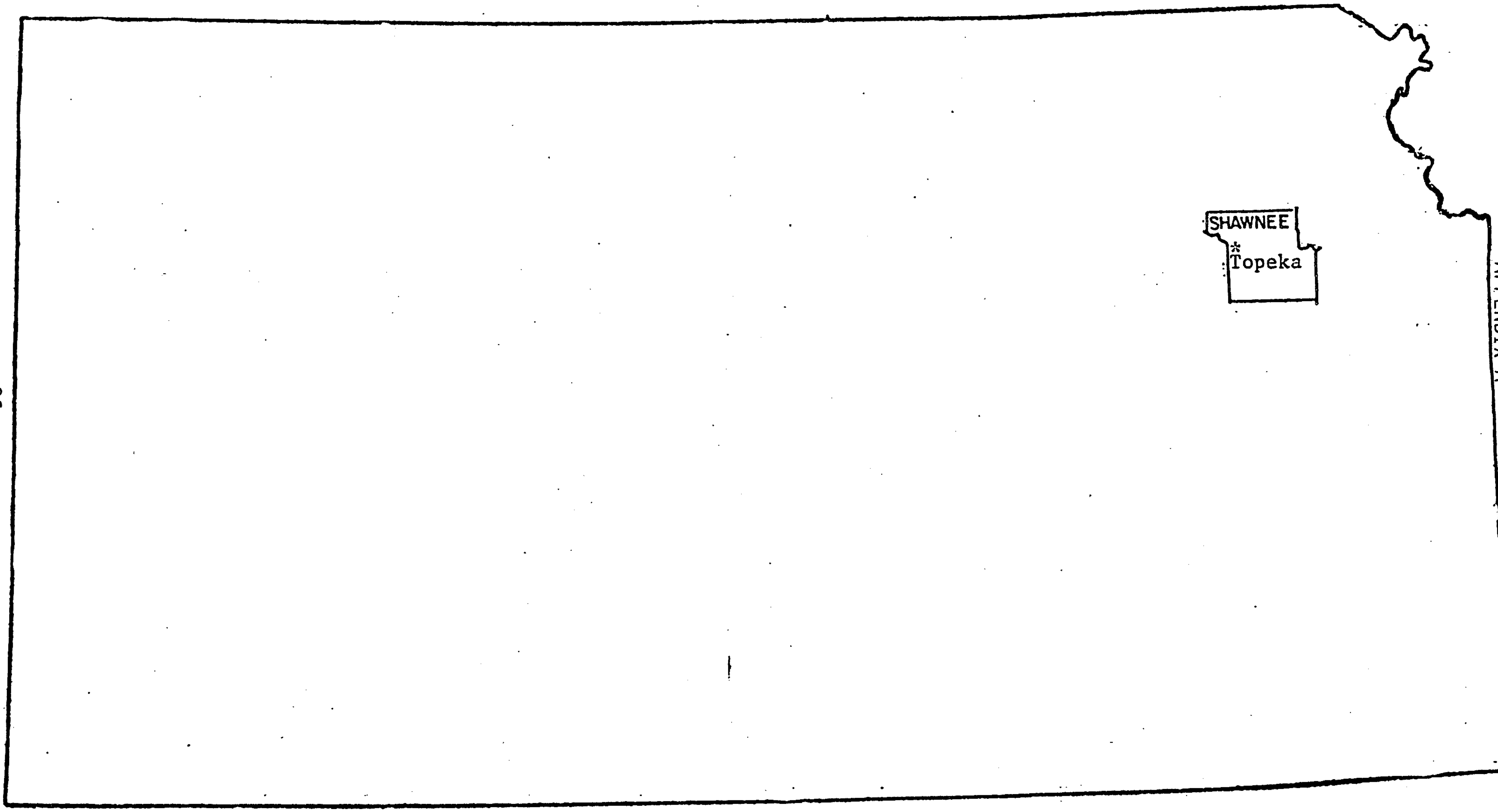


Figure 6. Topeka-Shawnee County

Reference 2

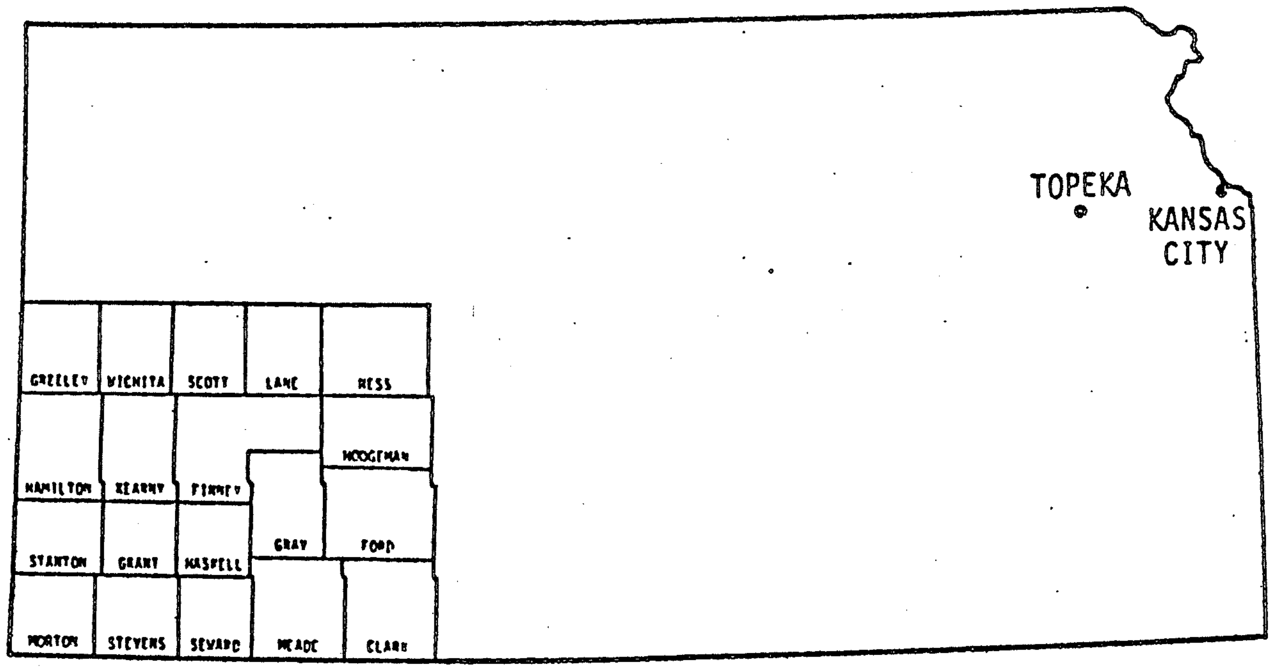


Figure 7. Counties within the Greater Southwest Regional Planning Commission area in Kansas.

- Reference 11

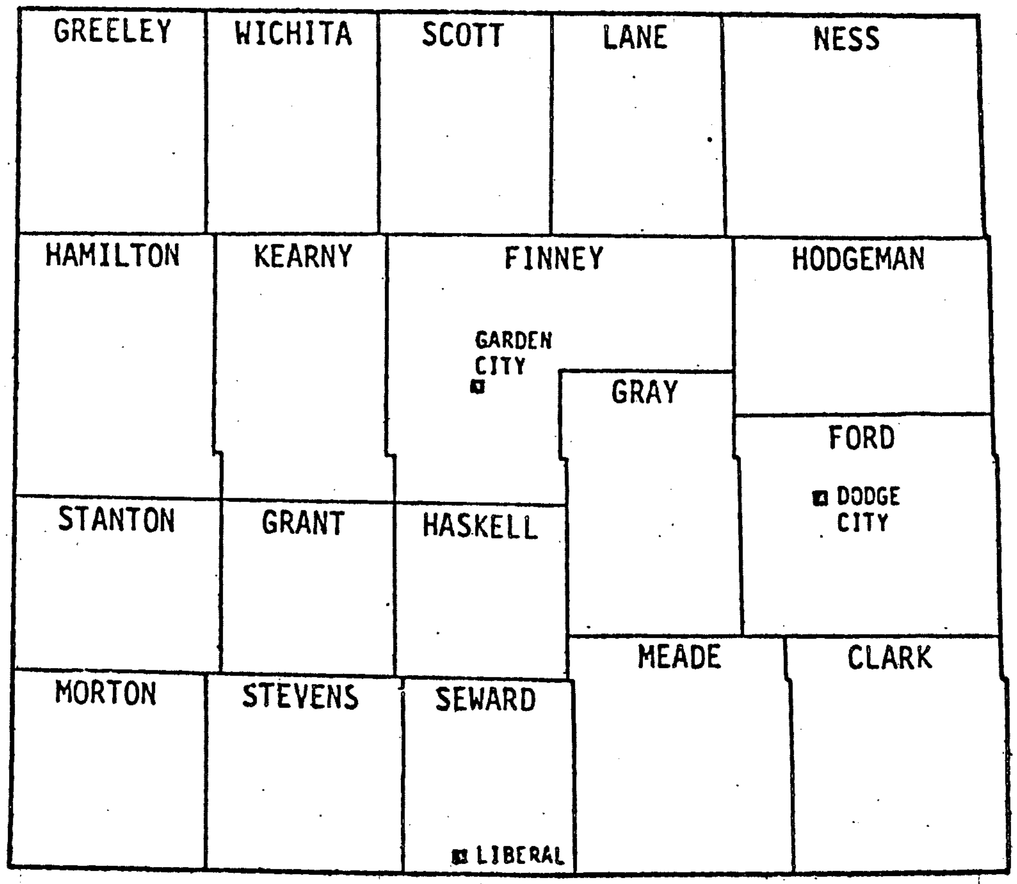


Figure 8, Sanitary landfills within the Planning Commission area.

Reference 11

APPENDIX B

TABLE 7. COMPARISON OF ENERGY PRODUCED BY BURNING MUNICIPAL SOLID WASTE VERSUS CONVENTIONAL FUELS

Energy source	Energy value, Btu/lb
Municipal solid waste	4,500
Wood	4,690
Lignite	7,065
Subbituminous B coal	10,245
Anthracite coal	11,100
No. 6 fuel oil	18,265
No. 2 home heating oil	19,565
Methane	23,895

Reference 5

LOWER HEATING VALUES OF TYPICAL WASTES

WASTE	BTU/LB., NET
Agricultural:	
Butter	15,240
Cotton Seed Hulls	7,910
Grain	7,130
Egg Yolk	13,400
Egg White	9,440
Pecan Shells	8,100
Garbage:	
Coffee Grounds	9,800
Corn Cobs	7,540
Corn, Shelled	8,550
Fats	15,360
Food Wastes (Dry)	7,800
Paper Products:	
Brown Paper	7,090
Corrugated Boxes	6,830
Food Cartons	7,110
Magazines	4,830
Newspapers	7,800
Plastic Coated Paper	7,090
Tar Paper (30% Tar)	10,120
Waxed Milk Cartons	10,790
Plastics:	
Polyamides (Nylon)	11,960
Polyesters	11,050
Polyolefins (Polyethlene, Polyproplene, etc.)	17,500
Polystyrene	15,650
Polyurethane	10,580
Polyvinyl Chloride	7,280
Plastic Film (Mixed)	12,740
Vinyl Coated Fabric	8,200
Vinyl Coated Felt	10,170
Vinyl Scrap	10,500
Rubber Products:	
Latex	9,200
Banbury-Rubber Scrap	12,180
Raw Batch Stock	13,040
Rubber Coated Fabric	10,120
Rubber Tape	8,860
Rubber Tires	12,000
Textiles:	
Cotton Batting	6,540
Uncured Duck	8,600
Rayon and Cotton Yarn	7,138
Rags	7,390

TABLE 8 (cont.)

WASTE	BTU/LB., NET
Wood:	
Oak	7,990
Pine	8,420
Sawdust	8,000
Yard:	
Brush	7,270
Grass	7,070
Leaves	6,530
Miscellaneous:	
Paints and Oils	12,330
Leather	8,140
Linoleum	7,700
Street Sweepings	5,520
Water	(1,000) Minus

Reference 6

APPENDIX C

TABLE 9. COMPOSITION OF MUNICIPAL SOLID WASTE

Material	Percentage of total waste
Paper	30-40
Newsprint	9-15
Magazine	1-3
Corrugated	1-2
Other	19-20
Glass, beverage	7-16
Clear	4-9
Green	2-4
Brown	1-3
Glass, other	6.5-10
Clear	5-6
Green	1-3
Brown	0.5-1
Ferrous, beverage	0.5-2
Ferrous, other	3-5
Aluminum, beverage	0.1-1
Aluminum, other	0.1-1
Nonrecyclable refuse	52.8-25

Reference 5

TABLE 10

TYPICAL DENSITIES OF MUNICIPAL SOLID WASTES BY SOURCE[a]

Source	Density, lb/yd³	
	Range	Typical
Residential (uncompacted)		
Rubbish[b]	150–300	220
Garden trimmings	100–250	175
Ashes	1,100–1,400	1,250
Residential (compacted)		
In compactor truck	300–750	500
In landfill (normally compact)	600–850	750
In landfill (well compacted)	1,000–1,250	1,000
Residential (after processing)		
Baled	1,000–1,800	1,200‡
Shredded, uncompacted	200–450	360
Shredded, compacted	1,100–1,800	1,300‡
Commercial-industrial (uncompacted)		
Food waste (wet)	800–1,600	900
Combustible rubbish	80–300	200
Noncombustible rubbish	300–600	500

[a] Adapted in part from Ref. 10.
[b] Does not include ashes.
‡ Low pressure compaction, less than 100 lb/in².
Note: $lb/yd^3 \times 0.5933 = kg/m^3$
$lb/in^2 \times 6.895 = kN/m^2$

Reference 10

TABLE 11

TYPICAL PER CAPITA SOLID WASTE GENERATION RATES

Source	Unit rate, lb/capita/day	
	Range	Typical
Municipal[a]	2.0–6.0	3.5
Industrial	1.0–3.5	1.9
Demolition	0.1–0.8	0.6
Other municipal[b]	0.1–0.6	0.4
Subtotal		6.4
Agricultural		—‡
Special wastes		—‡

[a] Includes residential and commercial.
[b] Excludes water, waste water, and industrial treatment plant wastes which must be estimated separately for each location.
‡ Must be estimated separately for each location.
Note: lb/capita/day × 0.4536 = kg/capita/day

Reference 10

State of Kansas . . . John Carlin, *Governor*

DEPARTMENT OF HEALTH AND ENVIRONMENT

Joseph F. Harkins, *Secretary*

Forbes Field
Topeka, Kansas 66620
913-862-9360

RESOURCE RECOVERY REPORT

STEAM AND ENERGY SURVEY

Organization ______________________________

Mailing Address ______________________________

City ______________ State ______________ County ______________ Zip ________

Plant Location ______________________________

Authorized Contact ______________________ Title ______________

Industry Type ______________________________ SIC ________

STEAM CHARACTERISTICS

Process or Use	Temp. (^{o} F)	Pressure (psi)	FLOW RATE (lb/hr.)		
			Max.	Min.	Ave.

EXISTING STEAM GENERATION

* Boiler and Furnace Type	FUEL				Heat Output (BTU/Hr-Hp)	Steam Generation		
	Type	Amt. Burned				Temp. (^{o} F)	Pres. (psi)	Max. Design Flow
		Max.	Min.	Ave.				

Explain steam demand cycles (annual, monthly, daily, hourly ______________________________

____

____

Show graphs on reverse side.

* Waterwall, Refractory, Fire-Tube, Stoker

BES 10/79

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6. Energy Bulletin No. 10-874, Consumate Systems, Inc.

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8. Kansas Statutes Annotated, Chapter 65 Article 34. Kansas Administrative Regulations, Article 29 (May 1981).

9. "Directory of Sanitary Landfills, Solid Waste Transfer Stations and Collectors in Kansas," Bulletin 4.10, Kansas Department of Health and Environment, May 1981.

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13. "Feasibility of Resource Recovery For the Greater Southwest Regional Planning Commission," Contract No. 68-01-6007, W.A. No. 20-1, PEDCo Environmental, Inc.

14. "Technical Assistance To Shawnee County, Kansas - Sensitivity Analysis," Contract No. 68-01-6007, Task Order No. 9, PEDCo Environmental, Inc.

MEMORANDUM OF AGREEMENT
BETWEEN
THE STATE CORPORATION COMMISSION AND
THE KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

SUBJECT: A management plan to integrate field operation for the regulation of oil and gas activity.

PREAMBLE: This Memorandum of Agreement is executed jointly by the State Corporation Commission (KCC) and the Kansas Department of Health and Environment (KDHE) in the interest of providing a plan for the management of field operations in the regulation of oil and gas activity pursuant to Sub. Senate Bill No. 498. Both agencies agree that the following procedures shall be implemented in order to execute 1982 Session Laws of Kansas, Chapter 228.

I. General Provisions

A. All activities concerning the protection of fresh and usable water as it pertains to the oil and gas industry shall be handled by the joint KCC-KDHE integrated staff.

B. All activities concerning solely oil and/or gas conservation shall be handled by the KCC staff.

C. All activities concerning water matters unrelated to oil and/or gas operations shall be handled by the KDHE staff.

D. A policy manual detailing joint field operations shall be written jointly by KCC and KDHE. This manual shall include explanations of the permitting process, the monitoring process, the inspection and compliance process, the enforcement process, the investigation process, and other operating procedures. The manual shall be reviewed at least annually and revised as needed by mutual agreement of KCC and KDHE.

II. Location of Offices

A. The joint District Offices shall be located at the six existing KDHE district offices.

B. Additional offices may be opened at locations mutually agreed upon by KCC and KDHE.

III. Division and Integration of Responsibilities

A. Operations shall be conducted in accordance with the attached flow chart which is made a part of this agreement.

B. Both KCC and KDHE field staff involved in activities covered by this agreement shall be integrated into district offices.

Atch. 5

C. The Officer in Charge (OIC) of each district office shall be a geologist appointed by KDHE.

D. The Deputy OIC of each district office shall be a Petroleum Industry Regulatory Technician (PIRT) supervisor appointed by KCC. In the absence of the OIC, the Secretary may designate an acting OIC and shall notify KCC of such designation.

E. In each district, a rotating duty roster shall be maintained to provide coverage 24 hours per day, 7 days per week. The integrated staff shall share in this responsibility.

F. The district OIC, when having determined enforcement actions are desirable, shall provide such recommendations to KCC and KDHE.

G. Enforcement procedures shall be in accordance with K.S.A. Chapters 55 and 65, as appropriate.

IV. Training of Integrated Personnel

All integrated personnel shall be trained by both KCC and KDHE in areas of shared responsibility as designated in I. A. of this agreement.

V. Miscellaneous Provisions

A. Activities conducted pursuant to the Underground Injection Control (UIC) Program shall be handled in accordance with the memorandum of agreement entered into by KCC and KDHE as submitted to the Environmental Protection Agency.

B. KCC and KDHE shall share all information and technical data relevant to the joint responsibilities.

C. No budget request or obligation of funds from the KCC Conservation Fee fund by KDHE shall occur without prior consultation with and written approval from the KCC. Day to day operating expenditures of the joint district offices shall be handled in a mutually agreed upon manner.

10/28/82

Richard C. (Pete) Loux, Chairman
Kansas Corporation Commission

Joseph Harkins, Secretary
Kansas Department of Health
and Environment

10-28-82

WORKFLOW: KCC - KDHE